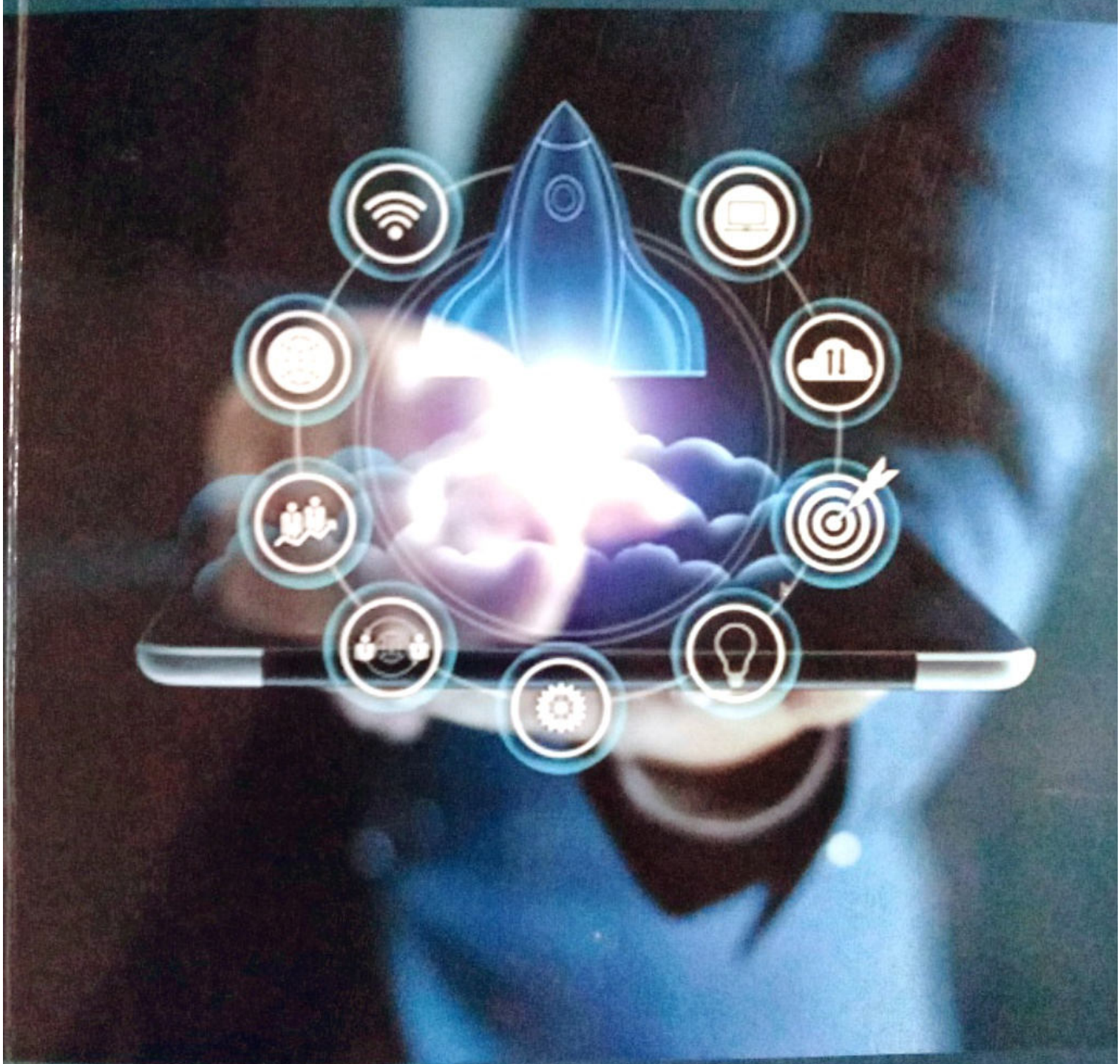
DIGITAL STARTUPS-A MULTIDISCIPLINARY APPROACH IN TECHNOLOGY AND SUSTAINABLE DEVELOPMENT



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Predictors Of Compulsive Buying: The Role Of Artificial Intelligence And Social Networking Sites

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Abstract

Despite extensive research on Artificial Intelligence (AI) and Social Networking Sites (SNSs) effects on users' lives, little is known about how much Artificial Intelligence and social media usage affect compulsive buying. This study fills in this knowledge gap by examining the influence of AI and SNSs on compulsive buying. The result suggests that AI and SNSs have a significant effect on compulsive buying. But that AI has a stronger impact on influencing the compulsive buying behaviour of customers.

Keywords: Artificial Intelligence, Social Networking Sites, Compulsive Buying

Introduction

Artificial intelligence (AI) is a transformative force that is shaping marketing strategy, and actions (Hermann and Erik 1). It is defined as "the use of computational machinery to emulate capabilities inherent in humans, such as doing physical or mechanical tasks, thinking, and feeling" (Huang et al. 30). The amount of humanization in AI is anticipated to rise along with the continual growth of AI and its intelligence levels. Over the years, businesses like Google (Google Home), Amazon (Alexa), and Apple (Homepod, Siri) have introduced several IVAs which induce the purchase intention of customers. It is obvious that AI actively acts in the background, monitoring client views on the internet and social media. (Grewal et al. 55). As a result, these customers frequently see pop-up ads for the products they require on the appropriate websites (Grewal et al. 55).

Every consumer is constantly seeking comfort and flexibility. Since individuals can do their work in the ease of their homes because of artificial intelligence, people are now able to realize what they want. When it comes to buying, customers can do extensive searches for the products they require (Michaei and George 57). This promotes consumer intelligence. The procedure is necessary, to enable consumers to shop online. Customers can make payments online and wait at home for their purchases to arrive, thus simplifying their shopping experience (Shinn 75). This is made feasible by the fact that machines capture and process instructions as well as give the company the necessary information (Shinn 75). Customers can now have more control and complete tasks at their convenience by interacting with AI in this way. Hence AI has a positive effect on social media addiction (Simay et al. 1569) which in turn have a positive effect on compulsive buying (Sharif and Yeoh 310).

In the literature on consumer behaviour, the phenomenon of compulsive buying has been extensively researched (Zheng et al. 13). The expression itself describes a persistent, uncontrolled desire to purchase that is typically brought on by unpleasant events or emotions and has detrimental psychological, social, and financial effects (Roberts et al. 147). Indeed, anomalous, "senseless" consumption behaviour has frequently been used to describe compulsive shopping (Spinella et al. 670).

About the Editors



Dr.M.Sekar is serving as an Associate Professor & Head in the Department of Commerce with CA in KPR College of Arts Science and Research. He utilizes his skills and upgrades his ability in teaching to offer professional growth in the field of Management Studies. He aims to gain an exceptional career through long efforts and constant performance. He initiated his teaching career in the year 2006. Presently, he has 17 years of teaching experience in UG and 14 years of experience in PG. He has published research papers in 12 International and 13 National Journals. He has also participated in various Seminars, Symposiums, and conferences. He has completed a UGC-funded project titled "A Study on Occupational Stress in Police Organizations and its effects on Organizational Performance with Special Reference to Kanyakumari District, sanctioned with Rs. 5,87,000/-. He is also a Member of the Coimbatore Management Association, Indian Academic Researchers Association (IARA), Board of Studies Member of various colleges, and a Question paper setter for other universities. He has completed various MOOC courses in NPTEL, ALISON, Digital Garage, Udemy and Future Learn



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Chapter 4
Wrapper-Based Feature Selection for Detecting the Lexical Phishing Websites Using Ensemble Learning Algorithms

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ABSTRACT

Phishing is one of the most serious issues now-a-days, and many internet users are falling prey to it. Website phishing is a major threat that focuses on developing spoofed sites as a legal ones. Phishers develop cloned websites and distribute the uniform resource locator (URLs) to a large number of people in the form of e-mail, short message service, or through social media. In the current scenario, phishing is

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the topmost cyber threat/cyber-attack that intrudes into the system to steal or capture sensitive information from the target. Machine learning methods, an important branch of artificial intelligence, are used to detect many critical problems. This chapter investigates the lexical features of website URLs to detect the phishing URL using wrapper-based feature selection on ensemble learning technique. To evaluate the model developed, the dataset from Mendeley repository is taken. The highest level of accuracy for the phishing websites was reached using bagging classifier with 95% accuracy compared with boosting algorithm.

1. INTRODUCTION

Cybersecurity is the process of safeguarding cyberspace from potential threats. Cyber security is concerned with defending, preventing, and recovering all web resources from cyber attacks by cabaj et al. (2018). It is incredibly difficult to identify, analyse, and control significant risk events due to the complexity of the cyber security sector, which is increasing daily stated by basit et al. (2021). During the year 2019, the UK government's Cyber Security Breaches Survey report investigated based on the frequency of occurrence, and it is noted that Phishing Attacks are the topmost ones by Alkhalil et al. (2021).

Information security is critical in protecting sensitive data from social engineering attacks like Phishing. Social engineering attempts to alter users' credentials in order to facilitate various cyber attacks. An example of a social engineering assault is phishing, which targets users' personal information using emails, SMS, voice calls, and anonymous URLs. Phishing has become a threat to many people, remarkably those ignorant of the risks they face when browsing. In FBI report (2018), between October 2013 and February 2016, a Phishing attack cost 2.3 billion dollars, according to a testimony by the Federal Bureau of Investigation (FBI). Phishing attacks can affect personal computers, smart devices, and Wi-Fi-enabled intelligent devices, among other things.

According to a Proof Point survey, approximately 90% of worldwide enterprises were targeted by Phishing attacks in 2019. Indicating that, cyber criminals continue to target individual end users. 55% of organization has been affected by Phishing attacks, out of which individuals targeted 88%, 86% in the form of social media, 84% reported in the form of SMS, 83% through Voice calls (APWG report 2020).

As per the security magazine (2020), the first six months of 2020 revealed a new side to this well-known Phishing Attack. Anti- Phishing Working Group (APWG) released eight reports in March 2020 regarding the e-Crime exchange of phishing attacks via the ZOOM video conferencing platform, which many IT employees and

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Chapter 5
Classification of Firewall Log Files Using Supervised Machine Learning Techniques

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ABSTRACT

A firewall prevents traffic entering and departing the domain it was supposed to protect. The logging feature keeps track of how the firewall handles different sorts of traffic. Monitoring and analyzing log files can assist IT businesses in improving the end-user reliability of their systems. This book chapter investigates and classifies the firewall log files using supervised machine learning algorithms. The main objective of this chapter is to examine firewall security by analyzing the firewall log files. Supervised machine learning classifiers such as support vector machine (SVM), Naïve Bayes, logistic regression and k-nearest neighbor (KNN) models are developed to classify the firewall log files. Feature selection using Ranker

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and Info_Gain_Attribute_Eval methods within the Weka tool is applied to derive the robust features from the data. Finally, a comparative analysis is performed to evaluate the efficiency of the supervised machine learning models. Results that, the Naïve Bayes Classifier attains the highest accuracy of 99.26% for the classification of firewall log files.

1. INTRODUCTION

A firewall is a security access management point that controls access to computer networks and ensures safe network connectivity. A network firewall is a device or collection of systems that control access between two networks - a trustworthy network and an untrusted network—by using pre-configured rules or filters by As-Suhbani et al. (2019). The outcomes of firewall rules can be audited, verified, and evaluated via monitoring. The analyzing and classifying of the firewall checks and decides the packets to pass it or not. It can improve security purposes even more by allowing based on the required protocols. Internet traffic kinds that are allowed or forbidden are specified by firewall rules. Figure 1 shows the Firewall security which allows the traffic and denies it.

Each firewall profile includes a set of firewall rules; these rules cannot be changed. The ability to create new rules is therefore limited to a few profiles. It is also possible to build your own rules using a profile with no predefined ones. The firewall profile will also impact how important the rules are compared to predefined rules, so make one selection carefully (Allagi et al., 2019).

Inbound traffic from the Internet to the computer or outbound traffic from the computer to the Internet can both be blocked by a firewall rule. A rule may be applied simultaneously in both directions. For instance, firewalls are security tools designed to prevent or restrict unauthorized access to intranets and other private networks connected to the Internet. Firewall policies that outline the only traffic that is permitted on the network forbid any extra traffic from connecting. At the network's front end, network firewalls act as a communication channel between internal and external devices (Ertam et al., 2018).

Figure 1. A phase of firewall in a network



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The Evolution Of Segmentation Techniques For Alzheimer's Disease Detection From Magnetic Resonance Images

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***Abstract* - Alzheimer's disease is a neurological sickness that is getting increasingly frequent and causes the structure and performance of the central nervous system to gradually deteriorate. The prevalence of Alzheimer's disease is expected to double by the year 2050. These illnesses pose a significant threat to the physical and mental well-being of individuals as well as their families across the globe. It is a sort of neurodegenerative sickness that is chronic and irreversible, and it is characterized by the gradual death of neurons. This death of neurons leads to reduced cognition and the loss of brain functions. There are presently 47 million Alzheimer's disease patients across the globe; however, it is expected that this number will more than double by the year 2050, attainment 152 million individuals. One of the several neuron imaging techniques that are currently at researchers' disposal is magnetic resonance imaging (MRI), which has made it possible for non-invasive in vivo studies of AD-related abnormalities in the brain. This research makes use of a number of different denoising techniques in order to cut down on noise and improve the overall picture quality. A clearer, more relevant and more easily digestible visual illustration is one of the goals that subdivision strives to achieve. For the purpose of segmenting the region of interest in MRI scans, a computer-aided model has been presented. For the purpose of evaluating the suggested method of image segmentation, which has been validated with a large number of images, alternative image segmentation algorithms, including Otsu thresholding and region expanding, have been compared. It has been determined, using the performance evaluation metrics, that the proposed method is capable of achieving a higher level of accuracy than other methods.**

Keywords: Alzheimer's disease, Active Contour, Grow Cut method, DWT, Fuzzy set, Threshold, Segmentation

I. INTRODUCTION

Alzheimer's disease (AD) touches people in dissimilar habits depending on the stage and symptoms they are experiencing. Patients began to experience memory loss in the early stages. They lost track of the names of common objects and their own familiar terms. The damage caused by AD's middle stage on the brain's nerve cells is far more severe, making AD difficult to detect. Patients with advanced Alzheimer's disease (AD) become less responsive to their environment. [1]. In daily activities, AD impairs memory and reasoning skills and alters a person's facial expressions. It is possible to precisely define the stages of AD using computer-aided diagnosis techniques on medical scan images, which will enable doctors treat patients as needed.[2].

Kumar et al. [3] proposed Improved Intuitionistic Fuzzy C Means algorithm (MIFCM) for segmenting countless brain topics. Ramudu and Babu [4] have future an efficient subdivision method in MRI biomedical imaginings with a level set method using KFPSO clustering. This new system is particularly useful for detecting white and grey matter and cancerous cells in brain and bone images.[4]. Sonavane and Sonar [5] have worked in brain MRI classification and organised images of brain interpretation have been studied in this paper. For segmentation, a neural network algorithm and skull stripping has been utilized to remove the skull region. For noise removal, edge detection and smoothing anisotropic diffusion filtering used.

Verma et al. [6] worked with the boundary pixel information, the vagueness and noise between brain image, and the subdivision has been the complex one. The noise has been handled by the FCM method in this study. In this projected work, the Intuitionistic Fuzzy C-Means (IFCM) technique has been imposed for segmenting the image. The intuitionistic fuzzy set theory advantages have been adapted. This proposed study dealt with uncertainty but exhibit noise sensitivity. A novel approach, namely improved IFCM proposed in this work. It mainly considers intuitionistic fuzzy way of spatial information locally. Using IIFCM shows the characteristics of noise insensitivity, preserving details of image and parameter tuning requirement free. On real and stimulated MRI image of the brain, Synthetic Square image, the segmentation results achieved as better than existing methods. IIFCM algorithm shows better performance compared with other existing algorithms.

While segmenting data, image space is divided into distinct cluster centres with comparable intensity values. There are overlapping grey-scale intensities for different tissues in the MRI image from the dataset. As a result, the

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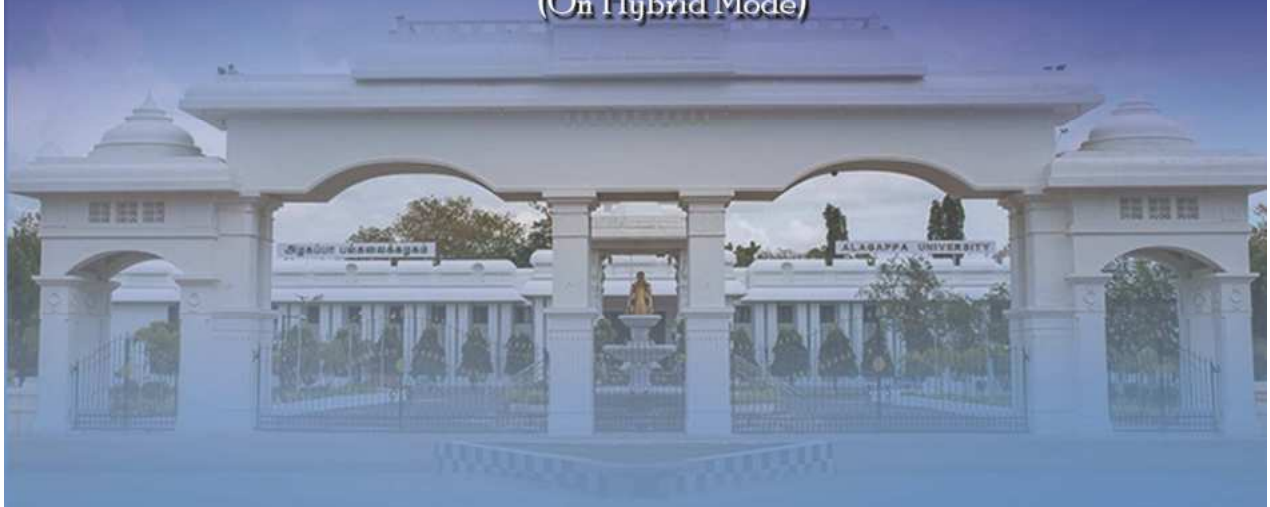
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Department of Computational Logistics, Alagappa University

Comparison of Text Classifiers on News

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Abstract :

Text categorization is a crucial machine learning and natural language processing (NLP) issue. One or more groups are used to categorize the documents. Digital material has proliferated on the internet in recent years, especially in the form of news articles. News articles are a great source of information, but manually classifying them into relevant topics can be difficult. As a result, the automatic classification of news articles has grown in significance as a research issue. In this work, we investigate how well machine learning algorithms can classify news articles. News articles frequently have a set structure that consists of a headline, an introduction, and a body that contains more in-depth material. News articles main goals are to inform, educate, and engage readers on a range of topics such as politics, economics, and more. News articles are a crucial component of democratic societies since they can have a big impact on public opinion and policy choices. There are many different categorising algorithms available, and they vary in efficiency and classification speed. They use four different news datasets that have been categorised with groups like sports, business, politics, entertainment, etc. Term frequency-inverse document frequency (TF- IDF) is utilised in the vectorization section. The four machine learning classifiers were used to classify news items. Some of the evaluation metrics are evaluated. SVM performs better than the other classifiers considered in terms of accuracy.

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AI-Powered YouTube Transcript Summarization with Transformers models

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ABSTRACT:

The rapid growth of videos on websites like YouTube in a period of information abundance has created an essential need for effective content summary. This research proposes a novel method for summarizing YouTube transcripts that makes use of state-of-the Transformers models. To make use of artificial intelligence (AI) to generate concise and coherent summaries of wide video transcripts, improving user accessibility and making content easier to read and understand. The background of this work is to shorten the length of the video transcript text. It can be challenging to provide time to watch such videos, which may last longer than expected and viewer's efforts may be useless if they cannot extract useful information from them. Summarizing transcripts of such videos allows us to spot essential patterns in the video and save time quickly. The method of this work consists of four main phases. The first phase is loading the YouTube video. Then apply Preprocessing techniques, which eliminate Punctuation, stop words, and case formatting. Next is to implementation of Abstractive Summarization using Pretrained Transformer models. Bidirectional Auto Regressive Transformers (BART) and Pre-training with Extracted Gap-sentences(PEGASUS) are these two models used for summarization in this particular instance. Next phase is to convert the summarized text into regional language(Tamil).The final of this work is Performance Evaluation using ROUGE Score(Accuracy, precision, recall, and F-measure) to find the best model. The finding is that the pre-trained language models built on the transformer architecture were best suited for summarization tasks. To conduct comparative studies, this is calculated by ROUGE scores for each model's predictions.

Keywords: Abstractive Summarization, Pretrained Transformer-BART Model, Pretrained Transformer - PEGASUS Model, Performance Evaluation.

Extractive Summarization of Text Document

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Abstract

In an era characterized by an exponential growth of information on the World Wide Web, the need for effective text summarization techniques has never been more pressing. Our research addresses this imperative by focusing on the task of extractive summarization specifically tailored for text documents. Text summarization, which falls under AI, has been an important research area that identifies the relevant sentences from a piece of text. This paper presents an **"Extractive Summarization of Text Documents**" approach for generating a short and precise extractive summary for the given text documents. It is crucial due to the growing volume of text data, and it can be categorized into extractive and abstractive methods. In this paper, an extractive approach is employed, involving the selection and concatenation of important sentences or paragraphs from the original text. The objective is to provide concise summaries, which is a challenging task in natural language processing. It comprises four phases: The first phase of the work is loading the input text document. Text preprocessing is done in second phase. The third phase is applying extractive summarization algorithms such as frequency summarizers, Textrank, and Lexrank. The fourth phase of the work is performance evaluation using rough scores .

Keywords : extractive Summarization, rouge scores,Textrank.

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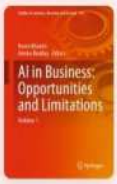
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Play serves as an essential component of a child's developmental progress. Play is the prism through which children experience their own and other people's worlds. Play promotes cognitive development by teaching children how to solve problems, recollect knowledge, and make decisions. Children also develop social skills through play by forming relationships, building trust, and forming bonds with their peers. The study aimed to identify the play behaviours of primary school children aged 6–8 years. Both the children's social and non-social play behaviours were investigated in the study. The sample comprises 600 primary school children from Biswanath, Assam. Data were collected through simple random sampling method. The study also developed a tool for measuring social and non-social play behaviour in children. The constructed tool will be helpful to identify the types of play behaviours among children, which will further help parents and teachers provide a suitable environment for their optimum development. This study will also help identify socialization patterns among children.

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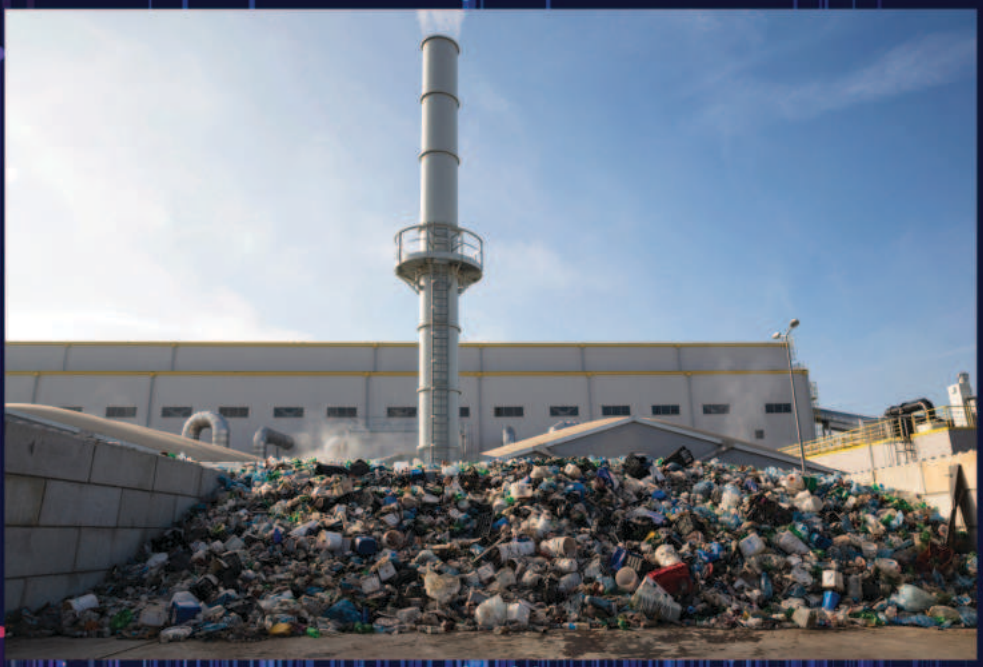
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Material and Energy Recovery from Solid Waste for a Circular Economy



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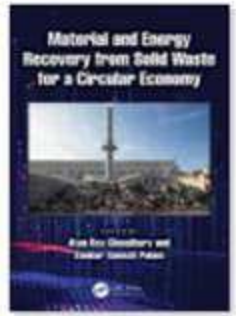
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Chapter

Appraising the Natural Bio-Processes over Thermal Treatments to Treat Municipal Solid Waste

A Step Toward a More Sustainable Environment

By Arumugam Poornima, Subramani Yashini Vidhya, Kanagaraj Suganya, Balraj Sudha, Sundaravadivelu Sumathi, Sanjeeb Kumar Mandal, Sumithra Salla

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ABSTRACT

Conventional environmental management and waste treatment technologies have shown significant advancements in recent times. "Waste" is no longer waste these days but has become one of the significant sources to generate tonnes of energy in different forms such as heat, fuels, and electricity. In that regard, municipal solid wastes comprising relatively more of degradable organic fractions than non-degradable wastes fall under one major category that drives toward energy plants. Management strategies had evolved with time, wherein burning of waste started fading while biological treatments are attracting more attention in order to bring the discipline of "Waste to energy" with less harm to the environment. Thermal treatments played effective roles in waste management but their harmful emissions became another concern in terms of environmental pollution. Though it cannot be completely replaced by another eco-friendly alternative, a unified solid waste managing system with controlled discharge of hazardous components and incorporation of biological processes to treat municipal solid wastes can serve well in reducing the dependence on more

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DIGITAL PLATFORM: A BRIDGE TO MODERN SCIENCE AND TRADITIONAL INDIAN KNOWLEDGE SYSTEM

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Abstract

The herbal medicine is gaining interest worldwide for health care management and conventional treatment methods. Recently, several modern medicines are obtained from traditional medicinal plants. Traditional medicine can address potent medical needs, with least side effects and enhanced efficacy. Several therapeutic properties of various traditional medicinal plants, still remains unexplored. Indian Knowledge System Division of Ministry of Education aims to bring into limelight, the significance of our traditional practices to the modern society. Initiatives of IKS division, has enabled to document many of our traditional knowledge in the form of database, literature and library for the access of students, academicians and researchers. Digital platforms like Indian Medicinal plants, Phytochemistry and Therapeutics (IMPATT), Duke's Ethnobotanical databases, Medicinal plant Database of Botanical Survey of India serves as a knowledge resource of herbal plants traditionally used for various ailments with details of its medicinal value. CYTOSCAPE software enable to explore the molecular mechanism of action of multiple phytocompounds present in medicinal plants. Network pharmacology is an emerging field, which is applied to predict the pharmacological mode of action to combat various diseases. Various in-built tools in CYTOSCAPE like CytoNCA, StringApp, ClueGo, CluePedia, etc enable to analyse more deeply on multi-drug, multi-targeted interactions. Several computational methods including high throughput virtual screening (HTVS) methods, ADMET analysis, structure – based approaches including molecular docking and dynamics have wide application in

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A PRACTICAL GUIDE FOR COMMUNICATION SYSTEMS LABORATORY



A PRACTICAL GUIDE FOR COMMUNICATION SYSTEMS LABORATORY

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A Practical Guide for Communication Systems Laboratory

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Technological Trends in Information Science and Engineering

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Microcontroller based Vision Bin – An Intelligent Waste Segregation System

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Abstract—The escalating global population and urbanization have led to a surge in waste generation, posing significant challenges to traditional waste management systems. Garbage management has been neglected in many areas in India hence an efficient solution is required. Recycling is one of the most potent strategies for waste management and reduction.
Successful recycling necessitates segregation as a crucial step. The proposed model will automate the process of waste segregation. It will minimize the labor as well as increase the speed and accuracy of the work. The Vision Bin make use of object detection method which uses Convolutional Neural Network (CNN) and various sensors for waste identification and segregation. The waste will be segregated into 5 types. To prevent potential disasters, as waste disposal areas are often susceptible to fire, the bin is also equipped with a fire sensor.

I. INTRODUCTION

Waste management includes the systematic processes and activities involved in managing waste from its inception to its final disposal. Recycling is a viable method for reducing waste, therefore segregation is needed. Waste segregation is the process of identifying, classifying, sorting garbage to reduce, reuse and recycle materials. It involves separating waste into various categories such as dry waste, wet waste, sanitary waste, e-waste and hazardous waste.

The significance of waste segregation lies in its ability to reduce the amount of waste being dumped at landfills, and it's always the first step for all types of waste management solutions. Additionally, it lessens the health risk of the workers. Unsegregated waste can lead to several problems like Health Risks, Environmental Damage, Blockage of Infrastructure and Pollution.

Unmanaged waste can transmit diseases, cause respiratory problems, and affect economic development. Improper segregation can lead to the accumulation of toxic waste mixtures in landfills, containing harmful substances like PCBs, PAHs, pesticides, and insecticides [1].

This project is based on the development of a Vision Bin which identifies and segregates waste using object detection. The system aims to revolutionize waste management by significantly

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2. Shri ram (2020). Research trends in green product for environment: A bibliometric perspective International Journal of environmental research and public health 8469(17), pp 1-21.
3. N.Divyapriyadarshini (2019). Consumer awareness towards green products and its impact International Journal and Innovation in Social science (IJRISS), 3, (10), pp. 2454-6186.
4. Yeowkaryan & Rashad Yazadanifard (2014). The concept of green marketing and green product development on consumer buying approach, Global Journal of Commerce & management perspective (GJCMP), 3, (2), pp.33-38.

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CHAPTER

Perception and Preference of Policyholders towards Products Offered by SBI Life Insurance

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Abstract

Policies sold by life insurance companies often provide for the payment of a single lump amount to beneficiaries upon both the death benefit and the maturity benefit. The major purpose of the research was to identify the primary factors that have the most impact on policyholders' views and choices about the various insurance coverage alternatives offered by SBI Life Insurance Company. The method of sampling utilised a selection process based on convenience. The study relied on descriptive research as its foundation. The collection of data was done via a primary source (a questionnaire), and the sample size was 301 people who filled out the questionnaire. Percentage Analysis, Analysis of Variance, and Regression, along with the help of the SPSS Statistical Package, were the analytical methods that were utilised in the study for the purpose of determining the perception and preference of Policyholders with regard to the products offered by SBI Life Insurance. According to the findings of the study, a substantial association exists between the demographic characteristics and the level of satisfaction regarding SBI Life Insurance.

Keywords: Insurance, Perception, Purchase Decision

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INTRODUCTION

The insurance industry is crucial to the growth of any economy because it boosts risk-taking capacity and offers long-term funding for infrastructure development. The contemporary environment in the insurance sector is one that is complex, competitive, and flavoured with little stability. Getting customers is the biggest problem the sector has. This is as a result of the sector's dominance by the big fish in the insurance business. This industry's ability to increase revenues

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CHAPTER

Mobile Banking and Its Influence on Customer Satisfaction and Loyalty

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Abstract

Traditional banking is a concept in which customers need to approach banks to do any financial services. It was replaced by net banking due to the growth of technology. Because of the entry of mobiles and the internet, net banking was replaced, and mobile banking came into existence. With the help of mobile and the internet, one can do all the financial transactions without visiting the branch. For the study SERVQUAL model has been used, which confers different service quality dimensions. The study analyses the factors influencing service quality. Two hundred sixty mobile bank customers were selected as samples, and data was collected through the questionnaire distribution. Percentage analysis, correlation, and multiple regressions are the tools used. It also finds the responsiveness, trust-worthiness, tangibles are the significant factors that influence service quality, in which responsiveness and reliability have more influence than the others. It also finds a correlation between customer satisfaction and customer loyalty. For ease of use the researcher has shortened the words for Customer Satisfaction as CS., Customer Loyalty as CL., Service Quality as SQ.

Keywords: Mobile banking, Servqual model, Customer satisfaction, Customer loyalty.

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INTRODUCTION

Mobile banking refers to using mobile devices to manage financial services and perform banking activities from anywhere at any time without visiting the branch. Mobile banking can be done by downloading an app from an app store or accessing a bank website. Apps are designed with a user-friendly interface that enables customers to navigate easily. Once installed, they can log in with banking credentials and use the app. Speed, convenience, and accessibility are the benefits of mobile banking. The growth and development of information and communication technology made sudden changes in the banking industry. Mobile banking has become popular in recent

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11. https://www.npci.org.in/what-we-do/bharat-billpay/product-overview.
12. https://www.npci.org.in/PDF/npci/bbp/notified-documents/BBPS_Product_Presentation.pdf
13. https://www.livemint.com/
14. https://khatabook.com/blog/what-is-bharat-billpay/
15. https://economictimes.indiatimes.com/wealth/spend/bharat-bill-payment-system-to-help-nris-pay-bills-in-india/inward-cross-border-payments/slideshow/93384098.cms
16. https://economictimes.indiatimes.com/wealth/spend/tax-payments-to-rent-to-school-fees-soon-you-can-use-bharat-bill-payment-system-make-to-all-payments/articleshow/96047809.cms

12 CHAPTER

Investor's Adoption and Attitude towards Online Trading in Coimbatore

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Abstract

Online trading has emerged as a popular method for investors to trade a variety of financial products, including stocks, commodities, and mutual funds. This study aims to understand investor adoption of and attitudes towards online trading, specifically in the city of Coimbatore. The study's goals were to examine investor intentions about the adoption of online trading as well as the factors influencing investors' opinions in this regard. The research design used was a descriptive research design, and primary data were gathered through a standard questionnaire using convenience sampling techniques, with 300 responses collected. The findings showed that investors' intentions to adopt online trading have a substantial positive link with attitude and behaviour. Therefore, it is recommended that investors improve their knowledge of online trading platforms and seek guidance from financial advisors, while online trading platforms should prioritise enhancing their functionality, user interface, and support services.

Keywords: Attitude, Intention, Behaviour, Expectancy

INTRODUCTION

Investment is essential because saving money on its own is insufficient to meet all of our financial goals. Investors have a variety of investment options to pick from, and they can do so based on their preferences and needs. Emerging technological advancements have made investing and managing investments hassle-free in today's busy society. Nowadays, online stock trading takes less time because one can do it independently, and investors or traders can now complete any stock market transaction using their smartphone or laptop. Trading platforms give users all the support and help they need by granting them secure, real-time access to trading, research papers, stock price analyses, market news, etc. If they have a trading account and a connection to the

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21 CHAPTER

A Conceptual Study about Intrapreneurship and Employee Empowerment

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Abstract

Intrapreneurship provides employees with opportunities for advancing their careers. By proactively spearheading new projects, they showcase leadership skills and can ascend the corporate hierarchy at a faster pace. Intrapreneurship opportunity for employees will help to acquire skills in promoting their ideas and empowering themselves through the utilization of support from the parent organisation. The primary aim of this article includes identifying shortcomings in the existing research, which predominantly concentrates on intrapreneurship within large corporations, and conducting an in-depth analysis of intrapreneurship literature. It is acknowledged that intrapreneurship plays a pivotal role in employees' empowerment and it is a part of HR strategy. Although research on intrapreneurial behavior tends to focus on large organizations, it is crucial to recognize that intrapreneurship is present across firms of all sizes. Existing research primarily centered on larger firms suggests that intrapreneurial standards may not be universally applicable, given the dynamic nature of intrapreneurship influenced by various organizational variables. Intrapreneurship is a concept which encourages employees to become entrepreneurs. Prior studies have recognized an Intrapreneurship Empowerment Model that highlights best practices, accelerates overall growth, and fosters transparency in the innovation culture. The article reveals the impact of intrapreneurship on business growth. In light of the necessity for companies to be innovative, adaptable to change, and sustainable, intrapreneurship has gained significant importance for employee development as well business sustainability.

Keywords: Intrapreneurship, Intrapreneurial Behavior, Intrapreneurship Empowerment Model, Employee Empowerment, Employee Development.

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6
CHAPTER

Effectiveness of Social Media Networks from IT Job Seeker's Perspective in Coimbatore

Ms. S. Krithika

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Abstract

In the modern world, social media becoming a crucial part of our daily lives and has revolutionized the way we engage and communicate with people. Social media platforms have also emerged as effective tools for job search, especially for job seekers in the IT industry. The article investigates the effectiveness of social media platforms for job search from the perspective of IT job seekers in Coimbatore, India. It has two main objectives: to identify which social media platform is opted by job seekers like to use for their job searches and to understand how various social media networks have been used and their effectiveness for job search. To achieve these objectives, the article employs a conceptual framework where the operational challenges faced by job seekers and their satisfaction act as independent variables, and the effectiveness of social media platforms as dependent variables. The results reveal that the majority of job seekers use social media networks especially LinkedIn for their job search. Moreover, the impact of satisfaction and challenges on the effectiveness of social media in job search was investigated, and the results indicated that satisfaction has impacted on effectiveness, while challenges did not. It emphasizes the need for organizations to ensure that they provide accurate and detailed information on their social media profiles, and make their social media presence more efficacious to attract potential candidates.

Keywords: social media, recruitment and selection, job search.

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INTRODUCTION

Technology has influenced our day-to-day routines and how an organization works, and it has made an imaginative road for the recruiting and job-searching processes. Throughout the first two decades of the twenty-first century, social media recruiting took off alongside social media.

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2 CHAPTER Assessment on Recruitment and Selection Process Based on Employer Branding by Prospective Employees

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Abstract

The article on "Assessment on Recruitment and Selection Process based on Employer Branding by Prospective Employees" conducts a thorough investigation into the different aspects of recruitment and selection practices within companies. The article has an objective to assess the recruitment and selection process based on the opinion of prospective candidates. By utilizing simple random sampling, data was collected from 71 individuals seeking employment and subjected to statistical analysis using SPSS software. The study uncovers a significant relationship between employer branding and the effectiveness of recruitment and selection processes, emphasizing the vital role of a strong employer brand in attracting high- quality candidates. Additionally, the research highlights the importance of effectively communicating values and growth opportunities to shape individuals' perceptions of employer branding. The findings suggest that organizations can enhance their recruitment and selection procedures by implementing targeted employer branding initiatives, enabling them to effectively compete for top talent and gain a competitive edge in the job market. For businesses seeking to improve their hiring and selection methods and confidently choose suitable candidates for their workforce, the insights provided by this article offer valuable guidance.

Keywords: Recruitment, Selection, Employer Branding, Onboarding.

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INTRODUCTION

The recruitment and selection process plays a crucial role in human resource management as it enables businesses to find, assess, and hire suitable candidates. This process ensures that organizations have access to talented individuals with the necessary skills and qualifications. By attracting

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18 CHAPTER

Study on Customers' Perception of Banking Chatbots at Coimbatore City

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Abstract

A chatbot is a human-like agent powered by artificial intelligence (AI) that can act like a human. Chatbots have been integrated into websites and customer-facing apps in various sectors. With messaging apps like Facebook, Slack, KIK & Viber, chatbots are becoming increasingly popular as marketing and customer engagement tools. The study investigated the customers' perception of banking chatbots in Coimbatore City. Random sampling is utilized as the sampling strategy. A Sum of 114 people took part in the research: used descriptive statistics and Friedman ANOVA tests, and Chi-Square tests for data analysis. "Social Influence" was the most crucial element. "Perceived Risk" is what comes next. Third place went to "Facilitating Conditions." On the other hand, 'Security' has the lowest average rank. Modern digital transformation requires AI-enabled technologies such as chatbots to increase customer value, strengthen customer loyalty, and maintain a competitive edge. Banks may save costs and improve customer satisfaction by utilizing chatbots in their service delivery while increasing operational efficiency. Chatbots' personal and online services are undeniably necessary for external occurrences like the COVID-19 pandemic and beyond, limiting face-to-face communications. The management of banks needs to use elements that influence the satisfaction, trust, perceived usefulness, and continuation intents of bank chatbot services to design action plans that help the long-term development of banks and competitive advantages.

Keywords: Chatbots, Information Quality, Perceived Risk, Self-Efficacy, Technology Anxiety.

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devices, sensors, and automated systems. These advanced devices and techniques allow farming to be more profitable, efficient, safer, and more environmentally friendly.

References

1. King, A. Technology: The Future of Agriculture. *Nature* **544**, S21–S23 (2017). https://doi.org/10.1038/544S21a
2. Lutz Goedde, Joshua Katz, Alexandre Ménard, and Julien Revellat: Agriculture's connected future:How technology can yield new growth,Mckinsey(2020)
3. Takeshima, H and P K Joshi (2019): Protected Agriculture, Precision Agriculture, And Vertical Farming: Brief Reviews of Issues in the Literature Focusing on the Developing Region in Asia, IFPRI Discussion Paper 1814, International Food Policy Research Institute (IFPRI), Washington D.C.
4. Taneja, G, B D Pal, P K Joshi, P K Aggarwal and N K Tyagi (2019): "Farmers' Preferences for Climate-Smart Agriculture — An Assessment in the Indo-Gangetic Plain", in Pal B, Kishore A, Joshi P, Tyagi N (Eds),Climate Smart Agriculture in South Asia: Technologies, Policies and Institutions, Springer, Singapore, pp. 91-111.
5. Varshney, D, P K Joshi, D Roy and A Kumar (2020): "PM-KJSAN and the Adoption of Modern Agricultural Technologies", Economic & Political Weekly, Vol. 55, No. 23, pp. 49-56.
6. World Bank (2014): Republic of India: Accelerating Agricultural Productivity Growth, World Bank, Washington D.C.
7. Wossen, T, T Abdoulaye, AAlene, M G Haile, S Feleke, A Olanrewaju and V Manyong (2017): "Impacts of Extension Access and Cooperative Membership on Technology Adoption and Household Welfare", Journal of Rural Studies, Vol. 54, pp. 223-233.

References

1. https://masschallenge.org/article/agriculture-innovation
2. https://www.biz4intellia.com/blog/5-applications-of-iot-in-agriculture
3. https://www.robotics247.com/article/innovation_at_the_intersection_of_agriculture_and_robotics
4. https://www.analyticsinsight.net/top-5-trends-of-precision-agriculture-technology-in-2021/
5. https://www.iberdrola.com/innovation/smart-farming-precision-agriculture
6. https://croplife.ca/field-notes-precision-agriculture-canada/
7. https://www.sciencedirect.com/science/article/abs/pii/S0168169921003082
8. https://www.croptracker.com/blog/drone-technology-in-agriculture.html
9. https://www.innovationnewsnetwork.com/drones-innovative-agriculture/10800/
10. https://enterslice.com/learning/agritech-innovation/
11. https://www.opengrowth.com/resources/know-about-agri-tech-innovation
12. https://www.forbes.com/sites/maggiemcgrath/2017/06/28/the-25-most-innovative-ag-tech
13. https://www.sciencedirect.com/science/article/pii/S0308521X21002511
14. Courtesy : Google for photos.

CHAPTER 14

Impact of Technology Adoption on Employee Engagement and Wellbeing

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Abstract

Technology adoption has become a crucial aspect of organizational success, especially in industries that rely heavily on technology, such as the Edu tech industry. The implementation of new technology can affect employee engagement and wellbeing, which are critical factors that impact employee performance and organizational success. The present study aimed to investigate the impact of technology adoption on employee engagement and wellbeing in the Edu tech industry. The study focused on four sub-constructs, namely Perceived ease of use, Perceived usefulness, intention to use, and actual use, to determine their impact on employee engagement and wellbeing. The study utilized a descriptive research method, and data was collected through a structured questionnaire between January and April of 2023. The questionnaire captured demographic and technology adoption-related characteristics, as well as employee engagement and wellbeing. A total of 353 Edu tech industry employees participated in the study through non-probability convenience sampling. The data collected was analyzed using statistical tools such as ANOVA tests, correlation, regression and Independent sample t test. The study findings revealed a significant positive relationship between technology adoption on employee engagement and wellbeing. The findings of this study provide valuable insights into the impact of technology adoption on employee engagement and wellbeing in the Edu tech industry and have practical implications for Edu tech organizations to improve their technology adoption strategies.

Keywords: Technology Adoption, Edu Tech Industry, Employee Engagement and Wellbeing

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CHAPTER

Introduction of Technology on Agriculture for a Sustainable Future

Ms. S. J. Maya

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Department of Business Administration,
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Abstract

Agriculture is always aimed at producing food for the world population. The technological advancement in agriculture have made a tremendous change to the lives of every human , both economically and socially. The introduction of new technologies, scientific and sophisticated methods has made a monumental impact on the farming sector in recent decades. But food production still 50 faces many agronomic challenges. There are a number of problems that affects the sector climate change, Heavy and unpredicted rain fall has completely destroyed farmland. The soil is now not fertile due to the soil erosion , water shortages , the misuse of nitrogen and pesticides has occurred in the past. Harming human health and wild animals, polluting the water from which we drink along with destroying natural ecosystems. All these causes major challenges in achieving adequate and sustainable food production .Apart from this the rise in energy prices, land and water degradation which can pose many dangers to food security besides the people who inhabit the land. It has been well documented that the livelihoods of many farmers in poorer regions have being ruined, as farming was their only means of income that they may have had and the hope of been able to provide food for their families is now in danger zone. This study aims at understanding how to increase food production and to introduce new and more potent technologies and practices that would result in increases in farming incomes. The study is carried in order find out to what extent a farmer could increase productivity whilst using low-cost, locally available technologies. This study surveys randomly selected 60 farmers across Kerala through using a questionnaire. The results were all mainly positive. The analysis results indicate that farmers are adopting high level of technology in seed variety and irrigation phases, medium level of technology in land preparation, pest management and fertilizer application phases and low level of technology in weeding and harvesting phases. There is a statistically significant difference in productivity between high and low degree technology adopters.

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Entrepreneurial Dynamics Towards Vision 2047

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Dr. A. Pankajam
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3 CHAPTER

An Overlook into Ethical Issues in IT Sector Entrepreneurship: Case of South India

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Abstract

Ethics is in charge of providing solutions to numerous morality-related issues that assist in defining what is good or wrong in terms of concepts. The rapid expansion of industrialization, globalization, and the emergence of IT parks are all contributing to the expansion of Indian information technology. The society is currently experiencing ethical problems like favoritism, immorality, partiality, animosity, and hate, as well as discrimination, gender differences, misuse of management positions, and internal project disputes and conflicts. In this study, it is hoped to evaluate information technology ethics, identify current ethical issues, and then offer methods to curb them in the IT industry. The results of this study and previous studies make it abundantly evident that ethics in information technology can be taught before it is effectively maintained. A collection of strategies and guidelines for policing immoral acts in the field of information technology are required in an effort to decrease their challenges. And even the staff members were open to accepting and implementing the shift in the organization's ethical standards.

Keywords: Ethics, IT Sector, South India, Employee Ethics, Policy adoption.

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INTRODUCTION

The term "ethics" relates to the moral philosophy, which entails systematizing, supporting, and defending various beliefs to show whether they are true or false [Singer 2011]. Axiology's philosophical sub discipline of ethics continues to be concerned with a wide range of values. Ethics is in charge of providing solutions to numerous morality-related issues that assist in defining what is good or wrong in terms of concepts. The three major categories that can be connected to ethics are described below:

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8 CHAPTER

Exploring Consumer Behavior in Relation to the Intent to Purchase Life Insurance Products

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Abstract

Understanding of individual's financial decisions is a complex procedure especially when it comes to analyze about the buying behavior of life insurance products. This study focuses on the behavioral aspects of purchase intention, which includes the psychological and social factors that affect individuals' attitudes towards purchasing life insurance. Aim of this study is to analyze the impact of customer attitude, subjective norms, risk aversion, and perceived behavioral control, on purchase intention. The study highlights the importance of customer attitude, subjective norms, risk aversion, and perceived behavioral control in shaping individuals' purchase intention and investment behavior. The findings contribute to the understanding of the behavioral aspects of individual's purchase intention and investment behavior, and provide valuable insights for marketers and policymakers to develop effective strategies for promoting life insurance products.

Keywords: Intention, Attitude, Subjective Norms, Perceived Behavioural Control.

INTRODUCTION

Life insurance offers financial support to the policyholder's loved ones in the event of the policyholder's untimely death. Although life insurance is essential to providing loved ones with financial security in the event of the policyholder's passing, research shows that a sizable portion of the population is still underinsured or uninsured. Life insurance products are not widely used for a variety of reasons, including customer risk attitudes and general financial literacy.

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ctive. Retrieved from https://www2.
ncial-services/deloitte-au-fs-biomet-

2 trillion worth of mobile payment
errescarch.com/press/press-releases/

levices more than themselves to keep
d.com/news/perspectives/2019/glob-
elves-to-keep-their-data-safe/
rom 2019 to 2025. Retrieved from
netrics-market-size/

CHAPTER 25

The Relationship between Big Five Personality Traits and Counterproductive Work Behaviour

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Dr. D. Arthi

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Abstract

This study aims to examine the relationship between the Big Five personality traits and counterproductive work behavior in the manufacturing industry. Previous research in this area has primarily focused on the service sector, leaving a gap in knowledge regarding the manufacturing sector. Counterproductive work behaviors are voluntary actions that are detrimental to the organization's interests. Personality traits play a significant role in shaping individuals' thoughts, feelings, and behaviors. The study adopts a descriptive research approach and collects data from 160 employees of Salzer Electronics Limited in Coimbatore. Data collection methods include interviews, random sampling, and the use of structured questionnaires. Statistical analyses such as correlation and regression are employed to investigate the relationship between the Big Five personality traits and counterproductive work behavior. The findings reveal no significant relationship between the Big Five personality traits and counterproductive work behavior. Understanding the impact of these personality traits on counterproductive behavior is crucial for fostering positive workplace environments and organizational success.

Keywords: Counterproductive Work Behaviour, Big Five personality traits.

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BACKGROUND OF THE STUDY

Employees play a crucial role in any business, and their behavior in the workplace significantly influences the success of the organization. Positive behaviors contribute to a healthy work environment and enhance company performance, while negative behaviors can have detrimental effects. To ensure employees' behaviors align with the organization's interests, companies often provide handbooks and guidelines. Moreover, many firms monitor employee behavior to maintain productivity and motivation.

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RIGHTS OF WOMEN WITH DISABILITIES

Towards Equity and Accessibility

Dr. K. Sambath Rani
Dr. T. Geetha



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Chapter

22

Inclusion of Visually Impaired Girls in Academics in IED-SS

*T. Premalatha**

*Dr. R.Vaijayanthi***

Abstract

Inclusive Education is a new approach towards educating children with disability and learning difficulties with that of normal ones within the same roof. It brings all students into one classroom and community regardless of strength or weakness in any area and seeks to maximize the potential of all students. Equitable, inclusive, and quality education identifies and attempts to eliminate barriers, promotes a sense of belonging lays the foundation for success and better learning outcomes for all learners. The study's overall objective is to find out the Inclusion of Visually Impaired girls in academics and involvement in Extracurricular activities in the Coimbatore district and differences among them due to age, and nature. The study discovered that there is no significant difference in English and Tamil Braille reading and writing due to age and nature. It also revealed that there are no significant differences in the involvement of Extracurricular activities based on age and nature.

Keywords: Inclusion, Integrated Education, Visually Impaired

Introduction

Inclusive education is a system of providing education that welcomes all children in a shared learning environment. All learners have a right to education, regardless of their individual characteristics, gender, or difficulties. Educationists consider the idea of inclusive education as similar to integrated and mainstreaming, but the concept of

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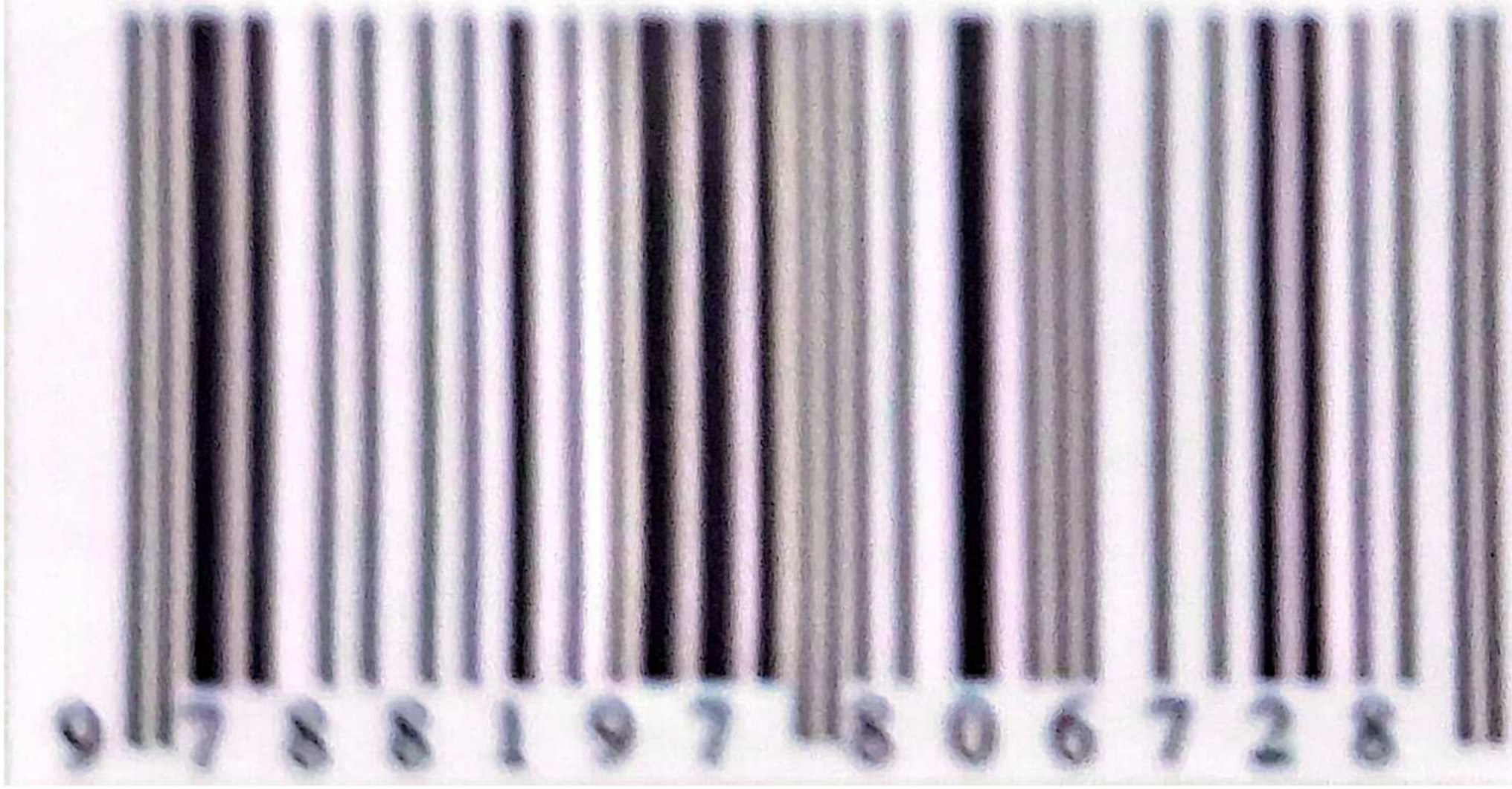
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COST OPTIMIZATION ANALYSIS OF MULTI-PHASE BATCH ARRIVAL RETRIAL G-QUEUE WITH NON-PERSISTENT CUSTOMERS

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Abstract

Consider a scenario involving a Batch Arrival Retrial G-queue featuring non-persistent customers. In this setup, when a batch of customers arrives and discovers that the server is available, one customer from the batch receives immediate service, while the others are directed to an orbit for subsequent service. Conversely, if the server is occupied, all arriving customers are directed to the orbit. The service process administered by the server unfolds in two distinct phases. The initial phase entails providing an essential service required for all arriving customers. The subsequent phase encompasses M stages of sequential services, where each stage (indexed as i=1, 2, 3, ..., M) comprises k_i distinct optional services of varying types. During the second phase, customers retain the flexibility to exit the system after completing service at any stage. Furthermore, customers have the option to balk, refusing service due to prolonged queues, or renege, choosing to leave the queue after a waiting period. The entrance of a negative customer disrupts the service of a positive customer, triggering immediate server repair. This repair process begins promptly. In instances when the server is idle, it may choose to embark on a single vacation with a certain probability or remain idle within the system, with the complementary probability. Upon concluding the vacation period, the server has the option to search for customers currently in the orbit. Employing the supplementary variable technique, the steady-state distribution of queue sizes, the expected queue length, and the anticipated system size concerning the number of customers in the orbit are derived. Additionally, the various reliability metrics for the system and delve into specific cases are computed. Also, numerical findings that illustrate the influence of different parameters on the system's behaviour are presented. Finally, the cost optimization analysis using particle swarm optimization algorithm is performed. This model finds applications in various fields, including call centers, manufacturing, healthcare systems, and public transportation, offering valuable insights for optimizing customer service, resource allocation, and system performance.

Keywords:Retrial Queue, negative customers, Multi – PhaseService, Non-Persistent Customer, Particle Swarm Optimization

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Chapter

22

Inclusion of Visually Impaired Girls in Academics in IED-SS

*T. Premalatha**

*Dr. R.Vaijayanthi***

Abstract

Inclusive Education is a new approach towards educating children with disability and learning difficulties with that of normal ones within the same roof. It brings all students into one classroom and community regardless of strength or weakness in any area and seeks to maximize the potential of all students. Equitable, inclusive, and quality education identifies and attempts to eliminate barriers, promotes a sense of belonging lays the foundation for success and better learning outcomes for all learners. The study's overall objective is to find out the Inclusion of Visually Impaired girls in academics and involvement in Extracurricular activities in the Coimbatore district and differences among them due to age, and nature. The study discovered that there is no significant difference in English and Tamil Braille reading and writing due to age and nature. It also revealed that there are no significant differences in the involvement of Extracurricular activities based on age and nature.

Keywords: Inclusion, Integrated Education, Visually Impaired

Introduction

Inclusive education is a system of providing education that welcomes all children in a shared learning environment. All learners have a right to education, regardless of their individual characteristics, gender, or difficulties. Educationists consider the idea of inclusive education as similar to integrated and mainstreaming, but the concept of

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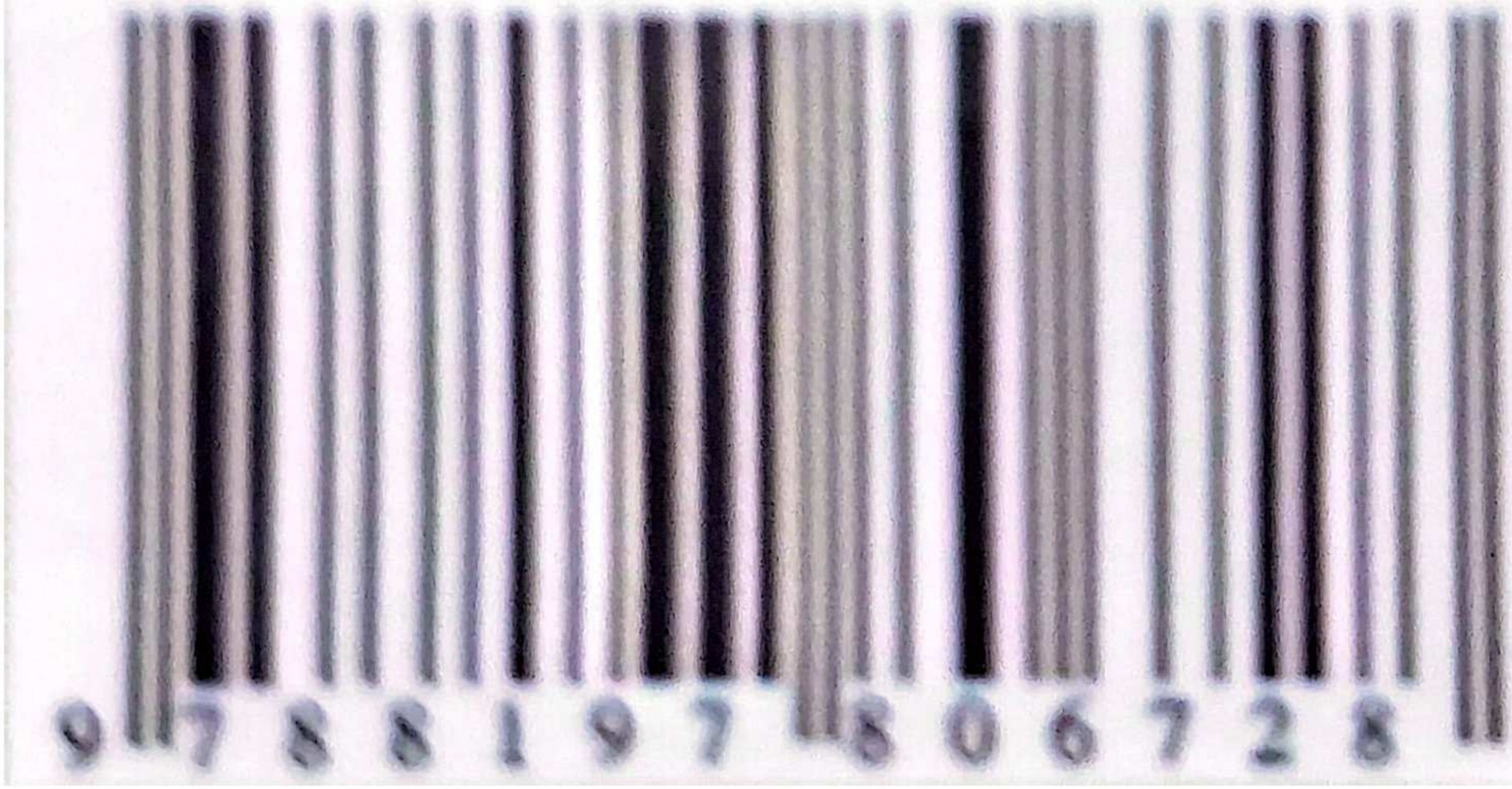
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Day-2(15th December,2023)

1	Session Talk by Technical Expert (Online) **Dr. Sumi Singh** **Founder-Generative AI Labs St. Louis, Missouri, USA**	09:30 AM
2	Paper Presentation in the respective tracks (Both online and offline)	10:00 AM
	High Tea - 11:00 AM (Venue :5th Floor Admin Block)	
3	Paper Presentation in the respective tracks (Both online and offline)	11:30 AM
	Lunch12:30PM(Venue :5th Floor Admin Block)	
4	ValedictoryFunction	2:00PM
5	WelcometoDignitaries	2:10 PM
6	WelcomeAddressbyConferenceGeneral Chair (Dr. Harikrishnan K, Dean VITBS)	2:20 PM
7	ConferenceReportbyConferenceChair (Dr.R.Vedhapriyavadhana,Asst.prof/SCOPE)	2:30 PM
8	Honoring theDignitaries	2:35 PM
9	Addressby-Guest of Honour (Ms.Sabita,Chief Human Resources Officer (CHRO),Fintech,Chennai)	2:40 PM
10	Guest Addressby Chief Guest(Dr.Nabin Sharma,Associate Professor, University of Technology, Sydney, Australia)	3:00 PM
11	Felicitation Address by Vice Chancellor (Incharge) & Pro Vice Chancellor (Dr.V.S.Kanchana Bhaaskaran)	3:15 PM
12	VoteofThanksbyConferenceChair (Dr.Kalaipriyan.T,Asst.Prof/SCOPE)	3:25PM
13	Group photo Session	3.30 PM
	HighTea-3:45 PM(Venue :5th Floor Admin Block)	

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1	02.15PM -03.15 PM	5	25
2	03.15 PM – 04.30 PM	5	25

SESSION NUMBER	SESSION TIMING	AREA OF SPECIALIZATION
1	02.15 PM - 03.15 PM	Networking Security and Machine Learning
		IOT, AI, Deep and Machine Learning
		Blockchain and network computing
2	03.15 PM - 04.30 PM	Machine Learning,IOT and FOG computing
		Computer Vision , IOT and AI
		Machine ,Deep Learning and IOT and FOG Computing
		Cyber Security, Fog Computing and machine learning

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Paper Presentation - Session 2

Date: **15th December 2023** **Track 3: Machine Learning and Deep Learning**
Time: **11.30 AM – 12.30 PM**
Mode: Online

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1	47	CNN based Human Intention-Behavior Prediction using Common Average Reference and STFT of EEG Signals	VIT-AP University	Mr.Kondagurava Reddy Atla and Mr.Rajeev Sharma
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Child Centric Disaster Risk Reduction in the Indian Context



Editors

Dr. Kumar Raka • Dr. Balu I. • Dr. R. Nithya

Dr. T. Geetha • Dr. D. Nithya

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Child-Centric Disaster Risk Reduction in the Indian Context

Editors

DR KUMAR RAKA • DR BALU I
DR R NITHYA • DR T GEETHA • DR D NITHYA



School of Engineering, School of Allied Healthcare Sciences & Women Studies Centre
of
Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu

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Child-Centric Post Disaster Healthcare

SHANTHI S AND NITHYA R

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ABSTRACT

Natural disasters are a common happening in this modern world. The impact of disasters on human beings has touched its extreme limit, causing causalities. Consequently, children are affected severely both physically and mentally. The anxiety due to the impact of disaster affects children and causes short- and long-term mental health effects like Post-Traumatic Stress Disorder (PTSD), in which Acute Stress Disorder is seen as typical. The affected children can be made to break through by screening tools to assess the mental health of the children after the disaster, reestablishing education programmes, reestablishing recreation programmes, bringing in reading habits, conducting Return to Happiness programmes, making children play with the toys they like the most and resilience.

Keywords: Child Centric, Healthcare, Impact of Disaster, Psychology of the Children

INTRODUCTION

Countries like India, with typically non-uniform physiographic and climatic conditions, often face natural disaster vagaries. The unique geo-climatic conditions in India act as a hub for the occurrence of natural disasters. About 54 per cent of the landmass is prone to earthquakes, 40 million hectares of landmass is prone to floods, 8,000 km of coastline is prone to cyclones and

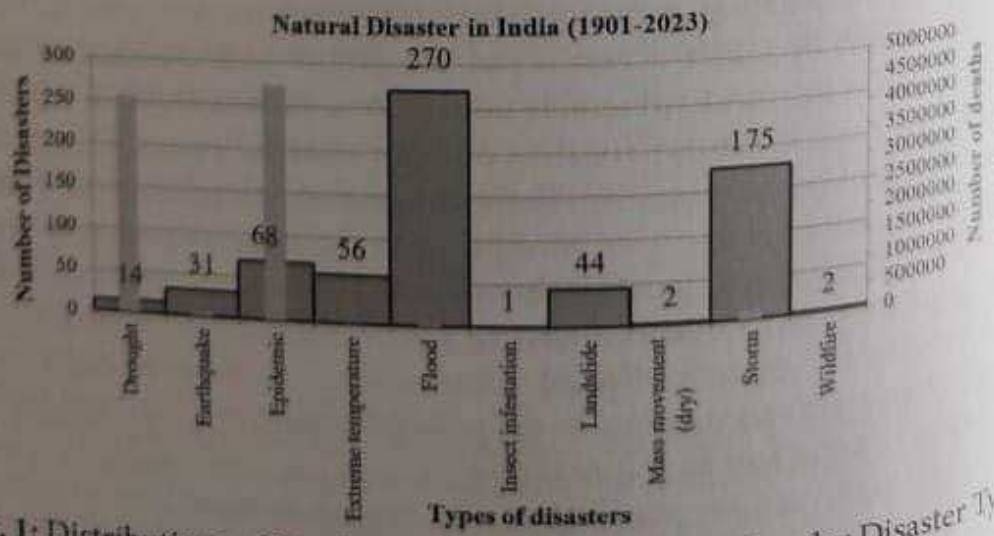


Fig. 1: Distributions of Death Tolls in India Categorised under Disaster Types

Child Centric Disaster Risk Reduction in the Indian Context

The Editors



Dr. Kumar Raka is a Social Scientist and Disaster Management Professional with a Ph.D. in Sociology from JNU, New Delhi, and a Master's in Disaster and Emergency Management from Tel Aviv University. With over 18 years in Disaster Risk Reduction (DRR), he has significantly contributed to the establishment of the National Disaster Response Force (NDRF) and developed robust disaster management mechanisms in Noida and Greater Noida. He led a record-breaking earthquake evacuation drill involving 110 schools, recognized by the Limca Book of World Records in 2018. His work emphasizes child and youth-centric and gender sensitive/disability inclusive DRR approaches.



Dr. Balu I. is a Disaster Risk Reduction and Development Management professional with 15 years of experience. He holds a Ph.D. in Sociology and a degree in Development Management from Tata-Dhan Academy. He has worked with the National Institute of Rural Development & Panchayat Raj, the Ministry of Home Affairs, and the Ministry of Youth Affairs and Sports. His expertise includes grassroots to national-level initiatives, focusing on Child Centric Disaster Risk Reduction and Youth for Development. He currently serves at the National Institute of Disaster Management, Ministry of Home Affairs, Government of India.



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Dr. D. Nithya is an Assistant Professor in the Computer Science and Engineering Department at Avinashilingam University, Coimbatore, with over 13 years of experience. She holds Bachelor's and Master's degrees, and a Doctorate in Computer Science and Engineering. She has organized numerous workshops and seminars, published over 12 papers in international and national journals, and contributed to three book chapters, focusing on Web Mining, Machine Learning, and Neural Networks.

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Exploring the Green Building Concept and Sustainable Materials to Augment Construction Practices

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ABSTRACT *: Due to India's rapid urbanization, a slew of major environmental issues are surfacing in the building industry. Increased demand for housing leads to increased consumption of energy, resources, and raw materials, resulting in an increase in carbon content in the air, which is hazardous to the environment and human health. We are currently dealing with a number of environmental issues, which necessitates the use of more environmentally friendly products in order to reduce environmental consequences. We are already seeing changes in weather patterns in towns like Nagpur, with hotter summers, shorter winters, and insufficient monsoons. As a result, it is now more vital than ever to take the city's ecology and scarce energy supplies seriously. To lessen their negative environmental impact, developers must identify better, more sustainable methods of building design. As a result, it is critical to employ more sustainable and locally available materials that are environmentally beneficial and set the standard for a brighter tomorrow. Considering all these factors, this paper presents a compilation of five environmentally friendly construction materials, elucidating their advantages, disadvantages, durability, and cost-effectiveness in the construction sector. These materials serve as viable alternatives to traditional counterparts.*

Keywords*: Green Material Cost Efficiency, Durability, Environmentally Friendly Construction Materials, Energy Efficiency, And Sustainability.*

INTRODUCTION

According to various studies, the term "green building" can be defined in multiple ways, often synonymous with "high-performance buildings" or "sustainable structures." The fundamental principles underlying green building encompass:

Environmental Impact Reduction: Minimizing the adverse effects of a structure on the environment.

Occupant Health Improvement: Enhancing and promoting the health of individuals residing in a building.

Economic Savings and Returns: Delivering investment savings and returns to investors and the community.

Life Cycle Consideration: Incorporating life cycle analysis during the planning and development stages.

The construction sector plays a pivotal role with significant environmental, economic, and social implications globally. While providing employment opportunities and essential infrastructure, it also poses challenges. In 2001, the Confederation of Indian Industries (CII) established the International Green Building Council (IGBC) in collaboration with the US Green Building Council (USGBC) and the World Green Building Council, marking a milestone with the inauguration of India's first green building, the Sohrabji Godrej Green Business Centre.

The Indian green construction market is poised to reach $40 billion by 2020, with continuous growth anticipated. The IGBC has developed 13 green building rating systems aligned with national objectives in India. These systems consider factors such as sustainable site planning, energy efficiency, water conservation, material selections, and indoor environmental quality in evaluating building performance.

India, like many other regions, faces environmental challenges, necessitating the adoption of eco-friendly products to mitigate impacts. Noticeable shifts in weather patterns, such as hotter summers and insufficient monsoons in cities like Nagpur, underline the urgency for more sustainable building practices. Developers must explore environmentally friendly and locally available materials to minimize negative impacts, setting the stage for a more sustainable and resilient future.

LITERATURE REVIEW

1. Examining Sustainable Building Materials for Green Construction, Conservation, and Refurbishing (2012)": This paper aims to underscore the role of sustainable building materials in mitigating the impact of environmental degradation on occupants and the overall environment.

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Bacteria Based Self Healing Concrete -A Review

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Abstract *: The essential method for enhancing concrete involves employing the self-healing technique to improve its properties. Concrete stability is jeopardized by cracking induced by acids and water, resulting in the deterioration of rebar in reinforced concrete (RC) structures. Additionally, routine assessments of concrete structures pose both challenges and substantial costs. Consequently, the self-healing method is recognized as an effective technique for repairing cracks and restoring the strength properties of concrete. This review focuses on applications, effectiveness, and various self-healing methods and agents explored in different studies. The geometry of cracks plays a pivotal role in self-healing methods and in evaluating different construction materials. This review highlights the encapsulation of chemical self-healing agents, which has proven effective, particularly in relation to un-hydrated cement elements and sustainable building materials. The paper aims to define bacterial concrete, covering aspects such as types and classification of microorganisms, the functioning of bio-concrete as a repair material, and an analysis of the merits and demerits of bacterial concrete. Furthermore, the application of bacterial concrete is explored through a comprehensive literature review.*

Keywords*: Concrete Crack formation, Durability, Microorganisms, bacterial concrete, and Self-healing methods.*

Introduction

Reinforced concrete stands out as the most crucial building material, finding application in road works, multistory buildings, tunnels, dams, and various other construction projects [1]. Concrete, composed of cement, sand, aggregate, admixtures, and water, serves as a versatile building material due to its various uses and properties, including compressive strength, durability, split tensile strength, and the availability of its ingredients [2]. Cracks in concrete are a consequence of corrosion, leading to a reduction in the properties of concrete structures [7,8]. Concrete can be categorized into two states: (i) Plastic state, involving plastic settlement, formwork movement, and plastic shrinkage; and (ii) Hardened state, encompassing thermal stress, chemical reaction, errors in detailing and design, as well as external or overload factors. While cracks in concrete may not initially impact reinforced structures, they can significantly affect the lifespan of these structures over time [10]. Annually, a substantial amount of money is allocated to repairing existing concrete structures globally. Developed countries such as the USA, Germany, South Korea, etc., grapple with significant deterioration in their concrete structures, necessitating increased expenditure on preservation and restoration, in contrast to constructing new buildings [11].

Working and preparation process of Bio Concrete as a Repair Material

Self-healing concrete generates minerals to repair cracks in reinforced concrete structures [8]. Bacillus pasteurii bacteria, along with its nutrient, is introduced into the concrete to sustain its viability for calcite production, which subsequently fills cracks through precipitation [12]. The bacteria facilitate the growth and reproduction of calcite in the form of calcium carbonate precipitation. As the calcite reacts with the concrete, it effectively seals and fills the cracks [18]. The initial concrete mixture includes both bacteria and calcium lactate capsules [22]. During construction, the fluid containing bacteria and calcium lactate is incorporated into the concrete. The use of capsules prevents premature interaction between the bacteria and calcium lactate [34,35]. The dormant fluids containing bacteria can remain viable for up to a century. Micro-cracks are inevitable in concrete structures due to physical reactions that reduce their durability [42,46]. The capsules, requiring water for nutrition, absorb moisture from the environment when exposed. After the water reacts, calcium lactate transforms into limestone, spreading throughout the cracks and facilitating healing. The development of limestone virtually eliminates the possibility of water leaking inside, contributing to increased sustainability [56]. The addition of bacteria in the form of inactive spores ensures a high survival rate [33]. In adverse conditions, the active bacteria can revert to spores and become dormant once again [39].

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Exploring the Role of Aluminum as Reinforcement in R.C.C. Beams : A state of art review

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Abstract *: The construction industry continually seeks novel materials and methodologies to improve the efficiency, sustainability, and cost-effectiveness of structural elements. This research explores the feasibility of replacing conventional steel reinforcement bars in concrete structures with lightweight aluminum hollow bars filled with Recronfibre. The motivation behind this substitution lies in the potential benefits of reduced weight, corrosion resistance, and enhanced tensile strength offered by aluminum, coupled with the reinforcing properties of Recronfibre.The study involves a comprehensive investigation of the mechanical properties, structural behavior, and durability of concrete specimens reinforced with aluminum hollow bars filled with Recronfibre. Experimental analyses include tests for flexural strength, compressive strength, and bond strength, comparing the performance of these innovative bars with traditional steel reinforcement.*

Index Term *: Aluminium hollow bars, Recronfibre, structural reinforcement, lightweight materials, concrete durability, sustainable construction.*

INTRODUCTION

The application of aluminum as reinforcement is a crucial and versatile aspect in various industries, ranging from construction to aerospace. Aluminum's unique combination of properties, including its lightweight nature, excellent strength-to-weight ratio, corrosion resistance, and malleability, makes it an ideal material for reinforcement purposes. Its high tensile strength enhances the overall durability and load-bearing capacity of concrete, contributing to the longevity of buildings and infrastructure. Additionally, aluminum's resistance to corrosion ensures that reinforced structures maintain their structural integrity over time, particularly in environments with exposure to moisture and harsh weather conditions. The application of aluminum as reinforcement is a testament to its diverse and advantageous properties. From enhancing the structural integrity of buildings to contributing to the efficiency of aircraft and vehicles, aluminum's role in reinforcement continues to shape and advance numerous industries.

OBJECTIVE:

1) To determine the strength of aluminum.
2) To study the characteristics ofrecron fiber filled aluminum circular bar as reinforcement in beam element.

PURPOSE OF USING RECRON FIBRE

Fiber reinforcement has become a cornerstone in modern construction practices, enhancing the mechanical properties of concrete. Recronfibre, with its unique composition and characteristics, serves as a compelling addition to the repertoire of construction materials.Recronfibre, typically made from polyester, offers a range of properties beneficial to construction applications. Its high tensile strength, flexibility, and resistance to environmental factors make it a promising candidate for reinforcing concrete structures.The addition of Recronfibre to concrete mixes contributes to improved tensile strength and crack resistance.



(Fig 1 – Recronfibre)

PURPOSE OF USING ALUMINIUM HOLLOW BAR

The high strength-to-weight ratio of aluminum is a hallmark of its structural capabilities. This property allows engineers to design and construct robust structures without the burden of excessive mass, making it particularly advantageous in aerospace, automotive, and lightweight structural applications.

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Exploratory study on Light Emitting Concrete

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Abstract: *In developing countries energy demand is insatiable and growing day by day. Road lighting is one of the biggest challenges faced by the government. One fifth of the rural areas still remain in darkness. Birth of many new construction materials after the industrial revolution, dominated the world with its advancement sand efficiency. Energy resources are gradually decreasing as the demand keeps increasing. The government faces a major problem in illuminating streets and highways. Frequent blackouts cause difficulty among travelers to recognize the path and pose a great threat to their sense of safety and security. A test procedure was developed to quantify the magnitude and duration of the luminance of the coated concrete surface; quantifying the luminance was the key in evaluating the performance of the luminescent sealant. Results of the tests indicated that the luminescent surface emitted light (i.e., glowed) for approximately 24 h in a dark space after it was excited. Larger particles of strontium aluminate were found to luminescent for a longer time.*

Index terms: *sulfides, photoluminescence, electro-luminescence, light emitting diodes, Luminescence, Aesthetic appeal, Eco friendly, Phosphorescence, Night-time radiance.*

INTRODUCTION

Concrete is one of the most durable building materials. Having numerous varieties, light emitting concrete has drawn a significant attention from global researchers due to its unique properties. Its ability to transmit light not only results in an improvement concerning visibility, but also reduces the light energy demand. The study aims to minimize the electricity consumption for the lighting required on the roads and highways during the night time. In day time, the light emitting concrete structure acts as a storage device. Light emitting concrete is a material designed to illuminate highways, roads, and bicycle lanes without using electricity. It absorbs solar energy during the day and radiates light at night. Cement is a opaque material that do not allow light to pass through it. When water is added to cement crystal flakes are formed as a result of hydration reaction. These crystals block the absorption of solar energy. This type of concrete can last up to 100 years. This concrete doesn't require any electricity. It is environment friendly. Light emitting concrete is a type of concrete that has been infused with materials that allow it to emit light. This can be achieved through the use of photo luminescent pigments which are capable of storing energy from the sunlight and then releasing it as visible light in the dark. Light emitting concrete can be used in a variety of applications including as a form of emergency light or as a way to add decorative lighting. It has a potential to highly energy efficient and potential solution. It is very economic, friendly as it does not require any electricity to work. During the night, these electrons emit light.

OBJECTIVE:

Our study aims

- To design M30 concrete.
- To determine the optimum percentage of chemicals used in the concrete.
- To study the mechanical properties of light emitting concrete.
- To reduce the energy demand.
- To improve light absorption.
- To develop phosphorescent cement in different colors such as green light, yellow light, red light and blue light by studying the chemical properties.

PROBLEM IDENTIFICATION

The problems due to which light installation on highways is not done:

- It takes a lot of money and manpower to install the LED street lights on the highway.
- At the same time, about the electricity supply or the maintenance also will require long-term investment.
- The length highway, if there is no vehicle during the illumination of the streetlight, will waste the power.
- If lights are installed on speed highway, it is neither energy-saving nor scientific.
- Increasing demand for energy is leading to rapid consumption of fossil fuels, which are exhaustible sources of energy.

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HUMIDITY DETERMINATION IN STRUCTURAL COMPONENTS

Dr.R.Nithya*[1], Dr.N.Srimathi*, Dikshita A[1] , Harsha varthani J[1] , Rathina Priya N[1], Nisha S[1]

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ABSTRACT:

Determining the right moisture content material of wetted construction substances and evaluation of corresponding locations, orientations, and patterns is of approaching cost to Forensic Engineers and building scientists. The objective of this research is to perceive the moisture issues that a leakage troubles or other moisture from outer supply and measure the moisture content material of the wall via the humidity sensor. The principle intention of this mission especially this moisture sensor used to decide moisture level of the hidden or difficult to get entry to areas. The result of this study is to find the moisture difficulty and rectify the hassle and stop the partitions structure the main issues. In building walls, the composite materials such as gypsum core and paper going through soak up and distribute distinctive moisture. The moisture meters were top in detecting, but no longer mounted the correct moisture values. In this regard we enhance the moisture meter.

Keywords: moisture issues, building scientists, Forensic Engineers, moisture sensor, walls, moisture, sensor, material

RIGHTS OF WOMEN WITH DISABILITIES

Towards Equity and Accessibility

Dr. K. Sambath Rani
Dr. T. Geetha



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RIGHTS OF WOMEN WITH DISABILITIES

Towards Equity and Accessibility

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Chapter

22

Inclusion of Visually Impaired Girls in Academics in IED-SS

*T. Premalatha**

*Dr. R.Vaijayanthi***

Abstract

Inclusive Education is a new approach towards educating children with disability and learning difficulties with that of normal ones within the same roof. It brings all students into one classroom and community regardless of strength or weakness in any area and seeks to maximize the potential of all students. Equitable, inclusive, and quality education identifies and attempts to eliminate barriers, promotes a sense of belonging lays the foundation for success and better learning outcomes for all learners. The study's overall objective is to find out the Inclusion of Visually Impaired girls in academics and involvement in Extracurricular activities in the Coimbatore district and differences among them due to age, and nature. The study discovered that there is no significant difference in English and Tamil Braille reading and writing due to age and nature. It also revealed that there are no significant differences in the involvement of Extracurricular activities based on age and nature.

Keywords: Inclusion, Integrated Education, Visually Impaired

Introduction

Inclusive education is a system of providing education that welcomes all children in a shared learning environment. All learners have a right to education, regardless of their individual characteristics, gender, or difficulties. Educationists consider the idea of inclusive education as similar to integrated and mainstreaming, but the concept of

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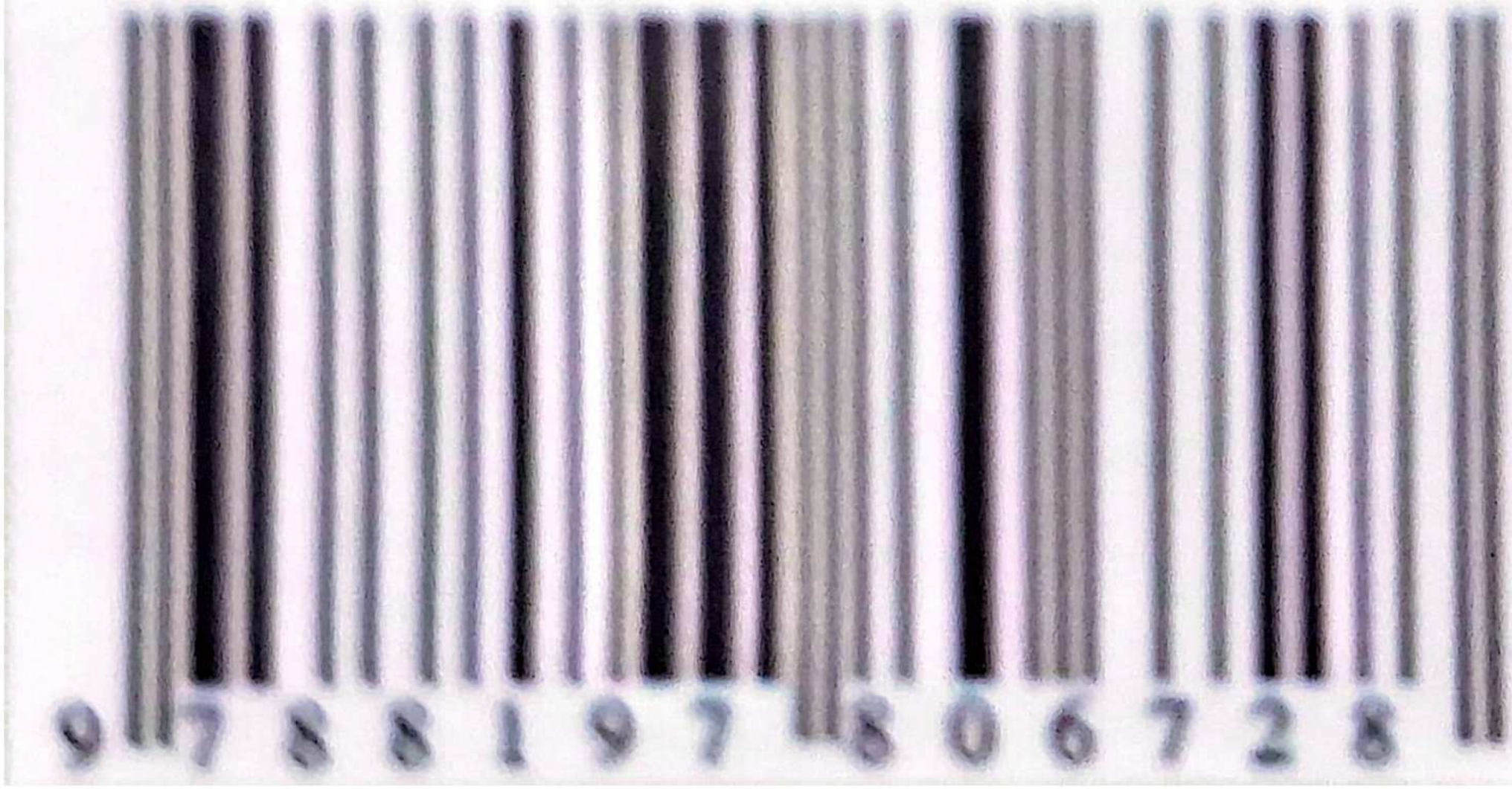
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Common Medicinal Plants of Our Surroundings







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A Precis Ledger on Pharmaceutical Development of Classical and New Drug Delivery System Using Herbals

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Abstract

Plant-based medicines have been used by humans for thousands of years to treat a variety of diseases. However, these phytomedicines have limitations, primarily due to stability difficulties and limited lipid solubility. The amount of phytoconstituent in a plant might vary depending on its age, time of harvest, environmental conditions, and so forth. Standardised medicinal plants, plant extracts, and separated constituents can be employed to address this issue. These herbal new drug delivery technologies include vesicular delivery systems such as liposomes, phytosomes, ethosomes, transferosomes, and particulate delivery systems such as microspheres, micropellets, nanoparticles, and micro and nano emulsions. The term "novel drug delivery system" refers to a new strategy to herbal drug formulation that solves the constraints of established drug delivery systems. However, the medication delivery technology employed to provide the herbal medicine to the patient is outdated, resulting in decreased therapeutic efficacy. Many herbal medications have been introduced into these systems in order to increase stability, bioavailability, and toxicity. The chapter focuses on the importance of herbal medicine in treating the diseases the classical traditional drug delivery system and the current state of the development of innovative novel drug delivery system with commercially available phyto products.

Key Words: *Herbal medicine, Traditional drug delivery system, Novel drug delivery system, Liposome, Phytosome, Ethosome, microemulsion, Micropellets, Nanoparticle.*

Introduction

Herbal medicines are almost certainly as old as the human race. Plant preparations or plant components have been utilised as medicine since antiquity and are still used by the majority of the world's population (WHO, 1991). Herbal medications have been utilised to cure sickness in local or regional healing practises since mediaeval times. These are naturally occurring plant-based products that have undergone little or no chemical processing. More than 80% of people in most underdeveloped nations still rely on traditional herbal remedies to satisfy their health-care needs. Despite the existence of modern medicine, traditional herbal remedies have acquired appeal due to their historical and cultural significance. Furthermore, they are thought to be safer and have fewer adverse effects than current drugs. Modern research has also revealed that many contemporary pharmacological therapies reduce disease symptoms while ignoring underlying issues, in contrast to natural herbal remedies, which produce superior outcomes by addressing the fundamental cause of the disease more effectively (Annie., 2015).

The use of plant material, such as the entire plant, roots, bark, leaves, flowers, berries, or seeds for therapeutic purposes is referred to as "herbal medicine" (HM), "traditional herbal medicine," or "phytomedicine." (WHO 2005). The first human evidence of the use of herbal medicine was discovered during the excavation of Neanderthal sites, such as the Shanidar caves in northern Iraq. Herbal medicine has a long history of usage outside of traditional medicine. Many herbal remedies have developed via customary usage in a particular cultural setting. Traditional practices have been passed down verbally from one generation to the next in certain societies, while in others they have been preserved in written documents A number of herbal remedies have produced significant

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Thymus vulgaris L (Thyme): A Versatile Medicinal Herb with Diverse Health Benefits

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Abstract

Thymus vulgaris, commonly called thyme, is a fragrant herb with a rich history of culinary and medicinal use. Thyme is known for its high antioxidant content, with flavonoid phenolic antioxidants such as zeaxanthin, pigenin, lutein, luteolin, and thymonin. It helps to combat oxidative stress and free radicals, contributing to its therapeutic potential. Thyme's essential oil contains key compounds like thymol and carvacrol, which exhibit strong antibacterial properties and are traditionally used to treat gastrointestinal and bronchopulmonary disorders. Furthermore, thyme demonstrates anti-inflammatory effects by reducing the production of inflammatory mediators like TNF-α and IL-6, making it valuable in managing various inflammatory conditions. Its antifungal properties, particularly against *Candida* species, have also been established, and thyme's essential oil inhibits fungal growth and biofilm formation. Recent research has explored thyme's antiviral potential, particularly against herpes simplex viruses and its potential application in COVID-19. Thymol, a primary component of thyme, has shown promise as an antiviral agent. A clinical study has confirmed the efficacy and tolerability of a thyme-primrose the combination in treating acute bronchitis, highlighting its therapeutic value in respiratory conditions. Its antioxidant, antibacterial, anti-inflammatory, antifungal and potential antiviral properties contribute to its reputation as a potent natural remedy. This current investigation aims to comprehensively examine the therapeutic attributes and advantageous health effects associated with thyme,

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Liquid Waste Management-A Minireview

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ABSTRACT

In both rural and urban regions, solid and liquid wastes from household and animal sources have the potential to seriously harm water supplies used for irrigation, leisure, and drinking. Over four millennia have passed, and waste management has been a problem. Trying to adopt an integrated waste management strategy has replaced the practice of disposing of trash into the biosphere. In addition to summarizing the most important findings of the present environmental monitoring programme, this report also analyses the history of liquid waste operations. Different waste issues from the past and present are defined, as well as environmental ecology, the basic concept of recycling, and materials recovery. In addition to the ability to contaminate groundwater and drinking water when incorrectly managed and disposed of, liquid waste is a growing concern in today's globe. In areas where untreated sewage is reused, illnesses such as cholera, plague, TB, hepatitis, and diphtheria are particularly frequent and can be exceedingly deadly over time. It poses a serious difficulty for medical facilities and poses hazards to the public's health. Since there is a water shortage, there is an increase in the amount of untreated wastewater used for irrigation, but over 90% of the wastewater generated worldwide from medical care facilities is still untreated. To maintain safety and prevent tainted drinking water, proper procedures should be carried out to dispose of untreated wastewater.

Keywords: Waste problem, Environmental ecology, Materials recovery, Effluent treatment Plant, Wastewater treatment plant.

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The Decisive Role of Animal Science in Modern Applications

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ABSTRACT

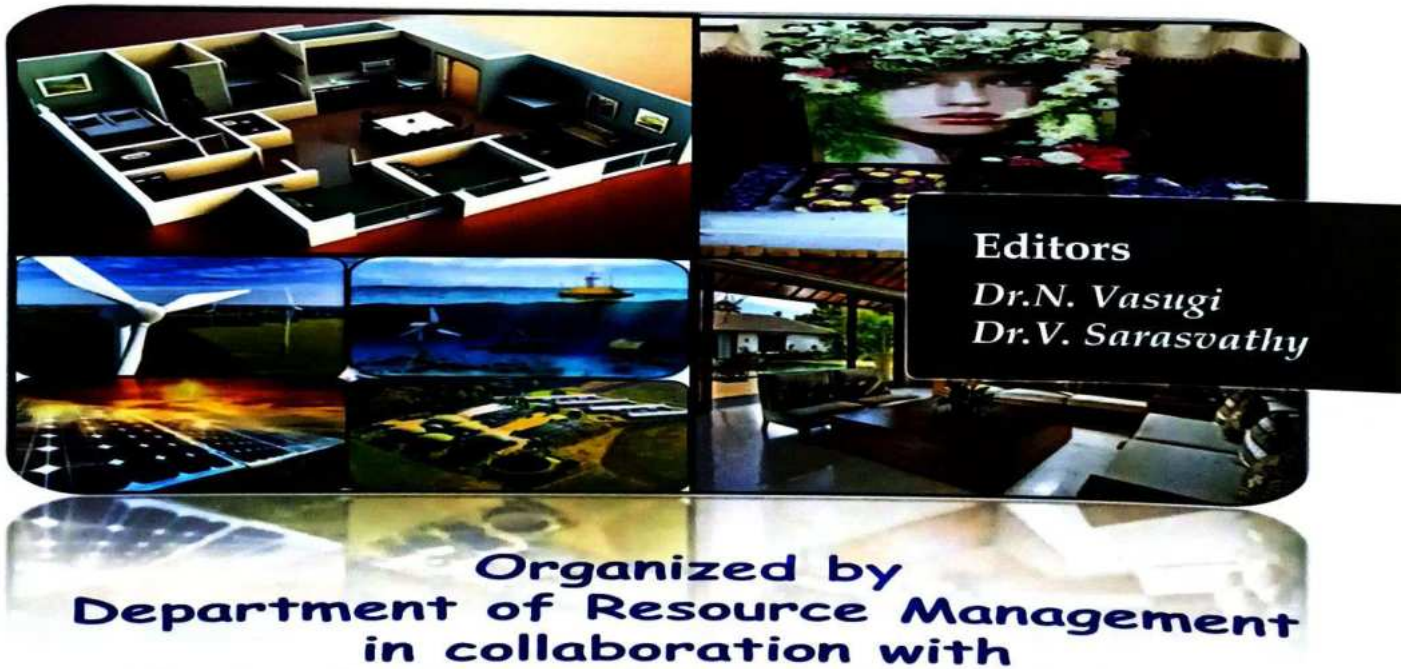
Animal science is a broad field. It has a wide range of applications, including the raising of animals, breeding, health care and disease prevention, marketing, processing, distribution, and a variety of related service enterprises. Animal models contribute to biomedical science by providing valuable insights into diseases, genetics, and therapeutic strategies that benefit both human and veterinary care. Ethical concerns are critical to the practice of animal science because they address the ethical concepts and values that govern how animals are handled, employed, and managed. Animal welfare refers to the physical and mental well-being of animals, as well as their ability to express natural behaviours. Animal science provides a wide range of job opportunities in government programmes, business, education, agriculture, and research. Animal welfare studies and improvements have a significant global influence, influencing various areas of food supply, economic development, and environmental sustainability all over the world.By enhancing animal productivity and efficiency, researchers help to meet the growing demand for animal products, Food system growth and an expansion in animal agriculture have far-reaching financial implications.Animal science research and innovation must continue in order to overcome the challenges of animal research and ensure a more sustainable and resilient food source for future generations.

Keywords: Animal science, Research, Environmental impact, Live stock management, Wildlife, Animal Biology, Ethical consideration.

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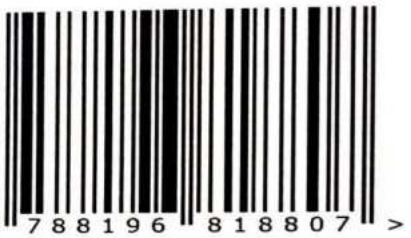
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Conversion of Agricultural Wastes into Wealth Using Waste Decompose Environmental Sustainability

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Abstract--- The agricultural wastes create major environmental problems without effective means of manag methods. There are many technologies being used for the decomposition, which mainly include ana decomposition, compositing, fermentation, etc. All these decomposition processes depend upon the differe inhabiting microbes. These microbes are the key components of agri-residue decomposition process. NCOF decomposer is used for quick composting from organic waste, soil health improvement and as plant protection It contains beneficial microorganisms from Desi Cow Dung for soil health reviver. This study reveals that in sug it decomposes stubbles in 60 days with high yield of 81.41t/ha by replacing burning of stubbles which kills ben micro-organisms in the soil and affects soil fertility.

Keywords--- Waste Decomposer, Agricultural Waste, Soil Fertility, Microorganisms.

1. Introduction

Agricultural waste is produced by various agricultural operations, and it contains

sugarcane baggage, paddy and wheat straw and husk, waste of vegetables, food products, jute fibers, crop etc. About 998 million tons of agri-residue waste is produced every year (Agamuthu, et.al., 2009). Eighty perc organic waste can be converted into organic manure (Overcash MR, et.al., 1983). The abundance of agricultural production causes a lot of environmental pollution and generates many environmental contamination prob During certain periods of time, characteristics of waste materials have changed and cause harmful and toxic e toward human beings. Approximately, 2 tons per day agri-waste is produced in rural areas. Besides this, cow h and sugar industry produced an average 20 million tons of waste, which is a rich source of nutrients manures. Conventionally, farmers burnt up or left the agricultural waste in the field, but this causes lots of air pol and soil pollution. Various techniques have been utilized for agri-residue disposal. Agricultural waste mainly co of crop residues which have lots of organic carbon content and a supply of plant nutrients. Crop residues' rete after 1 harvesting reduces soil erosion (Singh B and Rengel Z, 2007). Combine harvester machines contributes residue after harvesting but due to high silica content animals are not likely to feed these residues. Then farmers to burn the residues, but burning emits 8.77 Mt. of CO, 141.15 Mt. CO_2, 0.23 Mt. of NO, and 0.12 Mt. of NH_3 (Butch 2009), which causes air pollution and loss of organic content of approximately 80–90% N, 25% of P, 20% of K (S et.al., 2015). Development of agricultural waste management methods for sustainable and eco-friendly approa required for effective disposal of agri-waste (Hai and Tuyet, 2010). Agro-waste may cause several health

Revolutionizing Home Interior through Artificial Intelligence

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Abstract--- Leading AI textbooks place a high premium on "artificial intelligence," or systems that are capable of analysing their environment and taking actions that increase their chances of achieving their objectives. In recent years, the notion of a "smart house" has gotten a lot of attention. The smart home's major challenges involve intelligent decision making, safe identification and authentication of Iot systems, internet - based technologies, data security, and privacy concerns. Smart home automation solutions have been desperately required to address all three of these issues, but currently available systems only handle one or two of them. Artificial intelligence (AI)-enabled smart gadgets are becoming increasingly common. As the use of smart homes grows, security concerns are also projected to increase. When gadgets were turned on when they weren't needed, people had to step in and make judgments or remedy any faults. For this to become increasingly frequent there must be no human interference in current-generation AI systems. As technology evolves, many wise homeowners may swap in or out devices and equipment in their homes to save money and perhaps preserve the environment. Indeed, it has the potential to offer us with a green and long-term living environment. This article gives a quick summary of artificial intelligence's function in smart technology.

Keywords--- Artificial Intelligence, Intelligent Decision-making, Sustainable Living Place, Smart Home Automation.

1. Introduction

Artificial Intelligence is a new branch of research that focuses on how to create robots that can replicate human intelligence (AI). Artificial intelligence (AI) is becoming inevitability in the era of the Internet, and interior design is no exception. As a result, the smart home has become a member of the household. It also comes with two extra advantages: safety and mobility (Xu, Z., Wu, 2019). Building automation has recently received a lot of interest because of its potential to cut energy usage and make building administration, monitoring, and maintenance easier, as well as enhance satisfaction of the house owner. As a consequence, by utilising multiple sensors (such as temperature and CO2 concentration sensors, zone airflow sensors, daylight sensors, and occupancy sensors), these systems have the ability to cut expenses while preserving occupant satisfaction (Domingues and et al., 2016).

Artificial intelligence (AI) and home automation are often used interchangeably; however they are not the same concept. Despite the fact that we have no understanding what powers their minds, we name them "robots." To be clear, AI and automation are not interchangeable terms. It's as though they're contrasting apples with oranges (Wilkinson et al 2007). Despite the fact that there are automated and AI machines, AI can drive some automated machines. When artificial intelligence (AI) is developed, it is intended to think as autonomously as feasible or as nearly as possible to humans. The rules and instructions needed to automate a process are included in a computer programme or piece of software (Deng & Jin, 2019).

Existence and Care of Indoor Plants in Home Interiors

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Abstract--- Indoor plants have been a topic of interest in recent times due to ability to improve indoor air quality and promote overall health. The study was conducted in Coimbatore, thirty households were purposively selected for this survey and 20 nurseries were selected for market survey. The main focus of this study was to find out whether households were aware of oxygen- producing indoor plants and also to analyze the existing oxygen-producing plants that households prefer, find out the indoor flowers sold in the nursery, and get information about their care and treatment of indoor plants. Indoor plants have been widely studied for their ability to reduce pollutants and improve indoor air quality. Each plant has unique characteristics and maintenance requirements, making it suitable for various indoor environments. However, this article also sheds light on the challenges associated with the application and maintenance of indoor plants. The goal of the investigation was to explore the presence of indoor plants and their effects on the indoor environment. The article provides an extensive overview of indoor plants and its benefits towards air purification. Therefore, it is crucial for individuals to carefully select and care for indoor plants to maximize their benefits.

Keywords--- Indoor Plants, Care, Maintenance, Interiors, Indoor Environment.

1. Introduction

Keniger (2013) stated that natural environments and humans are closely related. Humans can improve their quality of life by engaging with nature, which has several measurable benefits such as improved cognitive abilities and psychological benefits. David Watson (2022) explored that houseplants are plants that are commonly grown indoors and used for decorative reasons in residential and commercial settings.

Han (2011) quoted that exposure to nature is considered advantageous for physical and mental well-being. Many people cultivate plants in their homes and workplaces to enhance the natural environment, as they are a representation of nature.

There was a growing public awareness regarding the risks connected with inadequate indoor environments, as urban dwellers spend 80–90% of their lives indoors (in residential areas and public places); this number increases for children, the elderly, the sick, and the disabled. (Deng et al., 2018). According to Claudio (2011), indoor plants are one way to create a healthier indoor environment and also believes that indoor environments are very essential to human health.

Deng and Deng (2018) examined the benefits of houseplants for human health in terms of transpiration, photosynthesis, psychological effects, and air purification. They also demonstrated how houseplants in the home affect stress levels, work performance, and health. According to Moya *et al.,* (2019), indoor plants are believed to increase human comfort and satisfaction but do not provide significant evidence of increased oxygen efficiency and productivity.

Reusing Shipping Containers as an Alternative Building Material for Sustainable Environment

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Abstract--- This paper investigates the potential of repurposing shipping containers as a sustainable and cost-effective alternative building material, highlighting the positive environmental impact and waste reduction achieved through their reuse in construction. The versatility of these steel containers, originally designed for global goods transportation, makes them an eco-friendly option with promising opportunities for promoting sustainability in the construction industry.

Keywords--- Shipping Containers, Cargotecture, Conventional Architecture, Eco- friendly Construction.

1. Introduction

Shipping containers, versatile in size and easily transportable by land or sea, offer a sustainable solution for construction by repurposing them into structures like homes, offices, and schools. Their durability, stackability, and modularity reduce construction waste and the demand for new materials. The emerging concept of "carotecture" integrates cargo container architecture with environmental sustainability, ensuring that these structures not only serve functional purposes but also positively impact the surrounding ecosystem.

Need for the Study

Basically, the concept of green building is about sustainable and "environment-friendly" living and commercial spaces. The advantages of the use of containers as building materials can contribute to environmental conservation, reduced time and cost of construction, and can be applied with accessible technology with the principle of structure and steel construction.After understanding the significance of shipping container as an alternative building material which is sustainable and eco-friendly for residential and commercial purpose, an attempt has been made to research on "Reusing Shipping Containers as an Alternative Building Material for Sustainable Environment".

Objectives

The aim of the study is, To

- To perform survey among the civil engineers, interior design students and practitioners of shipping container buildings.
- Gather the detailed case study on commercial building constructed with shipping container.

Recent Trends in Eco-Friendly Materials Used for Residential Interior Desig

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Abstract--- Green or eco-friendly interior design focuses on improving indoor air quality as well as reducing the impact of these materials on the environment. With the escalating awareness of environmental issues and the need for responsible consumption, designers are increasingly turning to materials that minimize environmental impact without compromising aesthetics and functionality aspects. The present study aims to explore the trends in eco-friendly materials for interior design solutions to preserve the environment and achieve the users' optimal interaction with their surrounding spaces. The study looks into the recent trends in selection and application of eco-friendly materials encompassing aspects such as recycled, upcycled, and renewable resources. It seeks to investigate the availability of such materials in the market, shedding light on the options and choices available to designers and consumers and the current usage of eco-friendly materials within households, examining the extent to which these materials are being incorporated into residential spaces. Lastly, the research endeavors to uncover the preferences surrounding trends in eco-friendly materials in residential interiors, offering insights into the factors influencing design choices in the pursuit of sustainable and aesthetically pleasing living environments. The study concentrated on Coimbatore, particularly exploring Sai Baba Colony, Shivananda Colony, R. S Puram, and Gandhipuram, where 20 samples were collected from stores specializing in eco- friendly interior design materials. There are constraints and barriers in the use of sustainable materials, such as a lack of experience and knowledge of information related to these materials, the role of suppliers in providing them and the high costs of sustainable solutions and sustainable materials that customers prioritize the aesthetic aspects of sustainable materials over sustainability issues.

Keywords--- Eco-friendly, Interior Design, Market, Materials, Residential Spaces.

1. Introduction

According to the Cambridge Dictionary, being eco-friendly means being designed to have little or no damaging effect on the environment. Products, events, and services that are eco-friendly do not harm the earth. Society is becoming increasingly aware of the importance of environmentally responsible building and interior design. As a result, more and more clients seek to incorporate sustainability principles in their interiors to incorporate sustainability principles in their interiors. The process of designing interior environments has witnessed in recent years a shift in design strategies that have adopted the provision of healthy and sustainable environments, relying on choosing eco-friendly building materials and appropriate design solutions in interior spaces, creating environmentally responsible architecture and interior design. (Alfuraty, 2020). Throughout a material's life cycle from production to disposal sustainability is a crucial concern. Extraction operations prioritize the abundance of raw materials and prevent depletion. Manufacturing processes focus on quality, reducing toxic emissions and pollution. During the operational stage, sustainability emphasizes correct usage and appropriate operation of products (Barbhuiya, 2023). The present paper looks into trends in eco-friendly materials for interior design solutions, with the goal of preserving the

Impact of Awareness Programme on Perception of Musculoskeletal Diso Among Women Tea Pluckers, Assam

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Abstract--- The main causes of musculoskeletal complaints in tea plantation workers include heavy lifting, re workdays, and a lack of breaks. However, because of a lack of awareness, instruction, and supervision re musculoskeletal diseases at work, the women tea pluckers gradually develop work related musculoskeletal di without realizing that this is the primary cause of their health problems and physical discomfort. This study ai evaluate the impact of ergonomic training and occupational health education on the knowledge, attitudes, and of women tea pluckers of Assam about work-related musculoskeletal illnesses. Two hundred fifty women tea pl with more than a year of experience who worked in the Jorhat and Dibrugarh districts of Assam were selected b study using the random sample technique. An ergonomic awareness campaign lasting four weeks was designe implemented for the selected female tea pluckers. To evaluate the effectiveness of the ergonomics awa programme, a pre-tested structured checklist was used. The results of the study showed that following participa an awareness workshop, participants' knowledge and attitudes about ergonomic work practices and occupa musculoskeletal disorders increased. The results of the study allow us to draw the conclusion that providing ergo awareness training to female tea pickers will increase their knowledge of musculoskeletal disorders associate their occupation.

Keywords--- Awareness Programme, Work Related Musculoskeletal Disorder, Women Tea Pluckers.

1. Introduction

Tea plantation requires a huge number of labour forces. The women tea plantation workers are significant industry as they form almost 50 per cent of the total workforce in the tea industry in Assam (*Baishya* 2016). In t plantation sector, women tea plantation workers have designated the bottom position in functional and social str Since tea plucking is tough and highly repetitive task, the prolonged exposure to such tasks often results in di health related problems. But due to lack of education, awareness and insufficient guidance, neglibility by their sup in their work, they don't even realize the sources of their body discomfort. Hence, the present study was undertak check their current knowledge of musculoskeletal disorder as well as healthy work practices involved in their and to conduct an awareness programe to minimize the ergonomic risk factors associated with their job by maki women tea pluckers aware of ergonomic work practices.

2. Objectives

The study was carried out to achieve the following objectives-

To,

- Check their existent knowledge on work related musculoskeletal disorder.
- Make them aware of work-related musculoskeletal disorder.
- Train them the different ways to overcome WMSD.

Influence of Biomimicry – A Sustainable Innovation in Interior Design

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Abstract--- This study delves into biomimicry in interior design, inspired by nature's efficiency. Biomimicry offers insights for eco-friendly living spaces by reflecting nature's mechanisms. It enhances lighting, energy efficiency, durability, comfort and productivity. Architects have long been intrigued by the interplay between design and nature. Integrating biomimetic principles fosters sustainable solutions, harmonizing human habitats with the environment. This approach advocates for innovative, nature-inspired problem-solving methodologies.

Keywords--- Biomimicry, Sustainable Building, Bio-inspired Design, Interior Design, Mankind.

1. Introduction

In a world facing myriad challenges from health to climate change, biomimicry emerges as a promising solution (Lodson et. al, 2018). Harnessing nature's wisdom, offers innovative answers to environmental and human issues. As technology advances, biomimicry goes beyond mere imitation, evolving into a sophisticated art (Benyus, 2013). The Biomimicry Institute defines it as replicating nature's finest ideas to tackle human problems. Nature, encompassing animals, plants, and microbes, serves as the ultimate source of inspiration. Biomimicry is derived from Greek word, "bios" for life and "mimesis" for imitation (Vierra, 2016). Utilizing biomimicry principles in interior design significantly boosts the ecological resilience of constructed spaces, presenting a promising avenue for tackling pressing global issues. This approach is particularly potent in mitigating biodiversity loss, climate change impacts, and resource depletion (Smith, 2020).

Need for the study: Biomimicry studies about the nature's designs to create sustainable solutions that encompass a wide application, ranging from energy-efficient building designs and water purification technologies to advanced materials and waste management systems. It fosters responsible innovation by mimicking natural themes in design. Utilizing biomimicry in interiors integrates motifs from nature in the form of color, texture, objects, and furniture. This approach harnesses nature's wisdom to promote healing for individuals and the planet.

Objectives of the study: Realizing the significance of biomimicry concept in sustainable interior spaces, an attempt is made in this research study with the following objectives: To

- Perform a survey from the public on their perceptions over the concept of biomimicry.
- Select a theme-based bio mimic decor for residential interiors.

2. Methodology

Statement of the Problem: The study addresses the necessity to gauge public awareness of biomimicry and the challenges interior designers face in strategically integrating biomimicry for sustainability.

Research Design: "Research design" refers to the systematic plan outlining the methods and procedures for conducting a study, as defined by Kerlinger and Lee in their seminal work on research methodology. This research

Exhorting Herbal Home Garden Paves Way for Cultural Heritage Recurrence – An Exploratory Study

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Abstract--- Therapeutic plants, the world's oldest renowned health care products, play a crucial role in traditional medicine. India is a veritable emporium of medicinal and aromatic plants. About 90% of the medicinal plants of India are found in forest habitats, while only 10% of the medicinal plants are scattered among other landscape aspects like open grasslands, agricultural pastures, waste land and in and around fresh water bodies, etc. Variety of herb garden can be furnished in houses for beneficial effect, each type of garden with their own charisma and character. The study was conducted with 200 households of Therkkupalayam, Coimbatore, which is a semi-rural area and Sai Baba colony, Coimbatore, which is the Semi Urban area. The sampling method chosen for the study was purposive sampling and the surveyed sample consist of 2/3 of landscape garden whereas 1/3 of potted gardens. The respondents surveyed belong to semi-urban (28%) and semi-rural (72%). It was found that though Allopathy medicine is the fastest recovering, many people choose traditional method for curing illness. Its welcoming to note that majority of the surveyed households (35 per cent) opt for traditional method of medicine for the reason that it is natural. At present, more than 80% of the world's population still relies on traditional herbal medicine for its foremost source of health care and numerous contemporary drugs approach directly or indirectly from plant extracts. An interesting trend was observed that a greater part of the households (76%) cultivate garden in the available space mainly for medicinal purpose. It is worth remembering that with advent creativeness and novelty, home can house more than furniture and décor. All that necessitate is a superior location, appropriate plants and sufficient light sources. Besides from getting divorced from natural world, the Herb Garden set up in house gives a live energy.

Keywords--- Gardenscape Environment, Herbal Garden, Medicinal Practices.

1. Introduction

Therapeutic plants, the world's oldest renowned health care products, play a crucial role in traditional medicine. India is a veritable emporium of medicinal and aromatic plants. The application of plants as medicine is older than documented history. Ayurvedic system dates back to 5000 B.C. All along with the Unani, Siddha and Yoga systems, these TSMs remain significant resource of everyday health and livelihood for tens of millions of populaces.

About 90% of the medicinal plants of India are found in forest habitats, while only 10% of the medicinal plants are scattered among other landscape aspects like open grasslands, agricultural pastures, waste land and in and around fresh water bodies, etc. (Chakraborty et al., 2012).

The Consumer's Experience of Wall Paint in Residential Buildings: An In-Depth Survey

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Abstract--- The origin and development of the home in human history marks the beginning of civilization, with the cave being the first form of shelter. Modern homes provide great comfort, convenience, and facilities, and are a place of health, happiness and comfort for the entire family. Walls are a vertical structure, usually solid, that defines and sometimes protects an area. Wall materials come from a variety of sources, both natural and fabricated. The present study utilizes both quantitative and qualitative research methodology to thoroughly examine the product from the time it reaches the home to the point of consumption by the consumer. A structured questionnaire was designed and administered to gather the information from the retailers, and distributors residing in and around Coimbatore.The study also gathered information on trends in wall paint and interior wall finishes in the residential building. The findings of the study are presented in two parts. About 23 percent admit that the above statement is appropriate in this seam.20 percent of them feel that paints are easily maintainable. Paints offer a wide range of choices, from simple finish to faux finish and plain to gloss finish. It can be the consumer's choice to choose his option based on the nature of utility. Other opinion includes compactness 11 percent, longevity 8 percent, and spaciousness and economical was opined by 5 percent and 3 percent respectively.

Keywords--- Walls, Materials, Trends, Paint, Interior Finishes, Consumer, Maintenance.

1. Introduction

The origin and development of the home in human history marks the beginning of civilization. The cave perhaps was the first form of shelter. From the cave to the modern home, home making has under gone great changes. With the advances in science and technologies modern home provide great comfort, convenience and facilities. It's a centre of social life, a place of health, happiness and comfort for the entire family in all stages and condition of life. The home provides its inmate, rest and privacy. One should make sure that home is comfortable, warm and inviting and is a "lived in" place (Singleton, 2000).

A wall is a vertical structure, usually solid, that defines and sometimes protects an area. Most commonly, a wall delineates a building and supports its superstructure, separates space in buildings into sections, or protects delineates a space in the open air. There are three principal types of structural walls: building walls, exterior boundary walls, and retaining walls (Enans, 2004).

Walls are the essential architectural elements of any building. They form the facades of buildings. It occpies the room's largest area and set its tone. They can be inconspicuous or dramatic, for malorcasual depending on how they

Disposal of Solid Waste and Its Management at Different Levels- A Study

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Abstract--- Solid waste management has become a major environmental issue in India. Solid waste management is one of the major problems faced by different cities all over the world. Human activities create waste and the wastes are handled, stored, collected and disposed of, which can pose risks to the environment and to public health. As environmental concerns increase worldwide, there have been efforts to develop creative ways to manage and control Municipal Solid Waste (MSW) effectively. Municipal solid waste is generally a combination of household and commercial refuse which is generated from the living community. Solid waste considered to be the most serious problem in Kovilpalayam. The study was conducted to know the impact of solid waste management programmes and to know the present situation of the study areas through an informal discussion among the residents and municipal workers.

The area selected for the study comprised of Kovilpalayam Municipal Corporation. In this study convenient sampling method was chosen for data collection. In order to collect relevant data for the study questionnaire was developed. Overall, the current state of hygiene in urban areas is due to the high density of population and also lack of space for the disposal of waste. So, this can be reduced by the active participation of the people, governing bodies and awareness creation on the effect solid waste on environment.

Keywords--- Disposal, Municipal Solid Waste, Environmental Concern, Governing Body.

1. Introduction

Solid waste is the unwanted or useless solid materials in residential, industrial or commercial areas. Solid waste management in India is going to be more complicate due to the increase in urbanization, the changes in lifestyle and also an increase the consumerism. Solid Waste management is the "generation, prevention, characterization, monitoring, treatment, handling, reuse and residual disposition of solid wastes".

Solid waste management is very much necessary to reduce the adverse impact on the environment and also human health. Municipal solid waste generally includes degradable materials- paper, textiles, food waste, straw and yard waste and partially degradable wood, disposable napkins and sludge. Non-degradable materials -leather, plastics, rubber, metals, glass, ash from fuel burning like coal, briquettes or woods, dust and electronic waste. Improper disposal of solid wastes pollutes all the vital components of the living environment (i.e., air, land and water) at local and global levels. Municipal solid waste is generally a combination of household and commercial refuse which is generated from the living community (Rajkumar, 2010).

Disposal Methods of Solid Waste management includes components of recycling, composting, incineration and land filling. All of these are often proposed as the solution. Both composting and incineration leave substantial amounts of waste that must be land filled. By far the most common method of disposal is land filling, as it is apparently the cheapest and easiest (Lema et al., 1988).

Exploring the Current Trends in Existing Commercial Space - Small Restaurants

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Abstract--- In the 21st century, restaurants have played a vital role in providing fine dining with a good ambiance to diners. Although there are a lot of restaurants, not all of them are properly designed to assess the current interior trends followed in restaurants. This was analysed using the interview schedule method. The investigator selected 20 restaurants in Saibaba Colony and Thudiyalur. Some restaurants were discovered to be trendy in terms of their interior, while many others were not following the trend.

Keywords--- Restaurants, Floors, Walls, Doors, Windows, Lighting and Ventilation.

1. Introduction

Restaurants serve as multifaceted hubs, playing a pivotal role in societal, economic, and cultural realms. In India, the restaurant industry, encompassing diverse establishments like cafes, fine dining venues, and fast-food outlets, is witnessing rapid growth. The National Restaurant Association of India predicts a 9% compound annual growth rate, reaching INR 5.99 lakh crore by 2022–23. Despite recent challenges, the restaurant business remains a top choice for Indian entrepreneurs, integral to the service sector. Creating an optimal restaurant layout involves understanding local context and thorough site analysis, considering elements like structure, outdoor spaces, and service areas. Architectural design guided by creativity and responsiveness to the environment is crucialwhile landscape integration, lighting design, and signage balance enhance the overall dining experience.This study delves into current interior trends followedin the small restaurant commercial spaces. Hence the study is titled as "Exploring the current trends in existing commercial space - small restaurants " with the following objectives to:

- Elicit information on the general profile of the selected commercial space.
- Analyse the current trends followed in existing commercial space.
- Assess the preferences of proprietor on designing the commercial space.

2. Methodology

This study focused on Coimbatore district, known for its abundant restaurants, making it a convenient location for the researcher. Utilizing simple random sampling, Saibaba Colony and Thudiyalur were selected areas, with a sample size of 20 restaurants chosen for the survey in year of 2023. Interviews were conducted using a structured schedule to gather primary and secondary data gathered through a set of prepared questions aiming to understand the trends and interior preferences among restaurant proprietors. on socio-demographic profiles and preferences of restaurant owners. The study employed direct personal interviews to collect information on current trends in small restaurant commercial spaces, and the obtained data were consolidated, analysed, and presented in results and discussion, shedding light on the observed trends and preferences in this context.

Influence of Wood as a Flooring Material in Interiors

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Abstract--- Wood is one of the longest standing building materials in existence, with evidence showing homes built over 10,000 years ago used timber as a primary source for construction materials. Wood is available in different shapes and sizes. Since wood comes from trees and there are many species of trees, there are such a large variety of woods to use for building. The basic types of wood are soft wood; hard wood and engineered wood. Softwoods are the wood used lumber which are milled from conifer trees. Examples of popular softwood trees used in woodworking and construction are pine, cedar, fir, spruce, and redwood. Most softwoods are strong and commonly used in many different building applications. Hardwoods come from any trees which do not produce needles or cones. Common hardwood species include oak, maple, cherry, mahogany, and walnut. Hardwood species are not always necessarily stronger than softwoods, but many species are well known for their beautiful and distinct wood grain patterns. The third type of wood is engineered woods. Engineered wood does not occur naturally in the environment but instead are manufactured. These boards are generally made with wood which is manipulated to have certain qualities or features. Examples of engineered woods include plywood, oriented strand board, medium density fibre board, and composite board. Wood veneers can also sometimes be classified as engineered wood. Hence the study is entitled as Influence of wood as a flooring material in interiors to know about the different types of wooden flooring available in the market, the performance of wood used residential flooring, its cost, durability and maintenance.

Keywords--- Wood, Flooring, Types, Cost, Durability, Maintenance.

1. Introduction

"Wood has been one of the most used building materials since the beginning of history. Although the use of steel, concrete or iron has brought significant advances to construction, wood has never lost its popularity (Veronica,2022).

Spruce, pine, and fir are commonly sold under as dimensional lumber at home improvement centres. These woods are often used in framing new construction, as well as building utility style structures. Many of these woods, particularly softwoods from the cypress family are renowned for their ability to resist rot and insects. This makes trees such as cedar and redwood ideal for exterior projects, such as decking and outdoor furniture.

Many hardwood species are well known for their beautiful and distinct wood grain patterns. There are also some woods which are considered to be hardwoods that are not deciduous trees, such as Bamboo and Palm. These plants are scientifically known as monocotyledons, but have many of the same characteristics of hardwoods and so are often classified as such. Bamboo and Palm can sometimes fall under the next classification of engineered wood.

The Engineered wood are also called as manufactured wood. It is often treated through chemical or a heat process to produce a wood product which can meet certain sizes that would be difficult to achieve from nature."

Usability and Adoptability of Drinking Water Storage Practices in Copper Vessel for Consumption

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Abstract--- Water is an essential component of daily life and is utilized by our body in several ways. Purified water consumption supports the preservation of bodily fluid balance. A state of good health and wellness is only possible with quality water. The study was conducted in Coimbatore, forty households were purposively selected for this survey. Ayurveda has given numerous inexpensive, simple-to-use methods for purifying water that may be implemented with common household supplies. This micro-level study aims to determine if selected households could comprehend and understand the benefits of drinking water from copper vessels regularly and examines the usability of copper drinking water containers among the selected families.

Keywords--- Benefits, drinking water, copper vessels, water storage, water quality.

1. Introduction

Kilic (2020), stated that one of the most necessities for living is water. Safe drinking water is vital for human health, and there are 0.3% of the world's water resources that can be used. About 60% of what makes up our bodies is water. Humans cannot exist without fresh water for longer than a week, demonstrating how important it is.

According to Sarsan (2013), storing water in the right containers is important to avoid recontamination and to lower the pathogen count. It is a cheap way to obtain high-quality drinking water. Copper, silver, and gold were utilized by the ancient Egyptian, Indian, and Sumerian civilizations for jewellery, cutlery, and water storage and water consumption containers. These materials provide great spiritual and health advantages to people, thus their use was not limited by its looks.

Indian Ayurveda quoted that there are numerous health advantages to keep water in a copper vessel overnight and drinking it first in the morning. Antimicrobial, anti-inflammatory, antioxidant, and anti-carcinogenic properties of copper are well established. Drinking water from a copper cup or a huge copper vessel that stores water is a simple, practical, and effective way for yogis and traditional Indian households to consume water in its most holistic form for four decades and beyond. (http://www.parivartanayurveda.com)

Kailash et al., (2018), the practice of storing water in copper has been around for a very long time in India and is even mentioned in ancient Ayurvedic books. According to Sharan et al. (2010), antimicrobial copper surfaces have shown promise for usage in healthcare and related fields. Copper has been utilized as a disinfectant since ancient times. It advised using affordable copper containers to preserve drinking water in order to prevent the spread of water- borne illnesses, particularly in rural regions. Srikumar (2018) stated that, since water is a necessary component for the body to function, drinking water needs to be clean and pure.

Sustainable Approach for Disposal of Organic Waste in Small Hotels

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Abstract--- This abstract introduces a sustainable approach for the disposal of organic waste in small hotels, emphasizing the urgent need for environmentally conscious waste management practices to significantly reduce the ecological footprint of small hotels. Recognizing the critical role of education, the approach involves awareness campaigns among staff encouraging responsible waste segregation and participation in sustainable disposal practices. By adopting this holistic approach, small hotels have the potential to contribute to a circular economy, promoting environmental stewardship while enhancing their overall sustainability profile. The abstract underscores the interconnectedness of waste management with both technological and social aspects of human development, with a focus on minimizing negative impacts on the environment and society. The study advocates for a comprehensive and integrated approach that aligns with the growing demand for eco-friendly practices in the hospitality industry, ultimately fostering a more sustainable and regenerative future.

Keywords--- Sustainable Approach, Organic Waste Disposal, Waste Management Practices, Circular Sustainability.

1. Introduction

Waste, characterized as undesirable material, presents challenges that extend beyond hotels and restaurants, impacting both the environment and society. Managing waste, involving the collection, treatment, and disposal of various types of waste, becomes crucial in addressing these adverse impacts. In the context of small hotels, effectively managing food waste is central, given industry challenges such as overstocking, inefficient manufacturing, and the prevalence of large portion sizes. This study delves into sustainable waste disposal practices tailored for small hotels, seeking to diminish environmental footprints while tackling the intricate issue of food waste management in the hospitality sector. The objective is to propose practical solutions that enhance resource efficiency, minimize waste generation, and foster a more sustainable and responsible approach within small hotel operations. The study was undertaken with the following objectives: TO

- Understand the general information and generation of food waste in small hotels.
- Find out the methods of managing food waste in small hotels and disposal methods practiced
- Create awareness on proper disposal of organic waste in small hotels.

A Probe into Consumer Perceptions on Sustainable Food Packaging with A Priority on An Eco-Friendly Future

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Abstract--- This study aims to explore potential future advancements in innovative sustainable food packaging and their impact on consumer perceptions. The research underscores the importance of sustainable packaging in advancing an eco-friendly future within the food supply chain, emphasizing the need to assess commonly used materials for sustainable food packaging. By conducting a survey at the household level the study aims to identify the effective utilization of commonly used packaging materials and their influence on consumer purchasing patterns. The results indicate that plastic packaging predominates in department stores with 87.5 percent of respondents acknowledging its prevalence. This highlights the need for alternative packaging solutions that reduce reliance on plastic and its negative environmental consequences. Furthermore the study delves into consumer attitudes towards sustainable packaging providing valuable insights crucial for advancing eco-friendly initiatives in the food packaging industry. Effective communication and education about the benefits of sustainable packaging are essential to encourage consumer acceptance and demand. These findings contribute to a deeper understanding of consumer preferences paving the way for innovative and sustainable packaging solutions that align with environmental concerns.

Keywords--- Food Packaging, Resource Use, Environmental Sustainability, Food Safety, Consumer Purchasing Pattern.

1. Introduction

Throughout history, humans have utilized packaging as a means to gather, collect, store, transport, and preserve goods (Pareeratanasomporn, 2018). Initially, people used natural materials like leaves, skin, and bark for packaging, but the practice evolved into highly technological methods. Scientific and technological advancements have made significant progress in material and packaging systems in the past decade (Srilakshmi, 2018). The evolution of packaging reflects a continual adaptation to new materials and technologies (https://www.egyankosh.ac.in).

Currently, consumer food purchasing behavior is undergoing significant changes around the world. Consumers are increasingly attracted to the taste, convenience, and health benefits of food (Ali et al., 2021), where packaging gives items a distinctive value, serves as a tool for differentiation, rather than assists customers in selecting a product from a large selection of comparable products, and encourages purchase behavior (Naveen & Ramesh, 2022). In addition to packaging materials, packaging sustainability and quality are also important factors when consumers make purchases and it has become a growing trend in the food industry in recent years. Many manufacturers are reducing waste, minimizing the use of non-renewable resources, reducing the carbon footprint of their products, and increasing consumer acceptance by enabling the use of sustainable end products. Consumers are also demanding more environmentally friendly packaging options, increasing the use of biodegradable and compostable materials, which includes the use of environmentally friendly materials such as paper, cardboard, and bioplastics, as well as design features that make packaging easier to recycle and reuse (Damini, 2023).

Sustainable Interior Design Execution and Deterrents among Practicing Interior Design Professionals in Urban Bengaluru

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Abstract--- Harmony between human habitats and environment in creating conditions for sustainable development is a necessary component in interior space development. The purpose of the study was to understand the sustainable practices adopted by the exponents in the field of architecture and interior design industry in Bengaluru urban. A Cross sectional, descriptive study was conducted amongst 50 random sample of practising designers. Interview method using a semi structured questionnaire was used for the study. Chi Square test results indicated significant differences with respect to their qualifications, job profile, and years of experience in the field ($p<0.05$). Sole proprietors could adhere to sustainability more than those who worked for corporate firms. The professionals handled varied residential, commercial, hospitality and educational projects. Sustainable design strategies of adaptive reuse, retrofit, refurbish were seen on more than 60 percent of the sample. Statistical analysis indicated significant differences between groups at 95% confidence level. Majority of the professionals (94%) were involved in renovation projects. Energy and water conservation were practiced by most of the architects and designers. But, in selection of sustainable materials priority for client needs and budget overweighed other sustainable practices. Client resistance in agreeing to sustainability due to aesthetics, difficulty in maintenance, difficulty in procurement of skilled labour and materials, transportation costs were major deterrents to sustainability practices. Sustainability is definitely an oxymoron, yet its pursuit should never be stopped as future relies on current generation so that their future needs are met. More research on sustainable materials and availability of the expertise to common man is need of the hour.

Keywords--- sustainable interior design, sustainable deterrents, interior design, sustainable materials.

1. Introduction

Human Habitats interact with the environment in various ways throughout their life cycles, from construction to operation and then demolition. They consume resources in the form of energy (40%), water (12-16% of all water), materials (25% timber, 40% raw materials), etc. and emit wastes (35-40% CO2) either directly in the form of municipal wastes or indirectly as emissions from electricity generation. The building industry is a huge consumer of natural resources. It is estimated that 20-50% of world's physical resources are consumed by buildings. In addition, 40% of all the trash is generated by the building sector (Kinebar et al., 2023).

The built environment continues to be a direct cause of pollution long after the construction is completed due to emissions produced in the process of running them and their impact on the ground. There is an urgent call for sustainable practices across nations to negate the challenges of climate change, pollution related health impacts and biodiversity loss caused by this sector (Ajayi, 2022).

Revitalizing Spaces: A Comprehensive Exploration of Innovative Upcycling Techniques for Waste Materials as Interior Accessories

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Abstract--- "Upcycling is a really interesting concept that's gaining more attention lately. Upcycling, a process where used materials are transformed into items of higher value and quality in their second life, is gaining recognition as a promising approach to reducing material and energy consumption and promoting sustainable production and consumption. The growing interest in upcycling is evident in the increasing attention it has received from researchers and business practitioners, leading to a surge in publications on the topic since the 1990s. Despite the rising interest, the overall volume of literature on upcycling remains relatively low, and there has yet to be a comprehensive review of the field. This paper aims to fill this gap by analysing and summarizing the existing body of literature on upcycling, delving into various aspects such as definitions, trends in practices, benefits, drawbacks, and barriers across different subject areas. By identifying knowledge gaps and offering suggestions for future research, the paper aims to contribute to the further development and establishment of upcycling as a viable and sustainable practice in various industries.

Keywords--- Up cycling, Waste management, Materials, Recycling

1. Introduction

Upcycling is based on sustainable consumption, and the main idea is to revitalise old material by placing it into new constellations and by suggesting new ways of using it while, at the same time, keeping its essence intact as a main value-adding feature of the process (Sung 2017)

Waste management is essential in today's society. Due to an increase in population, the generation of waste is doubling day by day (Sharma 2020) . Samples living in slums are very close to the waste disposal area. They are prone to various diseases. Hence, putting their lives in danger. To maintain a healthy life, proper hygiene and sanitation are necessary. Consequently, it is only possible through proper waste management.

Recognizing that waste generation is inevitable, rrecycling emerges as a highly beneficial option, allowing the reuse of materials such as paper, cloth, iron, steel, plastic, rubber, and tires. Beyond the environmental benefits, recycling also proves cost-effective, with paper recycling, for instance, playing a role in saving trees and consequently, the planet. By emphasizing the importance of recycling, particularly for materials with prolonged disposal times like plastics, the narrative underscores the positive impact on environmental preservation. Ultimately, the Earth's well-being is closely tied to responsible waste management practices.

"The act of taking something no longer in use and giving it a second life and a new function" is the definition of upcycling. By doing this, the final result frequently improves upon its original state in terms of usefulness, value, and beauty. The same old materials can be used again in upcycling, but the result is something better or more value.

Exploring Student Perspectives: Evaluating the Impact of Sustainable Design Education on Students

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Abstract--- This research investigates students' viewpoints and the effects of sustainable design education. It employs a questionnaire divided into four sections. By surveying students pursuing bachelor's degrees in interior design and architecture, the research aims to assess their awareness, beliefs, and practices regarding sustainability in design as they pertain to their future careers. Additionally, the study compares the awareness levels of respondents based on their fields of study, revealing that those studying interior design exhibit high levels of awareness and belief. Furthermore, it highlights a correlation indicating that increased awareness among respondents correlates with a more positive attitude and greater integration of sustainability into their future professional practices. Through thorough research and analysis, we recognize the significant impact that sustainable design education can have on students, enhancing their knowledge and skills and fostering a deeper understanding and appreciation of sustainable practices in their daily lives.

Keywords--- Sustainability, Awareness, Architecture, Interior Design, Practice.

1. Introduction

Sustainability refers to the ability to meet present needs without compromising the ability of future generations (What is sustainability? n.d.). Integrating sustainable principles in interior design becomes critical in creating aesthetically pleasing and functional spaces while minimizing environmental impacts and enhancing occupants' well-being (Mohsen & Matarneh, 2023). It encompasses various principles and practices to reduce the design process's ecological footprint and the resulting spaces. It also includes sourcing locally upcycled furniture and incorporating energy-efficient lighting to promote a more sustainable and eco-conscious design approach, including material selection, energy efficiency, local sourcing, upcycling and repurposing, indoor air quality, waste reduction, and social sustainability. Building sustainability means living in harmony with the natural environment, considering the social, environmental, and economic aspects of decisions, and reducing our footprint through a less energy, water, and material-intensive lifestyle (Media, n.d.).

While sustainability is commonly linked with environmental concerns, it's important to dispel the misconception that its focus is solely on the environment. Sustainability encompasses three dimensions. Environmental sustainability ensures that human consumption rates do not surpass nature's replenishment capacity and that pollution and greenhouse gas emissions are within nature's ability to restore. Social sustainability relates to a society's capacity to uphold universal human rights and fulfill basic needs like healthcare, education, and transportation. Healthy communities ensure that personal, labor, and cultural rights are respected and that discrimination is prevented. Economic sustainability pertains to human communities' ability to maintain independence and access necessary resources to meet their needs, ensuring secure livelihoods for all. These dimensions underscore the importance of

Familiarizing Wood Substitutes for Effective Interiors

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Abstract--- Housing is a fundamental requirement for human habitation, and throughout history, shelter has taken diverse forms using different materials. Wood has been a pivotal component in construction and interior design, with a longstanding tradition from ancient times to the present. However, in light of environmental considerations and the pursuit of sustainability, alternatives to wood have been introduced and adopted. This study assesses the several wood substitutes, focusing on materials such as Honeycomb Board, and Bamboo Plywood. The study delves into the distinctive features of these substitutes and underscores the application of new materials, in the context of interior design. Bamboo plywood and honeycomb board play crucial roles in interior design as sustainable alternatives to traditional wood. Bamboo plywood, known for its strength and eco-friendly nature, adds a unique aesthetic to interiors. On the other hand, honeycomb board, with its lightweight and sturdy construction, offers versatility in design and promotes resource efficiency. Both materials contribute to environmentally conscious interior solutions, providing architects and designers with innovative options that align with the growing emphasis on sustainability in construction and design practices.

Keywords--- Bamboo Plywood, Honeycomb Board, Material, Wood Substitutes.

1. Introduction

Every material possesses an inherent poetry that is interconnected with human experience and engages both the mind and the body (**Gesimondo,2011**).

Wood's durability, versatility, and unique aesthetics make it a prime material for interior design. Its strength ensures long-lasting furniture with minimal upkeep, while its adaptability allows for diverse design possibilities. The individuality of each piece adds a personalized touch, appealing to both designers and homeowners. Wood's capacity for custom finishes enhances its suitability for various styles, and its warmth and connection to nature contribute to a welcoming atmosphere. With a focus on sustainability, responsibly sourced wood remains a timeless and eco-friendly choice for interior spaces. **(Spielman, 2003).**

Furthermore, wood is not only a sustainable material but also incredibly versatile, capable of imparting both rustic and modern aesthetics to interior spaces. Serving as the predominant material, wood showcases its ability to seamlessly connect traditional, rustic sentiments with contemporary design approaches. Its historical use dates back to the earliest days of human existence, employed for various construction purposes. As civilizations developed, woodlands thrived, and people swiftly harnessed this resource for constructing shelters, homes, pens for animals during the advent of farming, and for ensuring heat and security, among other applications. **(Green, 2007).**

The utilization of wood in both building construction and decoration continues to be esteemed for its superior aesthetic appeal compared to alternative materials, (**Jain and Mehta in 2003**). Wood remains a timeless choice, ensuring a wise investment in the interior design of your home. What makes decorating with solid wood particularly

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Explore Python for Mathematics

Prof. P. Subashini
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Lecture Notes in Educational Technology

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Envisioning the Future of Education Through Design

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Chapter 10
Technology-Enhanced Mulsemedia Learning (TEML) Through Design for Learners with Dyslexia for Enhancing the Quality of Experience (QoE)



Mohana Murugan, Aleph Campos da Silveira, Parthasarathy Subashini, Gheorghita Ghinea, and Celso Alberto Saibel Santos

Abstract Design Thinking (DT) is a successful problem-solving approach used in education to address ill-defined problems. Traditional learning faces the challenge of static e-learning content, but enhanced e-content, such as multimedia, has improved the learning process. Recent research work suggests that Multi-sensorial Media mulsemedia content, which integrates haptic, olfactory, and gustatory to the traditional audiovisual multimedia content, enhances the Quality of Experience (QoE) by engaging multiple senses. This chapter proposes Technology-Enhanced Mulsemedia Learning (TEML) through design for learners with dyslexia to improve QoE and obtain twenty-first-century learning skills such as cognitive, productivity, social-cultural, metacognitive, and technological dimensions. This chapter also proposes a mulsemedia test bed with the help of IoT devices, which is cost-effective and can be adapted in future studies through design techniques and focuses on STEM (Science, Technology, Engineering, and Mathematics) subjects for dyslexia learners. Moreover, this chapter examines various questions related to mulsemedia's implementation, including the necessary devices and challenges and opportunities presented

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by the approach and argues that integrating mulsemedia through design can transform the learning process, especially for learners with dyslexia, and concludes by highlighting the potential for future research in this area.

10.1 Introduction

The concept of Quality of Experience (QoE) holds substantial significance across diverse domains, with education being no exception. Within the realm of learning, QoE pertains to the degree of satisfaction and engagement that learners encounter throughout their educational journey (Schmidt & Allsup, 2019). This holistic notion encompasses a multitude of factors, encompassing the efficacy of the instructional approach, the caliber of learning resources, the alignment of content with learners' requisites, as well as the depth of interactivity, and the quality of feedback delivered throughout the learning process (Zurbriggen, 2018).

The QoE in learning is critical for ensuring that learners achieve their learning objectives effectively and efficiently. It is a measure of the effectiveness of the learning experience, and it can impact learners' motivation, engagement, and retention of knowledge. As such, educators and instructional designers need to pay close attention to the QoE in their learning programs and strategies to ensure that learners have the best possible experience. Since QoE is an essential aspect of learning that involves creating an effective and engaging learning experience for learners, it is no surprise that in recent years, the use of mulsemedia in education has become increasingly popular as it has the potential to significantly enhance the QoE in learning (Tal et al., 2020).

Mulsemedia refers to the integration of different media types that engage more than three human senses into a single presentation environment (Ghinea et al., 2011) (See Fig. 10.1). The use of mulsemedia in education can significantly enhance the QoE in learning by providing learners with an immersive and engaging learning experience that caters to different learning styles (Ljubojevic et al., 2014; Bi et al., 2018; Tal et al., 2020). One of the key benefits of using mulsemedia in education is that it allows for the creation of highly interactive and personalized learning experiences (Bi et al., 2018; Tal et al., 2020). For example, a mulsemedia-based learning environment can include interactive simulations, animations, and videos, which can help learners better understand complex concepts and retain information more effectively. Plus, mulsemedia-based learning environments can be designed to cater to different learning styles, such as visual, auditory, and kinesthetic learners (Ljubojevic et al., 2014; Bi et al., 2018; Tal et al., 2020). This can help to enhance the QoE in learning by providing learners with a personalized and engaging learning experience that caters to their specific needs. This said the use of mulsemedia in education has the potential to significantly enhance the QoE in learning by providing learners with an immersive, interactive, and personalized learning experience.

However, it is still a subject of study how mulsemedia can improve QoE for Educational purposes when dealing with Learning disabilities (Elsharif et al., 2020;

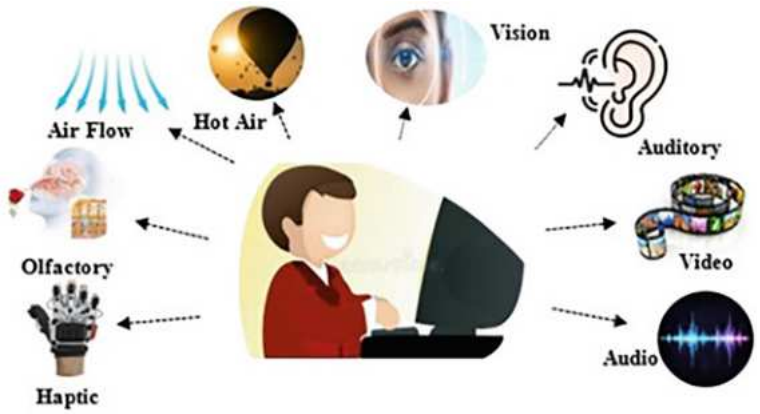


Fig. 10.1 Mulsemedia components



Fig. 10.2 Haptic devices

Ghinea et al., 2011). Since mulsemedia significantly improves the QoE in education, learners with learning disabilities can also benefit from this. Learning disabilities, such as dyslexia, dysgraphia, and Attention-deficit/hyperactivity disorder (ADHD), can make it challenging for learners to engage with traditional learning methods, such as reading and writing. However, mulsemedia-based learning environments can provide an effective and engaging learning experience for learners with learning disabilities.

One of the key benefits of using mulsemedia in education for learners with learning disabilities is that it can provide alternative means of presenting information (Tal et al., 2020). For example, a learner with dyslexia may struggle with reading text-based materials. Still, a mulsemedia-based learning environment can present the same information using images, videos, and audio, which can be more accessible for the learner. Moreover, mulsemedia-based learning environments can be designed to accommodate different learning styles and needs, which can significantly improve the QoE in learning for learners with learning disabilities. For example, a learner with ADHD may benefit from a highly interactive learning environment with frequent breaks and visual cues to help them stay engaged and focused (Hutson &

Hutson, 2023). Another advantage of using mulsemedia in education for learners with learning disabilities is that it can provide a more engaging and motivating learning experience. Many learners with learning disabilities may struggle with motivation due to their learning challenges (Silva et al., 2021a, 2021b). However, mulsemedia-based learning environments can provide an immersive and interactive learning experience that can significantly increase motivation and engagement. Furthermore, mulsemedia-based learning environments can provide immediate feedback, which can help learners with learning disabilities monitor their progress and identify areas where they need to improve. This can be particularly beneficial for learners with ADHD, who may struggle with self-monitoring and self-regulation (Silva et al., 2021a, 2021b).

That said, Learning Design (LD) can play a crucial role in creating effective mulsemedia-based learning environments for learners with learning disabilities. Designers can use the principles of Universal Design for Learning (UDL) to ensure that the learning environment is accessible, engaging, and effective for learners with diverse learning needs and styles (Rose & Meyer, 2002). UDL principles advocate for providing multiple means of representation, expression, and engagement to accommodate different learners' needs (CAST, 2018). For example, designers can use captions, transcripts, and audio descriptions to make multimedia content accessible for learners with hearing impairments and expand it with mulsemedia to improve attention and focus with scent deliverers or haptic devices. They can also use interactive features, such as quizzes and simulations, to provide learners with different ways of engaging with the content and expressing their knowledge. Furthermore, designers can use adaptive technologies, such as personalized learning algorithms and assistive technologies, to provide tailored learning experiences that meet learners' specific needs (Beetham & Sharpe, 2013).

An additional pivotal component involves the integration of Design Thinking (DT), as underscored by recent research (Koh et al., 2015; Lor, 2017). This methodology encompasses a problem-solving approach that places emphasis on creativity, empathy, and collaborative efforts to devise innovative solutions for complex challenges (Brown, 2008). Operating as a human-centered design framework, it commences with a profound comprehension of the requisites, viewpoints, and incentives of the individuals who will ultimately utilize the proposed solution. In the context of education, Design Thinking holds particular significance, as it equips educators and designers with the tools to construct compelling and efficacious learning experiences aligned with learners' objectives and needs (Lazo-Amado et al., 2023). Consequently, comprehending the role of multimedia becomes evident, as it emerges as a catalyst in enhancing the QoE for learners with learning disabilities. Through its provision of alternative modes of information presentation, catering to diverse learning styles and requirements, amplifying motivation and engagement, and furnishing immediate feedback (Koh et al., 2015; Kelly et al., 2013), multimedia plays a pivotal role in augmenting the educational landscape.

The organization of this chapter unfolds as follows: Sect. 10.2 will delve into the exposition of pertinent prior research and elucidate the driving factors behind our pursuit. Sections 10.3 and 10.4 will engage in a comprehensive exploration of

Learning Content and Learning Disabilities, respectively. Moving forward, Sect. 10.5 will shed light on the available devices for implementation. Subsequently, Sect. 10.6 will expound upon the essence of Design Thinking and its application in the integration of mulsemedia to enrich conventional multimedia content. The subsequent focus, Sect. 10.7, will lay out the proposed TEML (Technology-Enhanced Multimedia Learning) framework along with the outcomes of the user study. Tackling the intricacies, Sect. 10.8 will address both challenges and prospects that lie ahead. Finally, culminating the discourse, Sect. 10.9 will unveil our concluding remarks.

10.2 Motivation and Related Work

Learning is an important stage for gaining more insight into the world around them and understanding different perspectives of things for retaining the concept for the long term. Moreover, the QoE, or quality of service (QoS) plays a vital role in the fulfillment of the learner's expectation with respect to the utility and enjoyment of the application. For this, multisensory learning theories stimulate the various sensory channels to reinforce the learning process. Hence, mulsemedia offers an enriched learning encounter, particularly advantageous for learners with dyslexia. Previous studies indicate that the incorporation of diverse sensory signals assists in diminishing cognitive burden and enhancing the learning journey (Broadbent et al., 2018). Furthermore, such an approach holds promise for individuals with an array of conditions, encompassing sensory or cognitive impairments.

10.2.1 Motivation

To begin with, the genesis of the proposed concept finds its roots in the realm of education, catalyzed by the unprecedented rise of e-learning content in response to the COVID-19 pandemic. Moreover, it is driven by the aspiration to enrich e-learning content by seamlessly integrating multimedia elements, thereby elevating the entire pedagogical process. This impetus is further bolstered by insights from neuroscience, which accentuate the potential for enhanced learning outcomes that endure over time. This approach facilitates the retention of concepts in the long run while engendering an immersive learning journey, accomplished through the judicious use of mulsemedia resources to recreate real-world scenarios.

Multimedia helps to expand the possibility of real-world senses, which are involved in the research area of Multi-sensorial Media (Mulsemedia). It includes the combination of traditional multimedia (audio, video, text, images, etc.,) with other human senses (referred to as non-traditional media), such as olfactory, haptic (water jet, vibration, temperature, and generate airflow), gustatory, and so on. Previously published notable works (Stančin et al., 2020; Tal et al., 2016; Zou et al., 2017) show that the combination of both multimedia and other senses helps to enhance

the learner's QoE. Here, DT helps the educator to solve the problem in e-learning materials through the Mulsemedia approach.

10.2.2 Related Work

In order to create user-centered experiences, interdisciplinary teams work together under the principles of design thinking, which is an innovative, creative, and human-centered method and mindset. It has been applied in many areas such as business, engineering, and technology and more recently applied in education because of its ability to advance creativity and innovation through an empathetic, flexible, and iterative approach. Furthermore, it helps to develop twenty-first-century learning skills such as cognitive, productivity, social-cultural, metacognitive, and technological dimensions.

The work presented by Yedra et al. (2021) evaluates the design thinking-based playful application concept for learning with disabled children such as dyslexia. This problem occurs due to the way that the brain incorporates and processes information. Following that, Campos et al. (2019) presented gamification using a design thinking approach to understanding the learner's difficulties. Based on observation, the author designed a paper-based prototype as output and discussed the contribution of each group through the iterative process for increasing the learning experience. Lazo-Amado et al. (2023) presented a mobile application for children with dyslexia for primary education using augmented reality. This approach helped to solve the group work and decision-making problem of disabled children. Goodman et al. (2020) have introduced LaMPost, a natural language-based larger language model (LLM) for overcoming the challenges in writing experienced by people with dyslexia, which also addresses the challenges in new spelling, grammar, and word retrieval technologies. This method was assessed with 19 adults with dyslexia. Clemente et al. (2016) presented a toolkit for product design and development courses based on design thinking concepts. This tool was aimed at promoting students' creative and critical thinking skills. Furthermore, these results show that students' critical thinking is improved based on the didactic intervention integrated method.

The work presented by Zou et al. (2017) utilizes mulsemedia to enhance the QoE for learners. The authors developed a test bed to deliver video content enhanced with haptic, airflow, and olfaction effects. The experimental results demonstrate that mulsemedia enhances their learning experiences. Moreover, Guedes (2018) designed a multisensorial book combined with enhanced e-content and multisensorial media to improve the learning process. A prototype was developed with audio, haptic, and olfactory effects, which method gave promising results and opened new avenues for future research. Following that, Silva et al., (2021a, 2021b) created Mbook, a tool for presenting multisensorial books. This book is different from the normal traditional book, which is that mulsemedia devices are synchronized by capturing the reading position using an eye-tracker. This approach was experimented with by students aged 13 to 19 years. The main aim of this work is to improve the children's

learning experience while reading books. Nawandar et al. (2018) have presented an IoT-based multisensory network to assist people with visual disabilities. The authors designed their kit in an easy way and cost-effective as well as GPS-assisted outdoor navigation with RFID technology. Koukourikos et al. (2015) have introduced a low-cost haptic device that integrated tactile and audio to provide a multisensory effect for blind people. This was experimented with for 19 years to 46 years. Mon et al. (2019) have designed virtual edutainment environments for visually impaired users based on olfactory, audio, and haptic-based 3D applications. The author of this paper proved that those different kinds of applications are more attractive and efficient for visually impaired learners.

10.3 Limitations in E-Content

In recent years, e-learning, referred to as "e-content" or "electronic content", has become an effective method for students to learn concepts from anywhere in the world (Stecuła & Wolniak, 2022). However, individuals may encounter challenges in grasping information due to a variety of variables such as differences in learning styles, learning impairments, difficulties with attention and focus, memory problems, anxiety or stress, and a lack of desire or enthusiasm (Rose et al., 2002). Furthermore, certain forms of e-content, such as static text documents or online articles, might lack interactivity and engagement compared to traditional teaching methods. Although interactive multimedia within e-content assists learners in understanding concepts, it may not provide fully immersive learning experiences, as it typically focuses on only two senses: sight and hearing (Anene et al., 2014; Mayer, 2009). In real-time environments, humans perceive information through more than just two senses. Addressing these gaps by incorporating multimedia-based interactive content can be efficient for learners to interpret both the content and context, as supported by existing multimedia research (Hutson & Hutson, 2023). However, the inclusion of multisensorial media in e-content helps learners retain concepts for a longer time compared to conventional e-learning (Tal et al., 2020). Additionally, several factors significantly impact the effectiveness of e-content in learning.

10.3.1 Low Level of Student Engagement in the Classroom

A low-level degree of student engagement within the classroom context pertains to learners who exhibit limited involvement in the learning journey. These individuals may display signs of indifference, boredom, or distraction during instructional sessions, refraining from active participation in class discussions or exercises (Truong, 2016). This lack of robust engagement among students can stem from diverse factors, encompassing a disinterest in the subject matter, challenges in

comprehending the content, a feeling of disconnect from both the teacher and peers, or external influences such as personal preoccupations and distractions.

Insufficient student engagement can adversely affect both the students and the teachers involved. Students might encounter difficulties in retaining knowledge and achieving subpar outcomes in assessments or assignments. Concurrently, a dearth of active participation can lead to teachers experiencing frustration or a sense of demoralization, impeding their ability to deliver effective instruction.

10.3.2 Lack of Research on Methods of Learning and Teaching

The lack of research on learning and teaching methods refers to a scarcity of scientific studies and data on the most effective teaching and learning tactics (Hosseindoost et al., 2022). Because of this research gap, educators may find it challenging to make educated judgments about how to best assist their students' academic advancement. The limited research could be attributed to a few problems, including a lack of funding or resources, difficulties in conducting studies in real-world classroom settings, and the complexity of the learning process itself. Also, there may be a concentration on short-term outcomes, such as test scores, rather than a long-term assessment of the influence of teaching methods on the lives of students.

10.3.3 Lack of Interest and Relevant Content

The lack of interest and relevant content refers to a situation where students feel disengaged from the material being taught in the classroom. This detachment can be attributed to several factors, including a perceived disparity between the content and their personal interests or real-life encounters, complexities in comprehending the material, or a lack of engagement from the instructor (Anene et al., 2014). When this disconnect occurs, students often grapple with maintaining focus and motivation, resulting in diminished academic performance and an unfavorable disposition toward learning. Concurrently, teachers encounter challenges in delivering effective instruction when students are disengaged, perpetuating a cycle of frustration and dwindling interest.

10.4 Learning Disability and STEM Subjects

A learning disability is a neurological illness that hinders a person's capacity to properly acquire, process, store, or generate knowledge. It can have an influence on a variety of academic areas, including reading, writing, math, and communication abilities (Lam et al., 2008; Louick & Muenks, 2022). Moreover, learning difficulties are frequently identified in childhood and can last into adulthood. Common forms of learning disorders include dyslexia (reading trouble), dyscalculia (math difficulties), and dysgraphia (difficulty with writing). Additional disorders that might affect learning include ADHD and autism spectrum disorder (ASD) (Thapliyal & Ahuja, 2023).

Among all learning disabilities, dyslexia plays an important role. It is a neurological condition that affects a person's ability to read, write, spell, and, in some cases, talk (Hall et al., 2023). It is frequently distinguished by difficulties in phonological processing, or the capability to detect and control sound in language. Dyslexics may also struggle with word recognition, reading fluency, and understanding. Detecting dyslexia in an individual often requires a full evaluation undertaken by a certified expert, such as a psychologist, neuropsychologist, or educational specialist (Hall et al., 2023).

There are several sorts of evaluations that can be implemented to evaluate various areas of a person's talents and performance. The following are some examples of common sorts of evaluations: Achievement tests, Cognitive tests, Neuropsychological tests, Personality tests, Behavioral assessments, Diagnostic tests, and Aptitude tests (Andresen & Monsrud, 2022). Many elements, including the individual's age, developmental stage, and others, will determine the sort of assessment that is employed to meet the evaluation's unique demands and objectives (Andresen & Monsrud, 2022).

Learning difficulties can be accommodated in STEM subjects, which concentrate on science, technology, engineering, and mathematics. Students who have disabilities often focus less on STEM subjects (Asghar et al., 2017; Schreffler et al., 2019). More specially, science content can pose significant barriers to understanding concepts with disabilities or special learning needs (Israel et al., 2013; Klimaitis & Mullen, 2021).

Moreover, drawing insights from the existing body of literature, Design Thinking emerges as a noteworthy remedy catering to students with disabilities in the realm of education (Yedra et al., 2021; Goodman et al., 2022; Clemente et al., 2016). Building upon these foundations, this chapter pioneers the introduction of a mulsemedia framework tailored to learners with dyslexia, skillfully intertwining the principles of design and STEM subjects.

10.5 Mulsemedia Devices and Their Uses

The domain of mulsemedia presents a realm rich with diverse opportunities. Nevertheless, the optimal methods of delivering mulsemedia content remain an area under active investigation. Mulsemedia devices hold the transformative potential to reshape our engagement and interaction with digital media across an array of domains, spanning education, entertainment, healthcare, and rehabilitation. By concurrently engaging multiple senses, these devices have the capacity to engender heightened immersion and captivation. This, in turn, holds the promise of augmenting learning achievements, amplifying motivation, and elevating the overall quality of life for individuals grappling with disabilities.

Nonetheless, the integration of mulsemedia devices into practice introduces a host of challenges that warrant careful consideration to unlock their full potential. Foremost among these challenges is the elevated cost associated with the development and deployment of mulsemedia systems, which often surpasses that of traditional media systems by a considerable margin (Saleme et al., 2019). Furthermore, the utilization of multiple sensory modalities necessitates meticulous attention to design and user experience, ensuring harmonious synchronization without overwhelming the user (Silveira et al., 2023).

Another obstacle lies in aligning Mulsemedia devices with existing infrastructure and hardware, along with the requirement for specialized software and hardware provisions (Saleme et al., 2015). The creation of mulsemedia content also demands access to specialized expertise and resources, encompassing multimedia professionals and designers, thereby potentially limiting the widespread availability and accessibility of such content. Moreover, the inclusion of olfactory and gustatory elements within mulsemedia devices is a relatively nascent endeavor, with the development of fitting hardware and software to support these facets still in its infancy.

Lastly, ethical and safety considerations related to the use of mulsemedia devices, particularly in healthcare and rehabilitation, need to be considered. Despite these challenges, the potential benefits of mulsemedia devices are significant, and ongoing research and development are expected to address these challenges and pave the way for the widespread adoption of mulsemedia devices in various applications.

That said, there are some mulsemedia devices that can be highlighted for this work. For this, we are going to split the devices into three different categories: haptic, gustatory, and olfactory.

10.5.1 Haptic Devices

Haptic devices are hardware devices that provide users with tactile feedback by simulating the sense of touch (Kim et al., 2017; Lee et al., 2021; Saber-Sheikh et al.,

2019). These devices can be used to enhance the user experience of various applications, including virtual reality, gaming, and healthcare. Haptic devices typically include sensors that detect user input and actuators that generate tactile feedback, such as vibrations, pressure, or motion. The feedback can be programmed to simulate different sensations, such as texture, weight, or temperature, and can be used to provide users with a more immersive and interactive experience. In virtual reality, haptic devices can be used to simulate the sensation of touching and manipulating virtual objects, improving the sense of presence and realism. In gaming, haptic devices can provide users with feedback that enhances the gameplay experience, such as simulating the recoil of a weapon or the sensation of driving on different surfaces. In healthcare, haptic devices can be used for rehabilitation, allowing patients to perform exercises that require tactile feedback, such as gripping or reaching. The development of haptic devices has opened new possibilities for creating more immersive and interactive applications that can enhance the user experience and improve outcomes in various fields.

Examples of these devices are gloves to simulate touch, controllers with vibration (Adilkhanov et al., 2022), fans to simulate wind and thermal effects (Silveira et al., 2023), etc. Haptic devices can be grounded devices (not wearable), which are divided into graspable and touchable systems; Hand-held devices ("partially" wearable), distinguished based on the type of actuation (direct or indirect) with respect to the user's limb and wearable devices, further classified into exoskeletons and gloves, finger-worn devices, and arm-worn devices (Obrist et al., 2014). Haptic devices are becoming increasingly popular in education to enhance learning outcomes. By providing students with a tactile and interactive experience, haptic devices can help learners better understand complex concepts and retain information more effectively. For example, haptic feedback can be used in simulations to help students feel the forces involved in a physics experiment or to provide realistic sensations in medical training simulations (Liu et al., 2017). Additionally, haptic devices can be used to improve accessibility for learners with visual or auditory impairments, by providing alternative sensory inputs (Jones et al., 2014). As technology continues to evolve, haptic devices are likely to play an increasingly important role in education, helping learners to engage with the material in new and innovative ways.

10.5.2 Gustatory Devices

Gustatory devices, also known as taste interfaces, are a type of sensory feedback device that provides a taste sensation to the user. These devices work by stimulating the taste buds on the tongue, either using electrical or chemical stimulation. Gustatory devices have a range of potential applications, such as enhancing the sensory experience of food and beverages, providing sensory feedback in virtual and augmented reality applications, and assisting individuals with taste impairments or dysfunctions. Research on gustatory devices is still in the early stages, and there are currently few commercial products available on the market (Saleme et al., 2019). However, there

is growing interest in this area, with researchers exploring new ways to create and refine gustatory devices and exploring their potential applications.

According to (Saleme et al., 2019), in comparison to other stimuli, chemical senses have not been fully explored, and there is still little data on how they can be used in human–computer interfaces. Creating authentic taste experiences is challenging because it requires stimulating all senses, including taste, smell, and the trigeminal nerve. While the tongue can detect the five basic tastes, other taste sensations, such as heat and creaminess, are detected by the trigeminal sense (Saleme et al., 2019). Digital setups can modify taste and bring interesting insights (Obrist et al., 2014), as different tastes have varying effects on cognitive activities and decision-making. Sour tastes promote slower, more reasoned decision-making, while sweet and bitter tastes lead to quicker, instinctual decision-making. Systems that stimulate taste directly or modify taste through other senses can be included in multisensory systems.

Examples of these devices are Lollio (Murer et al., 2013) and Digital Lollipop (Ranasinghe & Do, 2017), which simulate sour and sweet via an outlet that pumps flavors to the lollipop and sour, salty, bitter, and sweet via electrodes, respectively. Some gustatory devices also don't make use of flavor pumps or electrodes, but do it via visual stimuli, like the Meta Cookie (Guimarães et al., 2022) which uses visual stimulation to promote different tastes. This is an example of how multiple senses can be used to achieve different objectives.

While gustatory devices, or devices that simulate taste, are not commonly used in education, they have shown potential in certain applications. One example is in language learning, where a gustatory device could be used to provide students with the opportunity to taste and identify foods from different cultures, while simultaneously learning the corresponding vocabulary. Additionally, a gustatory device could be used in science classes to demonstrate chemical reactions that produce different tastes or to teach about the different tastes associated with the various regions of the tongue (Guedes, 2018).

10.5.3 Olfactory Devices

Olfactory devices, also known as smell interfaces or scent devices, are a type of sensory feedback device that provides a scent or smell sensation to the user. These devices work by emitting scents or odors into the surrounding air, either using chemical or mechanical means. Olfactory devices have a range of potential applications, such as enhancing the sensory experience in entertainment, gaming, and virtual reality applications, providing sensory feedback in medical or therapeutic contexts, and assisting individuals with smell impairments or dysfunctions. Research on olfactory devices is still in the early stages, and there are currently few commercial products available on the market (Murray et al., 2017). However, there is growing interest in this, with researchers exploring new ways to create and refine olfactory devices and exploring their potential applications.

Examples of these devices are ExHalia and Vortex Active, which use fans to dissipate the scent in the ambient. Due to the evolution of virtual reality, Mounted Head Olfactory devices are also being developed so the olfactory stimuli are dissipated directly to the nose of the user, such as the work of (Narumi et al., (2011) and Alkasasbeh et al., 2020).

Olfactory devices can also play a role related to some haptic stimuli, like the use of scents to give the sensation of temperature change (Brooks et al., 2020) via the trigeminal nerve. The trigeminal nerve is a sensory organ responsible for detecting sensations such as temperature, pressure, and pain in the face. In addition to detecting temperature, the trigeminal system can also create the illusion of temperature through the activation of chemoreceptors. Chemoreceptors are sensitive to chemicals such as capsaicin (found in hot peppers) and menthol (found in mint) (Brooks et al., 2020). When these chemicals meet the trigeminal nerve, they can activate the thermoreceptors, creating the sensation of warmth or coldness even if there is no actual change in temperature. For example, capsaicin activates the thermoreceptors in such a way that we feel a burning sensation, even though the temperature of the food itself may not be particularly hot (Brooks et al., 2020).

Incorporating olfactory devices also presents the potential to enrich the landscape of learning encounters. The sense of smell shares an intimate connection with memory, rendering olfactory devices in education a tool capable of enhancing students' information retention and recall proficiency (Garcia-Ruiz et al., 2021). To illustrate, within a history class, the waft of a distinct perfume or spice might serve as a conduit, transporting students to a different era and location, thereby facilitating a deeper grasp of historical events and their contextual intricacies. Similarly, in a biology class, the utilization of olfactory devices could emulate the aroma of specific chemicals or organisms, fostering a heightened comprehension and recollection of the attributes and traits associated with these substances.

10.6 Design Thinking in Technology-Enhanced Mulsemedia Learning

Enhance the learning experience using design thinking with mulsemedia. The design thinking process typically involves five stages: empathize, define, ideate, prototype, and test (Meinel et al., 2009; Basham & Marino, 2013) (See Fig. 10.3).

(1) During the empathize stage, designers immerse themselves in the learners' world, comprehending their needs, motivations, and obstacles through observation and interaction. This process cultivates empathy and facilitates an in-depth grasp of the learners' perspectives and encounters. By commencing with the empathize stage, designers foster a thorough understanding of learners' requirements, challenges, and motivations. This comprehension serves as the bedrock

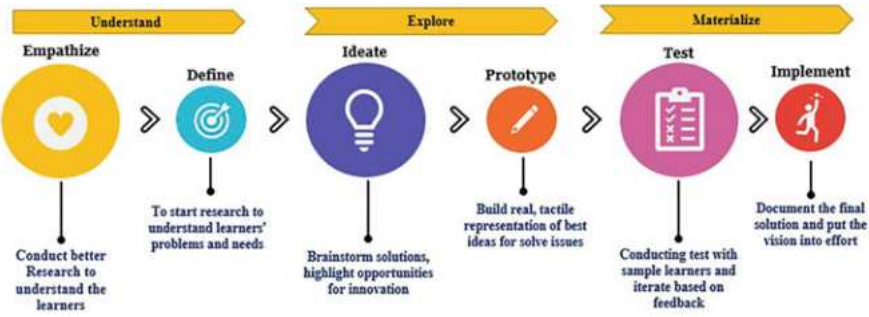


Fig. 10.3 Design Thinking Process

for crafting tailored mulsemedia experiences that align with learners' objectives, thus ensuring an engaging and effective learning journey (Meinel et al., 2009).

(2) In the defining stage, designers use insights gained from the empathize stage to define the problem they are trying to solve. They formulate a problem statement that captures the learners' needs and goals and guides the ideation process. For example, if learners with dyslexia struggle with reading text-based materials, the problem statement might be "How might we create a mulsemedia-based learning experience that presents information using stimuli beyond images, videos, and audio to make it more accessible and engaging for learners with dyslexia?

(3) In the ideate stage, designers generate a wide range of ideas and potential solutions to the problem. They encourage creativity and brainstorming to generate a diverse range of solutions.

(4) In the prototype stage, designers create low-fidelity prototypes of their ideas to test and refine. Prototyping allows designers to quickly test and iterate their ideas, gather feedback, and refine their solutions. They can use iterative testing and feedback to refine their mulsemedia-based learning experience until it meets the learners' needs and goals.

(5) Finally, in the test stage, designers test their prototypes with learners to gather feedback and evaluate their effectiveness. This allows designers to refine their solutions and make any necessary changes to improve their effectiveness and impact.

As said before, one of the key benefits of using mulsemedia in education is that it can provide an alternative means of presenting information (Saleme et al., 2020). For learners with learning disabilities, such as dyslexia or ADHD, mulsemedia-based learning environments can present information using stimuli like smells and touch which can be more accessible and engaging than standard multimedia content. Furthermore, mulsemedia-based learning environments can be designed to accommodate different learning styles and needs, which can significantly improve the quality of learning for learners with learning disabilities.

In summary, by combining design thinking with mulsemedia, educators, and designers can create highly engaging and effective learning experiences that meet the needs and goals of learners. These experiences can be tailored to accommodate different learning styles and needs, making them accessible and effective for learners with learning disabilities.

10.7 Proposed TEML for Learners with Dyslexia

The proposed TEML web portal utilizes both multimedia and mulsemedia technology, IoT devices, which creates an engaging and immersive learning experience. The system is designed to provide learners with a realistic and immersive learning experience by incorporating STEM content along with multisensory effects, such as airflow, olfaction, and vibration. The content was selected from science and physics backgrounds to engage learners with STEM subjects. Finally, self-feedback is given to analyze the QoE of learners. The humidifiers provide learners with a more realistic and engaging experience, as they can feel and smell the environment when they are learning about rosemary content. The addition of airflow and vibration effects allows students to experience the content of thunder and lightning through tactile feedback, making it more immersive. The TEML web portal includes audio and multimedia effects that are synchronized with the airflow, olfactory, and haptic feedback provided by the IoT devices. This allows learners to have an immersive learning experience while hearing STEM-related audio content. Figure 10.4 shows the first proposed prototype of TEML for learners with disabilities.

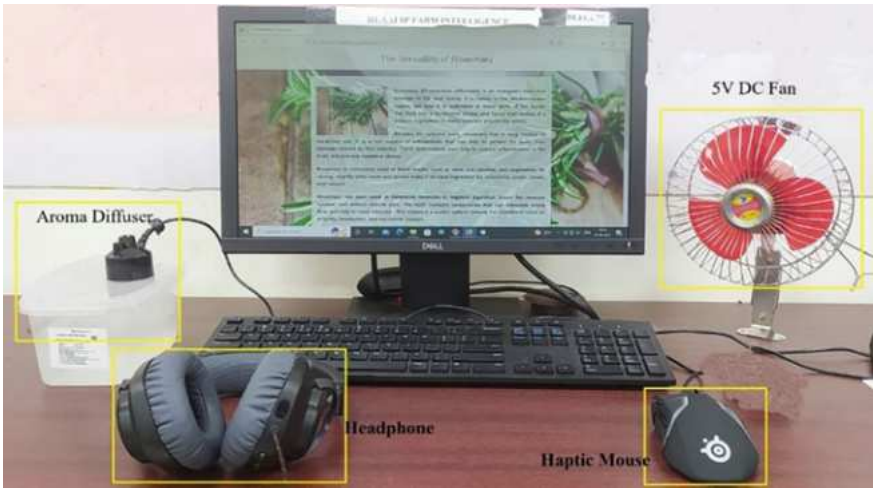


Fig. 10.4 Proposed mulsemedia testbed

The working principle of the proposed Internet of Things (IoT)-based mulsemedia learning system involves the integration of several components to create a multisensory learning environment. Here, the STEM content is selected and developed into a multimedia format such as images, audio, and interactive activities. These multimedia elements are then synchronized with the IoT devices, such as the cooling fans, and humidifiers for olfaction and haptics for vibration. The length of the audio is 3 to 4 min. The cooling fans are used to provide airflow that simulates the environment being learned about physics content (thunder and lightning). The humidifiers are used to provide olfaction to enhance the learning experience, particularly in subjects such as biology, where olfaction is an essential aspect. The Arduino microcontroller serves as the central control unit that controls the IoT devices, synchronizes the multimedia elements, and manages the sensory feedback. The website that accompanies the system is used to provide remote access to the multisensory learning environment. The website includes multimedia elements such as audio, images, and interactive activities, which are synchronized with IoT devices to provide a multisensory learning experience to students. The system's working principle involves the synchronization of multimedia elements with IoT devices to create a multisensory learning environment that engages students in an immersive experience. The use of haptics and IoT devices provides tactile feedback that enhances the learning experience, making it more engaging and realistic.

The Web portal is designed to offer learners a convenient and immersive platform to access educational resources in STEM concepts. Figure 10.5 shows the home page of the Multimedia web portal, where this web portal consists of both biology content and physics content. The multimedia web portal is built on HTML, CSS, and PHP techniques. It is leveraging the power of HTML and CSS to create a responsive and user-friendly interface. The portal is designed to provide a seamless experience to users across devices, including desktops and laptops. The content is organized into modules, which are easily accessible through simple Buttons. Each STEM module contains multimedia content, including text, images, and audio, that is synchronized to provide an engaging and immersive learning experience.

The integration of audio with e-learning content has several benefits. Audio provides an alternative way to consume content, particularly for learners who prefer auditory learning. It also helps learners retain information better as it reinforces the visual and textual content. Additionally, audio can be used to provide feedback and guidance, creating a more interactive and personalized learning experience. Figures 10.6 and 10.7 show STEM content using the mulsemedia effects, which consist of audio, Multisensory effects, and QoS assessment questions. The addition of audio can further improve the effectiveness of the interface by allowing learners to hear the information as well as read or see it. After the audio content finishes, learners are directed to an online assessment to test their understanding of the material. This type of online assessment allows for immediate feedback and provides learners with a better understanding of their knowledge gaps. The e-learning content for this research focuses on rosemary, and the presence of multimedia is used to enhance the learning experience. When the mulsemedia test bed is triggered by an Arduino, the rosemary essence is released, adding a sensory dimension to the learning experience. This can



Fig. 10.5 Home Page of TEML

help learners better understand and retain the information by engaging their sense of smell. In addition, while learning thunder and lightning effects airflow and vibration effects are given to the learner to feel audio content in a realistic environment. The duration of the audio content is 3 to 4 min. The synchronization works when the rosemary audio is playing, while the olfactory component turns the smell on and off automatically every 30 s. Similarly, it works on airflow and vibration in physics content.

10.8 Challenges and Opportunities in TEML

Technology-enhanced mulsemedia learning refers to the use of mulsemedia tools and technologies to create engaging and interactive learning experiences for students. While this approach offers many opportunities for enhancing learning, as presented below, it also presents several challenges in different fields (Ghinea et al., 2014).

As stated by Ghinea et al. (2014), mulsemedia is not just the sum of multiple multisensory stimuli, but also the understanding of how each stimulus works:

> [...] mulsemedia sensory media perception is not something that just happens. Perception is a complex combination of steps that combine bottom-up (sensory processing) and top-down (cognitive reasoning) processes, which result in the appreciation of the media information and the interpretation of its meaning in the context of existing semantic and episodic knowledge. Sensory processing is well understood. The process of understanding how knowledge impacts mulsemedia media interpretation, perception, and acceptance, however, is an exciting area of research.

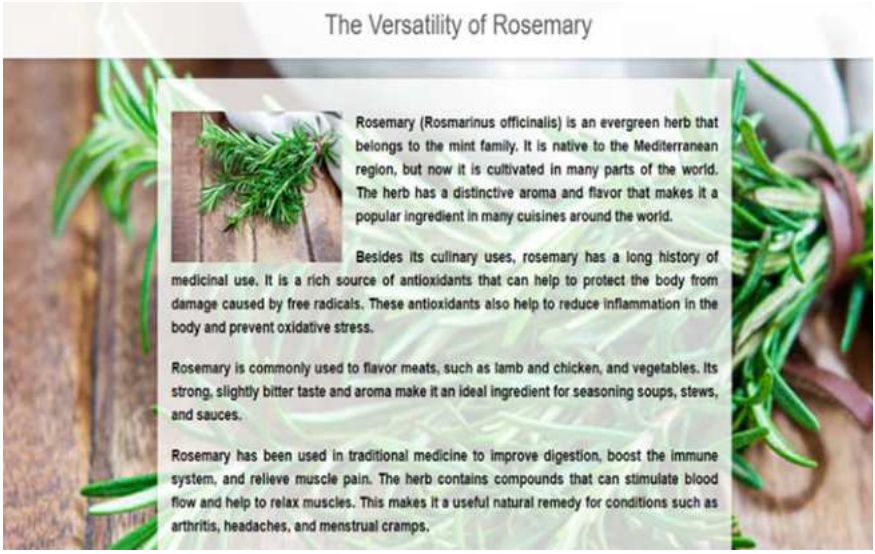


Fig. 10.6 Rosemary content (Olfactory)

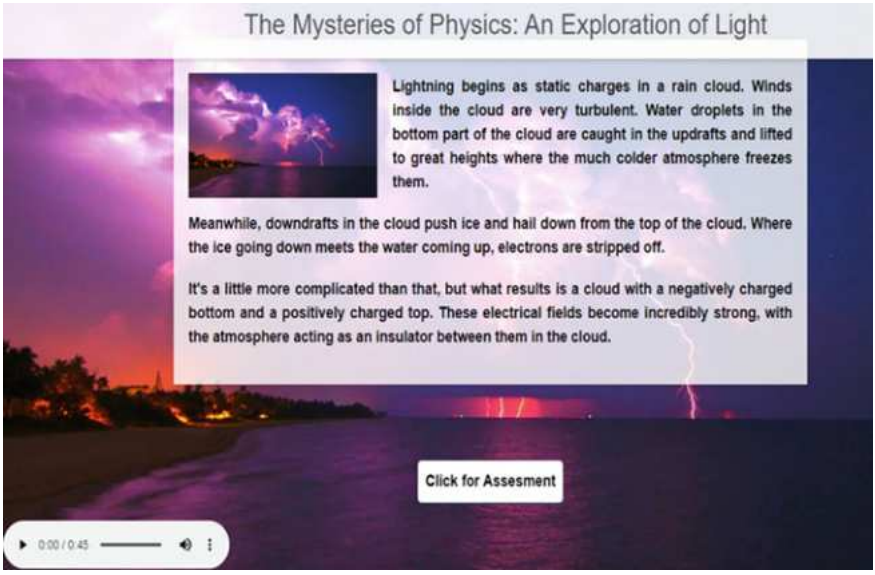


Fig. 10.7 Thunder and lighting content (Haptic and Airflow)

So how to employ mulsemedia elements in teaching is still a field to be explored. Teachers must be knowledgeable about the latest tools and technologies and must be able to effectively integrate them into their curriculum. This requires ongoing professional development and training, which can be time-consuming and costly. Another challenge is the potential for technology to distract students and hinder their learning.

However, technology-enhanced mulsemedia learning also presents many opportunities for enhancing the learning experience. It allows for the creation of engaging and interactive learning experiences that can help students develop critical thinking skills and improve their understanding of complex concepts. Additionally, technology-enhanced mulsemedia learning can help promote collaboration and communication among students, enabling them to work together on projects and share ideas. It can also help teachers to better assess student learning and provide timely feedback to support their growth. Overall, while there are challenges in implementing technology-enhanced mulsemedia learning, the opportunities it presents for improving the learning experience make it a valuable tool for educators to consider.

10.9 Conclusion and Future Work

In conclusion, mulsemedia stands as a promising technology for learners with disabilities, offering an avenue to grasp concepts within the context of a real-world environment. As of our current knowledge, no existing studies have addressed the challenge of unengaging e-content through a mulsemedia-infused design approach. In this chapter, we introduced the mulsemedia framework to enrich the QoE for learners with disabilities, all while embracing a design-oriented methodology. This approach not only contributes to enhancing QoE but also facilitates the cultivation of twenty-first-century learning skills, spanning cognitive, productivity, social-cultural, metacognitive, and technological dimensions.

Furthermore, the chapter expounded upon key concepts, including the significance of QoE and QoS, delineating how mulsemedia serves to elevate these aspects. The exploration extended to encompass the realm of learning disabilities and the role of mulsemedia in solidifying long-term concept retention. Additionally, the integration of mulsemedia into the learning journey of individuals with dyslexia was expounded upon through a design-centered strategy.

Notably, the chapter also delved into prevalent challenges encountered during the implementation of mulsemedia devices, alongside the array of opportunities this technology presents. In the forthcoming period, this approach will be put to the test with dyslexia learners, and their resulting QoE will be meticulously analyzed. In tandem, the proposed system underwent experimentation involving 10 participants, gauging their experiences and perceptions while learning within this framework. Participants corroborated that the infusion of multimedia effects into the learning process leaves a markedly impactful impression.

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References

Adilkhanov, A., Rubagotti, M., & Kappassov, Z. (2022). Haptic devices: Wearability-based taxonomy and literature review. *IEEE Access*. https://doi.org/10.1109/ACCESS.2022.3202986

Alkasasbeh, A. A., & Ghinea, G. (2020). Using olfactory media cues in e-learning–perspectives from an empirical investigation. *Multimedia Tools and Applications, 79*(27–28), 19265–19287.

Andresen, A., & Monsrud, M. B. (2022). Assessment of Dyslexia-Why, When, and with What? *Scandinavian Journal of Educational Research, 66*(6), 1063–1075.

Anene, J. N., Imam, H., & Odumuh, T. (2014). Problem and prospect e-learning in Nigerian universities. *International Journal of Technology and Inclusive Education (IJTIE), 3*(2), 320–327.

Asghar, A., Sladeczek, I. E., Mercier, J., & Beaudoin, E. (2017). Learning in science, technology, engineering, and mathematics: Supporting students with learning disabilities. *Canadian Psychology/psychologie Canadienne, 58*(3), 238.

Basham, J. D., & Marino, M. T. (2013). Understanding STEM education and supporting students through universal design for learning. *Teaching Exceptional Children, 45*(4), 8–15.

Beetham, H., & Sharpe, R. (Eds.). (2007). *Rethinking pedagogy for a digital age: Designing and delivering e-learning*. routledge.

Bi, T., Silva, F., Ghinea, G., & Muntean, G. M. (2018). Improving learning experience by employing dash-based mulsemedia delivery. In *2018 IEEE Games, Entertainment, Media Conference (GEM)* (pp.1–9). IEEE.

Broadbent, H. J., White, H., Mareschal, D., & Kirkham, N. Z. (2018). Incidental learning in a multisensory environment across childhood. *Developmental Science, 21*(2), e12554.

Brooks, J., Nagels, S., & Lopes, P. (2020). Trigeminal-based temperature illusions. In *Proceedings of the 2020 CHI conference on human factors in computing systems* (pp. 1–12). https://doi.org/10.1145/3313831.3376806

Brown, T. (2008). Design thinking. *Harvard Business Review, 86*(6), 84.

CAST. (2018). Universal Design for Learning Guidelines version 2.2. Retrieved from http://udlguidelines.cast.org.

Clemente, V., Vieira, R., & Tschimmel, K. (2016). A learning toolkit to promote creative and critical thinking in product design and development through Design Thinking. In *2016 2nd International Conference of the Portuguese Society for Engineering Education (CISPEE)* (pp. 1–6). IEEE.

Elsharif, A. A., Mousa, M., & Issa, A. (2020). Mulsemedia: Review and Perspective on Potentials in Rehabilitation and Disability Technological Developments. In *2020 International Conference on Assistive and Rehabilitation Technologies (iCareTech)* (pp. 97–102). IEEE.

Garcia-Ruiz, M. A., Kapralos, B., & Rebolledo-Mendez, G. (2021). An overview of olfactory displays in education and training. *Multimodal Technologies and Interaction, 5*(10), 64.

Ghinea, G., Andres, F., & Gulliver, S. (2011). *Multiple sensorial media advances and applications: new developments in MulSeMedia*. IGI Global.

Ghinea, G., Timmerer, C., Lin, W., & Gulliver, S. R. (2014). Mulsemedia: State of the art, perspectives, and challenges. *ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM), 11*(1s), 1–23. https://doi.org/10.1145/2617994

Goodman, S. M., Buehler, E., Clary, P., Coenen, A., Donsbach, A., Horne, T. N., ... & Morris, M. R. (2022). Lampost: Design and evaluation of an ai-assisted email writing prototype for adults with dyslexia. In *Proceedings of the 24th International ACM SIGACCESS Conference on Computers and Accessibility* (pp. 1–18).

Guedes, G. P. (2018). Multisensorial Books: improving readers' quality of experience. In *2018 XIII Latin American Conference on Learning Technologies (LACLO)* (pp. 33–36). IEEE.

Guimarães, M. P., Martins, J. M., Dias, D. R. C., Guimarães, R. D. F. R., & Gnecco, B. B. (2022). An olfactory display for virtual reality glasses. *Multimedia Systems, 28*(5), 1573–1583. https://doi.org/10.1007/s00530-022-00908-8

Hall, C., Dahl-Leonard, K., Cho, E., Solari, E. J., Capin, P., Conner, C. L., & Kehoe, K. F. (2023). Forty Years of Reading Intervention Research for Elementary Students with or at Risk for Dyslexia: A Systematic Review and Meta-Analysis. *Reading Research Quarterly, 58*(2), 285–312.

Hosseindoost, S., Khan, Z. H., & Majedi, H. (2022). A shift from traditional learning to e-learning: advantages and disadvantages. *Archives of Neuroscience*, *9*(2). https://doi.org/10.1145/2556288.2557007

Hutson, J., & Hutson, P. (2023). *Museums and the Metaverse: Emerging Technologies to Promote Inclusivity and Engagement.* https://doi.org/10.5772/intechopen.110044

Israel, M., Maynard, K., & Williamson, P. (2013). Promoting literacy-embedded, authentic STEM instruction for students with disabilities and other struggling learners. *Teaching Exceptional Children, 45*(4), 18–25.

Jerónimo Yedra, R., & Almeida Aguilar, M. A. (2021). Design thinking: Methodological strategy for the creation of a playful application for children with dyslexia. In *Informatics* (Vol. 9, No. 1, p. 1). MDPI.

Jones, M. G., Childers, G., Emig, B., Chevrier, J., Tan, H., Stevens, V., & List, J. (2014). The efficacy of haptic simulations to teach students with visual impairments about temperature and pressure. *Journal of Visual Impairment & Blindness, 108*(1), 55–61.

Kim, K., & Kim, J. (2017). Haptic devices for virtual reality: A study of user experience factors. *International Journal of Human-Computer Interaction, 33*(9), 686–698.

Klimaitis, C. C., & Mullen, C. A. (2021). Access and barriers to science, technology, engineering, and mathematics (STEM) education for K–12 students with disabilities and females. *Handbook of social justice interventions in education*, 813–836.

Koh, J. H. L., Chai, C. S., Wong, B., Hong, H. Y., Koh, J. H. L., Chai, C. S., ... & Hong, H. Y. (2015). Design thinking and 21st century skills. *Design thinking for education: Conceptions and applications in teaching and learning*, 33–46.

Koukourikos, P., & Papadopoulos, K. (2015). Development of cognitive maps by individuals with Blindness using a multisensory application. *Procedia Computer Science, 67*, 213–222.

Lam, P., Doverspike, D., Zhao, J., Zhe, J., & Menzemer, C. (2008). An evaluation of a STEM program for middle school students on learning disability related IEPs. *Journal of STEM education*, *9*(1).

Lazo-Amado, M., & Andrade-Arenas, L. (2023). Designing a Mobile Application for Children with Dyslexia in Primary Education Using Augmented Reality. *International Journal of Interactive Mobile Technologies*, *17*(2).

Lee, D. Y., & Shin, H. (2021). Development and application of haptic devices for rehabilitation: A systematic review. *Healthcare, 9*(7), 871.

Liu, L. M., Li, W., & Dai, J. J. (2017). Haptic technology and its application in education and learning. In *2017 10th International Conference on Ubi-media Computing and Workshops (Ubi-Media)* (pp. 1–6). IEEE. https://doi.org/10.1109/UMEDIA.2017.8074138.

Ljubojevic, M., Vaskovic, V., Stankovic, S., & Vaskovic, J. (2014). Using supplementary video in multimedia instruction as a teaching tool to increase efficiency of learning and quality of experience. *The International Review of Research in Open and Distributed Learning*, *15*(3).

Lor, R. (2017). Design thinking in education: A critical review of literature. *In: International academic conference on social sciences and management / Asian conference on education and psychology. Bangkok, Thailand. pp. 37–68.*

Louick, R., & Muenks, K. (2022). Leveraging motivation theory for research and practice with students with learning disabilities. *Theory into Practice, 61*(1), 102–112.

Mayer, R. E. (2009). *Multimedia learning*. Cambridge University Press.

Meinel, C., Leifer, L., & Plattner, H. (2011). *Design thinking: Understand-improve-apply* (pp. 100–106). Springer.

Mon, C. S., Yap, K. M., & Ahmad, A. (2019). A preliminary study on requirements of olfactory, haptic and audio enabled application for visually impaired in edutainment. In *2019 IEEE 9th Symposium on Computer Applications & Industrial Electronics (ISCAIE)* (pp. 249–253). IEEE. https://doi.org/10.1109/ISCAIE.2019.8743738

Murer, M., Aslan, I., & Tscheligi, M. (2013). LOLL io: exploring taste as playful modality. In *Proceedings of the 7th International Conference on Tangible, Embedded and Embodied Interaction* (pp. 299–302). https://doi.org/10.1145/3027063.3048408

Murray, N., Ademoye, O. A., Ghinea, G., & Muntean, G. M. (2017). A tutorial for olfaction-based multisensorial media application design and evaluation. *ACM Computing Surveys (CSUR), 50*(5), 1–30.

Narumi, T., Nishizaka, S., Kajinami, T., Tanikawa, T., Hirose, M. (2011). Meta cookie+: an illusion-based gustatory display. In Virtual and Mixed Reality-New Trends: International Conference, Virtual and Mixed Reality. (2011). *Held as Part of HCI International 2011, Orlando, FL, USA, July 9–14, 2011, Proceedings, Part I 4* (pp. 260–269). Springer.

Nawandar, P., & Gohokar, V. V. (2018). Design and development of multisensory smart assistive technology for blind persons. In *2018 International Conference on Research in Intelligent and Computing in Engineering (RICE)* (pp. 1–4). IEEE.

Obrist, M., Comber, R., Subramanian, S., Piqueras-Fiszman, B., Velasco, C., & Spence, C. (2014). Temporal, affective, and embodied characteristics of taste experiences: A framework for design. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 2853–2862).

Ranasinghe, N., & Do, E. Y. L. (2016). Digital lollipop: Studying electrical stimulation on the human tongue to simulate taste sensations. *ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM), 13*(1), 1–22. https://doi.org/10.1145/2996462.

Rose, D. H., & Meyer, A. (2002). Teaching every student in the digital age: Universal design for learning. *Educational Technology Research and Development, 55*(5), 521–525. https://doi.org/10.1007/s11423-007-9056-3

Saber-Sheikh, K., Bryant, E. C., Glattfelder, A. H., & Zabjek, K. F. (2019). Haptic feedback in healthcare: A narrative review. *Disability and Rehabilitation: Assistive Technology, 14*(2), 175–184. https://doi.org/10.3109/17483107.2012.697532

Saleme, E. B., & Santos, C. A. S. (2015). PlaySEM: a platform for rendering MulSeMedia compatible with MPEG-V. In *Proceedings of the 21st Brazilian Symposium on Multimedia and the Web* (pp. 145–148). https://doi.org/10.1145/2820426.2820450

Saleme, E. B., Covaci, A., Mesfin, G., Santos, C. A., & Ghinea, G. (2019). Mulsemedia DIY: A survey of devices and a tutorial for building your own mulsemedia environment. *ACM Computing Surveys (CSUR), 52*(3), 1–29. https://doi.org/10.1145/3319853

Schmidt, M., & Allsup, R. E. (2019). John Dewey and teacher education. In *Oxford research encyclopedia of education.*

Schreffler, J., Vasquez, E., III., Chini, J., & James, W. (2019). Universal design for learning in postsecondary STEM education for students with disabilities: A systematic literature review. *International Journal of STEM Education, 6*(1), 1–10. https://doi.org/10.1186/s40594-019-0161-8

Silva, E. P., Amorim, G., Guedes, G., Santos, J., & Mousinho, R. (2021a). A influência de mídias multissensoriais na aprendizagem de crianças com transtorno de leitura. *Revista Psicopedagogia, 38*(115), 104–120.

Silva, E. P., Vieira, N., Amorim, G., Mousinho, R., Guedes, G., Ghinea, G., & Dos Santos, J. A. (2021). Using Multisensory Content to Impact the Quality of Experience of Reading Digital Books. *ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM), 17*(4), 1–18.

Silveira, A. C., Rodrigues, E. C., Saleme, E. B., Covaci, A., Ghinea, G., & Santos, C. A. S. (2023). Thermal and wind devices for multisensory human-computer interaction: An overview. *Multimed Tools Appl.* https://doi.org/10.1007/s11042-023-14672-y

Stančin, K., Hoić-Božić, N., & Skočić Mihić, S. (2020). Using digital game-based learning for students with intellectual disabilities–A systematic literature review. *Informatics in Education, 19*(2), 323–341.

Stecuła, K., & Wolniak, R. (2022). Influence of COVID-19 pandemic on dissemination of innovative e-learning tools in higher education in Poland. *Journal of Open Innovation: Technology, Market, and Complexity, 8*(2), 89.

Tal, I., Ibarrola, E., & Muntean, G. M. (2016). Quality and standardization in technology-enhanced learning. In *2016 ITU Kaleidoscope: ICTs for a Sustainable World (ITU WT)* (pp. 1–8). IEEE. https://doi.org/10.1109/ITU-WT.2016.7805715

Tal, I., Zou, L., Covaci, A., Ibarrola, E., Bratu, M., Ghinea, G., & Muntean, G. M. (2019). Mulsemedia in telecommunication and networking education: A novel teaching approach that improves the learning process. *IEEE Communications Magazine, 57*(11), 60–66.

Tal, I., Zou, L., Farren, M., Muntean, G. M., Lane, H. C., Zvacek, S., & Uhomoibhi, J. (2020). Mulsemedia in Education: A Case Study on Learner Experience, Motivation and Knowledge Gain. In *CSEDU (2)* (pp. 180–187). https://doi.org/10.5220/0009579701800187

Thapliyal, M., & Ahuja, N. J. (2023). Underpinning implications of instructional strategies on assistive technology for learning disability: A meta-synthesis review. *Disability and Rehabilitation: Assistive Technology, 18*(4), 423–431.

Truong, H. M. (2016). Integrating learning styles and adaptive e-learning system: Current developments, problems and opportunities. *Computers in Human Behavior, 55*, 1185–1193.

Uchôa Bulhões Campos, J. D. S., Signoretti, A., & Almeida, A. M. P. (2019). Creating new learning experiences for students with dyslexia: A design thinking and human-centered approach. In *Project and Design Literacy as Cornerstones of Smart Education: Proceedings of the 4th International Conference on Smart Learning Ecosystems and Regional Development* (pp. 261–268). Singapore: Springer Singapore.

Zou, L., Tal, I., Covaci, A., Ibarrola, E., Ghinea, G., & Muntean, G. M. (2017). Can multisensorial media improve learner experience? In *Proceedings of the 8th ACM on Multimedia Systems Conference* (pp. 315–320). https://doi.org/10.1145/3083187.3084014

Zurbriggen, C. L., Venetz, M., & Hinni, C. (2018). The quality of experience of students with and without special educational needs in everyday life and when relating to peers. *European Journal of Special Needs Education, 33*(2), 205–220.

Spirituality
in Business Management

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Spirituality in Business Management

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ABOUT THE BOOK

Recently, there has been a noticeable change in how businesses define and pursue success. Success of business is not solely measured by financial gains but also, by the impact on individuals, communities and the environment. The field of Spirituality in Business Management is a niche area that explores the integration of spiritual principles, values and practices into the realm of business and management. This book, Spirituality in Business Management delves into the intersection of spirituality and business, exploring how organizations can cultivate a deeper sense of purpose, integrity and compassion to thrive in today's dynamic landscape.

This book encompasses 8 units which include Introduction to spirituality, Quantum Physics and Spirituality, Spirituality and Business, Laws of Karma, Spiritual and Ethics, Spiritual Growth, Spiritual Welfare in Business, and Tools to Spirituality. Unit 1 (Introduction to spirituality) consists of 7 chapters namely, Definition of spirituality, Principles, Importance and Types of Spirituality, Relationship between Spirituality and Religion, Relationship between Spirituality and Emotional/Mental Health, Goals in Life/Meaning of Life, Spiritual Intelligence and Quotient and Measurement of Spiritual Intelligence. Unit 2 (Quantum Physics and Spirituality) includes 4 chapters viz., Eastern and Western Way of Spirituality, Quantum Physics and Spirituality, Science and Spirituality, and Religious Consciousness and Tenets of Spirituality. Unit 3 (Spirituality and Business) has 4 chapters like, Spiritual Values in Business, Gross National Happiness to Gross Organizational Happiness, Spirituality and Prosperity and Sustainability, and Workplace Spirituality. Unit 4 (Laws of Karma) comprises of 5 chapters namely, Types of Karma, Concepts of Rebirth, Consequences of Rebirth, Karma Consciousness, and Eightfold Network of Primary Consciousness. Unit 5 (Spiritual and Ethics) covers 3 chapters such as Ethical Models, Corporate Spiritual Responsibility and Corporate Social Responsibility, and Spiritual and Individual Social Responsibility. Unit 6 (Spiritual Growth) possess 4 chapters as Spiritual Growth Parameters, Spirituality Characteristics and Functions, Spiritual Evolution Process, and Generations and Spiritual Growth Parameters. Unit 7 (Spiritual Welfare in Business) has 4 chapters and they are Emotional Intelligence, Spirituality and Stress Management, Spirituality and Performance Management, and Spirituality and Interpersonal Effectiveness. Unit 8 (Tools to Spirituality) encompasses 5 chapters consisting of Spirituality and Yoga, Spirituality and Meditation, Spiritual Tourism, Spiritual Growth and its Measurement Tools, and Spiritual Training.

We hope that this book Spirituality in Business Management gives a more holistic, values-driven approach to organizational success that prioritizes the well-being of individuals and the planet by integrating spiritual principles into business management and in addition business organizations can create environments that foster personal growth, ethical conduct and sustainable prosperity for all stakeholders involved.

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Medicinal and Aromatic Plants In and Around Protected Areas of the Indian Subcontinent

Editor - Dr. Debabrata Das

SHASHWAT PUBLICATION

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Chapter 1

Aloe vera In Cancer Medication and Assimilation of Radiation

M G Ashwathi and G Maheswari

Department of Zoology, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore – 641 043, Tamil Nadu, India

ABSTRACT

Aloe vera has many medicinal properties, along it has efficiency in absorbing certain radiations. The health care benefits associated with Aloe vera have been ascribed to the polysaccharides contained in the gel of the leaves. These physical pursuits include promoting wound healing, antifungal activity, hypoglycemic or antidiabetic effects, anti-inflammatory, anticancer, immunomodulatory and gastroprotective effects. Aloe vera has now been widely used as a natural body coolant and treats certain medical conditions. In this review, the role of Aloe vera in absorbing radiation and its therapeutic niche in cancer has been widely discussed.

Keywords: Aloe vera, cancer, topical, prophylactic, cytotoxic potential, radiation therapy

INTRODUCTION

Radiation is a powerful tool for managing cancer; about two-thirds of patients diagnosed with cancer are medicated with radiotherapy. Radiation therapy uses mainly X-rays which has



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Artificial Intelligence of Things for Smart Healthcare Development: An Experimental Review

Chapter · June 2023

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Chapter 3
Artificial Intelligence of Things for Smart Healthcare Development: An Experimental Review

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ABSTRACT

Smart healthcare systems are the health services that use the technologies like wearable devices, internet of things (IoT), and mobile internet to access medical information dynamically. It connects people, materials, and institutions related to healthcare; actively manages; and automatically responds to medical ecosystem needs. It helps the traditional medical system in making healthcare more efficient, convenient, and personalized. This chapter proposed (1) a review of smart healthcare development using artificial intelligence, the internet of things, and smartphone Android apps; (2) an experimental approach using IoT-based smart monitoring systems, Android apps for data collection, and artificial algorithms to predict cervical cancer diseases; (3) the integration of IoT and AI algorithms. Artificial intelligence of things (AIoT) is proposed in this chapter as an experimental method for predicting cervical cancer from smart colposcopy images. The literature published in international journals and proceedings between 2010 and June 2022 is considered for the study.

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INTRODUCTION

Artificial intelligence refers to an automated system that can perform cognitive functions and physical tasks. Genetic algorithms, neural networks, machine learning, pattern recognition, and autonomous decision-making fall within the broad category of artificial intelligence (AI). AI technologies have been steadily applied in the medical field to offer many benefits, such as automating physical tasks, analyzing vast amounts of patient data, and delivering better healthcare facilities lower costs (Davenport & Kalakota, 2019). According to statistical studies, 30% of healthcare costs are associated with administrative tasks. Therefore, AI can reduce the workload on healthcare professionals by automating duties such as pre-authorizing insurance, checking on unpaid bills, and managing patient data. Clinical Decision Support (CDS) employs AI to assist in patient therapy and diagnosis decisions and carry out population-based risk prediction assessments. The AI is moving towards smart health and intelligent-based healthcare systems in developing healthcare industry.

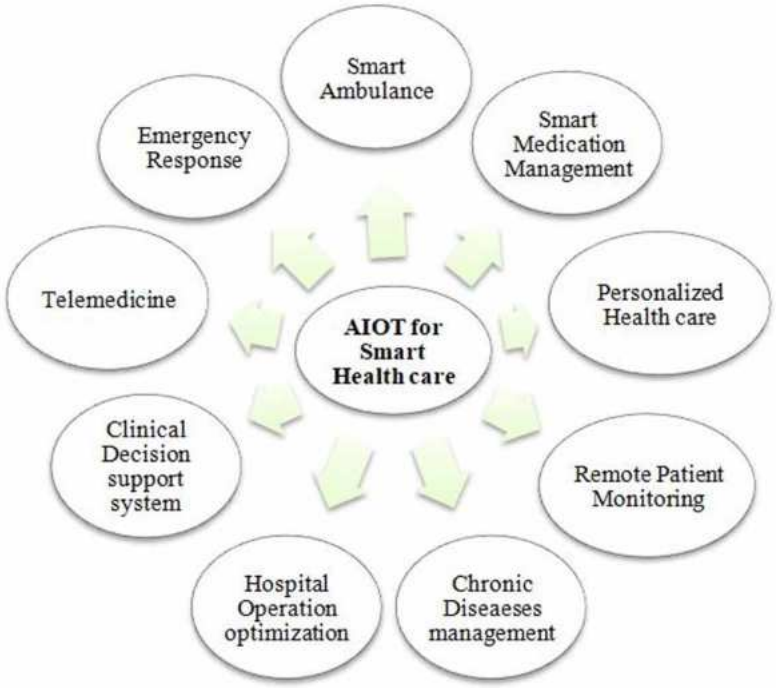
In 2009, IBM proposed the concept of smart healthcare as part of their "*Smart Planet"* initiative. The growth of smart cities is facilitated by the smart healthcare system (Jokanorvie, 2020). Traditional healthcare cannot meet everyone's needs due to the significant increase in the human population. Despite having high infrastructure and cutting-edge technologies, medical treatments may not be accessible or affordable for everyone. The smart healthcare system offers benefits by allowing individuals to quickly access medical facilities, medical documentation, diagnosis tools, and better treatment. It encompasses various situations, including smart homes, community health centers, and smart hospitals. It supports clinical reasoning, hospital administration, prescription recommendations, rehabilitation, post-marketing surveillance, and tracking of patients' anomalous behavior (Dhaka & Panda, 2020). It also aids in illness prevention, diagnosis, and treatment. Smart healthcare involves many stakeholders, such as hospitals, research institutions, physicians and patients, and all aspects of the system commonly use smart technologies. Patients uses the wearable smart devices to monitor their health continuously, request medical aid through virtual assistants, and use remote facilities to carry out procedures remotely. Doctors can use several highly advanced clinical decision-support tools to aid in and enhance diagnosis. It manages medical data using an integrated platform such as the Laboratory Information Management System, Communication Systems (PACS), Picture Archiving, Electronic Medical Records, and surgical robots for precise operations as shown in Figure 1.

Artificial Intelligence (AI) has significantly improved patient care and staff efficiency in healthcare by assisting with medical image analysis and diagnosis. The IBM smart cloud is one of the most popular AI tools, providing solutions for smart healthcare development, maintaining smart electronic health records, and offering personalized care to patients. Machine learning and deep learning algorithms are included with smart healthcare to speed up care delivery services (Saba & Durai, 2022). Internet of Things (IoT) combines connectivity, communication and computing, especially in the medical field, known as IoMT, or the Internet of Medical Things. According to analysis, the number of medical devices with IoT is expected to increase from 10 billion to 50 billion in the coming decades.

In 2021, Cisco estimated that IoT devices will generate 847 Zettabytes (ZB) of medical data per year. The IoT has improved monitoring and real-time data collection of patients, leading to better care services at the initial stages by identifying early disease stages (Tian et al., 2019). Recently, AI and IoT have been combined to improve smart healthcare development. IoT provides a worldwide connection, while AI gives these devices a sense of life. IoT tools collect real-time patient data, connect patients and doctors, maintain medical records, and predict body changes using sensors. AI analyzes the collected

data and helps in decision-making, ultimately assisting physicians with further treatment. For example, AI-based wearable tools are activity trackers that monitor and collect real-time human data from patients. The AI in the wearable tool detects physiological changes during the pandemic to identify early COVID infection, allowing for early isolation and testing, reducing the spread of the virus. Photoplethysmography identifies the elevated respiratory rate with single-point contact (i.e., the wrist), predicting diseases (Saba & Durai, 2022).

Figure 1. Smart healthcare system



This proposed chapter examines the growth of smart healthcare in the medical industry and how technologies assist smart healthcare to reach better quality. The technologies, such as IoT, smartphones and artificial intelligence algorithms, are discussed as they assist the growth of smart healthcare development. The experimental approach includes IoT-based monitoring tools for the patient, smartphone and Android apps, and the use of AI algorithms for decision-making processes. Finally, this chapter shows how AI and smart technologies are integrated to create an AIoT tool for improvising clinical support where IoT collects data, and AI makes the decision-making process. The IoT tools for health monitoring, smart Android app for data collection, AI algorithms for decision making, and AIOT for the medical field are explained with an experimental approach.

The proposed chapter is presented as follows: The first section discusses the growth of global market in smart healthcare system. The second part discusses the review of AIoT in smart health care system. This session discusses about the AI based wearable device and smart phone based sensor along with the android app for the development of smart healthcare development. The role of AI in diseases prediction is also discussed in brief. Each method is explained along with its experimental approach. The next

section discusses how AI and IoT are integrated together for smart healthcare developments, explained along with its experimental approach. The next section is the contribution of the chapter, and finally, the conclusion of the chapter is presented.

GLOBAL MARKET FOR SMART HEALTHCARE

According to the latest study by Grand View Research, the global intelligent health care industry is forecasted to reach approximately USD 225.54 billion by 2022. The global smart healthcare market is expected to be primarily driven by rapid technological advancements in the healthcare industry over the projected period. According to forecasts, the smart healthcare industry is expected to expand due to the emergence of new inventory management solutions like RFID KanBan and RFID smart cabinets that can effectively manage logistics and decrease inventory expenses. The utilization of smart syringes, smart pills and smart bandages is predicted to contribute to the expansion of the healthcare industry by facilitating remote patient monitoring, assisting in the diagnosis of gastrointestinal ailments, limiting the transmission of infections, and enabling remote tracking of the recovery progress (Data Bridge, 2023). The market for smart healthcare products was worth USD 143.6 billion in 2019, and it is anticipated to rise at a CAGR of 16.2% from 2020 to 2027. Demand for smart healthcare systems is expected to increase due to the rise in mHealth use, government efforts to digitize healthcare, and the prevalence of chronic diseases. According to the "*United Healthcare Consumer Sentiment Survey*", around 37.0% of Americans relied on the internet or mobile apps for health-related consultations in 2019. Currently, AI in the fitness industry enables smarter workouts without the need for gym equipment by incorporating AI into wearable devices like watches, which help personalize fitness goals. The wearable industry has undergone significant transformations since 2004, when it was deemed the year of wearable technology due to the sudden increase in activity trackers following the release of the Apple Watch. The smart health market is higher in developed nations like North America and Europe, as well as some countries in the Asia Pacific (Grand View Research, 2023). Smart health has also been introduced in developing nations like Latin America and the Middle East & Africa, as shown in Figure 2.

EMERGING TECHNOLOGIES IN SMART HEALTHCARE DEVELOPMENT

Artificial Intelligence of Things (AIoT) is a combination of the computational power of AI and IoT, which collectively pushes the limits on the intelligence of smart devices by enabling them to perform highly challenging tasks. The Internet of Things acts as the digital nervous system, and the AI acts as the brain of the system. The addition of AI to the Internet of Things can analyze data collected using IoT sensors and help make decisions and act on the data without human experts. The AI can identify and implement necessary measures in advance for critical medical conditions. Implementing AIoT can substantially reduce death rates by enabling the detection of high-risk diseases at their initial stages, monitoring disease spread, predicting mortality risks by analyzing the patient's health history, remote or home therapy, and other techniques that can significantly reduce hospital occupancy. AIoT-based healthcare includes the combination of IoT and AI algorithms, as shown in Figure 3. IoT helps in monitoring and data collection, whereas, AI automatically diagnoses and predicts diseases with the collected data. This session discusses how IoT and AI algorithms are used for the smart healthcare system.

Figure 2. Growth of smart healthcare

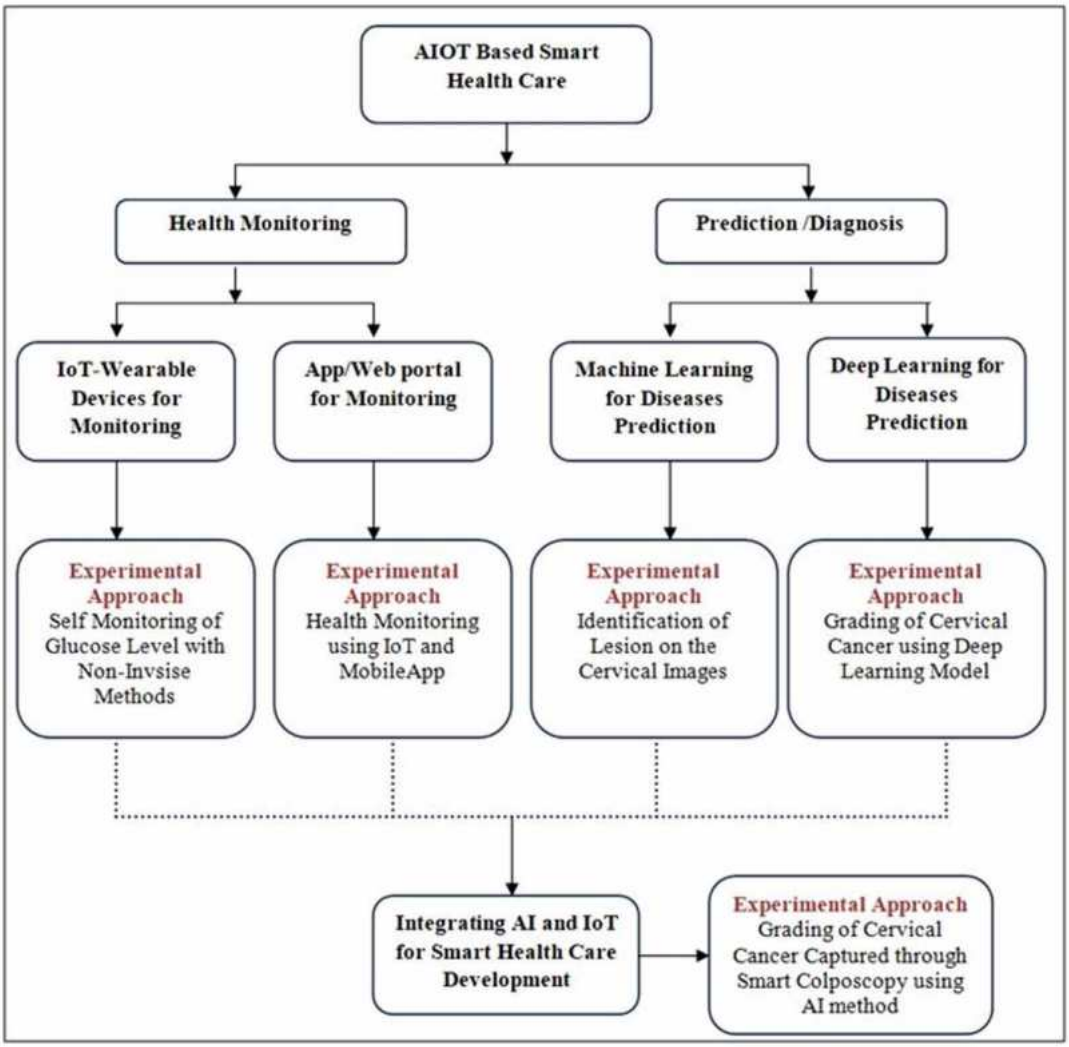


Smart Health Monitoring System

During the pandemic period, the world experience higher attention to remote patient monitoring systems. Regular monitoring is beneficial for early predicting various health conditions by collecting real-time acquisitions of patient health status. For instance, patients with chronic illnesses, disabilities and the elderly face mobility issues. So, providing smart monitoring in remote areas delivers good healthcare facilities to the patient with home comforts (Zouka & Hosni, 2019). An AI-integrated technology is proposed using neural networks and fuzzy systems for the secured health care monitoring system. It helps in collecting the health parameters using the sensor nodes. The collected data is transmitted using GSM modules to the IoT Hub of Azure. It converts the raw data into linguistic representations to apply the (FBIS) Fuzzy-based Inference System to predict vital signs of the patients. Similarly, monitoring equipment is proposed for keeping a close eye on patients' movements during exercise, sleep, and walking (Malche, et al., 2022). Health monitoring has become a significant aspect of daily living, particularly for elderly people and patients who are bedridden (Noble et al., 2018). The patients are provided with a caretaker, but still, it is a problem to monitor patients at each moment. So, a new IoT-based smart monitoring system is proposed for home patients, especially those suffering from chronic diseases like heart attacks, diabetes, arthritis and stroke. The monitoring includes measuring temperature, pulse, respiration, and blood pressure. The collected data are analyzed using hybrid model with minimum processing time. The model collects the real-time data from the patient which support in increasing the lifetime of the patients. By implanted IoT, the data collected are sent to the caretaker as monthly medical reports and shared through a Smartphone application. It has created a significant impact on rural people. The tool developed offers a processing time of 820ms with an overall accuracy of 95% to detect abnormalities in people. The smart health care monitoring system includes the IoT based wearable device for monitor-

ing health care and application or web based portal for the monitoring the health care system. So in this section let us discuss how IoT based wearable devices significantly impact the smart healthcare system and how this AI is integrated with the wearable devices.

Figure 3. Flow diagram for AIoT in smart healthcare systems



IoT-Based Wearable Devices for Health Monitoring

Wearable sensors have become an important component in smart healthcare services as they offer a cost-effective alternative to hospital settings (Islam et al., 2020; Majumder, 2017). These technologies enable medical personnel to assess general health information, screen patients for severe symptoms, and remotely identify anomalies (Dias & Cunha, 2018; Dian et al., 2020). The Massachusetts Institute of Technology (MIT) lab was one of the first institutions to develop wearable technologies, integrating

multimedia, wireless communications, and sensors into people's clothing as early as the 1960s. A proposed monitoring system uses parameters such as body temperature and cardiac frequency to monitor a patient's health (Islam et al., 2020). Sensors like CO, room temperature, and CO2 are used to predict living environment conditions. The collected data is transferred to a web server through the Wi-Fi module, and ESP32 device is utilized for processing the collected data. Data are continuously collected in the web server, and the level of toxic gas in the environment is measured in parts per million (ppm) (Elango & Muniandi, 2020). Another wearable tool is proposed to monitor a patient's vital parameters, and fall detection of the patients. The proposed model employs a heartbeat sensor (LM35), accelerometer, body temperature sensor, and MPU 6050 to predict anomalies in the patient's data. NodeMCU device used as the processing device and with the use of a handheld gadget, patients can be remotely monitored and visualized using a web service called Thing Speak.

The IoT and cloud computing frameworks are utilized for monitoring healthcare systems (Al-Sheikh & Ameen, 2020). The collected data are passed to cloud for further processing using Wi-Fi connectivity. A monitoring tool is introduced using pulse and body temperature sensors, and edge devices such as the NodeMCU and ATmega328P microcontroller are utilized for data collection (Ajaegbu et al., 2020). Data collected are transmitted through the network, and physicians can monitor the patient's medical status through an LCD display. A wearable tool's performance was assessed in diabetic patients with cardiac arrhythmia, and the proposed model generated higher quality data (Mohapatra et al., 2019). The suggested method utilized HR and TS to interpret patient data, and Arduino served as an edge device that was wired to the sensors and used to send information to cloud over Wi-Fi. Any internet-connected device can be used by doctors to quickly connect to the cloud server to check on patients' conditions and recommend appropriate treatments in an emergency. An IoT based framework was introduced for symptoms monitoring by intergrading the sensors with the mobile application and message passing services (Swaroop et al., 2019). The primary hardware employed for monitoring patients includes a Raspberry Pi and three sensors to detect health parameters. The handheld prototype is being developed with a Wi-Fi communication channel that has an average latency of 125.95 seconds. Meanwhile, (Al-khafajiy et al., 2019) presented a wearable based monitoring system for elderly patients, which enables patients to access healthcare resources in home setting. Data gathered is delivered to the patient's mobile application via Bluetooth after connecting all components to an Arduino UNO. Finally, the data is moved to the cloud server through Smartphone application, which serves as a gateway. The established monitoring platform allows clinicians to easily monitor patient records and sensor data. Similarly, sensors are used for collection of health parameters and transmission handled by an ATmega328P microprocessor and bluetooth module (Semwal et al., 2019). The cloud server's LabVIEW tool is used for visualization of data. The suggested prototype offers offline data collection from multiple sensors in areas with poor network connectivity, which is later uploaded to the cloud. Lastly, (Kumar et al., 2018) presented a smart healthcare monitoring system that allows patients and doctors to communicate via a camera. Health parameters, namely temperature and heart rate, are detected by the input sensors of the Raspberry Pi CPU module and sent to the LCD, enabling doctors to inspect health condition of patients in real-time by sending the processed information to the web server over the internet. The system only connects to a small number of sensors, but it still enhances the patient monitoring system.

A wearable health tracking platform is introduced to assists clinicians in monitoring patients and collecting data across an IoT network (Wan et al., 2018). The system uses an Arduino as an edge device along with sensing nodes such as blood pressure, heart rate, and body temperature sensors. The body area sensor network uses Wi-Fi to transmit all the collected data to a cloud server, and physicians can

monitor patients via a laptop or smartphone. Table 1 summarizes the developed health monitoring systems that utilize wearable devices. It considers several factors, including communication channels, sensors and edge devices, visual data for monitoring, and the outcome of each developed system. In this session, the AI is integrated with the IoT based wearable devices for health monitoring. (Al et al., 2021) proposed the IoT based wearable monitoring device to measure the various vital signs related to COVID-19. It automatically alerts the medical authorities about the infected patient and helps in tracking their real time location using GPS. The wearable sensor is connected to the human body and the collected data are processed and stored in the cloud. The proposed system is build with three layer called Iota sensors layer where all the sensor collect the medical parameters, cloud layer where all the parameters are stored simultaneously and finally the application peripheral interface(API) to monitor and visualize the collected data.

Table 1. Summary of wearable devices for smart healthcare monitoring

Author/Year	Sensors	Edge Device	Communication	Visualization	Outcome
Al et al., 2021	PPG Unit, GPS sensors, Temperature Sensors, Accerlometers	Arduino MKR	Bluetooth	Android Screen	The API based platform updated the health condition of the each patient which helps in easy tracking of patients
Islam et al., 2020	body temperature, heart rate sensor, sensor, CO sensor, room temperature sensor, and CO2 sensor	NodeMCU	web server and Wi-Fi	Thing Speak	Accuracy = 95%
Elango & Muniandi, 2020	Heartbeat sensor, body temperature sensor, and accelerometer	NodeMCU	Wi-Fi/HTTP, MQTT	Thing Speak, LCD	N/A
Al-Sheikh & Ameen, 2020	Heart rate, ECG, SpO2, and body temperature sensor	Arduino, NodeMCU	Wi-Fi	Blynk	Predict the parameter with minimum power consumption and tested on 4 people.
Chigozirim et al., 2020	Heart Beat sensor, body temperature sensor	ATmega328p, and NodeMCU	WiFI	LCD	The instrument's findings, along with a Cronbach's alpha of 0.71,
Mohapatra et al., 2019	Heart Beat sensor, body temperature sensor	ATmega328p, and NodeMCU	ATmega328p, and NodeMCU	Adafruit	The developed tool is highly secured than the existing method and emergency notification
Swaroop et al., 2019	ECG, Pulse rate, blood pressure and temperature	Raspberry pi	Wi-Fi and MQTT	Web application	Accuracy = 93.74
Al-khafajiy et al., 2019	Pulse, temperature, blood oxygen, and blood glucose sensors	Arduino	Bluetooth HC-06	Web application	Accuracy = 92.56
Semwal et al., 2019	ECG, pulse oximeter, body temperature, and blood pressure sensors	ATmega328P	Bluetooth HC-05	LabVIEW	Accuracy = 98.26
Kumar et al., 2018	Heartbeat, and temperature sensor	Raspberry Pi	Wi-Fi/ HTTP	Web application	Accuracy = 99
Wan et al., 2018	Heartbeat, blood pressure, and body temperature sensors	Arduino	Wi-Fi/ HTTP	Web application, LCD	Accuracy = 90.37

N/A – Not Applicable

AIoT-Based Wearable Device for Health Monitoring

The combination of artificial intelligence and wearable devices is a game changer in the healthcare world. IoT and mhealth devices help locate physicians or doctors closer to patients, enabling patients to receive timely treatment. The wearable biometric monitoring devices have fixed sensors to collect patient's behavioral, physiological, environmental, biological data. By using BMDs wearable tools, thousands of data are collected for assessment, predicting patient outcomes, and helping professionals choose the best treatment (Possamai et al., 2020). In 2019, a new AI wearable tool named Cambridge Heart wear was introduced for monitoring heart rhythm via electrocardiograms (ECGs) and the automatic interpretation and identification of irregularities using artificial intelligence. Patients can securely set the device to acquire and transmit real-time data directly to their physician (Research, 2018). A new wearable device has been introduced to assess COVID-19-related symptoms, such as breathing rate and core temperature. The smart helmet is outfitted with a thermal imaging system for the automatic identification of corona virus using thermal imaging technology without any human contact. It can detect higher body temperatures and immediately send notifications to healthcare workers by obtaining continuous data on people's body temperature.

Similar to this, China has introduced a 5G-based smart helmet at the recent "*China International Import Expo*". This helmet utilizes a low-power design and consumes 85% less power, speeding up the diagnosing process compared to traditional screening methods (Ahlawat & Krishnamurthi, 2022). Smart glasses has proposed to identify suspected COVID-19 cases in crowds with high body temperatures. The thermal camera screens and predicts a person with a high body temperature, and the person is captured through the optical camera. The face is identified using Viola-Jones algorithm, and the identified person's temperature details are shared with the healthcare department (Mohammed et al., 2020). A wearable device has been proposed to monitor long-term blood pressure and heart rate (HR). The IoT wearable tools are related to the machine learning framework to detect motion by head movements. The device is built with electrocardiogram and photoplethysmography sensors and is located at backside of the ears to acquire weak ear-ECG/PPG signals successfully (Zhang et al., 2017). The support vector machine is used to predict raw heartbeats based on human body motion (Kumar et al., 2017). Researchers are facing challenges in collecting real-time patient data, so wearables are playing a significant role in collecting real-time data from patients. Therefore, a new wearable tool is proposed by connecting IoT sensors and machine learning.

Recent studies have shown that heart attacks are the leading cause of death, with nearly 610,000 people dying from cardiac attacks in the United States. To address this issue, wearable devices and artificial intelligence can be employed to anticipate and avert heart attacks. For instance, the IoT based monitoring system employs three-tier design to collect, store and analyze data from wearable sensors, with significant variables including Respiratory Rate (RP), Blood Pressure Systolic Range (SR), Heart Rate (HR), and Blood Pressure Diastolic Range (DR). Apache HBase is used to store the large amount of information collected using IoT sensors, and Apache Mahout is utilized to build the machine learning model called logistic regression for predicting heart diseases (Guo et al., 2021). Another example is the IoT-based smartwatch paired with an Android app, which uses an accelerometer for data collection to predict falls in real-time. The smart fall application employs Support Vector Machine (SVM) and Naive Bayes, and convolutional neural network model for predicting falls. The performance of the smart watch, Notch and Farseeing, the deep learning outperforms machine learning for fall detection of patients. The AI algorithm has been displayed with online and real-time test results, with the deep learning model

processing the information without preprocessing method and achieving an overall accuracy of 100% for the real-time dataset. However, the fall prediction drops for the farseeing dataset at a percentage of 86% during the online test.

In contrast, severe heart attacks that cause loss of control while driving result in numerous fatal accidents. To predict heart abnormalities during driving, a new wearable ECG band that communicates using wireless technology was introduced. The electrocardiogram (ECG) is actively recorded and sent to the portable decision-making subsystem by sensors fastened to the wrist. The gathered data are processed using the "extended modified B-distribution" (EMBD), extended time-frequency features, and polynomial kernel of the support vector machine algorithm (Chowdhury et al., 2019). The tool's accuracy for detecting elevation myocardial infarction (STEMI) and non-ST-elevation MI (NSTEMI) methods are 97.40% and 96.30%, respectively. The proposed tool can detect heart abnormalities and help reduce the loss of lives and road accidents worldwide. Figure 4 shows the AI-based smart wearable, and Table 2 summarizes the wearable AI tool for smart healthcare development. The next section discusses the experimental approach to identifying the glucose level from patients using a non-invasive method. (Lin et al., 2019) proposed a AIoT based method for the prediction of cardiac diseases prediction. The ECG sensing device act as the front end for the wearable device. The smart app act the interface and the collected data are stored in the cloud database. The AI algorithm predict cardiac diseases and classifies the the arrhythmia from the collected data. Similarly, (wang et al., 2022) proposed a cardiovascular diseases prediction using the wearable devices. The proposed model predict the diseases with the average accuracy of 90.2%.

Figure 4. Wearable AI tool for smart healthcare development: (a) smart helmet, (b) smart glass, (c) smart watch, (d) wearable ECG band



Glucose Level Monitoring Using IoT-Based Tools: An Experimental Approach

One of the prevailing long-term health conditions affecting people across the globe is diabetes. Patients with diabetes often struggle to monitor their blood sugar levels because the intrusive procedures involved can harm nearby tissues. However, by using an Arduino Uno board and a sensor, it is possible to predict glucose levels without the need for blood strips or needles. This method can help in measuring a patient's sugar level without affecting their tissues.

Aim: To develop self-monitoring of glucose levels with non-invasive method using MAX30100 sensors.

Hardware Components: Sensors like Pulse Rate, SpO2 and Glucose level, microcontroller, LED light, MAX30100 sensor are used in the experiment

Table 2. Wearable AI for smart healthcare development

Author/Year	Sensors	Components	AI Algorithm	Type
Wang et al., 2022	Wearable ECG Monitor	ECG sensing device, Cloud, BLE, Smart phones	CNN and LSTM	Cardiovascular diseases prediction
Ahlawat & Krishnamurthi, 2022	Smart Glass	Optical camera, Thermal Camera, Google Location History	Viola–Jones	Screening tool crowds.
Guo et al., 2021	Smart Watch	Cloud-Internet of things (C-IOT), Smart phones	CNN	Health monitoring like blood pressure and step count
Possamai et al., 2020	Smart Helmet	Thermal camera, Optical camera, Arduino	Viola–Jones	Screening tool
Lin et al., 2019	Wearble ECG Patches	ECG sensing device	CNN	Cardiac diseases prediction
Chowdhury et al., 2019	Wearable ECG band	RFduino, ECG sensors, SIM 908 Moule, Cooling fan, BLE dongle, RPI micro USB	SVM	Heart attack Prediction
Zhang et al., 2017	Long-Term Motion-Tolerant Wearable Monitoring tool	electrocardiogram (ECG) and, photoplethysmography (PPG) sensors	SVM, K- Mediods clustering	Predict the abnormalities in the blood pressure and heart rate
Kumar et al., 2017	Wearable watch	Health rate sensor, blood pressure,	Logistic Regression	Heart Diseases Prediction

Methodology: The system reads pulse rate, SpO2, and glucose levels from a sensor attached to the microcontroller before processing the sensed data in the controller. The microcontroller is the decision-maker of the system. It is connected to two LED sensors; one emitting the red light, and the other the infrared light, which is necessary to measure the pulse rate. Using red and infrared light, the system determines the oxygen saturation measure in the blood stream. The ventricular motion pushes more blood when there is high oxygen, and the quantity of the oxygenated blood decreases as the heart relaxes. The duration between the ascent and descent of oxygen-rich blood aids in the determination of the pulse rate. The primary function of the MAX30100 sensor is to track the uptake capacity of both light sources and store in a buffer that can be taken through an I2C display. This non-invasive method minimizes skin infections caused by frequent tissue pricking and reduces discomfort for patients compared to invasive procedures. An IoT-based non-invasive monitoring system for pulse rate, oxygen saturation, and blood sugar promises to make users' lives easier by utilizing the advantages of an embedded system. The components connected are displayed in Figure 5(a), and a demonstration is shown in Figure 5(b).

Result and Discussion: The Easy Touch measurement was compared with a glucose monitoring instrument and the results indicates that both measurements were statistically indistinguishable from each other. The non-invasive approach has undergone extensive testing and has an accuracy rating of 90.3% with a variation of 1.2-3.6 mg/dL, as shown in Table 3.

Figure 5. Self glucose monitoring system: (a) construction of monitoring system, (b) predicting the glucose level using the proposed monitoring system

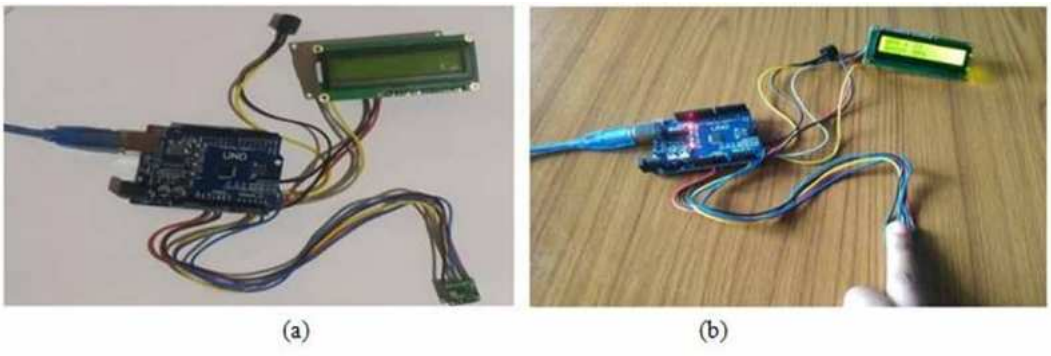


Table 3. Prediction of glucose level with existing and proposed non-invasive method

Methods	Easy Touch (mg/dl)			Non-Invasive Method		
Parameters	**Heart Rate**	**Spo2**	**Glucose Level**	**Heart Rate**	**Spo2**	**Glucose Level**
Sample	112	97	N	111	96	N

Smartphone Sensors and Android App for Smart Healthcare Development

Smartphone's are also playing a significant role in the smart healthcare system. Globally, there are many illnesses that affect the respiratory system, skin, eyes, heart and mental health. Continuous monitoring can help prevent or manage them. Using smartphones to enable constant health monitoring provides a non-invasive, affordable and accessible healthcare solution. With mobile phone penetration and sensors for advanced communication technologies, appropriate infrastructure has been established for continuous virtual monitoring of patients (Majumder & Deen, 2019). Health parameters collected through smartphones include heart rate, blood pressure, oxygen level, daily activity, mental health, etc., as shown in Table 4. The camera sensor connected to smart phones is also used for identifying skin, eye, and ear infections and for cancer screening. Hyperglycemic patients need to monitor their blood glucose levels regularly to prevent diabetes. Currently, in many clinics, an invasive method is used to check their glucose level, making it uncomfortable for regular screening. A non-invasive blood glucose monitoring system has been introduced using Photo Plethysmo Gram (PPG) data collected as a video over the smartphone. Data collected is analyzed and stored in the cloud. A machine learning model is applied to extract features using Gaussian filters, and it predicts the standard values based on the body's glucose level (Zhang et al., 2020). A new framework was introduced for instant monitoring of the user's health by estimating the vital sign of the patients. The two Smartphone sensors, rear camera, and the microphone, will helps in recording data. The heart rate and SpO2 data were converted into a photoplethysmogram (PPG) collected through image sensors.

Table 4. Build in smart phone sensor used in health monitoring

Health Monitoring	Build in Smart Phone Sensor
Cardiovascular Activity	Microphone, Image sensor
Eye Screening	Image Sensor
Respiratory and lung Diseases	Microphone, Image sensor
Skin health Diagnosis	Image Sensor
Daily activity and fall recognition	Motion sensors
Ear health	Microphone
Cognitive function and mental health	Motion sensors

The smart phone based blood monitoring system is introduced to predict the blood pressure. The system collects data using the user's six index fingers via a smartphone camera. The device predicts the systolic and diastolic blood pressure using pulse transit time (PTT) between two distinct photoplethysmogram (PPG) signals. The PPG signals are filtered and processed using peak detection techniques to reduce motion and noise. Finally, the predicted BP value is measured using mean square error (MSE), standard deviation, and correlation parameters (Tabei et al., 2020). Similarly, a respiratory monitoring system using a smartphone has been introduced to accurately measure respiratory rate. The measurement is done using imaging and Fourier transforms techniques. Patients' skin surfaces are captured on video through the camera with the flashlight connected to the smartphone. Data collected is converted to PPG signals and analyzed using discrete wavelet transform to predict the respiratory rate (Alafeef & Fraiwan, 2020). Furthermore, a non-invasive blood glucose monitoring system has been introduced using Photo Plethysmo Gram (PPG) data, collected as a video via smartphone. The collected data is analyzed and stored on the cloud. A machine learning algorithm is used to extract the data's features using Gaussian filters, and it predicts the standard, warning, and borderline levels based on the body's glucose level (Zhang et al., 2020). Finally, an android app was introduced to provide audio-visual feedback to determine whether placing the smartphone in the right spot would result in signals of high enough quality to estimate blood pressure (Nemcova et al., 2020).

Similarly, smartphones embedded with sensors have been introduced to measure blood pressure. The PPG data are split into 15-second epochs using the sliding window, and 233 features are retrieved from PPG pulse's raw signals with respect to time and frequencies (Dey et al., 2018). The BP monitoring system using seismo interprets vibrations produced by heartbeat and finger pulses. The blood releasing time is calculated from the seismocardiography signal with accelerometer, and the fingertip are used for calculating the receiving time from PPG data using image sensors. The speakers embedded in smartphone synchronize collects the data using an accelerometer and camera. The system's performance is evaluated in a longitudinal blood pressure perturbation study with nine participants (Wang et al., 2018). Heart rate monitoring using a smartphone is proposed using photoplethysmographic data. The data is collected using the reflected mode of PPG using image sensors for the user's index fingertips. The stored data is transferred to the processing device using Bluetooth communication. The system's performance is evaluated with 19 subjects (Alafeef, 2017). A new monitoring system is developed for accurately monitoring the patient's heart rate using the smartphone's camera images (Lomlize & Park, 2017). The signals are extracted from the region of interest, and noise from the raw data are removed using the threshold method. The experimental results showed that the framework's heart rate estimation

was accurate. The suggested approach, however, disregards the effects of various smartphone camera modules. Table 5 provides a summary of the smartphone sensors in smart healthcare development, which includes factors such as the sensors, smartphone used, and their outcomes.

Table 5. Summary of smartphone sensors in smart healthcare development

Author/Year	Type	Sensor	Smartphone	Algorithm	Outcome
Zhang et al., 2020	Blood Glucose level	Image Sensors	iPhone 6s Plus	Gaussian SVM, Bagged Trees (BT) and K-nearest neighbor (KNN) classifiers	Accuracy = 81.49%.
Nemcova et al., 2020	HR, BP, SpO2	The rear camera, microphone	Honor 7 Lite, Apple iPhone SE, Lenovo Vibe S1	Regression	Mean Absolute Errors (MAE) = 1.1% for SpO2 and 1.4 beats per minute (bpm) for HR estimation.
Alafeef & Fraiwan, 2020	Respiratory rate	Image sensor	Samsung Galaxy S6	Fourier transform techniques, discrete wavelet tranforms	Average Accuracy of 97.8% and an average error of 2.2%.
Tabei et al., 2020	Blood Pressure	Camera	iPhone X	Linear Regression Model	MAE = 2.10, standard deviation = 1.96, and correlation parameters = 0.90
Dey et al., 2018	Blood Pressure	Heart Rate Sensors	Samsung Galaxy S6	Lasso regression techniques	Accuracy = 95%
Wang et al., 2018	Blood Pressure	Rear camera, accelerometer	N/M	N/M	Pearson correlation = 0.20 and 0.77 for the volunteers
Alafeef, 2017	Heart Rate	Image Sensor	Samsung Galaxy	Mean filtering in intensity of each channel	Accuracy is 99.7%
Lomlize & park, 2017	Heart Rate	Rear camera	Pantech Vega Racer 3Samsung Galaxy S2 LG G3, HTC Desire HD	Adaptive threshold method	In real-time, system predict the heart rate with less than 5% error rate

N/M-Not Mentioned

Android App for IoT-Based Healthcare Monitoring System: An Experimental Approach

Previously, it was impossible for doctors to remotely monitor patients in critical conditions. To address this issue, an Android app-based Internet of Things (IoT) system has been presented. It automatically collects and sends patient data to a server, allowing doctors to constantly access it.

Objective: The system's main objective is to monitor the patient health record remotely and minimize hospital visits. It also helps the patient to know their health condition.

Hardware Components: Node MCU is first linked to the Wi-Fi by the health monitoring system. The system reads parameters like the heartbeat, oxygen level, high blood pressure, low blood pressure, and temperature as sensors are connected to the Controller. The Node MCU reads the ECG Value from the ECG sensor after receiving these data from the Controller. With the aid of the URL and API key, 14 values from the Controller and the ECG are now delivered to the Firebase database. The values in the database are promptly updated. The Firebase URL and API key are also used to display the values in the

developed App. Now that the doctor can access the App, the patient can assess the medical condition using the sensor's parameter values.

Methodology: The health monitoring system first connects the Node MCU to the Wi-Fi. Then, parameters such as heartbeat, oxygen level, high blood pressure, low blood pressure, and temperature are read from the sensors connected to the Controller. Once these data are received from the Controller, the Node MCU reads the ECG value from the ECG sensor. Using the URL and API key, the Controller and ECG data (a total of 14 values) are moved to the Firebase database, where they are promptly updated. The Firebase URL and API key are also used to display the values in the developed App, which can be accessed by the doctor to assess the patient's medical condition using the sensor's parameter values. The workflow of the methodology is shown in Figure 6.

Data Transfer: The Node MCU is utilized to transmit the sensor-collected data from the Arduino board are transferred to cloud. The Node MCU serves as a Wi-Fi module and sends the data to Firebase. Data transmission is carried out by utilizing the Firebase host URL and API keys obtained from the Firebase database. Additionally, the Firebase database is linked to the App using API keys, a Firebase Host URL, and a database bucket. The values obtained from the board are stored in the database and displayed in the App. The data transfer flow is illustrated in Figure.7.

Visualization: The doctor can remotely track the patient's records with the help of a created App, which consists of two modules. The first module is for doctors, where they can log in using their user ID and password and select the patient to monitor. The screen displays the patient's health parameter values, and the doctor can check their health condition and prescribe medication in the prescription text box provided. The second module is for patients, where they can log in using their user ID and password. This takes them to the screen displaying the doctor's name, hospital name, and prescription, as shown in Figure 8.

Figure 6. Workflow for monitoring the patient using IoT sensors and Android app

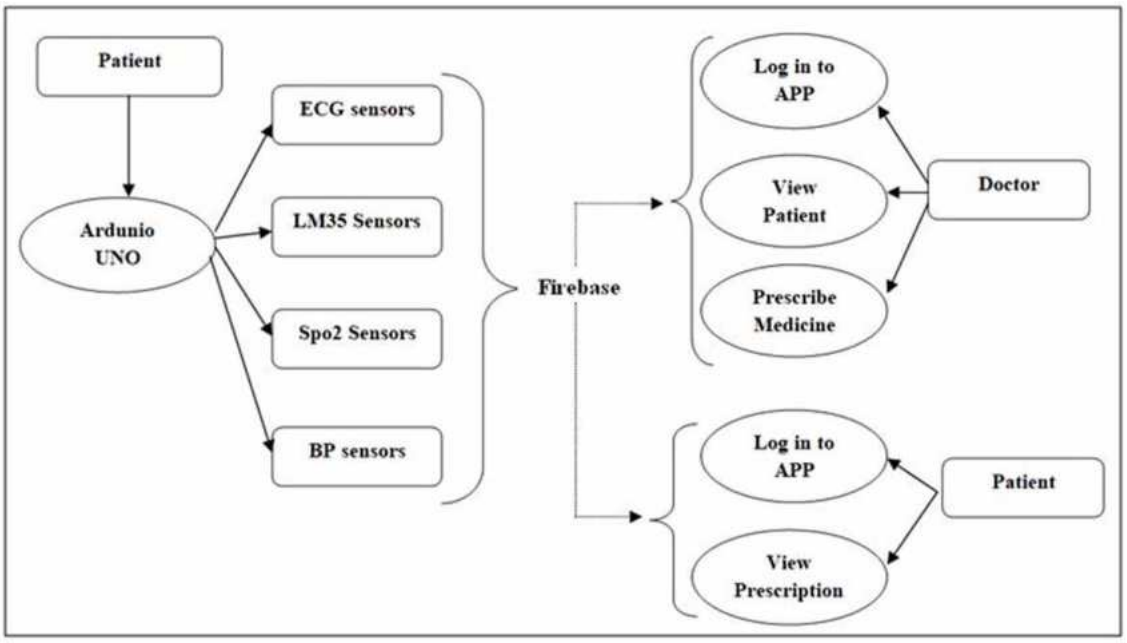
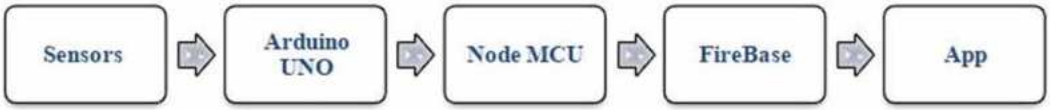


Figure 7. Data transfer flow



Role of Artificial Intelligence Prediction in Decision Making

Artificial Intelligence (AI) is rapidly gaining importance in the healthcare industry to improve smart healthcare systems. This technology has the potential to transform various aspects of patient care as well as internal administrative procedures at insurers, providers, and pharmaceutical businesses. Numerous studies have shown that AI is as good as, if not better than, humans in carrying out important healthcare activities like disease diagnosis. Today, algorithms are more effective than radiologists in identifying cancerous tumors and helping researchers create cohorts for costly clinical trials.

Figure 8. Android app for the patient and doctor monitoring system



Machine Learning for Decision Making in Smart Healthcare Development

A subset of AI, known as "*machine learning*", includes methods that enable computers to comprehend data and generate AI applications. In machine learning, various algorithms such as neural networks (NN), support vector machines, and the K-Nearest model are used for problem-solving. This section discusses how the machine learning (ML) algorithm is utilized to predict cancer, heart diseases, and an experimental approach on machine learning algorithm for the development of smart healthcare.

Cancer Prediction Using Machine Learning Algorithms

Machine Learning approaches and biosensors have been proposed for early diagnosis of breast cancer (Amethiya et al., 2022). A tumor detection algorithm from mammograms was proposed by Rejani and Selvi (2009). The first approach involves learning to recognize tumors as suspicious spots that have weak contrast with their surroundings, while the second approach is to learn to derive characteristics that categorize tumors. Tumor detection involves methods such as mammogram enhancement and segmentation of tumor areas. Enhancement involves improving image quality to more understandable levels, while segmentation is done using the threshold method for diagnosing breast cancer. A decision tree is presented using data mining techniques for initial breast cancer detection. Additionally, machine learning algorithms like random forest, nearest neighbor, and Naïve Bayes are used to predict breast cancer (Sharma et al., 2018). Based on comparison analysis, the K-nearest neighbor outperforms the existing machine learning methods in predicting cancer.

Skin conditions are prevalent among human illnesses, with skin colour being a powerful indicator of this condition. A system that recognizes skin cancer using captured skin images. The skin is filtered using the median filter, and the segmentation process is applied to the extracted features. The support vector machine and random forest are combined to classify skin diseases (Murgan et al., 2021). Machine learning algorithms, such as the random forest classifier, K nearest classifier, multilayer perceptron classifier and decision tree, are used to classify skin disease types (Verma et al., 2021). Based on comparative analysis, the random forest outperforms the other classification models in identifying the type of skin diseases. An approach called CervDetect, which uses machine learning algorithms to predict the risk of malignant cervical formation has been proposed (Weegar & Sundström, 2020). The random forest and feature selection techniques are used to select suitable features for cancer prediction. Table 6 provides a summary of the machine learning used in cancer prediction, including factors such as the dataset, type of cancer, and its outcome.

Table 6. Machine learning used in the prediction of cancer

Author/Year	Dataset	Type of Cancer	ML Algorithm	Outcome
Rejani & Selvi, 2009	mini-MIAS database	Breast cancer	SVM	The model achieved the sensitivity of 88.75%.
Sumbaly et al., 2014	Digitized images of FNAC of a breast mass	Breast Cancer	Decision tree and J48	The model achieved the sensitivity of 94.56
Sharma et al., 2018	Wisconsin - Digitized images of FNAC of a breast mass	Breast Cancer	KNN	Accuracy = 95.90
Murgan et al., 2021	ISIC dataset	Skin cancer	SVM+RF	Accuracy = 88.56
Verma et al., 2021	UCI machine repository	Skin cancer	Random Forest Classifier	Accuracy = 0.99
Weegar & Sundström, 202	UCI machine repository	Cervical Cancer	Random forest	Accuracy = 93.6%

Heart Disease Prediction Using Machine Learning Algorithms

Cardiovascular diseases have emerged as one of the most severe and acute illnesses affecting adults. According to studies, heart disease causes about 30% (18 million) of all annual deaths (Ahmed et al., 2019)(Kaptoge et al., 2020). To reduce the risk of heart disease, researchers are focusing on developing decision support systems in the smart healthcare environment. Heart disease prediction is carried out highly using ECG data, and early detection can prevent patients from leading to death (Nagaveli et al., 2022). The machine learning approach, like Naive Bayes with the weight approach (NBwa), is used to predict heart diseases. Similarly, feature-based frequency domain, time domain, and information theory are proposed for analyzing and automatically identifying ischemic heart disease. Classifier models such as the support vector machine and XGBoost are used for classification with the best performance rate. Clinical decision support systems (CDSS) use the hybrid synthetic minority oversampling technique-edited nearest neighbor (SMOTE-ENN) widely in the medical industry to identify and diagnose diseases. The support vector machine is used for stroke prediction with a pooled AUC of 92%, and the boosting algorithm attains 91%, while the convolution neural network is 90% (Krittanawong et al., 2020).

The CNN model performs well in image data, but the SVM outperforms the prediction due to the high dimensionality of the dataset. The naive Bayes algorithm is proposed to classify specific heart diseases (Jabbar & Samreen, 2016). A comparative study is conducted with six machine learning algorithms to predict coronary artery diseases (CAD) (Gupta et al., 2020).In order to improve heart disease prediction, various techniques and algorithms are proposed and utilized. Independent features are selected using the backward elimination approach and filter method based on the Pearson correlation coefficient, and KNN algorithm is used for accuracy improvising. Remote patient monitoring is used to collect datasets, and only the most significant parameters are considered. The random forest algorithm is proposed to predict heart disease using 14 features, and the KNN model is used for weight development. Additionally, the KNN model is employed to extract features and predict ideal features with SVM FRE, which increases computational speed. Table 7 provides a summary of the machine learning techniques used in predicting heart diseases, including dataset factors and outcomes.

Table 7. Machine learning for prediction of heart disease

Author	Data Set	ML Algorithm	Outcome
Nagaveli et al., 2022	PhysioNet database	SVM, NBwa, XG Boost	XGBoost outperform the existing ML algorithm with an accuracy of 95.9%.
Krittanawong et al., 2020	Cardiovascular Dataset	SVM	AUC of 92% in cardiovascular prediction
Jabbar & Samreen, 2016	Cleaveland Heart Diseases Dataset	Hidden Naïve Bayes (HNB)	Accuracy = 100%
Gupta et al., 2020	UCI - Cleveland Heart Disease Dataset	Naive Bayes, Regression, SVM, KNN,Decision Tress and radom forest	Random forest predict the heart diseases 86.84%
Enriko et al., 2018	Real time dataset collected from HarapanKita Hospital (HKH)	k-Nearest Neighbors	The KNN model without parameter weight predict heart diseases with accuracy of 75.11%
Pal et al., 2021	Kaggle Dataset	Random forest	Predict the accuracy of 86.9%
Hutamaputr et al., 2021	N/M	Weighted KNN	Accuracy = 82.65%

N/M – Not Mentioned

Cervical Cancer Neoplasm Identification Using Machine Learning Algorithm: An Experimental Approach

Cervical cancer is a malignancy formed at the lower part of the uterus. Colposcopy devices capture cervical images and are considered for analysis of screen cervical cancer. The machine learning algorithm is used to automate and identify the cervical cancer region, i.e., abnormal regions.

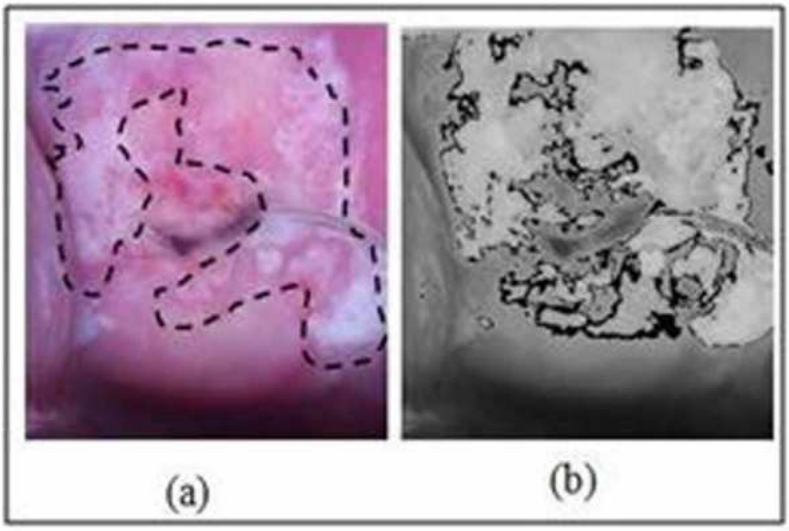
Aim: Detection of dysplasia region on the colposcopy images using the machine learning algorithm called bayes classifier.

Data Collection: The colposcopy images are collected from the UCI machine learning data repository with 287 instances and 69 attributes.

Methodology: Detecting cervical cancer at early stage is crucial for effective treatment, and colposcopy is a commonly used method for the identification of abnormal tissue on the cervical images (Hariharan et al., 2012). The dysplasia region appears as a white region after the applying the acetic acid during the colposcopy examination. The white areas are manually marked by the physician to differentiate the abnormal tissue on the colposcopy images. The images are initially divided into 32x32 overlapping square to focus on the abnormal regions. From the overlapped square red, green and blue channel are extracted for the process of feature extraction. The statistical feature like mean (μ), standard deviation (σ), and skewness value are extracted from each color channel of the colposcopy images. The statistical feature are extracted from the normal and abnormal region of the images and given as the input in the naïve bayes classifier to predict the dysplasia region on the colposcopy images.

Results: Based on the quantities analysis the machine learning algorithm predict the dysplasia region with an accuracy of the 98.03%, precision value of 97.08%, Specificity value of 97.12% and sensitivity value of 92.06%. The dysplasia region predicted is shown in Figure 9.

Figure 9. Cervical cancer detection using bayes classifier: (a) Represents the original image with the marked cancer region. (b) The cervix images for lesion detection using bayes classifier.



Deep Learning for Decision Making in Smart Healthcare Development

Deep learning, also known as deep neural learning or deep neural network, is a branch of machine learning that makes use of neural networks to analyse data in a manner like that of the human nervous system. It has networks that can autonomously learn from unlabeled or unstructured data. This section discusses how the machine learning algorithm is used for the prediction of cancer and heart diseases.

Cancer Prediction Using Deep Learning Models

The author suggested "end-to-end" training method, which effectively utilizes training datasets with either complete clinical annotation or only the cancer status (label) of the entire image, allows for the accurate prediction of breast cancer on screening mammograms (Shen et al., 2019). In order to predict breast cancer, the initial training stage involves lesion annotation, and the following level involves picture level labeling. The U Net model was proposed for the detection of breast cancer from the mammogram images (Mohammed et al., 2022). It assists in separating the breast region from the surrounding area, and the classification procedure is used to distinguish between the normal and pathological breast image regions. The fourth most common disease in the world among women, cervical cancer is more common in developing nations. Due to their low cost and painless diagnosis, Pap-smear tests are the most popular. The classification model called ResNet-152 architecture classify the of pap smear images based on the severity of the images (Tripathi et al., 2021). Table 8 provides an overview of the deep learning methods employed in the prediction of cancer, including the datasets, types of cancer, deep learning models, and results.

Table 8. Deep learning for prediction of cancer

Authors/Year	Database	Cancer Type	DL Model	Outcome
Shen et al., 2019	Digital Database	Breast cancer	Modern CNN	sensitivity: 86.1%, specificity: 80.1%.
Mohammed et al., 2022	DMR-IR	Breast cancer	U Net	Accuracy = 99.33%
Tripathi et al., 2021	SIPAKMED pap-smear image dataset	Cervical cancer	ResNet-152	accuracy = 94.89%

Heart Diseases Prediction Using Deep Learning Models

Heart diseases are highly reported in the developing countries like Africa and Asia. Cardiovascular disease prediction is made based on the deep learning algorithm. The author proposed a method for predicting heart diseases by applying the convolution neural network. Both organised and unstructured data are used to train the model (Shankar et al., 2020). The CNN model includes the softmax activation function with the Adam optimizers. The "UCI – Heart Disease dataset" is used to train and predict diseases (Heart disease data set, 2020). The author proposed a method called "*CardioHelp*", which helps predict cardiovascular diseases in a patient by using the convolution neural network (Mehmood et al., 2020). Heart failure prediction at early stages prevents diseases and also helps in providing suitable treatment.

Patients' data was captured by the body-worn sensors, which were then safely transmitted to cloud for supplementry processing (Arooj et al., 2022). Deep convolutional neural network (DCNN) is used for image recognition, and the model is trained with 1050 patients and 14 attributes. The feature vector is taken as input to discriminate whether the data belongs to a healthy or cardiac disease. It is predicted by compiling the collection of directly attainable characteristics from the heart-disease dataset using a Modified Deep Convolutional Neural Network (MDCNN) to detect heart illness. (Khan et al., 2020) suggested an IoT-based solution. The patient's smartwatch and heart monitor devices were used to obtain the data (BP and ECG) for this investigation. By comparing the proposed MDCNN to existing deep-learning neural networks and logistic regression, the system's performance is assessed. The outcomes show that the suggested MDCNN-based cardiac disease prediction system outperforms competing approaches. Table 9 provides a summary of the machine learning used in the prediction of heart diseases which includes the factors like dataset, and its outcome.

Table 9. Deep learning for prediction of heart disease

Authors/Year	Data	Algorithm	Outcome
Shankar et al., 2020	UCI – Heart Disease dataset	CNN	Accuracy = 85–88%
Mehmood et al., 2020	UCI – Heart Disease dataset	CNN	Accuracy =97%.
Sarmah et al. [4]	Hungarian dataset, real-time sensor data	DLMNN	Accuracy =96.8%.
Arooj et al., 2022	UCI – Heart Disease dataset	DCNN	Accuracy = 91.7%.
Khan et al. [6]	Cleveland database	MDCNN	Accuracy = 98.02%

Grading of Cervical Cancer Using Deep Learning Algorithm: Experimental Approach

Grading of cervical cancer is the process of classification based on the stages of the cervical cancer. There are three types of stages called CIN1, CIN2 and CIN3 which are represented as Type1, Type2 and Type3.

Data Collection: The smart colposcopy images are collected from the kaggle dataset (Kaggle, 2020). It consist of three grade of cancer based on the acetowhtie region affected on the cervical region. The three grades are Type 1, Type 2 and Type 3 which are labelled as shown in the Figure 10.

Deep Learning Model: The input of the model is set as 224 x 224 for the colposcopy image. VGG16 is a deep CNN model which has the convolution layers that uses narrow receptive field of filter size of 3x3. The 1x1 convolution filters is used for the linear representation before passing it into an activation function called ReLU. It helps in maintaining the spatial resolution is after passing through the convolution filter, the stride size is set as 1x1 for the consideration of each pixel. Each of the first two fully convolutional layers in the VGG contains 4096 channels, while the third layer has thousands of channels. (Sudha & Ganeshbabu, 2020).

Result: Based on the quantities analysis the deep learning model grade the smart colposcopy images with an accuracy of the 95.02%, precision value of 92.14%, Specificity value of 90.36% and sensitivity value of 92.46%.

Figure 10. Smart colposcopy images collected and Labelled as Type1, Type 2, and Type 3



AIoT for Smart Healthcare Development

AIoT combines the Internet of Things (IoT) and Artificial intelligence (AI) Algorithms. It is revolutionary for both technologies because the artificial intelligence algorithm depends on the IoT for data collection and connectivity. Similarly, the IoT value artificial intelligence for automation and prediction activities. IoT networks are highly used across large industries to collect machine-generated data. The AIoT support the data analysis and the prediction of some specified output from the generated data through IoT. Some IoT tools are designed for simple events that can control the signals generated by sensors—for instance, turning on/off light based on environmental light changes. Sometimes, analytical tools can be utilized to interpret many phenomena that are considerably more complex. AIoT is set up to take the right actions to accomplish this. The IoT tools are givens the ability to collect data, observe their environment, and make the best decisions with minimal human intervention (Talukdar et al., 2019). With the support of artificial intelligence, the AIoT delivers the information to control and become an intelligent machine capable of self-centred analysis, while operating independently. The AI can recognize critical medical conditions and assist in getting the required measures in advance.

Implementing artificial intelligence in things can significantly reduce hospital occupancy by lowering death rates. It assists in identifying high-risk diseases at their initial stages, tracking the spread of disease, and anticipating mortality risks by examining the patient's medical history. The brain of a system is artificial intelligence, whereas internet of things devices serves as its digital nervous system. An AIoT-based caregiver cockpit (C19CC) was introduced for the healthcare worker to predict the severity of COVID-19 in the patient. The colour code is used to represent the severity of the patients. An autonomous Artificial Internet of Things (AIoT) system for monitoring senior dementia patients in a smart home was introduced by the author (Wen Chen et al., 2021). The system primarily employs two functions, real-time abnormal activity monitoring and trend prediction of disease-related activities based on the activity inference of the sensor data. Long Short-Term Memory (LSTM) is utilized to forecast the disease-related activity trend of a patient from the collected real-time data. In the next session discuss how the AIoT is used for the data collection and grading of cervical cancer based on the neoplasm affected.

AIoT-Based Method for the Grading of Smart Colposcopy Images: Experimental Approach

Cervical cancer is the second most prevalent malignancy among women in developing nations and affects women globally at a rate of one in every four cases. Due to a lack of clinical resources, developing countries have a higher mortality rate for cervical cancer than developed countries, especially in the rural and tribal region. The main preventive strategy used to lower mortality rates is screening. The screening method like Papanicolaou (Pap) testing, biopsy and HPV test is the clinical screening procedure for the cervical cancer (Saini et al., 2020; Talukdar et al., 2019). The above screening method is high cost, invasive and needs high laboratory setup for the screening of cervical cancer which is highly inefficient in the rural and tribal region of the developing countries. To reduce the clinical procedure for screening, the smart colpsocopy device is introduced for the screening of the cervical tissues region.

Smart Colposcopy: The smart colposcopy is built with the image sensors, focus and the Samsung mobile is attached to it. It captures the digital images and the physician will consider the images for the screening analysis. The smart colposcopy device has an inbuilt app called EVA App. The Eva app for collecting the patients data storing the cervical images captured image sensor.

Data Collection: The smart colposcpy have an in built app called Eva app. Click and open the eva app as show in the Figure 11(a). Click on smart colposcopy as shown in Figure 11(b). The patient details like medical record, name of the patients, data of birth and number are saved and click on the start exam. The smart colpocopy camera will open. Capture the cervical region required for analysis and click on the finish exam. The eva app will completely store the data and upload them directly to cloud for further analysis.

Cloud Upload: The captured images are exported and click on the finish button. The caputed images are directly uploaded in the EVA online portal. The physician can analyse the images from the online portal and the whole patient record are stored in the cloud. To automate the grading of cervical cancer AI algorithm is applied on the captured images.

AI/Ml Algorithm: The AI algorithm ResNet model is used for the grading of cervical cancer. The image input of the ResNet model is set as 224x224 and for the feature map generation the size is set as 112x122 which is generated by the convolutional layer. The layer is built with the softmax activation function, dropout layer for the identification of stage of cancer such as Type1, Type 2 and Type3. The model is trained with 4000 image which is collected from the kaggle dataset.

Results: Based on the quantities analysis the deep learning model grade the smart colposcopy images with an accuracy of 90% as shown in Figure 12.

CONTRIBUTION OF THIS CHAPTER

This chapter provides a comprehensive overview of the growth of smart healthcare in the medical industry and how advanced technologies are helping to improve the quality of patient care. Smart healthcare is defined as the integration of innovative technologies and smart devices with traditional healthcare practices to create a more efficient and effective healthcare system. The chapter explores how technologies such as the Internet of Things (IoT), smartphones and artificial intelligence (AI) algorithms are contributing to the growth of smart healthcare. The chapter presents an experimental approach to smart healthcare development that involves using IoT-based monitoring tools for patient care, smart Android

apps for data collection, and AI algorithms for decision-making processes. The use of IoT devices for health monitoring is discussed in detail, including the benefits of real-time data collection, remote patient monitoring, and predictive analytics. The chapter also explores the role of smartphones and Android apps in smart healthcare, including their use for patient engagement, data collection and monitoring.

Figure 11. Smart colposcopy: (a) Smart colpocopy with Eva app. (b) Patient details are collected in the Eva App. (c) The cervical images captured through image sensor in saved in the Eva app.

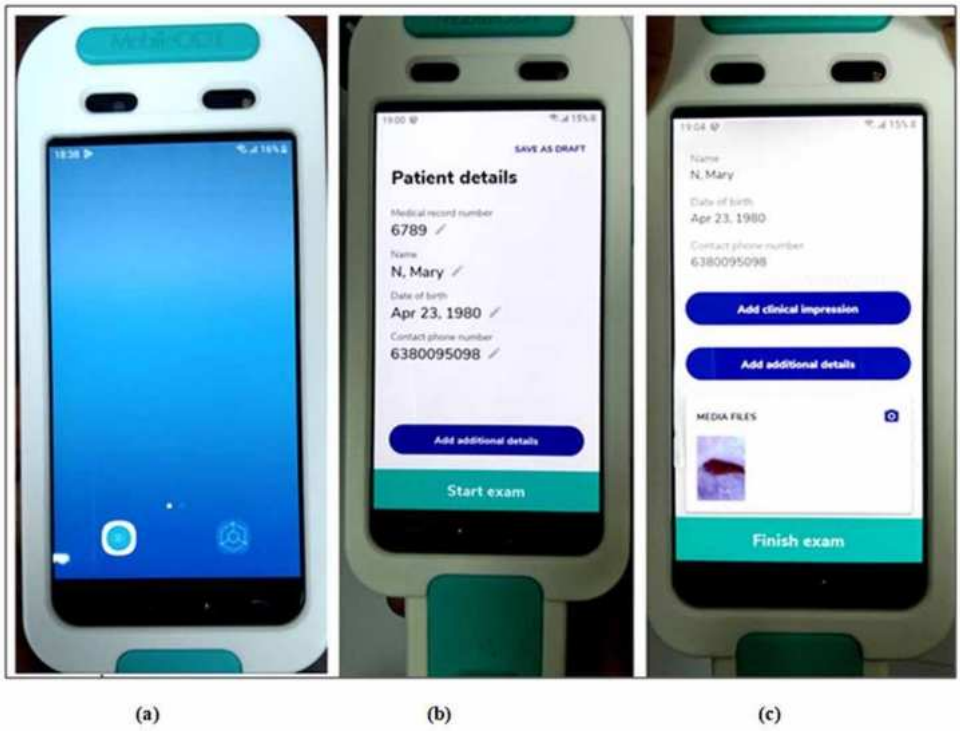
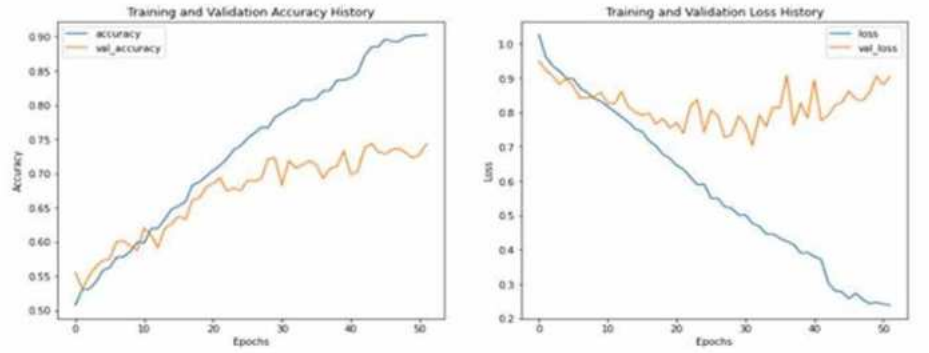


Figure 12. Loss and accuracy for the grading of cervical cancer



The chapter emphasizes the importance of AI in smart healthcare, particularly in the context of decision-making processes. AI algorithms are used to analyze large amounts of healthcare data to provide real-time insights and recommendations for healthcare professionals. The chapter also discusses the use of AI in personalized medicine, where patient-specific data is used to create personalized treatment plans. Furthermore, the chapter provides an overview of the integration of AI and IoT technologies to create an AIoT tool for improvising clinical support. The AIoT tool combines the data collection capabilities of IoT devices with the decision-making capabilities of AI algorithms to provide real-time and accurate insights into patient health. The chapter describes the implementation of AIoT in the medical field and its potential to transform healthcare delivery. The chapter concludes by highlighting the key benefits of smart healthcare, including improved patient outcomes, reduced healthcare costs, and enhanced patient experience. It also discusses the challenges and potential risks associated with the use of advanced technologies in healthcare, including data privacy and security concerns. Finally, the chapter provides recommendations for healthcare providers and policymakers on how to ensure the successful implementation of smart healthcare technologies.

Overall, this chapter makes a significant contribution to the understanding of smart healthcare and the role of advanced technologies in improving patient care. It provides a comprehensive overview of the latest trends and developments in smart healthcare and highlights the potential of IoT, smart phones, and AI algorithms to transform healthcare delivery. The chapter's experimental approach demonstrates how these technologies can be implemented in real-world healthcare settings to achieve better patient outcomes and enhance the overall healthcare experience. Finally, the chapter's recommendations provide valuable insights for healthcare providers and policymakers on how to leverage these technologies to improve healthcare delivery and achieve better health outcomes. This chapter helps direct the students, researchers and interns in computer engineering and computer science.

CONCLUSION

In conclusion, this chapter provides a comprehensive overview of the growth of smart healthcare and the important role of advanced technologies such as IoT, smartphones and AI algorithms in improving patient care. The experimental approach presented in the chapter demonstrates how these technologies can be used in real-world healthcare settings to achieve better patient outcomes and enhance the overall healthcare experience. The chapter's emphasis on the importance of AI in smart healthcare highlights its potential to transform decision-making processes and personalize treatment plans. Additionally, the chapter provides valuable insights into the challenges and potential risks associated with the use of advanced technologies in healthcare and provides recommendations for healthcare providers and policymakers on how to ensure the successful implementation of smart healthcare technologies. Overall, this chapter makes a significant contribution to our understanding of smart healthcare and highlights the potential of these technologies to improve healthcare delivery and achieve better health outcomes.

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REFERENCES

Ahlawat, C., & Krishnamurthi, R. (2022). Internet of Things-based smart helmet to detect possible COVID-19 infections. In *Cyber-Physical Systems.* Academic Press. . doi:10.1016/B978-0-12-824557-6.00004-2

Ahmed, H., Younis, E. M., Hendawi, A. M., & Ali, A. A. (2020). Heart disease identification from patients' social posts, machine learning solution on Spark. *Future Generation Computer Systems*, *111*, 714–722. doi:10.1016/j.future.2019.09.056

Ajaegbu, C., Nwaocha, V., Nzenwata, U., & Adesegun, O. (2020). A patient monitoring system using internet of things technology. *Ingénierie des Systèmes d'Information*, *25*(3), 351–357. doi:10.18280/isi.250309

Al Bassam, N., Hussain, S. A., Al Qaraghuli, A., Khan, J., Sumesh, E. P., & Lavanya, V. (2021). IoT based wearable device to monitor the signs of quarantined remote patients of COVID-19. *Informatics in Medicine Unlocked*, *24*, 100588. doi:10.1016/j.imu.2021.100588 PMID:33997262

Al-khafajiy, M., Baker, T., Chalmers, C., Asim, M., Kolivand, H., Fahim, M., & Waraich, A. (2019). Remote health monitoring of elderly through wearable sensors. *Multimedia Tools and Applications*, *78*(17), 24681–24706. doi:10.100711042-018-7134-7

Al-Sheikh, M. A., & Ameen, I. A. (2020). Design of mobile healthcare monitoring system using IoT technology and cloud computing. *IOP Conference Series: Materials Science and Engineering, 881*. 10.1088/1757-899X/881/1/012113

Alafeef, M. (2017). Smartphone-based photoplethysmographic imaging for heart rate monitoring. *Journal of Medical Engineering & Technology*, *41*(5), 387–395. doi:10.1080/03091902.2017.1299233 PMID:28300460

Alafeef, M., & Fraiwan, M. (2020). Smartphone-based respiratory rate estimation using photoplethysmographic imaging and discrete wavelet transform. *Journal of Ambient Intelligence and Humanized Computing*, *11*(2), 693–703. doi:10.100712652-019-01339-6

Amethiya, Y., Pipariya, P., Patel, S., & Shah, M. (2022). Comparative analysis of breast cancer detection using machine learning and biosensors. *Intelligent Medicine*, *2*(2), 69–81. doi:10.1016/j.imed.2021.08.004

Arooj, S., Rehman, S., Imran, A., Almuhaimeed, A., Alzahrani, A. K., & Alzahrani, A. (2022). A Deep Convolutional Neural Network for the Early Detection of Heart Disease. *Biomedicines*, *10*(11), 2796. doi:10.3390/biomedicines10112796 PMID:36359317

Chandran, V., Sumithra, M. G., Karthick, A., George, T., Deivakani, M., Elakkiya, B., Subramaniam, U., & Manoharan, S. (2021). Diagnosis of Cervical Cancer based on Ensemble Deep Learning Network using Colposcopy Images. *BioMed Research International*, *2021*, 1–15. doi:10.1155/2021/5584004 PMID:33997017

Chowdhury, M. E. H., Alzoubi, K., Khandakar, A., Khallifa, R., Abouhasera, R., Koubaa, S., Ahmed, R., & Hasan, M. A. (2019). Wearable Real-Time Heart Attack Detection and Warning System to Reduce Road Accidents. *Sensors (Basel)*, *19*(12), 2780. doi:10.339019122780 PMID:31226858

Data Bridge. (2023, January 7). *Global Smart Healthcare Market – Industry Trends and Forecast to 2029.* Retrieved from: https://www.databridgemarketresearch.com/reports/global-smart-healthcare-market

Davenport, T., & Kalakota, R. (2019). The potential for artificial intelligence in healthcare. *Future Healthcare Journal, 6*(2), 94–98. . doi:10.7861/futurehosp.6-2-94

Dey, J., Gaurav, A., & Tiwari, V. N. (2018). InstaBP: Cuff-less Blood Pressure Monitoring on Smartphone using Single PPG Sensor. *Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual International Conference*, 5002–5005. 10.1109/EMBC.2018.8513189

Dhaka, R. K., Panda, S., Panda, B., Pradhan, A., & Jena, C. (2022). AIOT in Healthcare systems: A Thought on Approaches and Criticism. *National Cave Research and Protection Organization*, *9*(2), 55–60. doi:10.21276/ambi.2022.09.2.rv02

Dian, F. J. R., Vahidnia, R., & Rahmati, A. (2020). Wearables and the internet of things (IoT), applications, opportunities, and challenges: A survey. *IEEE Access : Practical Innovations, Open Solutions*, *8*, 69200–69211. doi:10.1109/ACCESS.2020.2986329

Dias, D., & Paulo Silva Cunha, J. (2018). Wearable Health Devices-Vital Sign Monitoring, Systems and Technologies. *Sensors (Basel)*, *18*(8), 2414. doi:10.339018082414 PMID:30044415

Elango, K., & Muniandi, K. (2020). A low-cost wearable remote healthcare monitoring system. In G. R. Kanagachidambaresan (Ed.), *Role of Edge Analytics in Sustainable Smart City Development: Challenges and Solutions* (pp. 219–242). doi:10.1002/9781119681328.ch11

Enriko, A. I. K., & Suryanegara, M., & Gunawan, D. (2018). Heart Disease Diagnosis System with k-Nearest Neighbors Method Using Real Clinical Medical Records. In *Proceedings of the 4th International Conference on Frontiers of Educational Technologies (ICFET '18).* Association for Computing Machinery. 10.1145/3233347.3233386

Grand View Research. (2023, January 7). *Global Smart Healthcare Market Size, Share Report.* Retrieved from: 2030 https://www.grandviewresearch.com/industry-analysis/smart-healthcare-market

Guo, B., Ma, Y., Yang, J., & Wang, Z. (2021). Smart Healthcare System Based on Cloud-Internet of Things and Deep Learning. *Journal of Healthcare Engineering*, *2021*, 1–10. doi:10.1155/2021/4109102 PMID:34257851

Gupta, A., Kumar, L., Jain, R., & Nagrath, P. (2020). Heart Disease Prediction Using Classification (Naive Bayes). In *Proceedings of First International Conference on Computing, Communications, and Cyber-Security (IC4S 2019). Lecture Notes in Networks and Systems* (vol. 121). Springer. 10.1007/978-981-15-3369-3_42

Hutamaputra, W., Mawarni, M., Krisnabayu, R. Y., & Mahmudy, W. F. (2021). Detection of Coronary Heart Disease Using Modified K-NN Method with Recursive Feature Elimination. In *6th International Conference on Sustainable Information Engineering and Technology 2021 (SIET '21).* Association for Computing Machinery. 10.1145/3479645.3479664

Islam, M. M., Mahmud, S., Muhammad, L. J., Islam, M. R., Nooruddin, S., & Ayon, S. I. (2020). Wearable Technology to Assist the Patients Infected with Novel Coronavirus (COVID-19). *SN Computer Science*, *1*(6), 320. doi:10.100742979-020-00335-4 PMID:33063058

Islam, M. M., Rahaman, A., & Islam, M. R. (2020). Development of Smart Healthcare Monitoring System in IoT Environment. *SN Computer Science*, *1*(3), 1–11. doi:10.100742979-020-00195-y PMID:33063046

Jabbar, M. A., & Samreen, S. (2016). Heart disease prediction system based on hidden naïve bayes classifier. *2016 International Conference on Circuits, Controls, Communications and Computing (I4C)*, 1-5. 10.1109/CIMCA.2016.8053261

Jin, L., Y., Chuang Wei, C., Yen, C.Y., Huang, S.H., Huang, P.W., Chen, J.Y., & Lee, S.Y. (2019). Artificial Intelligence of Things Wearable System for Cardiac Disease Detection. *2019 IEEE International Conference on Artificial Intelligence Circuits and Systems (AICAS)*, 67-70. 10.1109/AICAS.2019.8771630

Jokanović, R. V. (2020). *Smart healthcare in smart cities. In Towards Smart World: Homes to Cities Using Internet of Things*. Taylor and Francis Group., doi:10.1201/9781003056751

Kaggle. (2023, January 7). *Intel & Mobile ODT Cervical cancer Screening*. Retrieved from: https://www.kaggle.com/competitions/intel-mobileodt-cervical-cancer-screening/data

Kaptoge, S., Pennells, L., De Bacquer, D., Cooney, M. T., Kavousi, M., Stevens, G., Riley, L. M., Savin, S., Khan, T., Altay, S., Amouyel, P., Assmann, G., Bell, S., Ben-Shlomo, Y., Berkman, L., Beulens, J. W., Björkelund, C., Blaha, M., Blazer, D. G., ... Di Angelantonio, E.WHO CVD Risk Chart Working Group. (2019). World Health Organization cardiovascular disease risk charts: Revised models to estimate risk in 21 global regions. *The Lancet. Global Health*, *7*(10), e1332–e1345. doi:10.1016/S2214-109X(19)30318-3 PMID:31488387

Khan, M. A. (2020). An iot framework for heart disease prediction based on mdcnn classifier. *IEEE Access: Practical Innovations, Open Solutions*, *8*, 34717–34727. doi:10.1109/ACCESS.2020.2974687

Krittanawong, C., Virk, H. U. H., Bangalore, S., Wang, Z., Johnson, K. W., Pinotti, R., Zhang, H., Kaplin, S., Narasimhan, B., Kitai, T., Baber, U., Halperin, J. L., & Tang, W. H. W. (2020). Machine learning prediction in cardiovascular diseases: A meta-analysis. *Scientific Reports*, *10*(1), 16057. doi:10.103841598-020-72685-1 PMID:32994452

Kumar, A., Chattree, G., & Periyasamy, S. (2018). Smart healthcare monitoring system. *Wireless Personal Communications*, *101*(1), 453–463. doi:10.100711277-018-5699-0

Kumar, P. M., & Gandhi, D. U. (2018). A novel three-tier Internet of Things architecture with machine learning algorithm for early detection of heart diseases. *Computers & Electrical Engineering*, *65*, 222–235. doi:10.1016/j.compeleceng.2017.09.001

Lomaliza, J., & Park, H. (2017). A highly efficient and reliable heart rate monitoring system using smartphone cameras. *Multimedia Tools and Applications*, *76*(20), 21051–21071. doi:10.100711042-016-4010-1

Majumder, S., & Deen, M. J. (2019). Smartphone Sensors for Health Monitoring and Diagnosis. *Sensors (Basel)*, *19*(9), 2164. doi:10.339019092164 PMID:31075985

Majumder, S., Mondal, T., & Deen, M. (2017). Wearable Sensors for Remote Health Monitoring. *Sensors (Basel)*, *17*(12), 130. doi:10.339017010130 PMID:28085085

Malche, T., Tharewal, S., Tiwari, P. K., Jabarulla, M. Y., Alnuaim, A. A., Hatamleh, W. A., & Ullah, M. A. (2022). Artificial Intelligence of Things- (AIoT-) Based Patient Activity Tracking System for Remote Patient Monitoring. *Journal of Healthcare Engineering*, *2022*, 1–15. doi:10.1155/2022/8732213 PMID:35273786

Mauldin, T., Canby, M., Metsis, V., Ngu, A., & Rivera, C. (2018). SmartFall: A Smartwatch-Based Fall Detection System Using Deep Learning. *Sensors (Basel)*, *18*(10), 3363. doi:10.339018103363 PMID:30304768

Mehmood, A., Iqbal, M., Mehmood, Z., Irtaza, A., Nawaz, M., Nazir, T., & Masood, M. (2020). Prediction of Heart Disease Using Deep Convolutional Neural Networks. *Arabian Journal for Science and Engineering*, *46*(4), 3409–3422. Advance online publication. doi:10.100713369-020-05105-1

Mohamed, E. A., Rashed, E. A., Gaber, T., & Karam, O. (2022). Deep learning model for fully automated breast cancer detection system from thermograms. *PLoS One*, *17*(1), e0262349. doi:10.1371/journal.pone.0262349 PMID:35030211

Mohammed, M. N., Hazairin, N. A., Syamsudin, H., Al-Zubaidi, S., Sairah, A. K., Mustapha, S., & Yusuf, E. (2020). 2019 Novel Coronavirus Disease (Covid-19): Detection and Diagnosis System Using IoT Based Smart Glasses. *International Journal of Advanced Science and Technology, 29*(7), 954-960.

Mohapatra, S., Mohanty, S., & Mohanty, S. (2019). Smart healthcare: An approach for ubiquitous healthcare management using IoT. *Big Data Analytics for Intelligent Healthcare Management*, 175–196. . doi:10.1016/B978-0-12-818146-1.00007-6

Murugan, A., Anu, H. N., Preethi, A. P., & Kumar, K. P. S. (2021). Diagnosis of skin cancer using machine learning techniques. *Microprocessors and Microsystems*, *81*, 103727. Advance online publication. doi:10.1016/j.micpro.2020.103727

Nagavelli, U., Samanta, D., & Chakraborty, P. (2022). Machine Learning Technology-Based Heart Disease Detection Models. *Journal of Healthcare Engineering*, *2022*, 1–9. Advance online publication. doi:10.1155/2022/7351061 PMID:35265303

Nemcova, A., Jordanova, I., Varecka, M., Smisek, R., Marsanova, L., Smital, L., & Vitek, M. (2020). Monitoring of heart rate, blood oxygen saturation, and blood pressure using a smartphone. *Biomedical Signal Processing and Control*, *59*, 101928. Advance online publication. doi:10.1016/j.bspc.2020.101928

Noble, D.R., Angello, L., Sheppard, S., Kee, J., Emerson, B.L., & Lieuwen, T. (2019). Investigation Into Advanced Combustion System Health Monitoring. *Volume 3: Coal, Biomass, Hydrogen, and Alternative Fuels; Cycle Innovations; Electric Power; Industrial and Cogeneration; Organic Rankine Cycle Power Systems*. . doi:10.1115/GT2019-91973

Pal, M., & Parija, S. (2021). Prediction of Heart Diseases using Random Forest. *Journal of Physics: Conference Series*, *1817*(1), 012009. Advance online publication. doi:10.1088/1742-6596/1817/1/012009

Possamai, G. C., Ravaud, P., Ghosn, L., & Thi Tran, V. (2020). Use of wearable biometric monitoring devices to measure outcomes in randomized clinical trials: A methodological systematic review. *BMC Medicien, 18*. 10.118612916-020-01773-w

Premalatha, G., & Bai, V. T. (2022). Wireless IoT and Cyber-Physical System for Health Monitoring Using Honey Badger Optimized Least-Squares Support-Vector Machine. *Wireless Personal Communications*, *124*(4), 3013–3034. doi:10.100711277-022-09500-9 PMID:35370364

Qayyum, A., Malik, A. S., Shuaibu, A. N., & Nasir, N. (2017). Estimation of non-contact smartphone video-based vital sign monitoring using filtering and standard color conversion techniques. *2017 IEEE Life Sciences Conference (LSC)*, 202-205. 10.1109/LSC.2017.8268178

Rejani, A. I. Y., & Selvi, T. S. (2009). *Early detection of breast cancer using SVM classifier technique.* DOI: /arXiv.0912.2314. doi:10.48550

Research. (2023, January 7). *Research News*. Retrieved from https://www.cam.ac.uk/research/news/low-cost-ai-heart-monitor-developed-by cambridge-start-up/

Saba Raoof, S., & Durai, M. A. S. (2022). A Comprehensive Review on Smart Health Care: Applications, Paradigms, and Challenges with Case Studies. *Contrast Media & Molecular Imaging*, *4822235*, 1–18. Advance online publication. doi:10.1155/2022/4822235 PMID:36247859

Saini, S. K., Bansal, V., Kaur, R., & Juneja, M. (2020). ColpoNet for automated cervical cancer screening using colposcopy images. *Machine Vision and Applications*, *31*(3), 15. doi:10.100700138-020-01063-8

Sarmah, S. S. (2020). An Efficient IoT-Based Patient Monitoring and Heart Disease Prediction System Using Deep Learning Modified Neural Network. *IEEE Access : Practical Innovations, Open Solutions*, *8*, 135784–135797. doi:10.1109/ACCESS.2020.3007561

Semwal, N., Mukherjee, M., Raj, C., & Arif, W. (2019). An IoT based smart e-health care system. *Journal of Information and Optimization Sciences*, *40*(8), 1787–1800. doi:10.1080/02522667.2019.1703269

Shankar, V., Kumar, V., Devagade, U., Karanth, V., & Rohitaksha, K. (2020). Heart Disease Prediction Using CNN Algorithm. *SN Computer Science*, *1*(3), 170. doi:10.100742979-020-0097-6

Sharma, S., Aggarwal, A., & Choudhury, T. (2018). Breast Cancer Detection Using Machine Learning Algorithms. *2018 International Conference on Computational Techniques, Electronics and Mechanical Systems (CTEMS),* 114-118. 10.1109/CTEMS.2018.8769187

Shen, L., Margolies, L. R., Rothstein, J. H., Fluder, E., McBride, R., & Sieh, W. (2019). Deep Learning to Improve Breast Cancer Detection on Screening Mammography. *Scientific Reports*, *9*(1), 12495. doi:10.103841598-019-48995-4 PMID:31467326

SimonyanK.ZissermanA. (2014). Very deep convolutional networks for large-scale image recognition. arXiv:1409.1556

Sudha, V., & Ganeshbabu, T. R. (2020). A Convolutional Neural Network Classifier VGG-19 Architecture for Lesion Detection and Grading in Diabetic Retinopathy Based on Deep Learning. *Computers, Materials & Continua*, *66*(1), 827–842. doi:10.32604/cmc.2020.012008

Sumbaly, R., Vishnusri, N., & Jeyalatha, S. (2014). Diagnosis of breast cancer using decision tree data mining technique. *International Journal of Computer Applications*, *98*(10), 16–24. doi:10.5120/17219-7456

Swaroop, K. N., Chandu, K., Gorrepotu, R., & Deb, S. (2019). A health monitoring system for vital signs using Iota. *Internet of Things*, *5*, 116–129. doi:10.1016/j.iot.2019.01.004

Tabei, F., Gresham, J. M., Askarian, B., Jung, K., & Chong, J. W. (2020). Cuff-Less Blood Pressure Monitoring System Using Smartphones. *IEEE Access : Practical Innovations, Open Solutions*, *8*, 11534–11545. doi:10.1109/ACCESS.2020.2965082

Talukder, A., & Haas, R. (2021). Aiot: AI meets iot and Web in Smart Healthcare. In *13th ACM Web Science Conference 2021 (websci '21)*. Association for Computing Machinery. 10.1145/3462741.3466650

Tian, S., Yang, W., Grange, J., Wang, P., Huang, W., & Ye, Z. (2019). Smart healthcare: Making medical care more intelligent. *Global Health Journal (Amsterdam, Netherlands)*, *3*(3), 62–65. doi:10.1016/j.glohj.2019.07.001

Tripathi, A., Arora, A., & Bhan, A. (2021). Classification of cervical cancer using Deep Learning Algorithm. *2021 5th International Conference on Intelligent Computing and Control Systems (ICICCS)*, 1210-1218. 10.1109/ICICCS51141.2021.9432382

UCI. (2023, January 7). *Heart disease data set*. Retrieved from https: //archive.ics.uci.edu/ml/datasets/heart+Disease

Verma, A. K., Pal, S., & Kumar, S. (2021). Prediction of Different Classes of Skin Disease Using Machine Learning Techniques. In S. Tiwari, M. Trivedi, K. Mishra, A. Misra, K. Kumar, & E. Suryani (Eds.), *Smart Innovations in Communication and Computational Sciences. Advances in Intelligent Systems and Computing (vol. 1168)*. Springer. doi:10.1007/978-981-15-5345-5_8

Wan, J., Al-awlaqi, A. A. H., Li, M., O'Grady, M., Gu, X., Wang, J., & Cao, N. (2018). Wearable IoT enabled real-time health monitoring system. *EURASIP Journal on Wireless Communications and Networking*, *2018*(1), 298. doi:10.118613638-018-1308-x

Wang, E. J., Zhu, J., Jain, M., Lee, T.-J., Saba, E., Nachman, L., & Patel, S. N. (2018). Seismo: Blood pressure monitoring using built-in smartphone accelerometer and camera. *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, 1–9. 10.1145/3173574.3173999

WangP.LinZ.YanX.ChenZ.DingM.SongY.MengL. (2022). *A Wearable ECG Monitor for Deep Learning Based Real-Time Cardiovascular Disease Detection*. arXiv:2201.10083

Weegar, R., & Sundström, K. (2020). Using machine learning for predicting cervical cancer from Swedish electronic health records by mining hierarchical representations. *PLoS One*, *15*(8), e0237911. Advance online publication. doi:10.1371/journal.pone.0237911 PMID:32822401

Zhang, G., Mei, Z., Zhang, Y., Ma, X., Lo, B. P., Chen, D., & Zhang, Y. (2020). A Noninvasive Blood Glucose Monitoring System Based on Smartphone PPG Signal Processing and Machine Learning. *IEEE Transactions on Industrial Informatics*, *16*(11), 7209–7218. doi:10.1109/TII.2020.2975222

Zhang, Q., Zheg, X., Hu, W., & Zhou, D. (2017). A Machine Learning-Empowered System for Long-Term Motion-Tolerant Wearable Monitoring of Blood Pressure and Heart Rate With Ear-ECG/PPG. *IEEE Access : Practical Innovations, Open Solutions*, *5*, 10547–10561. doi:10.1109/ACCESS.2017.2707472

Zhang, W., Han, J., & Deng, S. (2020). Heart sound classification based on scaled spectrogram and tensor decomposition. *Expert Systems with Applications*, *84*, 220–231. doi:10.1016/j.eswa.2017.05.014

Zouka, A., & Hosni, M. (2021). Secure IoT communications for smart healthcare monitoring system. *Internet of Things*, *13*, 100036. Advance online publication. doi:10.1016/j.iot.2019.01.003

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Technology Enhanced Mulsemedia Learning: Insights of an Evaluation

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Abstract. Human-Computer Interaction (HCI) is crucial in crafting effective, cost-efficient, and user-friendly e-learning systems. In the realm of e-learning, HCI focuses on creating interfaces and experiences that optimize learner engagement, interaction, and overall learning outcomes. Educators are actively pursuing initiatives to enhance student motivation, engagement, and academic achievement, particularly in Science, Technology, Engineering, and Mathematics (STEM) disciplines. However, learners often lack active engagement with electronic content when adapting and interpreting learning materials. This paper examines the Quality of Experience (QoE) in Science education content via a Technology Enhanced Multimedia Learning (TEML) Web portal featuring multisensory effects like rosemary scent, vibration, and airflow. Our ongoing research explores learners' emotional states during Mulsemedia-based learning. In this study, we present initial insights into the developed Mulsemedia test bed using IoT devices and a learning Web portal, based on self-assessed QoE questionnaires administered to 60 participants divided into experimental and control groups. The results indicate that both groups had a positive experience in the Mulsemedia-based learning environment, demonstrating its suitability for STEM subjects.

Keywords: Human-computer interaction · Mulsemedia · Multimedia · e-Learning · Quality of Experience (QoE) · STEM

1 Research Problem

In recent years, there has been a significant advancement in interactive multimedia, enabling learners to engage in dynamic and immersive learning experiences [27]. This is achieved by integrating various media elements such as audio, text, video, images, and animation. Virtual reality (VR) and augmented reality (AR) have particularly made remarkable progress in altering the educational landscape, providing learners with immersive and captivating experiences [20].

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Concurrently, e-learning or online learning has witnessed substantial growth and global adoption, with the market size projected to reach US$ 374.3 billion by 2026 [18]. In higher education, 74% of institutions in the United States now offer online or blended learning programs, and the number of students taking at least one online course has reached 6.6 million. The corporate e-learning sector is also expanding, with a projected market size of $38.09 billion. E-learning offers numerous advantages such as flexibility, cost-effectiveness, and scalability, resulting in higher retention rates and improved learning outcomes. As e-learning continues to transform education and training, it plays a crucial role in shaping the future of learning in the digital era.

Educators are currently engaged in numerous initiatives aimed at improving students' motivation, engagement, and academic performance, with a specific focus on Science Technology Engineering, and Mathematics (STEM) subjects. However, learners are not able to fully engage with e-content, when it comes to adapting and comprehending learning material and content [6,16,26]. Thankfully, advancements in multimedia technology have created opportunities for the development of innovative e-learning approaches, offering learners a diverse range of technological devices and solutions to enhance their educational experiences. As authors like [6,16,23,26] states, traditional multimedia applications in education usually only focus on two human senses, namely audio and visual, and emphasize improving the image and video quality. However, this limitation separates user and computer-based multimedia, resulting in less interaction with digital content. By incorporating a combination of audio and various other stimuli (e.g., olfactory, haptic, and gustatory), there can be increased interaction in digital content. In contemporary times, there is a growing focus on incorporating multisensory effects, including visual and audio information, haptic feedback, olfaction, and gustatory sensations, collectively known as Mulsemedia (Multisensorial Media) [13]. However, this involves exploring the integration of multiple senses to create immersive and enriched learner experiences within the e-learning environment.

In our investigation of this emerging field, we are currently evaluating a cutting-edge tool designed to enhance the learning experience through the implementation of Technology Enhanced Mulsemedia Learning (TEML). Our focus lies on the development of a web portal that serves as a comprehensive e-learning platform for STEM content. Moreover, learners' quality of experience (QoE) is analyzed through QoE self-reported questionnaires, and their emotional states have to be assessed during the learning process.

The TEML web portal extends its mission beyond mere accessibility and inclusivity by seamlessly weaving STEM concepts into its fabric, nurturing scientific literacy, and honing critical thinking skills. Within the portal's treasure trove of educational resources, with a primary focus on Biology and Physics, lie interactive simulations that explore diverse facets like airflow, olfaction, video, audio, and vibration. Meticulously crafted, the multimedia content within the Web portal serves as an indispensable tool for effortlessly grasping and comprehending complex STEM principles.

This paper presents the initial findings from the evaluation of the TEML Web Portal discussed earlier. As of now, a total of 60 participants have taken part in the subjective evaluation of this tool, providing valuable insights into both the strengths and weaknesses of the developed platform.

2 Objectives

The primary objective of this study is to gain a deeper understanding of how the TEML Web Portal can be enhanced to cater specifically to students' STEM content. To achieve this objective, we conducted an evaluation of the tool by gathering their feedback, insights, and noteworthy observations. The valuable input provided by these students will guide the iterative improvement process, resulting in a more tailored and effective learning solution for learning STEM subjects through Mulsemedia effects [3,5,12]. STEM courses might be challenging for learners. Science, technology, engineering, and mathematics encompass subjects with intricate concepts and demanding problem-solving skills. Students often find it difficult to grasp these complex ideas and apply them in practical situations. One common issue is a lack of engagement. STEM subjects can be perceived as dull or difficult, leading to a lack of interest and motivation among students, especially in e-learning [22]. This can hinder their willingness to explore the subjects further and limit their overall learning experience [24]. To address this issue, this study has to experiment with learners' experiences while using Mulsemedia effects in STEM subjects.

While biofeedback signals were not utilized in this particular study, they are planned to be incorporated in the subsequent stages of evaluation to provide a deeper understanding of participants' interactions with the system. The inclusion of both objective measures, such as cognitive and emotional response data, and subjective measures like questionnaires and interviews within a TEML Web Portal [21] is paramount for obtaining a comprehensive understanding of the listener's experience. This approach underscores the importance of multisensorial elements in fostering a positive and captivating learning environment. By capturing objective measures, such as EEG and GSR data, which offer quantifiable insights into cognitive and emotional responses [14,17], with subjective measures of QoE, a holistic assessment of the TEML Web Portal can be achieved. This comprehensive evaluation approach employed in the research facilitates a profound comprehension of the cognitive and emotional aspects of learners' responses, consequently informing further improvements and enhancements to the TEML Web Portal.

3 State of the Art

Active participation from learners plays a vital role in their academic progress and overall educational experience. When students engage actively in their learning, they shift from being passive recipients of information to becoming active participants. This transformation is essential as it influences their educational

journey and contributes to a more enriching learning experience. Mulsemedia can be applied in many kinds of applications in a virtual environment [13]. The aim of previous studies is to enhance the QoE, and learner performance, and improve human-computer interaction in different environments [19].

According to Tal et al. [23], Mulsemedia-based Technology-Enhanced Learning (TEL) has demonstrated its ability to enhance the learner experience, motivation, and knowledge acquisition compared to traditional text-based learning. Mulsemedia-based TEL utilizes various media types, including text, images, video, and audio, to create an engaging and immersive learning environment. However, the design and presentation of multimedia content must be carefully considered to optimize its effectiveness. Further research is necessary to explore the optimal design principles for Mulsemedia-based TEL and its potential in different educational contexts. In a QoE study conducted by Yuan et al. [25], the impact of delivering multimedia content through multiple sensory inputs was examined. The study involved 60 participants who were exposed to various multimedia content with varying sensory inputs. The findings revealed that combining multiple sensory inputs significantly enhanced user experience and satisfaction. This study highlights the importance of incorporating multiple sensory inputs in multimedia design, with implications for e-learning, entertainment, and advertising applications.

Covaci et al. [8] conducted a study to explore users' experiences with cross-modal correspondent Mulsemedia content. The study involved 40 participants who were exposed to four different types of Mulsemedia content, each comprising three distinct types of media. The participants were then asked to evaluate their experience based on several factors, including perceived usefulness, enjoyment, engagement, and overall satisfaction. This work by Garcia-Ruiz et al. [11] introduced a virtual environment with haptic, olfactory, auditory, and visual media for the student learning process, information retrieval, and mental association process. Here, authors experimented with different kinds of scents with different various visualizations. The study reported that participants were engaged with using this device in the learning process. To analyze the learner's performance in the learning process, Ademoye and Ghinea [1] have used six kinds of olfactory-enhanced video clips in their experiments. Each video was running in the 90 s in three segments, meanwhile, the middle video was enhanced by olfactory effects. The results show that learners did not experience any negative experiences in this type of learning.

In a similar study, Alkasasbeh and Ghinea [2], which investigated the effects of the olfactory on students' learning achievement. This study included 26 students to answered five questions to test their previous knowledge of the specific topic. This experiment was conducted with and without the Mulsemedia effects of two different groups. The results showed that students were eager to use olfactory in their learning in the future. In related work, Garcia-Ruiz et al. [11] investigated the influence of olfactory in English language learning. In another similar work, Kreitlon et al. [15] delved into the concept of affective multisensorial books, which are interactive books designed to provide an immersive reading experience

through the integration of various sensory inputs such as visual, auditory, and haptic feedback. The authors presented a prototype called "The Little Prince", which incorporated sensory stimuli like music, sound effects, and vibrations to enhance the emotional and affective aspects of the story. The study aimed to assess the effectiveness of affective multisensorial books in engaging readers and enhancing their emotional responses.

Zou et al. [28] also reported experiments that multimedia-based learning improves learners' experiences. The authors designed a mulsemedia test bed to play video content and synchronized it with haptic, airflow, and olfaction effects. The results showed that many learners openly suggested that mulsemedia-based learning enhanced their learning experience in the e-learning platform. Moreover, Covaci et al. [7] proposed game-based multisensorial learning using the effect of olfactory. In this study, the author investigates how fragrance improves learners learning performance, engagement, and QoE. The results showed that incorporating the olfactory smell in learning improves the learner's performance.

Several studies have focused on the development of technology-enhanced mulsemedia learning, which incorporates audio e-books, language, and video-based content to enhance the teaching and learning process. However, it is important to note that assessing the quality of learners' experiences and improving the content accordingly is essential for enhancing learner engagement in the learning process.

4 Methodology

This section presents the development and purpose of the web-based e-learning delivery system, covering its architecture and the principles governing the synchronization of Mulsemedia effects with audio and video content. The primary objective of the proposed system is to investigate the incorporation of multisensory effects into e-learning, particularly in the context of STEM-related educational material. Figure 1 provides an overview of the envisioned architecture for the Mulsemedia delivery system. This system consists of three senses namely olfactory, vibration, and airflow, which are synchronized with audio/video streaming.

4.1 Overview of Mulsemedia

Multimedia and multisensory are two related concepts that have become increasingly important in modern education. Both concepts involve the use of multiple sensory modalities to enhance learning experiences and improve learners' engagement. Multimedia refers to the use of multiple forms of media, such as text, images, audio, and video, to convey information. In education, multimedia resources are often used to provide visual and auditory cues to help students better understand complex concepts. Multisensory learning, on the other hand, refers to the use of multiple senses, such as sight, sound, touch, and even smell and taste, to enhance learning experiences. This approach can be also useful

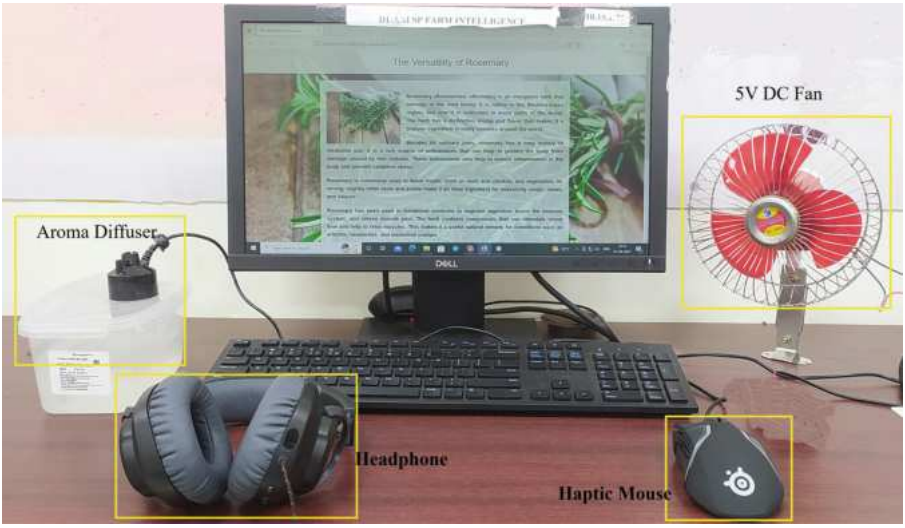


Fig. 1. Technology Enhanced Mulsemedia delivery System.

for learners with different learning styles or who have difficulty understanding complex concepts through traditional teaching methods [27]. Both multimedia and multisensory learning can be effective in promoting learner engagement and improving learning outcomes. By providing learners with multiple ways to interact with course material, teachers can create a more dynamic and engaging learning experience that caters to a wider range of learning styles and preferences of study.

TEML aims to explore the integration of affective computing and multisensory learning in e-learning, with a focus on STEM subjects. This research aims to extend the challenges faced in e-learning, such as positive and negative emotions in learning due to the over-reliance on text-based content, by utilizing the immersive and engaging aspects of multisensory learning and the personalized adaptation of affective computing. Understanding learners' involvement, motivation, and overall learning experience requires analyzing their emotional states during learning. During the learning process, emotional states have a substantial impact on learners' attitudes, behaviors, and cognitive processes. It also acknowledges the role of multimedia in enhancing the learning experience and improving student engagement.

4.2 Mulsemedia STEM Content

The proposed multisensory e-learning system incorporates multimedia technology, Internet of Things (IoT) components, and mulsemedia effects to deliver an engaging and immersive learning experience. The system features an IoT-based Mulsemedia learning platform that utilizes cost-effective components such

as cooling fans, humidifiers for olfactory, and haptics to create vibration in the learning environment. It has been designed to provide learners with a realistic and immersive experience, the system incorporates rosemary and thunder and lightning STEM content, which is made up of audio and video effects. These contents are synchronized with IoT devices to stimulate multisensory effects, including olfactory, vibration, and airflow. This video clip duration is 4–5 minutes. For example, when the rosemary video begins, the humidifier triggers olfactory effects. The integration of airflow and humidifiers enhances the learners' experience by allowing them to feel and smell the environment while seeing the video content. The inclusion of haptics for olfaction enables learners to experience the scent through tactile feedback, further enhancing the immersive nature of the learning experience. The system also features synchronized audio, video, and mulsemedia effects with the airflow, olfactory, and haptic feedback provided by the IoT devices, ensuring learners have a truly immersive learning experience. Figure 2 shows the home page of the TEML web portal, and Figs. 3 and 4 show the rosemary and thunder and lightning learning material. After watching these two video content, participants requested to assess the QoE of the TEML web portal learning experience of the mulsemedia effect in STEM subjects.

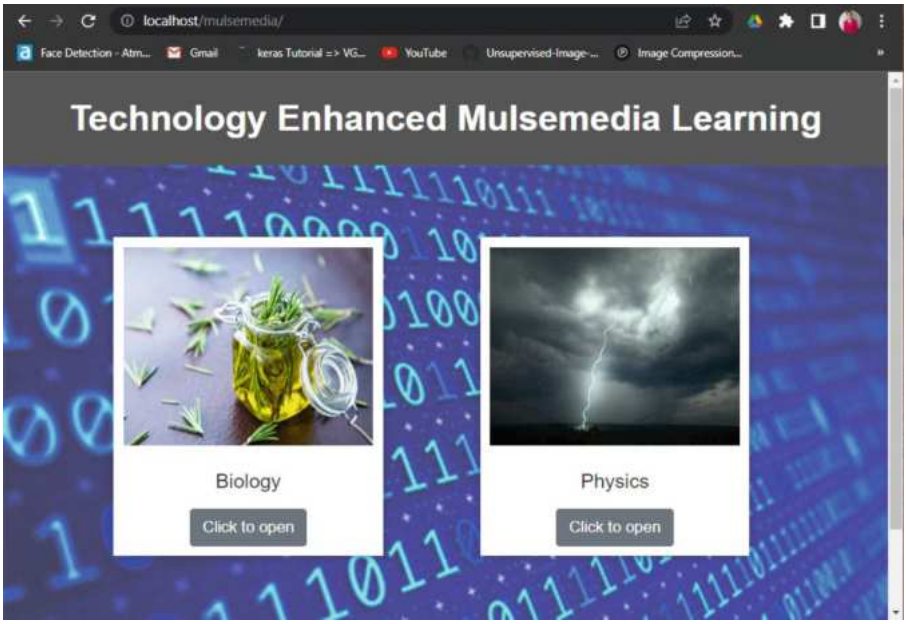


Fig. 2. Home Page of TEML.

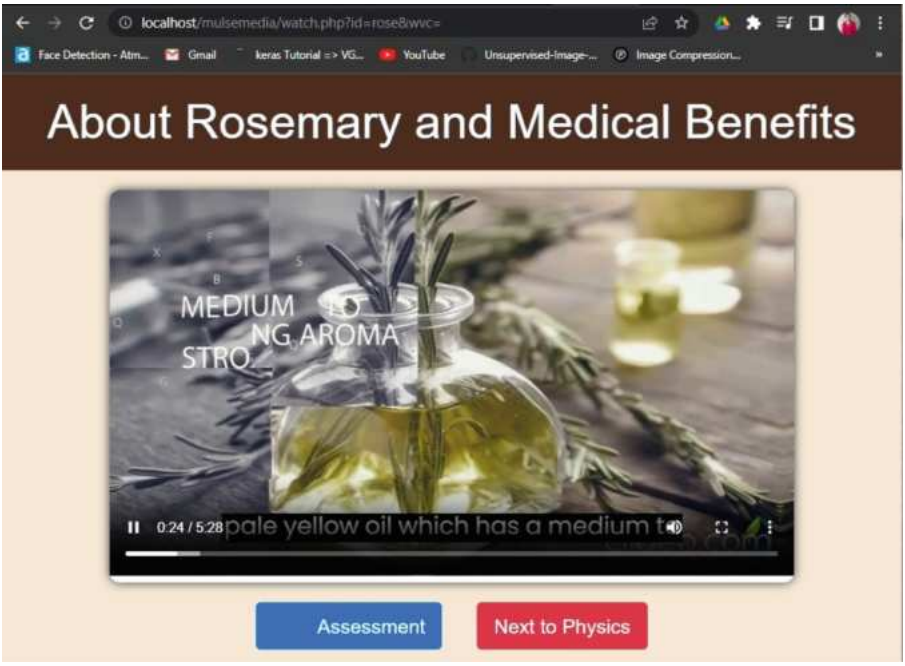


Fig. 3. Rosemary Content.

4.3 Mulsemedia Tools

To incorporate the Mulsemedia experience into e-learning, additional hardware components are required. The central processing unit of the system is the Arduino microcontroller, responsible for collecting data from sensors and controlling devices based on pre-defined rules and algorithms. Figure 1 shows the components that have been included in the TEML e-learning portal. The Arduino Microcontroller Interface plays a crucial role in connecting various devices such as cooling fans, ultrasonic humidifiers, relays, and power adapters, to the IoT system. The Cooling Fan is connected to the Arduino microcontroller via one of its digital output pins. Through the Arduino code, signals are sent to the digital output pin, enabling control over the fan's speed and direction. The ultrasonic humidifier is connected to the Arduino microcontroller using a power adapter and relay. When the code is executed, the relay sends a signal to the power adapter, activating the ultrasonic humidifier and producing mist. The relay, connected to one of the digital output pins on the Arduino, regulates the flow of electricity from the power adapter to the humidifier, allowing for on/off control. The power adapter supplies the necessary voltage to the ultrasonic humidifier, which is connected to the Arduino microcontroller through the relay. By utilizing this hardware setup, the system can integrate various sensory effects and enhance the Mulsemedia experience in e-learning.

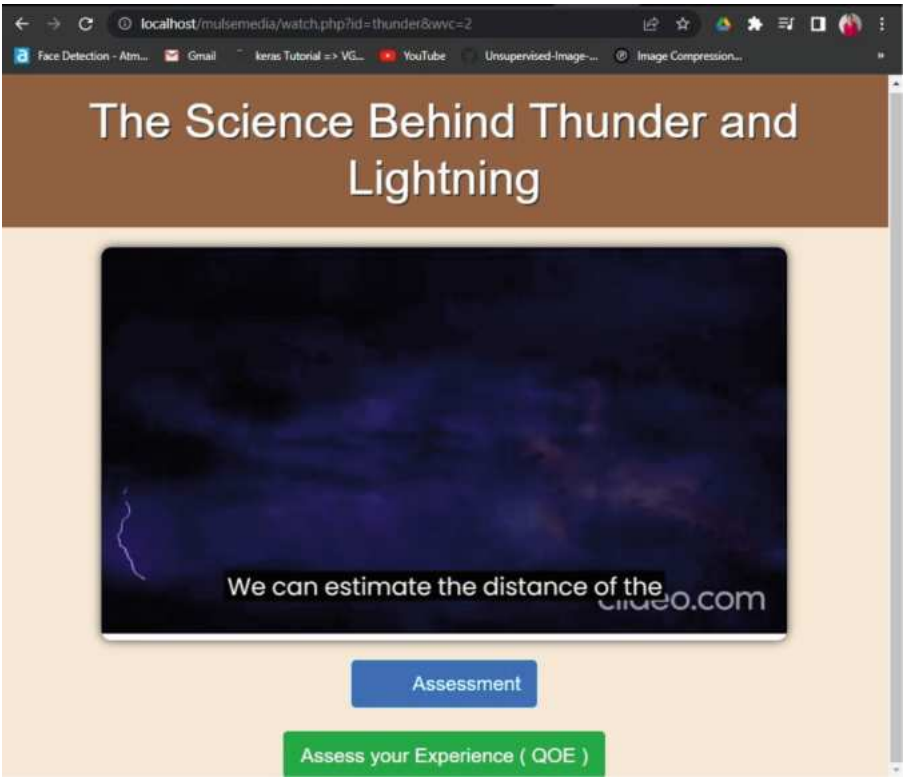


Fig. 4. Thunder and Lightning.

5 Evaluation

The experiment included a group of 60 female participants and was conducted at the Centre for Machine Learning and Intelligence, Avinashilingam University for Women (India). Their age range was 23 to 25 years old. Table 1 shows the evaluation study process. The majority of participants were undergraduate students, postgraduate students, and researchers. The test was conducted with two equal-sized groups: the experimental group and the control group. Prior to collecting the results, participants were asked to complete a consent form. The study involved approximately 20 min of watching learning content with the mulsemedia effect, and it assessed the learners' satisfaction level through a self-reported QoE questionnaire, which is presented in Table 2 in the next section. In contrast, the control group was assessed for QoE without the mulsemedia effect. This system was totally designed with Arduino-based programming to trigger the mulsemedia effects on and off at a particular time and the Web portal was designed with HTML, CSS, and PHP programs used to access the learning content based on the learner's choice of either physics or biology content first.

Table 1. Evaluation Process.

Ethical clearance	– Collection of self-consent form and obtained an ethical clearance certificate from Avinaishilingam Univerisity – Description of research study and benefits – Getting approval from the ethics office of Avinashilingam University
Assess learner QoE	– Users can see either biology or physics content based on their choice – Learning experience – Leaners satisfaction self-assessment

5.1 Questionnaire

For the evaluation, the questionnaire 2 was applied after each session. The questionnaire consists of 22 items designed to gather insights and opinions regarding the use of sensory effects and the experienced approach in e-learning. The items cover a range of factors, including olfactory effects, airflow effects, vibration effects, and the overall experience of the approach.

The first set of items (Q1-Q12) focuses on sensory effects and their impact on the sense of reality during e-learning. Participants are asked to express their views on how these effects enhance or hinder their learning experience. This includes items related to olfactory effects, such as whether they enhance the sense of reality, are distracting, annoying, or enjoyable. Similarly, items regarding airflow effects and vibration effects explore participants' perceptions of their impact on the sense of reality and their potential to be distracting or enjoyable.

The next set of items (Q13-Q22) delves into participants' evaluation of the experienced approach in e-learning. These items aim to assess the usability, effectiveness, and satisfaction with the approach. Participants are asked to provide their feedback on various aspects, including ease of use, understanding of concepts, improvement in learning, practical engagement, enjoyment, and the likelihood of recommending the approach to others. Additionally, participants are given the opportunity to express their interest in further learning with the experienced approach.

By collecting responses to this questionnaire, researchers can gain valuable insights into the subjective experiences, preferences, and perceptions of learners regarding sensory effects and the experienced approach in e-learning. The results can inform the development of instructional strategies, course design, and the integration of innovative technologies to create engaging and effective e-learning environments.

Table 2. Self-reported QoE Questions.

Item	Description
Q1	The olfactory effects enhance the sense of reality in e-learning
Q2	The olfactory effects are distracting
Q3	The olfactory effects are annoying
Q4	I enjoy e-learning with olfactory effects
Q5	The airflow effects enhance the sense of reality in e-learning
Q6	The airflow effects are distracting
Q7	The airflow effects are annoying
Q8	I enjoy e-learning with airflow effects
Q9	The vibration effects enhance the sense of reality in e-learning
Q10	The vibration effects are distracting
Q11	The vibration effects are annoying
Q12	I enjoy e-learning with vibration effects
Q13	The experienced approach was easy to use
Q14	The experienced approach was cumbersome
Q15	The experienced approach helped me better understand the concepts explained
Q16	The experienced approach did not help me learn the knowledge
Q17	The experienced approach can satisfy my learning needs
Q18	The experienced approach did not improve my learning experience
Q19	The experienced approach did not help me be more practically engaged in the learning process
Q20	I enjoyed the experienced approach
Q21	I would not recommend the experienced approach to my friends
Q22	I would like to learn more with the experienced approach

6 Results

In relation to the findings, Figs. 5 and 6 represent the participants' responses. Analysis of questions Q13 to Q22 reveals that participants highly regarded the setup and reported no discomfort.

This suggests that both groups had a positive perception of the overall experimental conditions, indicating that the setup was well-received by the participants. However, despite the positive feedback and the presence of multisensory content in the Experimental Group, there were no discernible differences were observed between the two groups. This lack of differentiation raises doubts about the actual influence of the multisensory content on the learning experience.

There are possible reasons for the absence of differences between the *Control Group* and the *Experimental Group*. One significant factor could be the homogeneity of the participants, as it is plausible that individuals in both groups

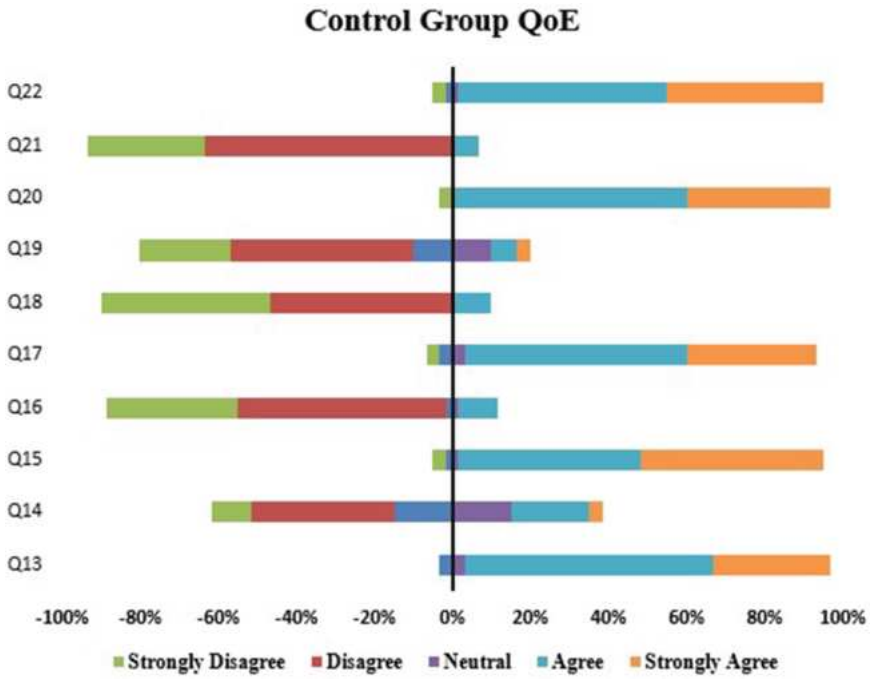


Fig. 5. Control Group QoE.

shared similar learning preferences or cognitive styles. When participants possess comparable characteristics or prior knowledge, the influence of multisensory content may not have been distinctive enough to yield noticeable distinctions.

Moreover, the learning task or materials employed in the experiment might not have posed sufficient challenge or engagement to elicit varying responses. In cases where the content was overly simplistic or if participants were already proficient in the subject matter, the impact of multisensory enhancements could have been limited in its effect. This highlights the need to explore into another aspect of the Multisensory Environment, specifically exploring ways to make multisensory elements an added value to traditional multimedia content.

6.1 One-Sample-Test

The results of the One-Sample Test presented in Table 3 provide valuable insights into the impact of olfactory, airflow, and vibration effects on the e-learning experience.

Q1: The Olfactory Effects Enhance the Sense of Reality in e-Learning. The analysis shows a significant positive mean difference of 0.933 ($p < 0.001$), indicating that participants perceived a heightened sense of reality when olfactory effects were incorporated into the e-learning environment.

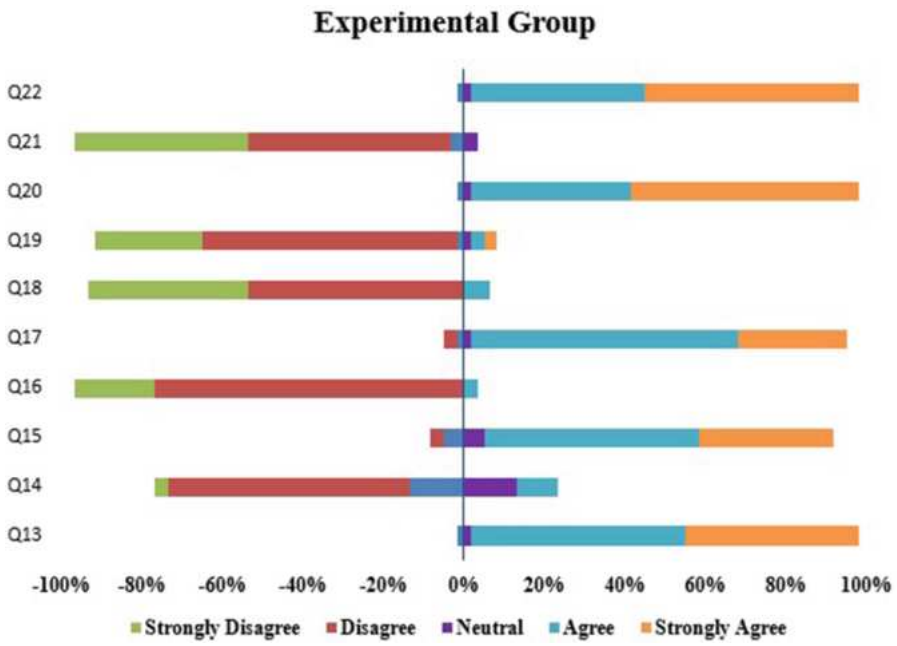


Fig. 6. Experimental Group QoE.

Q2: The Olfactory Effects Are Distracting. The analysis reveals a significant negative mean difference of -0.967 ($p < 0.001$), suggesting that participants did not find the olfactory effects to be distracting during the e-learning sessions. Regarding *Q3: The olfactory effects are annoying*, Similar to the previous question, the analysis indicates a significant negative mean difference of -1.167 ($p < 0.001$), indicating that participants did not find the olfactory effects to be annoying.

Q4: I Enjoy e-Learning with Olfactory Effects. The analysis demonstrates a significant positive mean difference of 1.533 ($p < 0.001$), indicating that participants reported enjoyment when olfactory effects were integrated into the e-learning experience.

The same pattern of analysis and significance continues for the questions related to airflow and vibration effects: Regarding *Q5: The airflow effects enhance the sense of reality in e-learning.* The analysis shows a significant positive mean difference of 0.967 ($p < 0.001$), suggesting that participants perceived an enhanced sense of reality with the incorporation of airflow effects.

Q6: The Airflow Effects Are Distracting. The analysis reveals a significant negative mean difference of -0.800 ($p < 0.001$), indicating that participants did not find the airflow effects to be distracting during e-learning sessions. Similarly to *Q7: The airflow effects are annoying* as the analysis indicates a significant negative mean difference of -0.700 ($p < 0.001$), suggesting that participants did not find the airflow effects to be annoying.

Table 3. One-Sample Test.

One-Sample Test							
	Test Value = 3						
	t	df	Significance		Mean Difference	95% Confidence Interval of the Difference	
			One-Sided p	Two-Sided p		Lower	Upper
Q1	5.215	29	<.001	<.001	.933	.57	1.30
Q2	−6.227	29	<.001	<.001	−.967	−1.28	−.65
Q3	−9.143	29	<.001	<.001	−1.167	−1.43	−.91
Q4	14.699	29	<.001	<.001	1.533	1.32	1.75
Q5	5.491	29	<.001	<.001	.967	.61	1.33
Q6	−5.174	29	<.001	<.001	−.800	−1.12	−.48
Q7	−5.114	29	<.001	<.001	−.700	−.98	−.42
Q8	6.528	29	<.001	<.001	1.100	.76	1.44
Q9	3.010	29	.003	.005	.667	.21	1.12
Q10	−5.137	29	<.001	<.001	−.900	−1.26	−.54
Q11	−3.357	29	.001	.002	−.633	−1.02	−.25
Q12	5.869	29	<.001	<.001	1.033	.67	1.39

Q8: I Enjoy e-Learning with Airflow Effects. The analysis demonstrates a significant positive mean difference of 1.100 ($p < 0.001$), indicating that participants reported enjoyment when airflow effects were integrated into the e-learning experience. Q9-Q12 follow the same format, focusing on the perception of vibration effects in the e-learning environment.

These findings highlight the subjective nature of sensory effects in e-learning. Most of the participants perceive enhanced reality and enjoyment with the incorporation of olfactory, airflow, and vibration effects. These results emphasize the importance of considering individual preferences and designing flexible e-learning environments that allow users to customize their sensory experiences based on their personal preferences and learning styles.

6.2 Discussion

The results from the T-TEST reveal findings about participants' perceptions and experiences related to sensory effects in e-learning and the effectiveness of an experienced approach. The T-TEST findings indicate that the olfactory effects enhanced the sense of reality in the e-learning environment, as evidenced by a positive mean difference of 0.933 ($p < 0.001$). This suggests that participants perceived a heightened sense of immersion and realism when olfactory stimuli were integrated into the learning materials. Additionally, participants did not find the olfactory effects distracting or annoying, as indicated by the negative mean differences for both questions (Q2 and Q3).

Similar patterns were observed for the airflow effects. Participants answered that the incorporation of airflow effects helped enhance the sense of reality in e-learning, as indicated by a positive mean difference of 0.967. Similar to the olfactory effects, participants also did not find the airflow effects distracting or annoying, as suggested by the negative mean differences and significant p-values for

Q6 and Q7. Furthermore, participants reported enjoyment when airflow effects were integrated into the e-learning experience, supported by a significant positive mean difference of 1.100 ($p < 0.001$).

The findings related to vibration effects followed a similar pattern. Vibration effects significantly enhanced the sense of reality in e-learning, as indicated by positive mean differences for the relevant question. Participants did not find vibration effects distracting or annoying, as suggested by negative mean differences and significant p-values. Additionally, participants reported enjoyment when vibration effects were integrated into the e-learning experience, supported by significant positive mean differences. Most participants perceived enhanced reality and enjoyment with the incorporation of olfactory, airflow, and vibration effects. These results suggest that sensory effects can contribute positively to the e-learning experience, fostering a sense of immersion, engagement, and enjoyment.

Comparing the results, we can observe a contrast: While sensory effects demonstrated positive effects on participants' sense of reality, enjoyment, and lack of distraction or annoyance, the experienced approach did not yield significant differences in participants' responses across the analyzed dimensions. These findings suggest that incorporating sensory effects might have a more profound impact on the e-learning experience compared to the experienced approach alone.

In conclusion, these results emphasize the importance of considering individual preferences and designing flexible e-learning environments. The integration of sensory effects, such as olfactory, airflow, and vibration, can enhance the sense of reality and enjoyment in e-learning. However, the experienced approach alone might not significantly influence participants' perceptions and experiences. Future research could explore the combination of sensory effects and the experienced approach to uncover potential synergies in enhancing the overall e-learning experience.

6.3 Study Limitations

One weakness of this study is its narrow focus on female students aged 23 to 25, including undergraduate, postgraduate, and researchers from various disciplines. The restriction to this specific age range raises concerns about the generalizability of the study's findings. Research has shown that people in different age groups possess diverse life experiences and perspectives, which can influence their responses and behaviors. For instance, [9] found that olfactory perception tends to decline with age, suggesting that younger participants may have had a more heightened sense of smell compared to older individuals. This could have implications for this study's investigation of multisensory experiences and its ability to improve them. By exclusively focusing on the 23 to 25 age range, valuable insights from both older and younger individuals may have been overlooked, potentially limiting the broader applicability and relevance of the study's conclusions. On the other hand, exclusively including female subjects in the experiment could be interpreted as a deliberate effort to foster heightened motivation among women pursuing careers in STEM professions.

Another limitation of this study is its exclusive focus on female participants, which disregards the potential nuances and differences that may exist between genders. Gender and sex are known to play a significant role in shaping experiences, attitudes, and behaviors. By excluding male participants, the study fails to address an important aspect of the research question. For instance, studies such as [4] have highlighted differences in odor perception between males and females. Their research suggests that female superiority in assessing olfactory information, including odor identification, may be attributed to cognitive rather than perceptual differences in olfactory processing. Similarly, the report Doty and Cameron also discusses sex differences and the influence of reproductive hormones on human odor perception, indicating that females are more selective about odor and smells, while not males, although socio-cultural factors may also interfere in this issue. By neglecting male participants, this study overlooks valuable insights that could contribute to a more comprehensive understanding of the topic. Including both male and female participants would have allowed for a more robust exploration of potential gender-related differences in the study's findings.

Furthermore, the concentration of participants within the academic setting, specifically among students and researchers within the specified age range, presents another limitation. Although their insights and experiences are undoubtedly valuable, they may not fully represent the broader population. Including individuals from different professions and diverse backgrounds could have provided a more comprehensive understanding of the impact of multisensory content on the learning experience. This limitation calls for caution when generalizing the study's findings beyond the academic context and highlights the need for future research to incorporate a more diverse participant pool to enhance the external validity of the study.

7 Conclusion

The evaluation findings demonstrated that the use of sensory effects had a positive impact on participants' perception of reality, enjoyment, and ability to focus without distractions. This indicates that the participants responded favorably to the implementation of multisensory devices.

However, the approach based on prior experience did not result in noteworthy variances in participants' reactions to the examined aspects. These findings indicate that the integration of sensory effects may have a more substantial effect on the e-learning experience compared to relying solely on prior experience.

To gain deeper insights, future studies could explore the specific factors contributing to the differences in participants' perceptions and further investigate the relationship between these perceptions and learning outcomes. Additionally, gathering qualitative data, such as participant feedback and observations, could provide valuable context and a more comprehensive understanding of the implications of these findings in the context of e-learning.

Furthermore, regarding the participant pool, it would be beneficial to explore additional dimensions of diversity, such as socioeconomic status, cultural backgrounds, and geographic locations, to capture a wider range of perspectives and experiences. This would help to mitigate potential biases and ensure that the findings are applicable to a more diverse population.

In addition, it would be worthwhile for future studies to assess the long-term effects of incorporating sensory effects in e-learning. Tracking participants' retention of knowledge, skill acquisition, and overall learning outcomes over an extended period could provide valuable insights into the sustained benefits of multisensory approaches. Such investigations would contribute to the development of evidence-based guidelines for designing effective and engaging e-learning experiences that leverage sensory effects to optimize learning outcomes in diverse educational settings. Besides, evaluating learners' emotional states through physiological signals helps to adapt the learning content based on learners' needs and increases engagement levels.

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References

1. Ademoye, O.A., Ghinea, G.: Information recall task impact in olfaction-enhanced multimedia. ACM Trans. Multimed. Comput. Commun. Appl. **9**(3), 1–16 (2013). https://doi.org/10.1145/2487268.2487270. Jun
2. Alkasasbeh, A.A., Ghinea, G.: Using olfactory media cues in e-learning - perspectives from an empirical investigation. Multimed. Tools Appl. **79**(27–28), 19265–19287 (2020). https://doi.org/10.1007/s11042-020-08763-3. Mar
3. Astleitner, H., Wiesner, C.: An integrated model of multimedia learning and motivation. J. Educ. Multimed. Hypermedia **13**(1), 3–21 (2004)
4. Bengtsson, S., Berglund, H., Gulyas, B., Cohen, E., Savic, I.: Brain activation during odor perception in males and females. NeuroReport **12**(9), 2027–2033 (2001)
5. Bi, T., Lyons, R., Fox, G., Muntean, G.M.: Improving student learning satisfaction by using an innovative dash-based multiple sensorial media delivery solution. IEEE Trans. Multimed. **23**, 3494–3505 (2021). https://doi.org/10.1109/TMM.2020.3025669
6. Choriev, R., Kucharov, S.: Methodology of using electronic textbooks in the field of technological education. Sci. Innov. **2**(B1), 371–373 (2023)

7. Covaci, A., Ghinea, G., Lin, C.H., Huang, S.H., Shih, J.L.: Multisensory games-based learning - lessons learnt from olfactory enhancement of a digital board game. Multimed. Tools Appl. **77**(16), 21245–21263 (2018). https://doi.org/10.1007/s11042-017-5459-2
8. Covaci, A., Zou, L., Tal, I., Muntean, G.M., Ghinea, G.: Is multimedia multisensorial? A review of mulsemedia systems. ACM Comput. Surv. (CSUR) **51**(5), 1–35 (2018)
9. Doty, R.L.: Age-related deficits in taste and smell. Otolaryngol. Clin. North Am. **51**(4), 815–825 (2018)
10. Doty, R.L., Cameron, E.L.: Sex differences and reproductive hormone influences on human odor perception. Physiol. Behav. **97**(2), 213–228 (2009)
11. Garcia-Ruiz, M., El-Seoud, S.A., Edwards, A., AL-JA'AM, J.M., Aquino-Santos, R.: Integrating the sense of smell in an educational human-computer interface. Interact. Comput. Aided Learn. (2008)
12. Ghinea, G., Thomas, J.: Quality of perception: user quality of service in multimedia presentations. IEEE Trans. Multimed. **7**(4), 786–789 (2005). https://doi.org/10.1109/TMM.2005.850960
13. Ghinea, G., Andres, F., Gulliver, S.R. (eds.): Multiple sensorial media advances and applications. IGI Global (2012). https://doi.org/10.4018/978-1-60960-821-7
14. Hussain, N., Ghinea, G.: Guidelines for evaluating wearables' quality of experience in a mulsemedia context. Multimed. Tools Appl. **81**(30), 43283–43314 (2022)
15. Kreitlon, J., Chen, L., Santos, L., Nascimento, R., Carrara, M.R., Guedes, G.P.: Affective multisensorial books. In: 2019 XIV Latin American Conference on Learning Technologies (LACLO), pp. 190–195. IEEE (2019)
16. Mortaza Mardiha, S., Alibakhshi, G., Mazloum, M., Javaheri, R.: Electronic flipped classrooms as a solution to educational problems caused by COVID-19: a case study of a research course in Iran higher education. Electron. J. e-Learn. **21**(1), 26–35 (2023)
17. Raheel, A., Majid, M., Alnowami, M., Anwar, S.M.: Physiological sensors-based emotion recognition while experiencing tactile enhanced multimedia. Sensors **20**(14), 4037 (2020)
18. ReportLinker: Global E-Learning Market to Reach $457.8 Billion by 2026 – globenewswire.com (2021). https://www.globenewswire.com/news-release/2021/07/13/2262081/0/en/Global-E-Learning-Market-
19. Richard, E., Tijou, A., Richard, P., Ferrier, J.L.: Multi-modal virtual environments for education with haptic and olfactory feedback. Virtual Real. **10**(3–4), 207–225 (2006)
20. Sanfilippo, F., Blazauskas, T., Salvietti, G., Ramos, I., Vert, S., Radianti, J., Majchrzak, T.A., Oliveira, D.A.: A perspective review on integrating VR/AR with haptics into stem education for multi-sensory learning. Robotics **11**(2) (2022). https://doi.org/10.3390/robotics11020041, https://www.mdpi.com/2218-6581/11/2/41
21. da Silveira, A.C., Santos, C.A.S.: Ongoing challenges of evaluating mulsemedia QoE. In: Proceedings of the 2nd Workshop on Multisensory Experiences-SensoryX 2022. SBC (2022)
22. Skliarova, I., Meireles, I., Martins, N., Tchemisova, T., Cação, I.: Enriching traditional higher STEM education with online teaching and learning practices: students& rsquo; perspective. Educ. Sci. **12**(11) (2022). https://doi.org/10.3390/educsci12110806

23. Tal, I., Zou, L., Covaci, A., Ibarrola, E., Bratu, M., Ghinea, G., Muntean, G.-M.: Mulsemedia in telecommunication and networking education: a novel teaching approach that improves the learning process. IEEE Commun. Mag. **57**(11), 60–66 (2019)
24. Tal, I., Zou, L., Farren, M., Muntean, G.-M.: Improving Learner experience, motivation and knowledge gain when using mulsemedia-based technology enhanced learning. In: Lane, H.C., Zvacek, S., Uhomoibhi, J. (eds.) CSEDU 2020. CCIS, vol. 1473, pp. 146–161. Springer, Cham (2021). https://doi.org/10.1007/978-3-030-86439-2_8
25. Yuan, Z., Bi, T., Muntean, G.M., Ghinea, G.: Perceived synchronization of mulsemedia services. IEEE Trans. Multimed. **17**(7), 957–966 (2015)
26. Yunusov, V., Gafarov, F., Ustin, P.: Deep learning techniques for the study of student's academic performance during distance education caused by COVID-19. In: 2023 17th International Conference on Electronics Computer and Computation (ICECCO), pp. 1–5 (2023). https://doi.org/10.1109/ICECCO58239.2023.10147143
27. Zhang, D.: Interactive multimedia-based e-learning: a study of effectiveness. Am. J. Distance Educ. **19**(3), 149–162 (2005)
28. Zou, L., Tal, I., Covaci, A., Ibarrola, E., Ghinea, G., Muntean, G.M.: Can multisensorial media improve learner experience? In: Proceedings of the 8th ACM on Multimedia Systems Conference, pp. 315–320. Association for Computing Machinery (2017). https://doi.org/10.1145/3083187.3084014

A Study on Technology-Enhanced Mulsemedia Learning for Enhancing Learner's Experience in E-Learning

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***Abstract*—Multimedia makes e-learning more interactive, which helps learners to remember information for a long time. The role of multimedia in education is to create content in an interactive format using videos, images, audio, and animation that enhance the interests of the learners and the learning process. However, the human sense covers more than two media senses. Mulsemedia denotes Multiple sensorial media that combines more than one sense (i.e., visual, hearing, haptic, gustatory, air flow, water jet, and olfactory), which helps to provide a more interactive and immersive learning experience instead of traditional multimedia learning styles in e-learning. In this paper, a study has been conducted on the possibility of including mulsemedia effects such as olfactory, airflow, and haptic effects in e-learning, and analyzing the learner's satisfaction through Quality of Experience (QoE) with and without Mulsemedia effects. For this preliminary study, two pieces of audio content have been created with multimedia and mulsemedia effects. This work initially experimented with 10 participants who are under and post-graduate students with the help of a self-recorded QoE form. Moreover, learners' stress level has been analyzed with Galvanic Skin Response (GSR) when using Mulsemedia in e-learning. The results show that the usage of Mulsemedia in e-learning enhanced the learner experience and had a significant impact on learners' performance compared to traditional learning methods and participants recommend this kind of learning in future e-learning environments.**

Keywords— Multimedia, Mulsemedia, E-learning, Quality of Experience, GSR, Learner Experience

I. INTRODUCTION

In recent years, interactive multimedia [1] allows learners with dynamic and immersive learning experiences by integrating multiple media such as audio, text, video, images, and animation. By providing immersive and engaging learning experiences, virtual reality (VR) and augmented reality (AR) have made major progress in altering the education landscape [20]. However, e-learning, or online learning, has witnessed remarkable growth and global adoption, with the market size projected to reach $374.3 billion by 2026 [21]. In higher education, 74% of institutions in the United States offered online or blended learning programs, and the number of students taking at least one online course reached 6.6 million. Corporate e-learning is also on the rise, with a projected market size of $38.09 billion. E-learning offers benefits such as flexibility, cost-effectiveness, and scalability, leading to higher retention rates and improved learning outcomes. E-learning continues to transform education and training, shaping the future of learning in the digital era.

Traditional multimedia learning provides information to learners in a more interactive way, which enhances their cognitive skills, as such media make it easier for understanding and recalls information quickly. However, current e-learning mainly provides auditory and visual media effects to learners, ignoring senses such as gestation and olfactory effects. E-learning is not only related to cognitive skills but also related to affective computing. Nowadays, research is going to bring multisensory (multi-sensorial learning) effects into e-learning, however, it encompasses the exploration of multisensory integration to create immersive and enhanced learner experiences in e-learning [7]. This field investigates the combination of visual, auditory, haptic, olfactory, and gustatory stimuli to deliver cohesive and engaging media content [3]. This approach can be particularly useful for students with different learning styles or who have difficulty understanding complex concepts through traditional teaching methods [5][8]. Both multimedia and multisensory learning can be effective in promoting learner engagement and improving learning outcomes. By providing students with multiple ways to interact with course material, teachers can create a more dynamic and engaging learning experience that caters to a wider range of learning styles. With applications in virtual reality, augmented reality, entertainment, assistive technologies, and human-computer interaction, mulsemedia research aims to understand crossmodal perception, develop inclusive technologies, and leverage neuroscientific insights to create more intuitive and impactful media experiences [17].

Research in mulsemedia in e-learning focuses on the integration of auditory stimuli to enhance educational experiences. By incorporating audio elements such as sound effects, music, narration, and interactive feedback, mulsemedia audio creates immersive and engaging learning environments [5]. It enhances cognitive engagement, promotes multisensory integration, and fosters emotional engagement and motivation. Audio narratives and storytelling facilitate knowledge acquisition, while considerations for accessibility and inclusivity ensure that diverse learners can benefit from audio-based materials. Attention and distraction

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are important factors to consider, and pedagogical strategies guide the optimal use of audio elements for effective learning.

Overall, mulsemedia audio research offers valuable insights into leveraging auditory stimuli to enhance learning outcomes and create enriching educational experiences. This research paper [2] explores the potential of multisensorial audiobooks in enhancing the learning experience. Furthermore, this work [2] highlights the benefits of audiobooks in education, such as improved comprehension, memory retention, and engagement. Furthermore, the Quality of Experience (QoE) is an important consideration for multisensorial learning, which aims to provide an immersive and engaging experience to the learners. Multisensorial learning combines audio content with other sensory inputs such as ambient sounds, and music to enhance the listening experience [18]. When assessing the quality and effectiveness of mulsemedia research, it is common practice to use a combination of subjective and objective measures [6]. Subjective measures involve collecting opinions and perceptions from human observers through methods such as surveys and focus groups. These measures provide insight into the overall quality of the project, including aspects such as user experience and feedback. Objective measures, on the other hand, are based on quantitative data and evaluate technical aspects of the project, such as its efficiency, accuracy, and speed. By utilizing both subjective and objective measures, researchers can obtain a more comprehensive understanding of the research strengths and weaknesses [20]. This paper presents a novel Mulsemedia audio e-content delivery system including three sensorial effects (haptic, vibration, and airflow) in order to enhance conventional e-learning multimedia content. This system has been implemented with various effects such as audio quality, synchronization between different sensory inputs, and the relevance of the additional sensory inputs to the content. In addition, the subjective measure has been conducted to analyze the effectiveness and quality of experience (QoS) of learners in the proposed Mulsemedia system. Moreover, learners' stress level has been analyzed with GSR signals. This paper's contribution is as follows:

- Designed Mulsemedia enhanced ted-bed for improving learners' engagement in e-learning, especially in STEM content.
- Proposed system has been validated with the user QoE questionnaire.
- Analysed learner's engagement and satisfaction levels with and without Mulsemedia effects.

The remaining section is divided into the following ways: Section 2 provides related works regarding Mulsemedia in e-learning, section 3 describes the Mulsemeida delivery system and research study method, Section 4 discusses the results and analysis of learners' experiences, finally, Section 5 concludes the insides and suggestions.

II. Related work

According to Tal et al. [9] Mulsemedia-based technology-enhanced learning (TEL) has been shown to improve learner experience, motivation, and knowledge gain compared to traditional text-based learning. Mulsemedia-based TEL combines multiple media types, such as text, images, video, and audio, to create an engaging and immersive learning experience. However, the design and presentation of multimedia content must be carefully considered to maximize its effectiveness. Further research is needed to investigate the optimal design principles for Mulsemedia-based TEL and to explore its potential in other educational contexts. Yuan et al. [10] conducted a QoE study to examine the impact of multiple sensorial media delivery on user experience. The Experiment involved 60 participants who were presented with different multimedia content that varied in terms of sensory inputs. The findings showed that the combination of multiple sensory inputs significantly improved user experience and satisfaction. The study emphasizes the importance of considering multiple sensory inputs in multimedia design, with implications for e-learning, entertainment, and advertising applications.Covaci et al. [11] conducted a study to investigate how users experience cross-modal correspondent Mulsemedia content. The study involved 40 participants who were presented with four types of Mulsemedia content, each consisting of three different types of media. The participants were asked to rate their experience of the content on a range of factors, including perceived usefulness, enjoyment, engagement, and overall satisfaction. Kreitlon et al. [12] explore the concept of affective multisensorial books, which are interactive books that combine various sensory inputs, such as visual, auditory, and haptic feedback, to create an immersive reading experience. The authors present a prototype of such a book, called "The Little Prince," which incorporates sensory stimuli, such as music, sound effects, and vibrations, to enhance the emotional and affective aspects of the story. The study investigates the effectiveness of affective multisensorial books in engaging readers and enhancing their emotional responses. Jalal et al. [13] propose a Quality of Experience (QoE) model for Mulsemedia TV in a smart home environment. The study involved 30 participants who watched Mulsemedia TV content in a smart home environment while their physiological signals were measured. The authors then used the collected data to develop a QoE model that considers various factors such as audio, video, haptic, and ambient conditions. The study emphasizes the importance of considering the overall user experience in designing and delivering Mulsemedia content in a smart home environment. Raheel et al. [14] investigated the classification of emotional response to tactile-enhanced multimedia using frequency domain features of brain signals. The study involved 15 participants who were exposed to tactile-enhanced multimedia stimuli while their EEG signals were recorded. The results showed that the proposed feature extraction method, combined with a support vector machine classifier, achieved a classification accuracy of 81.2% for four different emotional states. The authors suggest that their findings can contribute to the development of affective computing systems that can recognize users' emotional states in response to tactile-enhanced multimedia content. Sanfilippo et al. [15] conducted a prospective review on the integration of virtual reality (VR), augmented reality (AR), and haptic feedback into STEM education for multisensory learning. The authors discuss the benefits and potential applications of multisensory technology in STEM education and review existing studies that have investigated this approach. They also provide a framework for designing effective multisensory learning experiences. The study highlights the potential of VR/AR and haptic feedback to

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enhance the learning experience and engagement of students in STEM education. Similar work [22] has used VR techniques with Mulsemedia effect to teach medical practitioners, the study found learners experienced significant effects from this approach. In addition, this work [23] added additional strength to incorporate Mulsemedia in education. This study analyzed how olfactory improved learners' recall power and retention process.

Murray et al.[16] provide a tutorial for designing and evaluating olfaction-based multisensorial media applications. The authors review existing research on multisensorial media and discuss the potential of olfaction as a sensory modality for enhancing user experience. They also describe a study that involved the design and evaluation of an olfaction-based multimedia application, which provided users with different scents to enhance the overall user experience. The study highlights the importance of considering multiple sensory modalities in designing and evaluating multimedia applications to enhance user experience.

III. Proposed Approach

This section presents the development of the Mulsemedia audio e-content delivery system including research methodology, and work principles of synchronizing Mulsemedia effects with audio E-content. The proposed system aims to explore the integration of multisensory effects in e-learning, with a focus on STEM-related educational audio content (See Fig.1)

A. Mulsemedia Audio E-Content

The proposed multisensory e-learning utilizes multimedia technology, IoT devices, and haptics to create an engaging and immersive learning experience. The system incorporates an IoT-based Mulsemedia learning platform that utilizes cooling fans, humidifiers for olfaction, and Haptics to create a multisensory learning experience and also cost-effective.

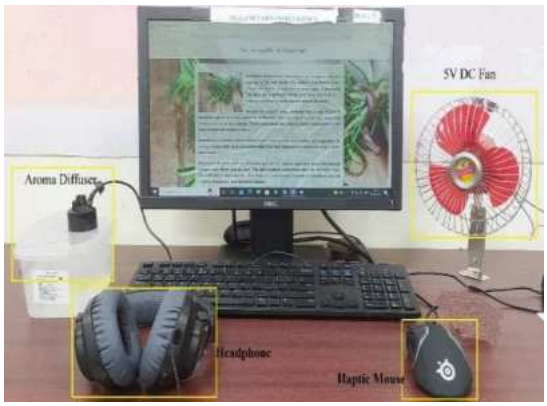


Fig. 1. Mulsemedia Enhanced E-learning test-bed

The system is designed to provide learners with a realistic and immersive learning experience by incorporating STEM content such as rosemary and thunder and lightning audio content which include multisensory effects such as olfactory, vibration, and airflow respectively. The individual audio effect is 60 seconds long and synchronized with IoT devices to stimulate multisensorial effects. For instance, when rosemary audio is started to play, then olfactory effects are stimulated by the humidifier. The use of airflow and humidifiers (for olfactory effects) provides learners with a more realistic and engaging experience, as learners can feel and smell the environment when they are hearing audio content. The addition of haptics for olfaction allows students to experience the smell through tactile feedback, making it more immersive. The site includes audio and multimedia effects that are synchronized with the airflow, olfactory, and haptic feedback provided by the IoT devices. This allows learners to have an immersive learning experience. Moreover, this paper focuses on the user quality of experience of the Mulsemedia services.

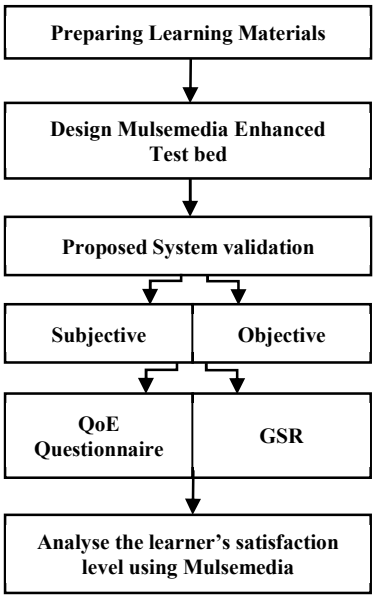


Fig. 2. Research flow for this study

Fig. 2 shows the research flow of this study. According to the flow chart, this paper describes each section and analyzes the results. First, learning content regarding STEM has been prepared. Next, Mulsemedia effects have been created according to the content with the help of IoT devices. Finally, the developed Mulsemedia web portal has been assessed with learners' QoE. In addition, learners' engagement has been assessed with GSR signals.

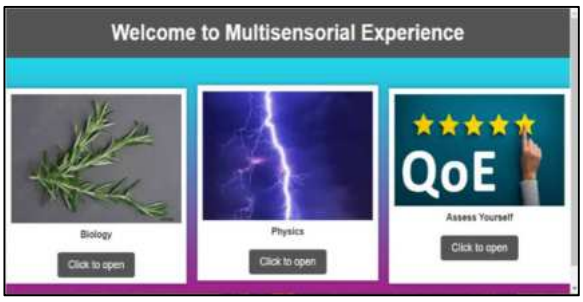


Fig. 3. Home page of Mulsemedia Enhanced Delivery System

Fig. 3. shows the home screen of the Mulsemedia delivery system, which includes rosemary content (See Fig. 4), thunder and lightning content (See Fig. 5), and self-assessment quality of experience questionnaire (See Fig. 6) for assessing learner quality of experience. This system has been designed with HTML, CSS, and PHP and synchronized with IoT devices, which are responsible for turning the Mulsemedia effects on and off during learning.

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Fig. 4. Biological facts of rosemary audio e-content

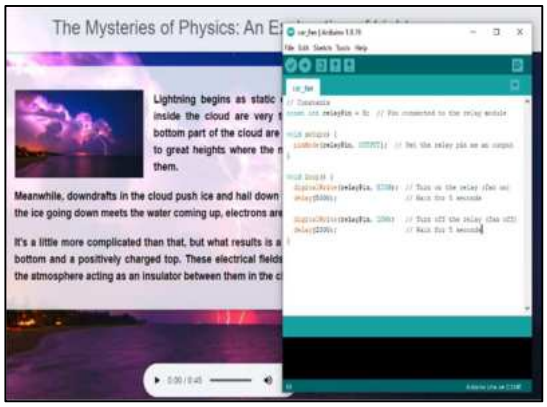


Fig. 5. Facts of Thunder and Lightning in audio e-content

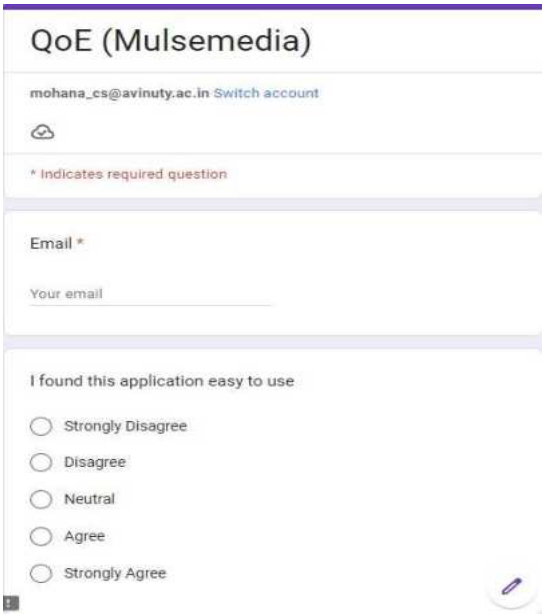


Fig. 6. Quality of Experience (QoE) self-assessment questionnaire

B. Mulsemedia Tools (Software and Hardware)

In order to integrate the Mulsemedia experience in e-learning, the additional hardware part is required. Table 1 shows the adopted hardware part which can make sensorial effects in the proposed system. The Arduino microcontroller acts as the central processing unit for the system, collecting data from the sensors and controlling the devices based on pre-defined rules and algorithms. The Arduino Microcontroller Interface plays a crucial role in connecting various devices to an IoT system such as cooling fans, ultrasonic Humidifiers, relays, and power adapters. The Cooling Fan is connected to the Arduino Microcontroller. The fan is connected to one of the digital output pins of the Arduino. The Arduino code is used to control the Cooling fan involved in sending signals to the digital output pin, which were then used to control the fan's speed and direction. The ultrasonic humidifier is connected to the Arduino microcontroller using a power adapter, and relay. When the code runs, the relay sends a signal to the power adapter, which turns on the ultrasonic humidifier. As a result, mist is produced. The relay is connected to the Arduino microcontroller. When the code runs, the relay sends a signal to the power adapter, which turns on/off the ultrasonic humidifier. The relay, which is connected to one of the digital output pins on the Arduino, was used to control the flow of electricity from the power adapter to the humidifier. The power adapter supplies the necessary voltage to an ultrasonic humidifier, which is connected to an Arduino microcontroller through a relay.

TABLE I. Mulsemedia Hardware

Components	Purpose
Olfactory (Aroma diffuser)	Produce rosemary smell
Exhaust fan	Airflow
Haptic Mouse	Vibration
Arduino UNO Board	Control Entire Unit
GSR	Monitor User engagement level

IV. RESULTS AND DISCUSSION

This section presents subjective and objective results analysis of the proposed Mulsemedia delivery system.

A. Subjective Test Analysis

Subjective measures are those that are based on the personal opinions, perceptions, and preferences of learners. A total of 10 participants have taken this experiment. This test has been conducted with the Centre for machine learning and Intelligence, Avinashilingam University (India) without disturbing participants while taking a test with a Mulsemedia test bed. Before collecting the results, participants were requested to fill out the consent form. 10 volunteers are invited to take part in it. For this study, users have been selected from various backgrounds such as undergraduate, postgraduate, and researchers. A QoE questionnaire has been designed to assess the learner's experiences. The questionnaire includes the following questions: Q1. The olfactory effects enhance the sense of reality in e-learning; Q2. The olfactory effects are annoying; Q3. The airflow effects enhance the sense of reality in e-learning; Q4. The airflow effects are annoying; Q5.The vibration effects enhance the sense of reality in e-learning; Q6.The vibration effects are annoying; Q7.The experienced approach was easy to use; Q8. The experienced approach can satisfy my learning needs; Q9. The experienced approach did not improve my learning experience; Q10. I enjoyed the experienced approach. Each user has been given the following five options to rate the Mulsemedia audio e-content experience for the above question such as strongly disagree, disagree, neutral, agree, and strongly agree. Use can see either rosemary content or thunder and lightning content based on their preferences. After watching two audio content, a user was asked to take a self-assessment of the QoE test. This test took around 15 minutes to complete for each participant.

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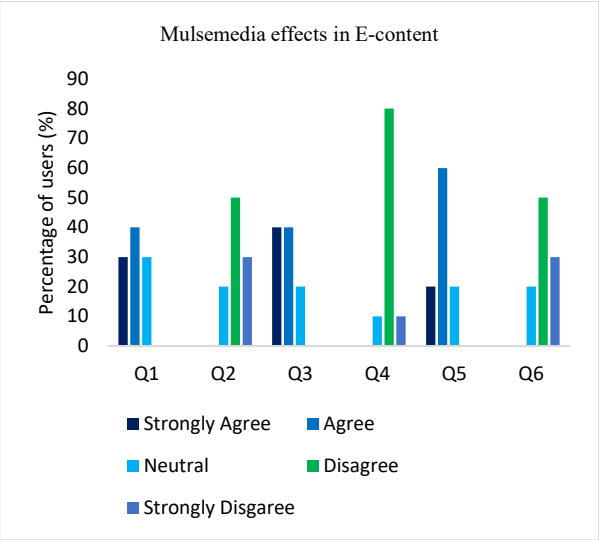


Fig. 7. Learner's Mulsemedia experience satisfaction level

Fig. 7. shows the learner's Mulsemedia experience satisfaction level, which shows that (Q1, Q3, Q5) learners really enjoyed the Mulsemedia experience in e-learning. Moreover, questions Q2, Q4, and Q6 present the response to the user's questionnaire statement "Mulsemedia effects are annoying". The results show that most of the users disagree and strongly disagree. In addition, one or two users respond that those experiences are neutral. Furthermore, Fig. 8. shows the overall user experience of Mulsemedia learning. It shows clearly users have enjoyed Mulsemedia-based learning experiences. The question response to the users' questionnaire statement "The experienced approach did not improve my learning experience". The results show that most of the participants disagree with this statement, and a few participants stated it as a neutral experience.

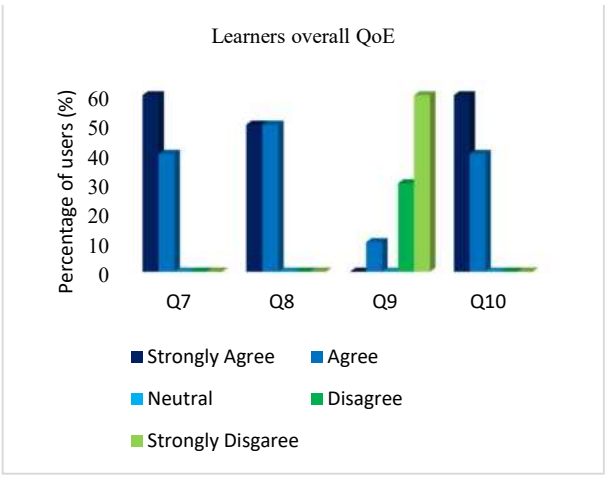


Fig. 8. Learner's overall satisfaction level with the Mulsemedia effects

B. *Objective Test Analysis*

Objective measures are those that are based on measurable and quantifiable data, which are often used in scientific and technical fields to evaluate the performance or characteristics of a system. In this research study, objective measures are used to evaluate the effectiveness of the multimedia content, and Galvanic Skin Response (GSR) is used to provide these measures.GSR (Galvanic Skin Response) is a measure of the electrical conductance of the skin, which can be used to monitor changes in the activity of the sympathetic nervous system. GSR is also known as Skin Conductance (SC) or Electrodermal Activity (EDA). Figure 8 shows the analysis of participants' GSR signals. GSR data is collected using a wristband sensor that measured changes in skin conductance. This method provides an indication of physiological arousal and is used to identify the emotional impact of the Mulsemedia on participants. First, the participants were instructed to relax for two minutes. The index and middle fingers on the left hand were then fitted with the Grove GSR finger sensor. The GSR data was analyzed by examining the changes in skin conductance over time, particularly in response to key moments of the multisensorial effects in that audio. The GSR analysis showed that participants experienced significant increases in physiological arousal during intense and emotional scenes. These findings suggest that the multisensorial elements of the Mulsemedia system are successful in eliciting emotional responses from participants.



Fig. 9. GSR measurements while hearing rosemary audio e-content

Fig. 9. shows the participant's GSR measurement while leaning, this sensor is configured with the left-hand index and middle finger.

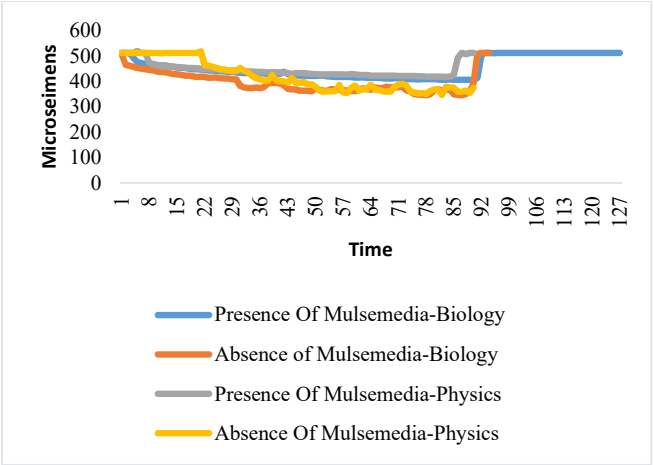


Fig. 10. Participant stress level analysis while learning

Fig.10. shows the GSR values between the presence and absence of Mulsemedia content in both Biology and Physics STEM concepts. The graph uses the data collected through the GSR sensor to illustrate the impact of multimedia content on learners' engagement levels and arousal in the two subjects. The findings suggest that Mulsemedia content can enhance learners' engagement and arousal in both Biology and Physics, as indicated by the higher GSR levels observed in classes with the Presence of Mulsemedia content. Additionally, participants exhibited high levels of excitement

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during their initial use of this system due to their lack of prior experience with this type of learning. Consequently, measuring GSR values presented a challenge at the initial stage. Moreover, learning content may have affected engagement. Hence, future research focuses on such aspects to analyse the emotional state of learners using GSR and EEG.

V. Conclusion and Future work

In conclusion, the research conducted on the impact of Mulsemedia audio e-content on learning provides valuable insights into the effectiveness of Mulsemedia in e-learning enhancing the learning experience. The proposed system is validated through a self-assessment QoE questionnaire and GSR. The research employed both subjective and objective measures to measure the impact of multimedia content on learners' engagement and satisfaction. The results suggest that the use of Mulsemedia in E-learning, such as cooling fans, ultrasonic humidifiers, and haptic feedback can significantly enhance student engagement and arousal, leading to better learning outcomes. Thus, the proposed system is cost-effective, and it is developed using IoT devices. Moreover, in the objective measures, the comparative analysis of GSR values in Biology and Physics STEM concepts with and without Mulsemedia content indicates that Mulsemedia content can enhance learners' engagement arousal in both subjects. These findings demonstrate the potential for Mulsemedia effects to provide an effective means to improve learners' engagement and learning outcomes in e-learning environments. Overall, this research study highlights the importance of Mulsemedia content in enhancing the learning experience in e-learning. In the future, this work will be extended to analyze learners' emotional states while learning with Mulsemedia effects in e-learning. Furthermore, this will be more efficient for learners with a disability, especially dyslexia learners. Apart from the educational setting, Mulsemedia can be fruitful for e-commerce, and gaming.

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References

[1] D. Zhang, "Interactive multimedia-based e-learning: A study of effectiveness". *The American Journal of Distance Education*, vol. *19*(3), pp. 149-162, 2005.

[2] H.Y. Okuno, S.Netto, and G. Guedes, "Multisensorial audiobooks". In *2020 XV Conferencia Latinoamericana de Tecnologias de Aprendizaje (LACLO)* pp. 1-6, 2020.

[3] G.Ghinea, F.Andres, and S. Gulliver, Multiple sensorial media advances and applications: new developments in MulSeMedia. IGI Global, 2011.

[4] G.Ghinea, C.Timmerer, W.Lin, and S.R.Gulliver, "Mulsemedia: State of the art, perspectives, and challenges". *ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM)*, vol. *11*(1s), pp. 1-23, 2014.

[5] L.Zou, I.Tal., A.Covaci, E.Ibarrola, G.Ghinea, and G.M.Muntean, "Can multisensorial media improve learner experience?,"In *Proceedings of the 8th ACM on Multimedia Systems Conference*, pp. 315-320, 2007.

[6] I.Tal, E.Ibarrola, and G.M.Muntean, "Quality and standardization in technology-enhanced learning,". In *2016 ITU Kaleidoscope: ICTs for a Sustainable World (ITU WT)*, pp. 1-8, 2016.

[7] A.A.Alkasasbeh, and G.Ghinea, "Using olfactory media cues in e-learning–perspectives from an empirical investigation," *Multimedia Tools and Applications*, vol.*79*(27-28), pp.19265-19287,2020.

[8] I. Tal, L.Zou, A.Covaci, E.Ibarrola, M.Bratu, G.Ghinea, and G.M.Muntean, "Mulsemedia in telecommunication and networking education: a novel teaching approach that improves the learning process,". *IEEE Communications Magazine*, vol. *57*(11), ,pp. 60-66, 2019.

[9] I.Tal, L.Zou, M.Farren, G.M.Muntean, H.C.Lane, S.Zvacek, J.Uhomoibhi, "Mulsemedia in Education: A Case Study on Learner Experience, Motivation, and Knowledge Gain". In *CSEDU vol. 2,* pp.180-187,2020.

[10] Z.Yuan, T.Bi, G.M.Muntean, and G.Ghinea, "Perceived synchronization of mulsemedia services," *IEEE Transactions on Multimedia*, vol. *17*(7) ,pp. 957-966,2015.

[11] A.Covaci, E.B.Saleme, G.Mesfin, N.Hussain, E.Kani-Zabihi, and G.Ghinea, "How do we experience crossmodal correspondent mulsemedia content?," *IEEE Transactions on Multimedia*, vol.*22*(5), pp. 1249-1258,2015.

[12] J.Kreitlon, L.Chen, L.Santos, R.Nascimento, M.R.Carrara, and G.P.Guedes, "Affective multisensorial books,". In *2019 XIV Latin American Conference on Learning Technologies (LACLO)*,pp. 190-195,2019.

[13] L.Jalal, R.Puddu, M.Martini, V.Popescu, and M.Murroni. "A QoE model for mulsemedia TV in a smart home environment,". *IEEE Transactions on Broadcasting*, 2022.

[14] A.Raheel, M.Majid, M.Alnowami, S.M.Anwar, "Physiological sensors-based emotion recognition while experiencing tactile-enhanced multimedia,". *Sensors*, vol.*20*(14), 4037,2020.

[15] F.Sanfilippo, T.Blazauskas, G.Salvietti, I.Ramos, S.Vert, J.Radianti, and D.Oliveira, "A perspective review on integrating VR/AR with haptics into stem education for multi-sensory learning". *Robotics*, vol. *11*(2), 2022.

[16] N.Murray, O.A.Ademoye, G.Ghinea, and G.M.Muntean, "A tutorial for olfaction-based multisensorial media application design and evaluation". *ACM Computing Surveys (CSUR)*, vol. *50*(5), pp. 1-30, 2017.

[17] I.Tal, L.Zou, M.Farren, and G.M.Muntean, "Improving Learner Experience, Motivation, and Knowledge Gain When Using Mulsemedia-Based Technology Enhanced Learning," In *Computer Supported Education: 12th International Conference, CSEDU 2020, Virtual Event, Revised Selected Papers 12,2021,* pp. 146-161. Springer International Publishing,2020.

[18] H.J.Broadbent, H.White, D.Mareschal, and N.Z.Kirkham, " Incidental learning in a multisensory environment across childhood". *Developmental science*, vol. *21*(2), 2018.

[19] A.C.da Silveira, and C.A.S.Santos, "Ongoing Challenges of Evaluating Mulsemedia QoE," In *Proceedings of the 2nd Workshop on Multisensory Experiences-SensoryX'22*. SBC, 2022.

[20] F.Sanfilippo, T.Blazauskas, G.Salvietti, I.Ramos, S.Vert, J.Radianti, and D.Oliveira, "A perspective review on integrating VR/AR with haptics into stem education for multi-sensory learning". *Robotics*, vol. *11*(2), 2022.

[21] Globenewswire,https://www.globenewswire.com/newsrelease/2021/07/13/2262081/0/en/Global-E-Learning-Market-to-Reach-457-8-Billion-by-2026.html

[22] A.Kumar,B.Srinivasan,A.K.J.Saudagar, A.AlTameem, M.Alkhathami, B.Alsamani,K.U.Singh, "Next-Gen Mulsemedia: Virtual Reality Haptic Simulator's Impact on Medical Practitioner for Higher Education Institutions". Electronics, vol. 12(2),pp. 356, 2023.

[23] V.Andonova, F.Reinoso-Carvalho, M.A.Jimenez Ramirez, D.Carrasquilla, "Does multisensory stimulation with virtual reality (VR) and smell improve learning? An educational experience in recall and creativity," Frontiers in Psychology, vol. 14, 1176697,2023.

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Technology Enhanced Mulsemedia Learning (TEML) for Learners with Dyslexia

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ABSTRACT

Mulsemedia-multiple sensorial media- includes both traditional multimedia and human sensorial effects, which gives immersive real-world experience. The booming of new technology and wearable devices creates a new avenue for Mulsemedia research in education and has brought new opportunities for Technology Enhanced Mulsemedia Learning (TEML). Traditional methods focus on unisensory experiences, even though the surrounding environment is multisensory. Moreover, this type of learning helps to stimulate various sensory channels to reinforce the learning process, which can also more benefit individuals with a variety of learning disabilities particularly dyslexia which affects a person's ability to read. Moreover, TEML helps to obtain 21st-century learning skills such as cognitive, productivity, social-cultural, metacognitive, and technological dimensions. This paper proposes TEML for learners with dyslexia, for that, this study focuses on an approach for identifying methods for dyslexia, a method for designing Mulsemedia devices using IoT technology, and an evaluation method for performing quality of experience (QoS) using questionnaire, and physiological signals such as GSR (Galvanic Skin Responses), and EEG (Electroencephalography). Those methods help to analyze the learner's emotional responses while experiencing Mulsemedia content.

CCS CONCEPTS

• **Human-centered computing** → **Interaction paradigms**; • **Information systems** → **Multimedia information systems**.

KEYWORDS

Mulsemedia, Technology Enhanced Mulsemedia Learning, Quality of Experiences, Dyslexia, Learning Disability

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1 INTRODUCTION

In recent years, educators are taking many initiatives for improving students' motivation, engagement, and academic performance, especially in STEM (Science, Engineering, Technology, Mathematics) subjects. However, normal students can easily adapt concepts, but it is not easy for slow learners (dyslexia). Out of many learning disabilities, Dyslexia is a specific learning disability that affects the reading accuracy and fluency of learners in learning [13, 17]. The latest advancement in technology has enabled a wide range of opportunities for e-learning methods by providing learners with diverse technology devices, and solutions for enhancing the learning experiences, especially for learners with disabilities. Furthermore, NEWTELP [20] projects show the impact of Technology Enhanced Learning (TEL), and how enables mulsemedia enhanced teaching and learning in STEM subjects for normal students, which is mainly focused on Telecommunication and Networking related modules [20, 21].

Mulsemedia is a term that combines multimedia content (Audio, Video, Image, text, etc.,) and human sensory channels [7]. Mulsemedia content includes audio-visual components, and metadata to trigger stimuli for other senses (touch, smell, taste). STEM education gives special attention to practical training that facilitates a deep understanding of design procedures, practical limitations, and engineering trade-offs. Due to technological development, different kinds of technology are involved in engineering education such as multisensory virtual and augmented reality and game-based learning [3, 4]. Designing mulsemedia content includes the real-time environment experience when reading e-content. In addition, while developing a typical Mulsemedia delivery system, one needs to consider the following workflow. (1) Creation of Mulsemedia content, (2) content distribution and reception, (3) synchronize the content to the end-user via a collection of devices with different senses (e.g., haptic, taste, olfactory, airflow, and waterjet). Mulsemedia learning

theories help to stimulate the various sensory media for reinforcing the learning process [5]. Elsharif et al. [6] have reported that the help of Mulsemedia creates a major impact to solve problems in rehabilitation technologies, assistive technology, and learning disability. Moreover, the previous finding shows that when providing sensory cues while reading, his/her cognitive load is reduced and learning enhanced [2]. However, learning environments based on mulsemedia can provide an immersive and interactive learning experience that can significantly increase motivation and engagement [2]. Furthermore, mulsemedia-based learning environments can provide immediate feedback, allowing learners with learning disabilities to track their progress and identify areas for improvement. This is especially useful for students with disabilities who may struggle with self-monitoring and self-regulation [18].

The level of satisfaction and engagement that learners experience during the learning process is referred to as QoE in the context of learning [10, 17]. It takes into account a variety of factors, such as the effectiveness of the teaching methodology, the quality of the learning materials, the relevance of the content to the learner's needs, and the level of interactivity and feedback provided during the learning process. The use of mulsemedia in STEM education can significantly improve QoE in learning by providing learners with an immersive and engaging learning experience that accommodates various learning styles. One of the primary advantages of using mulsemedia in education is the ability to create highly interactive and personalized learning experiences. The quality of experience in learning is critical for ensuring that learners achieve their learning objectives in an effective and efficient manner. It is a measure of the effectiveness of the learning experience and can influence learners' motivation, engagement, and knowledge retention. Recent studies [11] show that mulsemedia can improve the quality of experience of learners while affective computing can capture the individual affective states during reading (e.g., sleep and boredom). In addition, this study evaluates the possible changes of detection when reading. For evaluating the quality of experience of learner questionnaires and biosignal responses are commonly used to analyze the state of learner engagement in Mulsemedia learning. Furthermore, technology enhanced mulsemedia learning gives a potential benefit to create an active learning environment and helps to develop motivation and self-esteem by allow learners to take responsibility for their learning.

This paper has been divided into the following sections: Section 2 explains the proposed approach for technology-enhanced Mulsemedia learning for learners with dyslexia. Section 3 describes the evaluation approach for quality of experience (QoE). Finally, Section 4 concludes the overall approach of Mulsemedia learning for learners with dyslexia.

2 TECHNOLOGY ENHANCED MULSEMEDIA LEARNING (TEML) WEB PORTAL

Technology Enhanced Mulsemedia Learning (TEML) web portal aims to provide a comprehensive e-learning platform for individuals with dyslexia. This portal focuses on developing an inclusive and accessible platform that caters to the needs of individuals with dyslexia, providing them with specialized tools and resources to enhance their quality of experience and analyses emotional state of learners while learning.

The TEML web portal not only provides an accessible and inclusive learning experience but also incorporates STEM concepts to promote scientific literacy and critical thinking skills. The educational learning resources related to Biology and Physics include interactive simulations like airflow, olfaction, video, audio and vibration, and the multimedia web portal content is designed to help individuals with dyslexia grasp concepts regarding STEM area [16].

2.1 Mulsemedia based Web portal

The methodology used in the development of the TEML web portal includes five phases which includes gathering learning materials, device preparation, prototype for experimentation, analyzing the quality of experience (QoE), and emotion analyses.

Technology plays a critical role in addressing the challenges faced by individuals with dyslexia, and the TEML platform is designed with specialized devices and tools. The important unique feature of the TEML web portal is the synchronization of the specialized device with Arduino code to trigger the exhaust fan, humidifier, and vibration to create a multisensory learning experience [9]. In addition, the web portal incorporates olfactory stimuli into the learning experience. By triggering the Arduino code with XML in the web portal, the platform emits the smell of rosemary which has been used to enhance cognitive function and memory retention while learning [1]. The Arduino code is programmed to work in sync with the audio content, ensuring that the fan works on time. This synchronization of devices and video content creates an immersive learning environment that engages learners and promotes active learning. These devices are designed to reduce the impact of environmental factors on learning and enhance the learning experience for individuals with dyslexia. To identify individuals with dyslexia is a challenging task, as IQ and language are not needed to identify the disorder. Dyslexia is a specific learning disability in reading words, spelling of words and working memory capacity are necessary for identifying dyslexia. The dyslexia question preparation module helps individuals with dyslexia improve their reading and comprehension skills. This module includes a range of exercises and activities designed to improve phonological awareness, decoding, fluency, vocabulary, and comprehension. The dyslexia question preparation module is personalized to meet the specific needs of each individual and provides immediate feedback to help learners track their progress. This questionnaire includes assessing reading performance, identifying individual letters, and spelling of more relevant words. This innovative approach to dyslexia intervention is a testament to the TEML web portal's commitment to creating an inclusive and accessible platform that meets the diverse learning needs of individuals with dyslexia. Thus, the study represents a significant advancement in the field of dyslexia intervention and education. It has the potential to revolutionize the way individuals with dyslexia learn and provide them with equal access to STEM education and other learning opportunities [12]. With further development and refinement, the TEML web portal could serve as a model for other platforms seeking to create a more inclusive and accessible learning environment for individuals with diverse learning needs.

3 EVALUATION APPROACH

The evaluation approach for the Technology Enhanced mulsemedia learning (TEML) web portal includes QoE questionnaire, EEG, and GSR sensors to collect the data and analyses experience of learners. Those are an evolutionary approach for multisensorial learning, which provides valuable insights into user engagement and emotional impact. These methods are to be chosen to provide both objective and subjective measures of cognitive and emotional responses [22]. The EEG and GSR measurements provide objective measures of cognitive and emotional responses to the learning content on the platform. This data can be used to optimize the learning experience and modify the content to meet the specific needs of each individual with dyslexia.

The subjective measures are important in QoE evaluation because they provide direct feedback from participants, which can help to identify the strengths and weaknesses of a mulsemedia application. This assessment provides a subjective measure of how the participants perceived the proposed Technology-enhanced Mulsemedia learning (TEML) web portal. The assessment included questions about learning content, questions about specific elements such as olfactory, airflow, vibration and QoE questions to evaluate the mulsemedia experience. Here, Open-ended questions allow participants to provide detailed and personalized responses, while Likert scale questions can provide quantitative data that can be analyzed statistically [4, 19]. Participants fill out the questionnaire after watching the learning with mulsemedia effects. Moreover, this type of analysis is not more efficient to analyze the learners real QoE because when learners explore new fields of experience.

These subjective measures of quality of experience are important to consider alongside the objective measures of cognitive and emotional response recorded in the Technology-enhanced Mulsemedia learning (TEML) Web portal [4]. It provides a holistic understanding of the listener's experience with the TEML web portal and suggests that multisensorial elements can contribute to a positive listening experience. Overall, the evaluation approach employed in this research provides a comprehensive understanding of the cognitive and emotional responses to the TEML web portal. The EEG and GSR data provide objective measures of these responses, while the quality of experience assessment provided a subjective measure [8, 14].

An EEG device is a tool that measures the electrical activity of the brain using electrodes attached to the scalp. The EEG device can be used to measure the brain activity of participants in response to specific stimuli, providing insights into cognitive processes and emotional responses [14, 15]. The EEG data is collected using a 16-channel wireless EEG headset. Participants were instructed to wear the headset while listening to the audio, and data is collected for the entire listening session. The data is analyzed using open-source software, focusing on three types of brain waves: alpha, beta, and theta waves. Alpha waves are associated with relaxation and calmness, beta waves with cognitive load and attention, and theta waves with relaxation and mental imagery.

GSR (Galvanic Skin Response) is a measure of the electrical conductance of the skin, which can be used to monitor changes in the activity of the sympathetic nervous system. GSR is also known as Skin Conductance (SC) or Electrodermal Activity (EDA) [11]. GSR data is collected using a wristband sensor that measures changes in skin conductance. This method provides an indication of physiological arousal and is used to identify the emotional impact of the Mulsemedia on participants. First, the participants were instructed to relax for two minutes. The index and middle fingers on the left hand were then fitted with the GSR finger sensor [11]. The GSR data was analyzed by examining the changes in skin conductance over time, particularly in response to key moments of the multisensorial effects in that audio. The GSR analysis showed that participants experienced significant increases in physiological arousal during intense and emotional scenes. These findings suggest that the multisensorial elements of the web portal are successful in eliciting emotional responses from participants.

Furthermore, the objective method gives a more accurate state of learners, and also helps to detect hidden information. However, some limitations are in objective measure such as cost of device, controlled environment, and learners not comfortable with wearable devices.

4 CONCLUSION

In conclusion, the Technology Enhanced Mulsemedia Learning (TEML) web portal represents a major step forward in the field of education and learning. It provides an inclusive and engaging platform for learners of all abilities, including those with dyslexia. With the incorporation of STEM concepts, Mulsemedia learning has the potential to provide even greater benefits. By incorporating a variety of leveraging technology such as the Arduino microcontroller, exhaust fans, humidifiers-olfactory sensors, and even haptic feedback devices to create a truly multisensory learning experience. This creates a rich and engaging learning experience that is accessible to a wide range of learners, including those with dyslexia. Moreover, TEML incorporates a quality of experience evaluation approach that utilizes EEG and GSR sensors to collect data on cognitive and emotional responses. Overall, the TEML web portal initiative represents a major step forward in the field of education anad learning, offering a truly immersive and effective learning experience that leverages the latest technologies and best practices.

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REFERENCES

[1] Ahmad A Alkasasbeh and Gheorghita Ghinea. 2020. Using olfactory media cues in e-learning–perspectives from an empirical investigation. *Multimedia Tools and Applications* 79, 27-28 (2020), 19265–19287.

[2] Hannah J Broadbent, Hayley White, Denis Mareschal, and Natasha Z Kirkham. 2018. Incidental learning in a multisensory environment across childhood. *Developmental science* 21, 2 (2018), e12554.

[3] Alexandra Covaci, Esteban B Saleme, Getachew Mesfin, Naveed Hussain, Elahe Kani-Zabihi, and Gheorghita Ghinea. 2019. How do we experience crossmodal correspondent mulsemedia content? *IEEE Transactions on Multimedia* 22, 5 (2019), 1249–1258.

[4] Adson Carlos da Silveira and Cledson Akio Sakurai Santos. 2022. Ongoing Challenges of Evaluating Mulsemedia QoE. In *Proceedings of the 2nd Workshop on Multisensory Experiences-SensoryX'22*. SBC.

[5] Fabien Danieau, Anatole Lécuyer, Philippe Guillotel, Julien Fleureau, Nicolas Mollet, and Marc Christie. 2012. Enhancing audiovisual experience with haptic feedback: a survey on HAV. *IEEE Transactions on Haptics* 6, 2 (2012), 193–205.

[6] Amr Ali Elsharif, Marwa Mousa, and Amr Issa. 2020. Mulsemedia: Review and Perspective on Potentials in Rehabilitation and Disability Technological Developments. In *2020 International Conference on Assistive and Rehabilitation Technologies (iCareTech)*. IEEE, 97–102.

[7] Gheorghita Ghinea, Christian Timmerer, Weisi Lin, and Stephen R Gulliver. 2014. Mulsemedia: State of the art, perspectives, and challenges. *ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM)* 11, 1s (2014), 1–23.

[8] Naveed Hussain and Gheorghita Ghinea. 2022. Guidelines for evaluating wearables' quality of experience in a mulsemedia context. *Multimedia Tools and Applications* 81, 30 (2022), 43283–43314.

[9] Lara Jalal, Raffaella Puddu, Maria Martini, Vlad Popescu, and Maurizio Murroni. 2022. A QoE model for mulsemedia TV in a smart home environment. *IEEE Transactions on Broadcasting* (2022).

[10] Elahe Kani-Zabihi, Naveed Hussain, Getachew Mesfin, Alexandra Covaci, and Gheorghita Ghinea. 2021. On the influence of individual differences in cross-modal Mulsemedia QoE. *Multimedia Tools and Applications* 80, 2 (2021), 2377–2394.

[11] Júlia Kreitlon, Ling Chen, Leonardo Santos, Rian Nascimento, Marisa R Carrara, and Gilson P Guedes. 2019. Affective multisensorial books. In *2019 XIV Latin American Conference on Learning Technologies (LACLO)*. IEEE, 190–195.

[12] Henrique Y Okuno, Suely Netto, and Gilleanes Guedes. 2020. Multisensorial audiobooks. In *2020 XV Conferencia Latinoamericana de Technologias de Aprendizaje (LACLO)*. IEEE, 1–6.

[13] Beth A B Phillips and Timothy N Odegard. 2017. Evaluating the impact of dyslexia laws on the identification of specific learning disability and dyslexia. *Annals of Dyslexia* 67, 3 (2017), 356–368.

[14] Ammar Raheel, Muhammad Majid, Majdi Alnowami, and Syed Muhammad Anwar. 2020. Physiological sensors-based emotion recognition while experiencing tactile enhanced multimedia. *Sensors* 20, 14 (2020), 4037.

[15] Atif Raheel, Muhammad Majid, Syed Muhammad Anwar, and Ulas Bagci. 2019. Emotion classification in response to tactile enhanced multimedia using frequency domain features of brain signals. In *2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*. IEEE, 1201–1204.

[16] Esteban B Saleme, Carlos A Santos, and Gheorghita Ghinea. 2018. Coping with the challenges of delivering multiple sensorial media. *IEEE MultiMedia* 26, 2 (2018), 66–75.

[17] Sally E Shaywitz. 1998. Dyslexia. *New England Journal of Medicine* 338, 5 (1998), 307–312.

[18] Elen Priscila Silva, Gabriela Amorim, Gláucia Guedes, João Damásio Santos, and Renata Mousinho. 2021. The influence of multisensory media on learning children with reading disorder. *Revista Psicopedagogia* 38, 115 (2021), 104–120.

[19] Eraldo Pereira Silva, Nídia Vieira, Gustavo Amorim, Renato Mousinho, Gilson Guedes, Gheorghita Ghinea, and José Antônio Dos Santos. 2021. Using Multisensory Content to Impact the Quality of Experience of Reading Digital Books. *ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM)* 17, 4 (2021), 1–18.

[20] Ido Tal, Lei Zou, Alexandra Covaci, Eva Ibarrola, Marian Bratu, Gheorghita Ghinea, and Gabriel-Miro Muntean. 2019. Mulsemedia in telecommunication and networking education: a novel teaching approach that improves the learning process. *IEEE Communications Magazine* 57, 11 (2019), 60–66.

[21] Ido Tal, Lei Zou, Margaret Farren, and Gabriel-Miro Muntean. 2021. Improving Learner Experience, Motivation and Knowledge Gain When Using Mulsemedia-Based Technology Enhanced Learning. In *Computer Supported Education: 12th International Conference, CSEDU 2020, Virtual Event, May 2–4, 2020, Revised Selected Papers*, Vol. 12. Springer International Publishing, 146–161.

[22] Zheng Yuan, Gheorghita Ghinea, and Gabriel-Miro Muntean. 2014. Quality of experience study for multiple sensorial media delivery. In *2014 International Wireless Communications and Mobile Computing Conference (IWCMC)*. IEEE, 1142–1146. https://doi.org/10.1109/IWCMC.2014.6906515

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Relationship between Stress and Test Anxiety among Nursing Students

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One of the significant models on the topic of stress defined stress as a state of psychological and physiological imbalance caused by a discrepancy between situational demands and people's capacities and motivations to meet those demands. Nursing students become increasingly stressed during their education as they are exposed to several stressors. When stress is perceived as uncontrollable or unmanageable performance levels start to decline slowly to dramatically. This causes a decline in productivity and enthusiasm. It's momentous to find out the relationship between stress and test anxiety among nursing students. For this purpose, required data were randomly gathered from 208 nursing students taken from three different nursing colleges in Kozhikode District, Kerala, India. In this study, two standardized instruments were used student stress scale developed by Manju Agrawal (2012) and the test anxiety scale developed by Sharma, V. P. (2000). Data were analyzed by applying mean, standard deviation-test, correlation, and regression. Research findings reveal a significant correlation between stress and test anxiety. Stress related to familial, social, educational, ego threat, bereavement, and personal setbacks were found to be strongly associated with test anxiety. Furthermore, total stress was found to be positively related to test anxiety. Financial stress, separation, and the health of others had no significant association with test anxiety. It is suggested that higher authorities of an educational institution may organize regular stress management workshops, guidance, and counseling service to meet students' needs, help them to manage stress, and to reduce test anxiety among nursing students.

Keywords: Stress, Test anxiety, Correlation, Education, Nursing students.

Nursing students have significantly more stress, anxiety, sleep disturbances, and stress-related illnesses than the general student body (Bartlett et al., 2016; May et al;2021). Nursing is, by meaning, a stressful profession, partly owing to the specialized nature of the activity of those under their care (Augusto & Lopez-Zafra, 2010; José M. Augusto Landa et al.2011). We can conclude from the 12 reviewed studies that the most stressful factors for student nurses are certainly related to the world of academia. This finding is highlighted in six studies (Jones & Johnston, 1997, 2006; Lindop, 1999; Prijmachuk & Richards, 2007; Thyer & Bazeley, 1993; Timmins & Kalinszer, 2002). In four studies, clinical practice-related factors were identified as the most stressful among students (Chan, So, & Fong, 2009; Lindop, 1991; Sheu, Lin, & Hwang, 2002; Zupiria et al., 2007). Finally, two studies find the same significance for both stressors (academic and clinical) (Evans & Kelly, 2004; Seyedfatemi, Tafreshi & Hagani, 2007)

Test anxiety can be defined as the subjective experience of acute physiological, cognitive, and/or behavioural anxiety symptoms before or during test-taking situations that disturb test performance (Miller,2011). Test anxiety has always been a common occurrence among college students. Extreme anxiety and stress, on the other hand, can have negative consequences before and during an exam. Test anxiety is a set of physical and emotional symptoms that impair one's capacity to perform well enough on tests. Many students experience varying degrees of test anxiety for a variety of reasons (learning center, university of north caroline at chapel hill, 2011)

Theories of Stress

Theories focusing on the specific relationship

between external demands (stressors) and bodily processes (stress) can be divided into two categories: approaches to systemic stress' based on physiology and psychobiology (among others, Selye 1976) and approaches to 'chronic stress' based on psychology. The term "psychological stress" originated in the cognitive psychology field (Lazarus 1966, 1991, Lazarus and Folkman 1984, McGrath 1982).

Systemic Stress: Selye's Theory

The prominence of the stress concept in scientific research and the media is largely due to the work of endocrinologist Hans Selye. According to Selye (1976, p. 64), stress is "a state manifested by a syndrome that consists of all the nonspecifically induced changes in a biological system. This stereotypical response pattern is referred to as the 'General Adaptation Syndrome' (GAS). (a) The alarm reaction consists of an initial shock phase followed by a countershock phase. Autonomic excitability increased adrenaline discharge, and gastrointestinal ulcerations are all symptoms of the shock phase. The counter-shock phase is characterized by increased adrenocortical activity and marks the start of defensive processes. b) If the noxious stimulation continues, the organism enters the resistance stage. The symptoms of the alarm reaction disappear at this stage, which appears to indicate the organism's adaptation to the stressor. However, as resistance to noxious stimulation increases, resistance to other types of stressors decreases. (c) If the aversive stimulation continues, resistance gives way to exhaustion. The organism's ability to adapt to the stressor has been depleted; the symptoms of the stage (a) reappear, but resistance is no longer possible. Irreversible tissue damage occurs, and the organism dies if the stimulation continues.

Psychological Stress: The Lazarus Theory

The Lazarus stress theory has undergone several critical revisions since its first presentation as a comprehensive theory (Lazarus 1966) (cf. Lazarus 1991, Lazarus and Folkman 1984, Lazarus and Launier 1978). Stress is considered in the most recent version (Lazarus 1991).

Stress is defined as a relational concept, not as a specific type of external stimulation or a specific pattern of physiological, behavioural, or subjective reactions. Instead, stress is viewed as a relationship (or 'transaction') between people and their surroundings.

Psychological stress is defined as a relationship with the environment that a person perceives to be important for his or her well-being and in which the demands tax or exceed available coping resources. (Lazarus and Folkman 1986, p. 63).

Concept of Test Anxiety

Modern society can best be described as test-oriented and test-consuming (Zeidner & Most, 1992). Testing is widely used in education, as well as by the industrial, government, and military sectors to help make personnel decisions. Growing up in modern society is almost impossible without encountering some type of test, whether it is a classroom test in language, math, or science, a standardized competence or achievement test, a military placement or mechanical aptitude test, a scholastic aptitude test for college application, or an industrial. occupational placement test. Test and other assessment data may provide objective and reliable information that directly influences choices made in the processes of vocational guidance and counselling, selection, classification and placement, and screening and diagnosis—all of which help shape an individual's upbringing, education, and career. When one considers the numerous applications of tests in our culture and how they can affect the lives of those who take them, it's no surprise that the testing situation can cause anxiety in many people. Many children in our culture become test-oriented and test-anxious at a young age. Test anxiety is frequently mentioned in the literature as one of the main antagonists in the ongoing drama surrounding psycho-educational testing (Zeidner, 1990).

Test anxiety is characterized by physiological over arousal, feelings of worry and dread, self-deprecating thoughts, tension, and somatic symptoms that occur during testing situations. It is a physiological condition in which individuals feel extreme stress, anxiety, and discomfort while taking a test and/or before taking it. These reactions can significantly impair an individual's

ability to perform well and hurt their social, emotional, and behavioural development, as well as their feelings about themselves and school (Basha and Babu, 2013).

Stress

Stress has always been primarily a physical and psychological reaction to threats, pressure, and demand. The heart rate rises and the palms sweat. Concentration is difficult for the mind. (Porterfield, 2013). Adolescents with high levels of perceived stress were more likely to develop a mental disorder. Interventions to reduce perceived stress among adolescents could therefore potentially help to identify groups at high risk for later mental disorders (Lindholdt et al,2021).

The onset of stress, symptoms, and behaviour and experience patterns, particularly during the first two years, demonstrating rising study-related stress in the preclinical years, as well as the high proportion with an unambitious pattern at the end of the course of study, highlight the importance of prevention and health promotion at both the individual and contextual levels. (Voltmer et al,2021).

Test Anxiety

The study concludes that students' self-esteem can be enhanced and test anxiety can be reduced by creating an enabling environment for mentoring where they can practice assertiveness skills which will in turn boost their confidence to perform all academic tasks successfully (Thomas et al,2022). Both test anxiety and the tendency to procrastinate were present among undergraduate and postgraduate physiotherapy students, in varying degrees. There was a positive correlation between the two factors (Desai et al, 2021). Adolescents show a differential response to TA based on the physiological, cognitive, and motor components, mediated by the variables of gender, age, grade, academic performance, and type of exam. These results serve to design specific intervention programs to manage anxiety in situations of academic assessment (Torrano,2020).

The majority of studies on stress levels and test anxiety have been conducted on undergraduate and medical students. Only a few studies on nursing students are known. Student nurses are significantly more stressed and anxious than the general student population. Numerous studies on stress have been conducted but no emphasis has been placed on test anxiety among nursing students.

The study on "Relationship between Stress and Test Anxiety among Nursing Students" was conducted with the objectives to investigate the relationship between stress and test anxiety among nursing students and to assess the difference in test anxiety and stress among nursing students based on demographic and find the effect of stress and test anxiety among nursing students.

The Hypotheses for the study were as follows:

1. There will be no significant difference between stress and test anxiety among nursing students.
2. There will be no significant difference in test anxiety and stress among students based on demographic.

Method

Tools:

*Student Stress Scale:*The Student Stress Scale was developed by Manju Agrawal (2012). It included 64 questions. The participants rate their responses on a Likert scale from 1 to 7, with 1 denoting no stress at all, 2 denoting very little stress, 3 denoting some stress, 4 denoting average stress, 5 denoting much stress, 6 denoting too much stress, and 7 denoting unbearable stress. The questionnaire has nine subscales, including financial stress, family stress, social stress, education stress, separation stress, ego threat, bereavement stress, other people's health stress, and personal setback stress. Students were deemed to be at a high risk of developing stress if they received any sub-test scores of greater than 60%. (Bajpai, et al., 2017). One of the standardized tests has been the Students Stress Scale, and its validity and reliability have been proven. The reliability of the tool is 0.878.

Test Anxiety: The scale was developed by Sharma, V. P. (2000). The questionnaire has 25

items, each having 5 response opinions, ranging from minimum to maximum test anxiety. The reliability of the scale was .92.

The study population consists of nursing students from the different colleges of the Kerala University of Health Science, Kozhikode district, Kerala state, India. Incredibly, 180 students from Baby Memorial College of Nursing, 193 Government college of nursing .150 National hospital college of nursing. The total population consists of 523. By random sampling method, 75 students were from the Baby memorial college of nursing, 78 were government nursing students, and 55 were from the National hospital college of nursing. So the present study involved 208 students (39.7% of the total population).This present study used a quantitative method, correlation study, to determine the degree of relationship between two variables stress and test anxiety. For variable stress, nine dimensions were included in the scale. For the test anxiety variable, the level of test anxiety was measured using 4 point scale. Data obtained from the variable were analyzed through inappropriate tests of the international Business Machines Corporation (IBM) Statistical Package for the Social Sciences (SPSS, version 20).

Results

From table 1, it was noticed that test anxiety was found to be strongly associated with stress related to familial, social, educational, ego threat, bereavement, and personal setbacks. Furthermore, total stress was also positively associated with test anxiety. Stress due to finances, separation, and health of others did not have any significant association with test anxiety.

Table 1: Correlation between stress and text anxiety among students

Stress	Test anxiety
Financial stress	.097
Family stress	.183**
Social stress	.148*
Education	.296**
Ego Threat	.175*
Bereavement	.166*
Separation	.100
Personal set back	.344**
Health of others	-.010
Total stress	.294**

Note: **p<.01; *p<.05

From table 2, it was observed that there was a significant difference in test anxiety based on gender, year of study, and area of living. Girls had a higher score than boys (M=87.25 vs M=83.90). First-year students scored higher in their test anxiety than final-year students (M=86.01 vs M=84.59). Furthermore, students from rural areas scored higher in their test anxiety than students from urban areas (M=85.64 vs M=84.85).

Table 2: Differences in test anxiety by demographic categories

Variables	Category	N	M	SD	t-value
Gender	Male	123	83.90	0.75	19.425*
	Female	85	87.25	1.69	
Year of studying	First year	100	86.01	2.01	5.279*
	Final year	108	84.59	1.85	
Area of living	Rural	110	85.64	2.03	2.805*
	Urban	98	84.85	2.01	

Note: *p<.05

Table 3 demonstrated the influence of stress on test anxiety among students. It was clear from that table that stresses due to ego threat, and the health of others had a significant impact on test anxiety whereas stress due to financial, family, social, education, bereavement, separation, and personal setback did not have any significant impact.

Table 3: Influence of stress on test anxiety among students: Regression analysis

Predictors	Un-standardized coefficient		Beta	't' value	p value	Model Summary
	B	Std. Error				
Financial stress	-.069	.041	-.143	1.686	.093	F = 4.537 R = 0.433 R^2 = 0.187
Family stress	-.035	.037	-.110	.940	.349	
Social stress	.008	.043	.018	.197	.844	
Education	-.022	.030	-.153	.731	.466	
Ego Threat	-.090	.036	-.357	2.497	.013	
Bereavement	.072	.047	.128	1.528	.128	
Separation	-.140	.083	-.193	1.677	.095	
Personal set back	.056	.044	.148	1.272	.205	
Health of others	-.119	.048	-.263	2.507	.013	
Total stress	.052	.027	.921	1.937	.054	

Note: *p<.05

Discussion

The present study aimed to determine the influence of stress on test anxiety among nursing students. Stress related to family, social, education, ego threat, bereavement, and personal set back was positively associated with students' test anxiety [Table 1]. The academic success of the students is significantly influenced by the family environment. Students with educated parents typically perform well in school, which helps them avoid test anxiety. Studies also revealed that students whose mothers had educational levels between elementary school and a high school diploma had significantly lower test anxiety (Kurt et al., 2014). A peaceful study environment, family financial support, social support, and participation in social activities are recommended to lessen exam anxiety (Kurt et al., 2014). Students may experience test anxiety due to the aforementioned factors' inadequacy. Lists of significant traumatic life experiences, including the loss of a loved one or close relative, may cause test anxiety in students. Students evaluate themselves based on their grades, with high regard for themselves emerging from a good mark. Such evaluation of oneself can occasionally result in ego threat as a result of a challenge to one's self-image or self-esteem.

Girls had a higher level of test anxiety compared to their counterparts [Table 3]. In general, female students usually report higher levels of test anxiety than their male peers (Núñez-Peña et al., 2016). In a study to gauge students' test anxiety, Nez-Pea et al. (2016) showed that female students reported higher levels of test, math, and trait anxiety, as well as greater, predicted anxiety in three of the four test conditions taken into account. These results are consistent with the current findings. Earlier studies on test anxiety also focused on gender differences, and it was repeatedly found that female students have higher test anxiety levels than male students. (Bandalos et al., 1995).

Additionally, it was observed that first-year students had more test anxiety than third-year students [Table 2]. Being a first-year student, having a heavy course load, and taking an oral exam are some of the elements that influence students' test anxiety. Additionally, students test anxiety is independently predicted by a lack of a systematic study plan, low social support, moderate social support, and psychological suffering (Tsegay et al., 2019).In the line with the current findings, Tsegay et al. (2019) demonstrated that first-year students had 10 times higher risk of developing test anxiety

than final-year students did and that having an excessive course load was 6 times higher in developing test anxiety compared to final-year students.

Furthermore, students from rural areas had a higher level of test anxiety than students from urban areas [Table 2]. Due to their general lack of preparation or fear of exam outcomes, students from rural areas tend to worry more and have higher levels of test anxiety than students from urban areas (Lohiya et al., 2021). Similar results have been reported by earlier studies (Deepika& Asha, 2013; Nweze, 2014); the reasons postulated are infrequent exposure to evaluative situations, economic disadvantage, and deprivation of exposure to educational facilities (Von Der Embse et al., 2013).

Moreover, it was revealed that exam anxiety among students was significantly predicted by stress due to ego threat and other people's health [Table 3]. Test anxiety is "the set of cognitive, physiological, and behavioral responses that accompany concern about possible negative consequences or failure on exams or similar evaluative situations" (Zeidner (2007). It creates "excessive amounts of concern, worry, and fear about negative evaluation during or in anticipation of performance or evaluative situations" (Goonan (2003,). In other words, individuals are afraid of getting embarrassed by their unsatisfactory performance since they consider it as a threat to their ego or self-esteem (Putwain, 2008; Goonan, 2003; Sapp, 1999) and consequently, they either avoid evaluative situations or experience excessive stress if they cannot flee from being tested (Sarason, 1978). Test anxiety appears in specific situations or contexts where one's performance is being evaluated and it has an evident social aspect due to the concerns with how that performance will be judged by others (Putwain, 2008).

Conclusion

It was revealed that stress related to familial, social, education, ego threat, bereavement, and personal setbacks were directly correlated with test anxiety. Financial stress, separation, and the health of others had no significant relation with test anxiety. There was a notable change in test anxiety based on sex, year of study, and area of residence. In test anxiety, girls scored higher than boys. Test anxiety was higher in first-year students than in final-year students. Besides, that rural students scored higher than urban students.

Recommendation

In light of these findings, the researcher concluded that students who have high levels of stress and test anxiety should be trained and motivated to apply appropriate coping skills. Stress management programs should be included in the student's curriculum. To study the needs of the students and efficiently achieve their academic goals, higher authorities should organize orientation, seminars, regular stress management programs, and guidance and counseling services.

References

Augusto-Landa, J. M., & López-Zafra, E. (2010). The Impact of Emotional Intelligence on Nursing: An Overview. *Psychology, 1,* 50- 58.

Bandalos, D. L., Yates, K., & Thorndike-Christ, T. (1995). Effects of math self-concept, perceived self-efficacy, and attributions for failure and success on test anxiety. *Journal of Educational Psychology, 87*, 611-623.

Bartlett, M.L, Taylor ,H and Nelson J.D. (2016). Comparison of Mental Health Characteristics and Stress between Baccalaureate Nursing Students and Non-Nursing Students. *Journal of Educational Psychology, Feb;55*(2):87-90. doi: 10.3928/01484834-20160114-05. PMID: 26814818.

Deepika, V., & Asha, C. (2013). Study of academic anxiety among rural and urban adolescent girls. *Asian Journal of Home Science, 8*(1), 128-130

Desai M, Pandit U, Nerurkar A, Verma C, Gandhi S. Test anxiety and procrastination in physiotherapy students. *Jornal of Educational Health Promotion. 2021 May 20;10:*132. doi: 10.4103/jehp.jehp_851_20. PMID: 34222507; PMCID: PMC8224484.

Goonan, B. (2003). Overcoming test anxiety: Giving students the ability to show what they know. In J. E. Wall & G. R. Walz (Eds.), Measuring up: Assessment issues for teachers, counselors, and administrators (pp. 257–272). The University of North Carolina Press.

Jones, M. C., & Johnston, D. W. (1997). Distress, stress and coping in first-year student nurses. *Journal of Advanced Nursing, 26* (3), 475- 482.

José M. Augusto Landa, Manuel Pulido Martos and Esther Laópez Zafra University of Jaén, spain.(2011).Nursing Professionals and Nursing Students' Stress and Concerns Associated to Clinical Practice online book, Nova science publishers.

Kurt, A. S., Balci, S., &Kose, D. (2014). Test anxiety levels and related factors: Students preparing for university exams. *Journal of Pakistan Medical Association, 64*(11), 1235-9.

Lazarus, R. S and Folkman, S. (1984). Stress, Appraisal, and Coping. New York: Springer.

Lazarus, R. S and Folkman, S. (1986). Cognitive theories of stress and the issue of circularity. In M H Appley and R Trumbull (Eds), (1986). Dynamics of Stress. Physiological, Psychological, and Social Perspectives (pp. 63–80). New York,: Plenum. Abstract-PsycINFO | $Order Document.

Lazarus,R.S and Launier, R. (1978). Stress-related transactions between person and environment. In L A Pervin and M Lewis (Eds), (1978). Perspectives in Interactional Psychology (pp. 287–327). New York,: Plenum

Lazarus, R. S. (1966). Psychological Stress and the Coping Process. New York: McGraw-Hill.

Lazarus, R. S.(1974). Psychological stress and coping in adaptation and illness. International Journal of Psychiatry in Medicine, 5, pp. 321–333. Abstract-EMBASE | Abstract-PsycINFO | Abstract-MEDLINE | $Order Document.

Lazarus, R S, (1990). Theory-based stress measurement. Psychological Inquiry, 1, pp. 3–13. Abstract-PsycINFO | $Order Document

Lazarus, R. S.(1991). Emotion and Adaptation. New York: Oxford University Press.

Lazarus, R.S. (1993). Coping theory and research: Past, present, and future. Psychosomatic Medicine, 55, pp. 234–247. Abstract-EMBASE | Abstract-PsycINFO | Abstract-MEDLINE | $Order Document

Lindholdt, L, Labriola, M, Andersen J.H, Kjeldsen M-MZ, Obel C, Lund T. (2022) Perceived stress among adolescents as a marker for future mental disorders: A prospective cohort study. *Scandinavian Journal of Public Health; 50*(3):412-417. doi:10.1177/1403494821993719.

Lindop, E. (1999). A comparative study of stress between pre- and post Project 2000 students. *Journal of Advanced Nursing, 29* (4), 967- 973.

Lohiya, N., Kajale, N., Lohiya, N., Khadilkar, A., Khadilkar, V., Gondhalekar, K., &Agarkhedkar, S. (2021). Test anxiety among school-going children and adolescents, factors affecting and impact on quality of life: a multicenter study. *Indian Journal of Pediatrics, 88*(9), 892-898.

May, N., Fontaine, D. K., Cunningham, T. (2021). Self-Care for New and Student Nurses. United States: Sigma Theta Tau International.

Mukthar Basha, K., Rajendra Nath Babu, M. (2013). Test-Anxiety and Students. Germany: Lap Lambert Academic Publishing GmbH KG

Núñez-Peña, M. I., Suárez-Pellicioni, M., & Bono, R. (2016). Gender differences in test anxiety and their impact on higher education students' academic achievement. *Procedia-Social and Behavioral Sciences, 228*, 154-160.

Nweze, T. (2014). Assessing the level of test-anxiety manifestation among junior secondary school students in Ebonyi state. *Journal of Educational Policy and Entrepreneurial Research, 1*(1), 1-14.

Porterfield, J. (2013). Teen Stress and Anxiety. United States: Rosen Publishing Group.

Pryjmachuk, S., & Richards, D. A. (2007). Predicting stress in preregistration nursing students. *British Journal of Health Psychology, 12* (1), 125-144.

Putwain, D. W. (2008). Deconstructing test anxiety. *Emotional and Behavioural Difficulties, 13*(2), 141-155. https://doi.org/10.1080/13632750802027713

Sapp, M. (1999). Test anxiety: Applied research, assessment, and treatment interventions. New York: University Press of America.

Sarason, I. G. (1978). The test anxiety scale: Concept and research. In C. D. Spielberger& I. G. Sarason (Eds.), Stress and Anxiety (pp. 193-216). Washington, DC: Hemisphere.

Sawka-Miller, K.D. (2011). Test Anxiety. In: Goldstein, S., Naglieri, J.A. (eds) Encyclopedia of Child Behavior and Development. Springer, Boston, MA. https://doi.org/10.1007/978-0-387-79061-9_2890

Selye, H, (1976). The Stress of Life (rev. edn.). New York: McGraw-Hill.

Thomas, T., Joseph, G., & Paul, S. (2022). A Study to assess the Correlation between Academic Test

Anxiety and Self-Esteem among Undergraduate Students. *Journal of Health and Allied Sciences NU*.

Thyer, S. E., & Bazeley, P. (1993). Stressors to student nurses beginning tertiary education: An Australian study. *Nurse Education Today, 13* (5), 336-342.

Timmins, F., & Kaliszer, M. (2002) . Aspects of Nurse education programmes that frequently cause stress to nursing students – fact finding sample survey. *Nurse Education Today, 22* (3), 203-211.

Torrano, R., Ortigosa, J. M., Riquelme, A., & Méndez, F. J. (2020). Test Anxiety in Adolescent Students: Different Responses According to the Components of Anxiety as a Function of Sociodemographic and Academic Variables. *Frontiers in Psychology, 11*. https://doi.org/10.3389/fpsyg.2020.612270.

Tsegay, L., Shumet, S., Damene, W., Gebreegziabhier, G., &Ayano, G. (2019). Prevalence and determinants of test anxiety among medical students in Addis Ababa Ethiopia. *BMC medical education, 19*(1), 1-10.

Voltmer, E., Köslich-Strumann, S., Voltmer, JB. et al. Stress and behavior patterns throughout medical education – a six year longitudinal study. *BMC Med Educ. 21,* 454 (2021). https://doi.org/10.1186/s12909-021-02862-x

Von Der Embse, N., Barterian, J., &Segool, N. (2013). Test anxiety interventions for children and adolescents: A systematic review of treatment studies from 2000–2010. *Psychology in the Schools, 50*(1), 57-71.

Zeidner, M. (1998). An Introduction to the Domain of Test Anxiety. In: Test Anxiety. Perspectives on Individual Differences. Springer, Boston, MA. https://doi.org/10.1007/0-306-47145-0_1

Zeidner, M. (1998). Test anxiety: The state of the art. New York: Kluwer Academic Publishers.

Zeidner, M. (2007). Test anxiety in educational contexts: Concepts, findings, and future directions. In P. A. Schutz & R. Pekrun (Eds.), Emotion in education (pp. 165-184). CA: Academic Press.

https://learningcenter.unc.edu/tips-and-tools/tackling-test-anxiety/

https://poliklinika-harni.hr/images/uploads/440/teorije-nastanka-stresa.pdf

https://www.google.co.in/url?sa=i&url=https%3A%2F%2Fnovapublishers.com%2Fshop%2Fnursing-professionals-and-nursing-students-stress-and-concerns-associated-to-clinical-practice.

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Chapter 17

BIOLOGICAL ACTIVITIES OF *OCIMUM SCANTUM* L. – AN OVERVIEW

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ABSTRACT

The therapeutic uses of plant are considered as safe, inexpensive and efficient as their ease of availability. Tulsi is recognized as the "Queen of herbs "and "Nature's Mother Medicine." Tulsi, also known as *Ocimum sanctum*, is an herb with powerful anti-disease qualities. In the Indian subcontinent, it is revered as a divinity. *Ocimum sanctum* Linn. (Labiateae or Lamiaceae) include 30 species that grow in tropical and subtropical climates. This plant belongs to lamiaceace family and characterized by square stem and specific smell Essential oil is extracted from the leaves and blooming tops. The oil of *Ocimum sanctum* contains five fatty acids (stearic, palmitic, oleic, linoleic, and linolenic acids). Tulsi is a medicinal plant present in India recognized and valued for its medicinal and therapeutic use. Several medicinal properties of Tulsi are present in the roots, leaves and seeds. It has a wide range of action on the human body. It heals many diseases chronically due to its chemical constituent and believes that it has Anti-ageing, Immunomodulatory property along with antimicrobial and anticancer property. Tulsi is famous for its vital role in the conventional ayurvedic and unani systems of body fitness health and herbal medicine of the East. The biological functions of holy basil are fully summarized in this chapter.

KEYWORDS: *Ocimum sanctum*, eugenol, Anti-cancer, Anti-oxidant effect.

INTRODUCTION

The Lamiaceae plant family has a wide variety of medicinally significant plants that are used to treat and prevent a wide range of illnesses. Basically, There are more than 6000 species in 236 genera belong to lamiaceace family. The Lamiaceae family's major genera include Plectranthus, Scutelleria, Stachys, and Salvia Vitex, Thymus, Nepeta, Hyptis, Teucrium, the medicinal potential of these herbs Genus is due to the existence of a diverse array of phytochemicals such as flavonoids, alkaloids, and saponins content of polyphenols. Many academics have described a number of bioactive potentials of Various Lamiaceae genera display biological diversity. Actions such as cardio protective, antibacterial, anti-inflammatory, anti-inflammatory, anti-diabetic, and antioxidant effects.

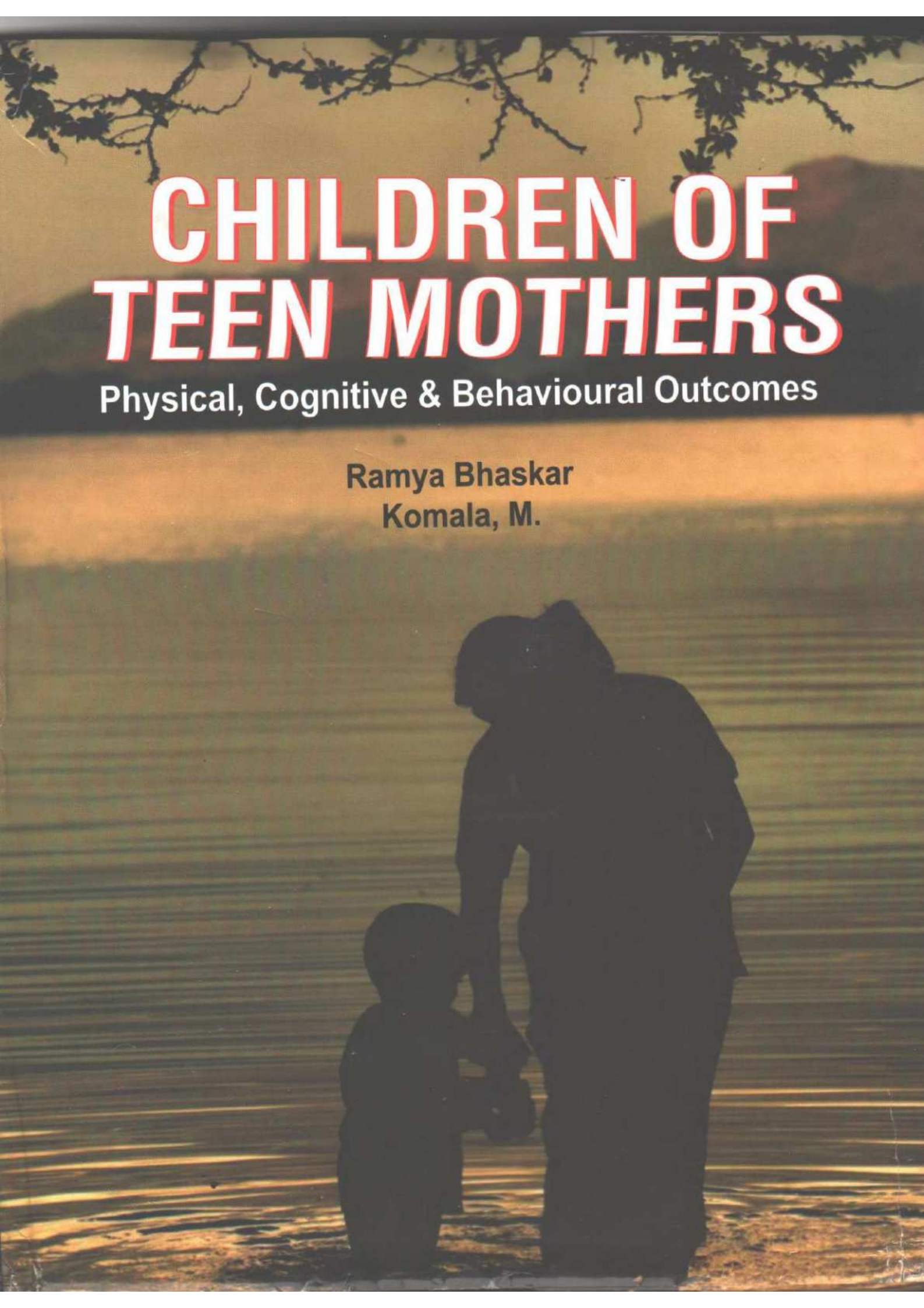
There are more than 150 species in the genus Ocimum, including *Ocimum tenuiflorum* L. (holy basil), *Ocimum gratissimum* (African basil), *Ocimum basillicum* (sweet basil), and *Ocimum ammericanum*. It has been established that this genus of plants has a number of key bioactivities for medicine, including antifungal, antinociceptive, anticonvulsant, antioxidant, germicidal, and antimalarial activities. These Ocimum genus members have outstanding therapeutic potential and medicinal qualities. Holy basil or tulsi are common names for *Ocimum tenuiflorum*.

Tulsi has been described as of two types- vanya (wild) and gramya (grown in homes). Since ancient times, Tulsi has been used for therapeutic purposes. Tulsi is utilized in a variety of ways, including as an

CHILDREN OF TEEN MOTHERS

Physical, Cognitive & Behavioural Outcomes

Ramya Bhaskar
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Teenage pregnancy is one of the significant public health problems in today's world, even though it is a preventable condition but associated with negative sequelae for both teen mothers and their children. World Health Organization fact sheet report indicates that 16 million children are born to women under the age of 20 worldwide during the last decade. India is no different in the issue of teenage pregnancy. According to NFHS 5 data, 122,544 women i.e. 6.8% of women aged 15-19 have had a live birth (4.5%) and are pregnant with the first child (2.3%). Even though there has been a declining trend in teenage pregnancy in India, the problems associated with teen pregnancy have not been solved yet. Teenage pregnancy continues to occur within marriage, usually arranged by parents and family members. Teenage pregnancy is almost double in rural areas i.e. 9.2%, as compared to urban i.e. 5% in India.

Teenage pregnancy comes with heavy baggage with a double burden which manifests itself in multiple issues related to social, economic, educational, and health aspects. It is well documented on the effects of teenage pregnancy on maternal outcomes. But less documented on child outcomes. A child of teen mothers often faces numerous risks such as pregnancy complications. low birth weight, health problems, lower IQ and academic achievement including repetition of a grade, and socio-emotional problems. Although there are variations in the findings of teenage pregnancy and its effects on child outcomes, it is observed that the effects are decided by other variables such as parenting, parental quality, and socioeconomic conditions. Nevertheless, whatever the cause may be, the long-term implication on the children's physical, cognitive and behaviors are of serious concern for research in child development. Scientific research studies play a crucial role in developing in-depth knowledge as well as developing interventions that positively affect the growth and development of children of teen mothers.



Dr. Ramya Bhaskar, Assistant Professor, Department of Human Development, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, has 14 years of teaching experience in UG and PG programs in Human Development. In this span of teaching and research she has developed a keen interest in Adolescent and Child Development, Guidance and Counselling, and Early Childhood care and Education. She has been guiding scholars in their doctoral research. She has published research articles in various reputed national and international journals and has more than forty presentations at various conferences and seminars. She completed her Post-Doctoral Research awarded by UGC-DSRPDFHSS in the year 2015 and subsequently won the mid-career award at the 33rd Biennial Conference of the Home Science Association of India (HSAI) in the year 2020.



Dr. Komala M. has been serving as a Professor of Human Development and a Chairperson of the Department of Studies of Food Science and Nutrition, University of Mysore, Manasagangotri, Mysore. She has also been serving as a Coordinator of Mysore University Day Care Centre, Manasagangotri Campus, Mysore. She has 27 years of teaching and 23 years of research experience in Human Development and Family Studies. Under her able guidance four candidates were awarded Ph.D. Degree and 7 students are working, one candidate completed Post-Doctoral Research and two are working as Post-Doctoral-Fellows. She has guided more than 70 students for their M.Sc. Dissertation research work. So far, she had published 33 research articles, edited one book, and authored 16 chapters in edited books. Prof. Komala M. had participated in 77 and presented 127 research papers in Conferences/Seminars of national and international fame. As one of the authors, she had written the chapters for the Human Development Report- 2014 of Mandya district and the Human Development Report- 2014 of Chamarajanagar district of Karnataka State. She had also written lesson plans for the certificate course in Pre-school Education (2009) and the Diploma Program in Nutrition and Health Education (2013) of Karnataka State Open University, Manasagangotri, Mysore. She had involved herself as a co-investigator in a research project of MHRD, New Delhi, under the Institute of Excellence scheme, University of Mysore, Mysore as well as in the ICMR Project. Prof. Komala had reviewed research papers for the International Journal of Educational Sciences, KRE publishers, New Delhi, and she is serving as a member of an editorial committee in Pratibimba - Multidisciplinary Kannada research journal of Indian Institute of Multidisciplinary Research and Development as well as in Apoorv Knowledge – International Journal of Multidisciplinary Research Mumbai.

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Tourism in Crisis



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Introduction

Tourism in Crisis: New Problems, New Paradigms

Maximiliano E. Korstanje*
University of Palermo, Argentina

Introduction

Over recent years, the industry of tourism comes across different global [major] risks. These risks included terrorist attacks, natural disasters resulting from the acceleration of climate change as well as political instability, economic downturn, and the recent COVID-19 pandemic [only to name a few]. To put the same bluntly, the turn of the twentieth century witnessed a radical transformation in tourist demand and travel behavior worldwide (Korstanje & George 2021). Borrowed from psychology, risk perception theory shed originally the light on the first applied works oriented to describe how tourist demands evolve to these global risks. Of course, although risk perception theory has more than four decades in the fields of psychology and sociology, the attacks perpetrated by Al-Qaeda in 2001 paved the way for the rise of different studies mainly based on how tourists perceive risks and dangers (Fuchs & Reichel 2006; Yang & Nair, 2014). To some extent, the goals of these studies were twofold. On one hand, they have systematically striven for implementing different instruments and protocols to make destinations safer. Through the inference of algorithms and statistical methods, these publications contributed to the decision-making process for making safer destinations. On another, risk perception theory played a leading role in describing [if not measuring] the evolution of the international demand to some disrupting events. In so doing, these studies were based on large samples and questionnaires applicated to tourists in the most important travel hubs, airports, and stations (Floyd & Pennington Gray, 2004). Having said this, the risk perception theory started from the premise that risks are often perceived and internalized according to manifest variation by age, ethnicity,

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culture, ideology, and of course genre (Reisinger & Mavondo, 2006; Rather 2021). Knowing further how these risks are construed and lived is an efficient manner to placate their potential effects (Korstanje, Seraphin & Maigni, 2021). At a closer look, this corpus of studies emphasized quantitative methods while relegating the qualitative ones to a marginal position. It is not otiose to mention that tourism safety and security and risk management occupied a central position in the published content of top-tiered journals from 2001 to 2012 (Qian et al. 2019; Wang et al. 2019).

Somehow, the burgeoning growth of tourism made it more difficult to mitigate the consequences of global risks. Problems like terrorism or climate change have been simply aggravated in the threshold of time. New more radicalized cells perpetrated new attacks in France, Spain, Belgium, the UK, and the US. At the same time, governments failed to coordinate efforts toward a more sustainable agenda for the next decades. The precautionary doctrine which is the cornerstone of the risk perception theory as a leading paradigm sets the pace for new understandings and academic positions. The concept of precaution was plausibly replaced by adaptation. Post-disaster or post-conflict tourism and crisis tourism evolved as leading paradigms since 2012 to date. Likewise, scholars acknowledged overtly the urgency to contemplate the notion of crisis as a necessary component of the tourist system (Valeri 2022; Korstanje, Seraphin & Maigni, 2022). In sharp contrast with risk perception theory, post-disaster research focuses not only on the immediacy of the disaster but also on the need of co-existing with a potential crisis (Isaac, Cakmak & Butler 2019). It Is important to mention the concept of crisis never means the end of tourism consumption, but the opportunity for a new rebirth. The survival of a tourist destination depends on how efficiently crises are ultimately managed (Ritchie & Jiang 2019). What is more important to discuss, the COVID-19 pandemic grounded the international tourism industry into an unparalleled halt but paradoxically hid some other terminal crises as the humanitarian disaster of migration, the ecocide, as well as the material asymmetries between the Global South and North (Tzanelli 2021; Bianchi 2021). As Rodanthi Tzanelli (2021) eloquently observes, the crisis of mobilities elicited by the COVID-19 pandemic evinces two important things. At a closer look, the concept of virocene not only speaks to us of the circulation of different viruses which confront mankind but also marks the hegemony of bio-discourse. The spirit of globalization and grand mobilities that historically characterized capitalism has gone. COVID-19, instead, inaugurates a climate of low mobility but higher uncertainty that crystalizes in a political crisis. In this respect, lay citizens manifest their hostilities against

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authorities and foreigners. In a post-covid-19 world, the figure of the "Other" has been redrawn. For the sake of clarity, this moot point will be re-addressed in the end of this piece.

The present editorial project, which is drawn by book chapters authored by well-known experts who are global scholars in their fields, put the concept of the tourism crisis into the foreground. As debated, crises [as social construes] have been somehow overlooked from the academic discussion (Gale 2008). As their main object of study, tourism research ignored the important role played by crises in the configuration of the tourist system. The two World wars, not only accelerated a radical revolution in the transport system but also cemented a new worldmaking process [citing Hollinshead 2009a; 2009b; 2007].

As the previous backdrop is given, the first chapter, which is authored by Cyril Peter & Lim Kuang Long, discusses critically the place of safety in individual and collective travel plans. Having said this, the chapter looks to interrogate furtherly to what extent guests are willing to pay further for safer rooms. With echoes of the earlier terrorist attack in Christchurch, New Zealand [2015], authors hold the thesis that safety and security have been situated as new perceived facilities that often make more expensive tourist products. At a closer look, the specialized literature suggests that safety and security are ranked as more desirable when they are out from home. Under some conditions, foreign tourists not only are vulnerable to the locals` hostility but when tourists are vulnerated the social contract is breached. The tourism industry has expanded successfully and evolved according to a much deep social contract between hosts and guests. While terrorist groups look to harm tourists to destroy this social contract, no less true seems to be that hotels are public spaces with open entrances and exist. Terrorism is mainly motivated to affect the credibility of local governments stressing their incapacity to protect foreign tourists. In this way, terrorism accelerates a political crisis affecting seriously international destinations but paradoxically [at the same time] it builds the pathways for new products associated with safety and security. To put this simply, a safer New Zealand is globally preferred and ranked as a hallmark in the marketing campaign. Hence, it is not simply to say that marketing campaigns, terror, and engagement are inseparably entwined.

In the second chapter, Maximiliano Korstanje makes mentions the long-lasting effects of COVID-19 not only in the tourism industry but also in travel behavior. The COVID-19 pandemic, doubtless, opened the doors to an unparalleled crisis for the industry as well as for global trade. Governments imposed several restrictive measures to stop the virus contagion. This leads us

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to consider that tourism was not only the main carrier but also the main victim of COVID-19. In consonance with this, Governments entered into a crisis of sense where shared coordination and protocols simply fell short. While each country adopted different measures and steps to restrict public circulation, a new process of re-feudalization emerged. Global capitalism, as well as the international tourism industry, has set the pace for unseen geopolitical tensions, heavy travel bans, and even a sentiment of hostility against Asian [foreign] tourists. The question of whether J. Urry (1992) contemplated the tourist gaze as a magnificent figure of globalization, sets the pace to a new [dark] world where tourists became undesired guests. To what extent COVID-19 ignites a state of crisis in the industry or simply evinces the end of an epoch seems to be one of the aspects this book chapter unravels. Any state of crisis puts new challenges but at the same time new opportunities for evolution.

The risk perception theory has gained notable traction in recent years. The number of credited publications has exponentially grown. Anyway, less attention was paid to the role played by travel insurance as a key factor that predicts the levels of anxiety in travelers. The third chapter which is authored by Varghese, Sandhya & Thomas explores travel insurance as a fertile method to study risk perception in the context of tourism and hospitality. Having said this, travel insurance signals any type of full or partial coverage for travel which includes medical expenses, as well as any hurts incurred during the travel. In some nations, travelers are compelled to buy travel insurance as a precondition for migratory authorities. In other countries, travel expenses [which are based on expensive costs] are unfree and should be absorbed by tourists. The authors distinguish two types of profiles in travel insurance consumption. Those tourists who developed a high tolerance for uncertainty and those tourists who are prone to buy travel insurance when they travel abroad. Ultimately, they enumerate a list of interesting ethical dilemmas revolving around travel insurance as well as business travel.

In the fourth chapter, Keziah Odemba & Maingi Shem W. shed light on the necessary steps and protocols to mitigate the negative consequences of the COVID-19 pandemic in the Eastern Africa Region. This region not only has been devastated but also faces serious challenges in coping with the post-COVID-19 pandemic context. With the basis of the theory of resiliency and preparedness, the authors eloquently explain that there are several obstacles to planning strategies before disasters. The concept of crisis escapes any type of planning. The authors review systematically a set of different documents and studies that focus on tourism policy preparedness as well as the importance of post-pandemic practices and policies. The book chapter enumerates and

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carefully reviews a set of interesting and useful recommendations to be seriously taken by policymakers in the next decades.

As the previous argument is given, dark tourism occupies a central place as an instrument towards economic revitalization just after a disaster takes a hit. In consonance with the earlier chapter, Korstanje argues that the globalization of risks not only is placing the industry in jeopardy but also in creating new morbid forms of consumption where disaster becomes the main commodity to exchange. In this vein, if the precautionary logic which punctuated that studies should locate and eradicate risks failed to give responses to the new challenges, no less true seems to be the notion of adaptancy has played a leading role in the new tourism research. Like dark tourism or post-disaster tourism, new emerging paradigms emphasize the importance of adaptancy and preparedness to mitigate the negative effects of disasters. This is exactly the lesson left by COVID-19 or the attacks on the World Trade Center. The concept of crisis is very hard to grasp while escaping human control. This book chapter lays the foundations towards a new understanding of Thana-capitalism, which signals a new stage of capitalism where the "Other`s pain" is the main commodity to consume.

In the sixth chapter, Thiago Duarte Pimentel, Elias Mediotte, Paulo Rodrigues Cerqueira, Marcela B. Costa de Olivera, Mariana Pereira Chaves Pimentel and Stella Freesz examine the negative aftermaths of COVID-19 in the tourism industry in Juiz de Fora, Brazil. The chapter is originally orchestrated within the organizational ecology paradigm. The chapter aims to study how firms and subsectors not only move in a context of crisis but also how they ultimately survive. In this vein, the concept of adaptation plays a leading role in the future of the industry. The main thesis here is that firms and sectors are pressed to mutate to new forms because of external changes (threats) like COVID-19. In so doing, firms should turn their attention to the environmental factor.

The seventh chapter, which is authored by Maximiliano E. Korstanje, discusses critically to what extent the current tourism research enters a state of crisis as never before. Today`s scholars have enthusiastically applauded the introduction of metrics and the culture of publishing or perishing as a valuable option to enhance tourism research. From this perspective, the culture of metrics contributes directly to discipline maturation. Of course, some critical voices have alerted on the methodological limitations of the metrics culture as well as the problems associated with higher tourism education. Needless to say, in this direction the present book chapter goes. The recent over-valuation

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of the metric culture not only is wreaking havoc in professional fieldwork but also is leading the discipline into an unparalleled crisis.

After further examination, a correct definition of crisis is very hard to accomplish. This happens simply because there is no lineal definition of what a crisis means or what is more important its real impact on society. To some extent, the question of crisis seems to be incompatible with well-being and sustainable tourism. This point is widely discussed in the eight chapter, which is authored by K. P Anju, V. T Bindu & Babu George. Responsible tourism should be seen as a valid strategy towards safer and most resilient destinations. Having said this, one of the benefits of responsible tourism is associated with the control of crises. It is important not to lose sight of the fact that tourism growth often escapes to the nation-states` control. Unless dully regulated by other stakeholders or organizations, tourism accelerates a countless number of crises. At the time the precautionary doctrine failed to make safer destinations, the concept of responsible tourism and well-being tourism occupied a central position in the debate. The chapter is oriented to address two important questions: what are the methods to promote RT through wellness tourism practices? and how are responsible tourism practices situated at wellness centers minimizing tourism crises? Here authors open the doors towards a new type of sustainable practices finely organized in Ayuverdic therapies. Through well-being tourism, the involved stakeholders engage directly with a shared common good which avoids future disasters.

The question of responsibility straddles the classic application of environmentalism or sustainability. Being accountable or responsible draws the lines between rationality and the ability to make an individual decision. To put the same simply, responsibility plays a crucial role in indicating who are autonomous agents and those who are not. One of the young [promising] researchers in the field of special interest tourism, Bintang Handayani argues convincingly that even if the specialized literature in special tourism has advanced a lot in these years, little information is found on pets on vacation. To some extent, this happens because tourists are rational agents who are legally encouraged to visit different places, but the same does not apply to pets. However, the inclusion of pets in holidays enhances the personal quality of life. In this vein, knowledge production on pet vacation is not only needed but an urgent step to imagine the figure of the non-human tourist. Over the years, tourism was legally reserved for humans while non-humans have been systematically debarred from any leisure practice. During the COVID-19 pandemic, many families decided to travel with their pets for protection or an

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as a form of relational engagement. This triggers a hot-debate revolving around the new travel behavior in a troubled world while laying the foundations towards a much deep reconfiguration that transcends the classic definitions of tourism. The book chapter, which is based on Munar`s works, considers innovative epistemic discussions on pet tourism and social responsibility amid an unparalleled crisis for the tourism industry.

Last but not least, there is an interesting debate given in the core of English-speaking countries regarding the center-periphery dependency just after the COVID. In her new trailblazing book titled Cultural immobilities and the virocene: mutating the crisis, Rodanthi Tzanelli (2021) argues convincingly that there is a sharp inconsistency between the state of crisis accelerated by the COVID-19 pandemic, and the real challenges posed by mankind in the years to come. Beyond the promises of the de-growth tourism and sustainability paradigms, the post-COVID-19 world is mainly characterized by geopolitical tensions, frictions, and much deep sentiment of hostility against foreigners. Not only the effects on the tourism industry have been devastating [if not irreversible in some sectors] but also enacted a type of new biopolitical discipline based on the medical discourse. Having said this, the pandemic refers to a plague that often escapes to the control of nation-states. However, a closer insight suggests that this emergent state of crisis is culturally enrooted in a set of new emerging crises such as illegal migration, ethnic violence or racism, ecological pollution or the problems of states to reverse climate change, massive population and overcrowding, without mentioning human trafficking and enslavement. While over-exaggerating the COVID-19 effects, we neglect [if not passively accept] the other most important emergencies. It is not difficult to resist the impression that that in a climate of high uncertainty and unpredictability medical reasoning is never questioned. What is more important, before the crisis the Anglo-World seems to evoke a colonial archive of the virocene. The question of whether the virocene is understood as a new epoch where viruses mold human action on the earth, no less true is that some long-dormant discourses [originally coined in the colonial period separating The European culture from the periphery] have ultimately surfaced. As Tzanelli put it, the sense of immobility imposed by governments derives into a climate of recrimination directed against the local governments and foreigners. To some extent, crises impair human relations. At the same time, the Global North has developed a sentiment of recrimination against Asia [above all China] and the rest of the periphery. Tzanelli`s book is very helpful to expand the current understanding of the effects of pandemics on the Western social imaginary. As discussed, the

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central nations [first of all the US and the UK] are engulfed in a narrative of separatism where the "Other", the stranger is now "an undesired guest". Foreign tourists [above all Asian tourists] as seen as silent carriers of a lethal virus. For that reason, they should be closely scrutinized and quarantined. Some critical voices have alerted on the hospitality crisis in the Anglo-World (Korstanje 2017; Korstanje & George 2021a; 2021b; Korstanje & Seraphin 2022; Selwyn, 2019). The question of blame and blameworthy have been widely studied by philosophy. By blaming the "Other" the normal social conditions or local rules, which have been breached, are restored. This, so to speak, suggests that blaming "Others" entails common shared values and norms that have been ultimately vulnerated. It is safe to say that blame-worthy is one of the glues of social cohesion. Anyway, what does happen when the stranger should be blamed?

To wit, George Sher (2013) goes not to answer this question acknowledging that the relational paradigm has no few problems to resolve the philosophical quandary revolving around the blame. The victim`s vulnerability echoes the intervention of the state, as a Leviathan, which punishes the wrong-doer. Put things in these terms, whenever the state takes direct action the victim has not the status of victim any longer. In consonance with this, Jacques Derrida calls the attention on the law of hospitality as the preconditions towards hostility. As he describes, at the time the stranger violates the local law, he is isolated and trialed by the state. The borders of hospitality collide with hostility, which sparks at the moment the law is breached. Given the problem, as Derrida understands, under some conditions strangers can be very well vulnerated and persecuted [as parasites in his words] when hospitality is negated. After all, hospitality can be given only when two questions are successfully answered: who are you and what do you want?

Not surprisingly, the COVID-19 pandemic not only woke up the Western hemisphere from the slumber it was, but also paved the ways for the emergence of countless separatist and racists discourses finely-ingrained to undermine the "stranger". It is important to remind that the figure of "neglected Other" has opened an unparalleled state of fear that invariably led the Western nations into a deep crisis (Korstanje 2017). Given this context, the present book is plausibly formed by global and well-versed authors who anyway come from peripheral nations. Their stances confront directly with the hegemonic discourse monopolized by the Global North. Part of the material published here has no place in the leading journals or the main narratives formed in the core of the Anglo-centrism. To some extent, this editorial project

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situates as a multicultural and multidisciplinary approach to understand the crisis the industry is facing today while laying new perspectives to understand the phenomenon. Humbly, this book appears to be an initial contribution to rethink tourism in a post COVID-19 world. Hence, we [the editors and invited authors] not only limit our analysis to the effects of the pandemic, but also we discuss other profound crises in the tourism industries which remain unlooked in the specialized literature. This begs some pungent questions: is the crisis of tourism the crisis of global capitalism? Or put more simply, the rise of a new re-feudalization process?

References

Bianchi, R. V. (2021). *Tourism, COVID-19 and crisis: The case for a radical turn. In Socialising Tourism* (pp. 93-108). Higgins-Desbiolles, F, Doering A & Chew B. (eds) Abingdon, Routledge.

Derrida J (2000) *Of Hospitality*. Stanford, Stanford University Press.

Floyd, M. F., & Pennington-Gray, L. (2004). Profiling risk perceptions of tourists. *Annals of Tourism Research*, 31(4), 1051-1054.

Fuchs, G., & Reichel, A. (2006). Tourist destination risk perception: The case of Israel. *Journal of Hospitality & Leisure Marketing*, 14(2), 83-108.

Gale, T. (2008). The end of tourism, or endings in tourism. *Tourism and mobilities: Local-global connections*, 1-14.

Hollinshead, K. (2009a). The "worldmaking" prodigy of tourism: The reach and power of tourism in the dynamics of change and transformation. *Tourism Analysis*, 14(1), 139-152.

Hollinshead, K. (2009b). 'Tourism state' cultural production: the re-making of Nova Scotia. *Tourism Geographies*, 11(4), 526-545.

Hollinshead, K. (2007). 'Worldmaking'and the transformation of place and culture: The enlargement of Meethan's analysis of tourism and global change. In *The critical turn in tourism studies* (pp. 187-216). Abingdon, Routledge.

Isaac, R. K., Çakmak, E., & Butler, R. (Eds.). (2019). *Tourism and hospitality in conflict-ridden destinations*. Abingdon, Routledge.

Korstanje M. E (2017). *Terrorism, tourism and the end of hospitality in the West*. Basingstoke, Palgrave Macmillan.

Korstanje, M. E., & George, B. (2021a). *Mobility and globalization in the aftermath of COVID-19: Emerging new geographies in a locked world*. Basingstoke, UK: Palgrave Macmillan.

Korstanje, M. E., & George, B. P. (2021b). *COVID-19 and the End of Hospitality: At Least as We Know It in the West. In Socio-Economic Effects and Recovery Efforts for the Rental Industry: Post-COVID-19 Strategies* (pp. 148-164). Hershey, IGI Global.

Nova Science Publishers, Inc.

Korstanje, M. E., & Seraphin, H. (2022). *A Problem Called Alterity: The Position of the 'Other'in HBO Saga Westworld. In Tourism Through Troubled Times* (pp. 7-20). Korstanje M. Seraphin H & Maingi S. W (eds). Bingley, Emerald Publishing Limited.

Korstanje, M. E., Seraphin, H., & Maingi, S. W. (Eds.). (2022). *Tourism Through Troubled Times: Challenges and Opportunities of the Tourism Industry in 21st Century*. Bingley, Emerald Group.

Qian, J., Law, R., Wei, J., & Wu, Y. (2019). Trends in global tourism studies: A content analysis of the publications in tourism management. *Journal of Quality Assurance in Hospitality & Tourism*, 20(6), 753-768.

Rather, R. A. (2021). Monitoring the impacts of tourism-based social media, risk perception and fear on tourist's attitude and revisiting behaviour in the wake of COVID-19 pandemic. *Current Issues in Tourism*, 24(23), 3275-3283.

Reisinger, Y., & Mavondo, F. (2006). Cultural differences in travel risk perception. *Journal of Travel & Tourism Marketing*, 20(1), 13-31.

Selwyn, T. (2019) "Hostility and hospitality: connecting Brexit, Grenfell, Windrush". In *Experiencing Hospitality*. B Rowson & C Lashley (eds) (51-72), Hauppauge, Nova Science Publishers.

Tzanelli, R. (2021). *Cultural (Im) Mobilities and the Virocene: Mutating the Crisis*. Cheltenham, Edward Elgar Publishing.

Sher, G. (2013). Wrongdoing and relationships: The problem of the stranger. *Blame: its nature and norms*, Coates J & Tognazzini N (eds). (49-65) Oxford, Oxford University Press.

Urry, J. (1992). The tourist gaze "revisited". *American Behavioral Scientist*, 36(2), 172-186.

Valeri, M. (Ed.). (2022). *Tourism Risk: Crisis and Recovery Management*. Bingley, Emerald Group Publishing.

Wang, J., Liu-Lastres, B., Ritchie, B. W., & Pan, D. Z. (2019). Risk reduction and adventure tourism safety: An extension of the risk perception attitude framework (RPAF). *Tourism Management*, 74, 247-257.

Yang, C. L., & Nair, V. (2014). Risk perception study in tourism: Are we really measuring perceived risk?. *Procedia-Social and Behavioral Sciences*, 144, 322-327.

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Chapter 1

Is Safety an Important Consideration When Making Travel Plans? An Interpretive Study of Guests' Perceptions

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Abstract

This research was conducted to understand guests' perceptions of security in New Zealand. Before COVID-19 lockdowns and closed borders (2019), international tourism expenditure accounted for $17.5 billion (Tourism Industry Aotearoa, 2021). In comparison, revenue from the dairy industry in 2019 was $18.11 billion (Hinton, 2022). Tourism is important to New Zealand and only second in earning potential to dairy. It makes a valuable contribution to the New Zealand economy. Hence, the reason for this research. The assumption from the onset was that to preserve and protect the tourism industry, security had an important part to play, especially with terrorism shifting its interest to softer targets. However, the specific needs want and expectations of tourists and hotel guests in New Zealand were not clear. Using interpretivism and semi-structured interviews, this study focused on hotel guests and their security expectations. A total of 10 guests participated in this study and they were each asked 10 questions. However, the responses to only eight

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of those questions have been analysed and presented in this article. The findings confirmed that security was a concern for guests when they made travel plans. It also found that most guests considered New Zealand to be safe.

A significant finding from this study was that guests were willing to pay extra for better-quality of security protocols. Well-travelled guests were able to compare the difference between New Zealand hotel security and that of other hotels around the world.

Keywords: safety, security, tourism consumption, New Zealand, well-travelled guest

Introduction

This exploratory study was conducted in New Zealand as part of a PhD thesis. This research intends to understand guests' perceptions of New Zealand's hospitality security. In an era where terrorism is a major concern, is it common practice to emphasise safety and security? How does it affect planned travel behaviour? What are some of the guests' expectations around security? Will guests be willing to pay a higher room rate for a better level of security?

The data for this study was collected in 2018. Before 2019, New Zealand hadn't experienced any major terrorist events. So, the data in some ways perhaps demonstrates the attitudes earlier than the March 15th, 2019, Christchurch attacks. On Friday 3rd September 2021, another terrorist attack occurred in New Zealand. A Sri Lankan-born terrorist attacked and stabbed several shoppers at a supermarket in Auckland. While New Zealand has been largely terrorism-free for a long time before 2019, the events since 2019 have certainly changed the security landscape quite a bit. This research was designed to draw on the perception of the hotel guests; trying to understand their expectations, wants and needs, and what the hospitality industry is doing to meet those needs. This article is purely from the perspective of the guests.

In this study, hotels referred to are generally variations of paid commercial accommodation where they have guest rooms, restaurants, and other services. Some hotels will have gyms, swimming pools, nightclubs, banquet rooms and other facilities. What this definition of hotels does not include are Airbnb, small motels, caravan parks, backpackers etc. The reason for this is that it is not reasonable to expect an Airbnb (for instance) to have security guards or other security features. Also, the guests referred to in this study are guests who stay in paid accommodation, not the likes of caravan parks and backpackers.

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Literature Review

Concept of Safety and Security

Security as an attribute has been ranked very high when compared to other attributes of a hotel. It scored 4.8 out of 5 with 5 being *a 'relevant attribute*' Marić, Marinković, Marić, & Dimitrovski (2016). Safety and security broadly refer to a desire to be harm free. Blokland & Reniers (2020), provide an in-depth study of what each word means and they also discuss risk as a part of the discussion around the definition of safety and security. In everyday use, safety and security are used interchangeably. Wanting to be safe & secure, in the context of this study, it can be said that guests want to avoid harm, and disruptions to their travel plans and they largely want to avoid threats and the associated stress (Anichiti, Dragolea, Hars, Haller, & Butnaru, 2021). Safety and security become more important when people are away from their normal habitat, their home, and all that is familiar to them. While travelling overseas, they could be in an unfamiliar environment, or they may not be fluent in the local language and dialects. Despite this, there is a reasonable expectation to be safe and secure. Who bears the responsibility to keep guests safe and secure? Is it a case of *caveat emptor*? Is it the guest's responsibility to do due diligence or can they reasonably expect the hotel to ensure their safety?

It is not just about being harmed; it is about identifying and mitigating the risk. Studies have shown that females tend to be more risk-averse, they tend to be more careful. Males, on the other hand, tend to ignore risks or pay less attention to risks. This is known as the *white male effect* (Sansani, 2018). This would explain the risk-taking activities sportsmen tend to partake in.

Travel Behaviour

Planning a holiday or even a work-related trip takes a lot of effort. With work-related travel, the destination often has already been decided. It's just the logistics of the trip that needs to be worked out. With a family holiday or even a holiday for one, the planning must include destination choice, budget, routes, and requirements of all the travellers amongst other considerations. It's not easy to organise holidays especially if it is for a group of people. It is much easier when the planning is just for yourself. You know what you want from your holiday.

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Security and safety considerations limit options and make planning slightly more difficult. Which destination is safer? Which hotel will be more secure? Where can we travel unimpeded? People don't want their holiday plans disrupted. Even if they are not personally hurt or injured, travel and movement, in general, might be disrupted. So, the tendency is to find stable destinations for their holidays. Opinions of family and friends, news stories, travel advisories etc may impact travel planning (Kapuscinski & Richards, 2016; Buigut, Braendle, & Sajeewani, 2017).

Tourists tend to change their travel plans once news about a particular destination is released e.g., terrorist attack. Hajibaba, Boztug, & Dolnicar (2016) have concluded a study to explore how hotels can avoid cancellations. Their findings show that a change of accommodation and if coupled with a room upgrade could work. Another finding that could help to avoid cancellations is if tourists/guests are provided with more up-to-date information about the situation. Guests want to know whether it's safe for them to travel.

Hotel Security

There is a realistic expectation that hotels are safe for guests to stay in. In accepting a reservation, the hotel enters into a contract to protect, service and take care of their guests. This a serious obligation and one that hotels should undertake, secure in their minds that they have done their utmost to keep their guests safe. Efendi (2020) and Nwokorie & Igbojekwe (2019) both discuss safety and security and the issues hotels face but from different perspectives. The bottom line is that security is important and that there is a reasonable expectation that hotels will ensure that their guests are safe. Hotels are generally very public spaces, with several entrances and exits. It is extremely difficult to secure all points of entry and exits. Hotels, by their very nature, are expected to be porous, with very few restrictions. The reason for this is to emit a welcoming and inviting feeling. If there are too many restrictions, guests will not feel comfortable.

Hospitality Terrorism

The relationship between hospitality, tourism and terrorism has been around for a long time. Now, with the increased difficulty for terrorists to penetrate or

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attack military and government properties, soft targets, such as hotels have become the preferred targets. Terrorists want to utilise their limited resources effectively and efficiently. So, they make every attack count. They want to ensure that they get the best return for their effort. Zeman (2020) describes soft targets as places that have a high chance of being attacked but they don't possess the means to protect themselves. Hotels along with restaurants, shopping malls and schools, will fall in this category.

Bac, Bugnar, & Mester (2015) describe the effects of a terrorist attack as being temporary. What they mean is that the destination will not suffer long term. However, it must be noted that not all destinations are built the same, nor are they all similarly resilient. Some may fall over after just one, single attack. They present Northern Ireland and Turkeys as examples of destinations that have bounced back after countless attacks. Gurtner (2016) also states, using the example of Bali, that returning to normalcy is possible, but it is fraught with difficulties and challenges. Even today, Bali is vulnerable because the threat is still alive. Seabra, Reis, & Abrantes (2020) state that destinations that are geographically close to existing terrorism targets are also affected. So, the threat is not just to that particular destination or country. The surrounding areas will also be negatively affected.

Paraskevas (2013) understanding the close relationship between hospitality and terrorism devised a six-step strategy to prevent or disrupt any terrorist attempts on hospitality properties. If properties can break up one of the six steps, they would have effectively prevented a terrorist attack. Hotels must be watchful and try and avert terrorist attacks. They must find ways to implement deterrents into their properties.

Risk and Insurance

Morakabati & Kapuscinski (2016) discuss risk and how reactions to threats depend on the personality of the individual. Not everyone reacts in the same manner. The article also goes on to explain how the cycle perpetuates. If tourists are fearful, they will avoid specific destinations. This in turn affects tourism in that area and that reduces employment opportunities. Some destinations are very dependent on tourism. So when tourism ceases, there is mass unemployment and hardship, and this now becomes the breeding ground for terrorists. Terrorist groups find recruits in these affected areas.

Insurance will not prevent any incident or accident from occurring. It is merely a tool used to help after an event occurs. It can compensate when you

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need to change flights, travel itinerary and even in cases where medical assistance or evacuation is required. It is also useful when someone dies, and the body needs to be repatriated to their home country. But it does nothing before the event, aside from providing some comfort knowing that should one have to alter their travel plans due to terrorism, they will be compensated. This does not alter the fact that insurance is useful, and tourists should always be insured when travelling.

Fanelli (2016) describes and discusses in detail a myriad of claims by victims, their families, and guests against hotels. These are cases involving acts of terror. Hotels must defend against these lawsuits which can be costly and damaging to their brand.

Risk profiles differ according to the destination, property, event, time of year etc. Travelling in a pandemic for instance will be harder to insure. Similarly, travelling to a known warzone will also be difficult to insure.

From the perspective of the hotel property, they too will find it difficult to insure against terrorist acts, if they do not have basic security. Hotels are eventually liable to provide safety and protect their guests. To provide this protection, hotels will need to be insured. But insurance companies may steer clear of protecting against terrorist acts because of the many unknowns involved. Hotels need to be able to show that they have provided reasonable care and security for their guests and that they could not have known about the possibility of an attack. This means that they could not foresee a specific danger or attack. Even if a court rules in favour of the hotel property, any drawn-out lengthy court process will be expensive for hotels.

Paying Extra for Security

The idea of paying extra for security, even though it should already be a part of the package, is because tourists are now more security conscious. The general idea is to avoid terrorist or criminal acts at all costs. So, guests tend to lean towards a more expensive property due to the implied additional security. Mekinc and Cvikl (2013), discuss the importance of recognising safety breaches, especially the type of breach. Breaches that are deemed to be beyond the control of the hotel are less likely to be of concern to tourists and guests. Guests are more concerned about situations where hotels could take reasonable actions to prevent breaches.

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A study conducted by Kim, Brewer and Bernhard (2008), about guests' understanding of biometrics, concluded that guests are security conscious and support the use of such technology to keep them safe. Such high technology comes with a big price tag attached. Yet, it appears that guests are willing to pay that extra for security. Will hotels invest?

Another piece of evidence that guests are prepared to pay extra for security comes from a study conducted by Hilliard and Balogu (2008). This study covers guests as well as conference organisers and their expectations around security. The conclusion is that guests and other users of hotels expect to be safe and secure. There is perhaps a need for safety and security certification so that consumers can be assured that the property has been checked and certified. Kekovic and Markovic (2009) have extended the concept in that they have concluded that hotels that have a security certification or security rating, can use it as a competitive advantage. They will rank higher when compared with hotels that are not certified.

Methodology

This exploratory, qualitative research used interpretivism extensively. In total ten hotel guests were interviewed using the semi-structured interview method, and they were asked a total of ten questions each. That makes it 100 responses in total to analyse and discuss. The main reason for using the semi-structured interview method is because, especially with sensitive topics such as security and terrorism, they elicit better, richer responses. People are more likely to respond to questions about security and terrorism only if they feel safe discussing them. Adeloye, Carr, & Insch (2020), Cohen-Louck (2019), Cornejo, Rubilar, & Zapata-Sepulveda (2019), Fenge, Oakley, Taylor, & Beer (2019) have all employed qualitative research methods in research including sensitive issues such as war, terrorism, health, drugs, violence etc. A survey will not do the job effectively. With semi-structured interviews, the researcher can follow new lines of questioning if they discover something interesting or significant during the interview. They start with a list of questions that Bryman (2016) refers to as interview guides. It is a very flexible method. The only concern is the bias of the interviewer or researcher themselves. They need to know their own biases and be mindful of them and not allow their biases to interfere with the research itself. One of the biggest challenges with this group of participants was their English. They could not articulate properly what they wanted to say. So, the discussions were very limited. There were a lot of hand

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gestures to make up for the lack of English. Some participants relied on their electronic dictionaries or discussed with friends before providing answers.

Findings, Analysis, and Discussion

While a total of ten questions were asked of the ten guest participants of this study, only eight of those questions will be addressed here. They are the ones that will help us understand the importance placed on safety and security when travelling.

Q1 - What kind of security arrangements have you encountered in your stay at various accommodation properties around the world e.g., x-ray machines, luggage checks and explosives detecting dogs? Where have you encountered this? How did you feel about this level of security? Did you feel safer or more concerned?

G1 - No. We were only staying at a bed & breakfast [motel type accommodation]. They all just mainly have gates and locked doors.
G2 - No. No actually [nothing special].
G3 - Not really. Maybe only luggage checks.
G4 - No [no special checks].
G5 - No. I haven't seen those [x-ray machines, luggage check etc]
G6 - The only thing is like lockers, to lock our [valuables]. Nothing special to be honest.
G7 - Not really about luggage and stuff. About earthquake. Security - no I didn't pay attention to that. In New Zealand - not really. It looks pretty safe country, to be honest.
G8 - No. There's not been much security at all. No bomb dogs. No one's checking my luggage. Nothing out of the ordinary.
G9 - I've worked a bit offshore so there have been several x-ray machines. I've stayed in Iraq so you would expect some sort of level of security. And Middle East, Qatar. It's only in the Middle East that I've had x-ray machines. No [New Zealand]. Nowhere that comes to mind [security in Asia].
G10 - We have a card that we use to lock the door. No [x-ray machines or luggage checks]. It's just a normal hotel.

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Question one was designed to ascertain what security features guests had encountered in their travels and what they thought of that experience. Security features such as luggage x-ray machines, vehicle undercarriage checks, and explosive-detecting dogs are popular in some parts of the world but not all. They are generally not part of the security protocol in New Zealand. So, it wasn't surprising that they had not experienced any of the security features discussed while travelling through New Zealand. Some participants were perplexed and puzzled by the question. Feickert, Verma, Plaschka and Dev (2006), through their study, have concluded that some segments of the population would appreciate more security features.

The only discussion around security they have had with hotels was around the use of key cards, and public access to guest room floors. They appeared to be more concerned about criminal activities as opposed to terrorism. They also appeared to think the higher the quality of the hotel itself, the better the security protocols. This was concerning because providing good, effective security should not be dependent on the quality of the hotel.

Q2 - Were you informed about security by the property at any time before or during your stay?

This question was to find out what, if any, information was provided about the property's security protocols. This would give an idea of the emphasis on security or whether security wasn't an important feature.

G1 - Yes [was briefed about security].
G2 - Yea [briefed about key cards]. When we checked in, they tell us that.
G3 - No. Not really.
G4 - Yes.
G5 - Yes. They tell us that they have security outside, both doors and that the rooms and hallways are checked.
G6 - No.
G7 - Yes, of course. They are pretty clear about it [security provisions].
G8 - No. There was nothing [they weren't informed].
G9 - With regards to safety aspects regarding earthquakes, but nothing else.
G10 - We were just pointed to the room, and that's it

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50% of the participants stated that security information wasn't provided, nor did they ask. They did not feel the need to. There was some mention of natural disasters and earthquakes but nothing specific to security. The other 50% had some interaction around security but they seemed to focus on the key card and Closed-Circuit Television cameras (CCTV).

Q3 -Do you consider personal security and safety when making travel plans?

This question tries to understand individual tourists' decision-making process when it comes to travel plans. Is security important when making travel plans?

G1 - Yes
G2 - It's very important to us. Ya, it's important.
G3 - Ya. It's very important.
G4 - I think so [important]
G5 - No.
G6 - Yea, sometimes
G7 - Yea, of course [laughs].
G8 - No, I never think about it at all [laughs].
G9 - Yes, I do because of some of the places I go.
G10 - It's like life risks. No, we never consider things like that. I reckon this country is safe enough. We always consider our belongings, not being stolen and things like that.

70% claimed that security was an important factor when making travel plans but they were not able to elaborate. For instance, did they specifically choose better quality, more expensive hotels to ensure better security? The balance of 30% did not make security a deciding factor. G10 seems to imply that risks are a part of life. However, they also stated that New Zealand was safe and so security wasn't a consideration. Brossman (2016) stresses the importance of security in his book about travel risk and findings from this study generally tend to agree with that sentiment. Henderson (2016) also expresses the same sentiments in that people need to always feel secure, even when they are out and about in commercial spaces. The relevance of Maslow's theory around security is very clear (Abulof, 2017).

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Q4 - What do you do to mitigate security risks while travelling? e.g., avoid particular destinations or activities.

This question was about understanding how guests mitigated travel risks. Did they have specific strategies that they employed?

G1 - I avoid particular countries.
G2 - Ya, if I travel alone, I won't go out at night.
G3 - Try not to go out at night. Only stay in big cities.
G4 - I don't go outside at night.
G5 - I would avoid destinations and certain activities if I know that it was life-threatening. Or if people [say] that's dangerous. There's usually more than one person with me.
G6 - Probably [not go out at night].
G8 - We might avoid small alleyways at night. Probably stay in the central part.
G9 - Usually common sense stuff. As you would in your home cities. Stick to well-lit streets. Take care when you are carrying things of obvious value. Be aware of your surroundings.
G10 - Yes. Pretty much. That's true. Sometimes if we are informed or if we get information about whether they are not safe, we will just choose whether to go out.

A few participants said it is as easy as simply avoiding some countries that they deemed unsafe. They took their advice from the experiences of others such as friends, family, and even social media. This is not necessarily good because the advice they are receiving may not be accurate and is often biased. Some claim that they will not go out at night when they are travelling because, for some reason, night-time is when it is unsafe. Also, one participant claimed that keeping yourself safe, was basic common sense. That again is not necessarily true. They suggest that people should follow whatever they did in their home country to keep safe. However, it must be noted that when you are travelling, you are in an unfamiliar environment, you may not be familiar with the language, and you will also not have your support network around you in case of an emergency. So how you behave when you are travelling will be drastically different to how you live your life in your home country.

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Q5 - Are there any particular countries/regions that you would not visit and why?

Here the purpose was to understand whether participants avoided specific countries, whether New Zealand was one of those countries and how they came to decide which countries to avoid.

G1 - Probably some in the Middle East that I would not visit.
G2 - Maybe India. Just some news that makes me a little bit nervous when I will go to travel.
G3 - No. Not really. Maybe in another country, I take a group. So that I am not alone.
G4 - Africa
G6 - Papua New Guinea. I would love to go but I heard that it's really dangerous for a tourist.
G7 - Iran, Iraq, Syria - not fun at all.
G8 - I would avoid North Korea and stuff like that. I would avoid all advertised 3rd world countries.
G9 - No. I tend to go everywhere. They won't send us to Iraq at the moment, or Afghanistan.
G10 - That's hard to say but I think probably like the country where they have war, terrorism [avoid].

Their answers seem to imply that they considered New Zealand safe since it did not make it into the list of countries to avoid. However, the list does not appear to be fair. They seemed to have taken negative stories from the media and made decisions based on that. The list did not include the United States of America, the United Kingdom and France. They seemed to have omitted western countries. These countries and many others have experienced terrorism firsthand. Yet they did not make the list. So, at the very least, the list is biased and not well thought through.

Q6 - Do you think that accommodation security is important and why? Would you choose a particular property because of its high level of security? Do you think security will be rated highly like cost and location? Security, Cost, Location – Prioritise them (1 most important – 3 least important)

Evaluating the importance of security and gaining respondents' perspectives on it is the main crux of this study. The question is not just

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whether security was important, but also how important is it. That is where the ranking exercise comes in. 100% of the respondents, stated that security was important to them. They understood that the study was specifically about security while travelling. Security in our home country is different to security while travelling. If there is a terrorist incident in our home country, we are in an environment that we are familiar with and we will have our support networks around us.

G1 - Yes. Just a personal safety.
G2 - Ya, it's really important.
G3 - Yes.
G4 - Yes, it's important.
G5 - Yes, because it's like really important.
G6 - Yea. I think so. Depending on how high or low the normal [security standard] standard of a hotel are [stay in accommodation with extra security]. I've never asked or looked for it. I cannot say whether it's worth it for me to pay extra.
G7 - Yes
G8 - Yes, it is.
G9 - I think so. In Australia, we are very complacent. I am sure New Zealand might be the same. Until there has been an incident and then everything will escalate.
G10 - Yes, of course. Definitely

While all the respondents consider security to be important, the degree of importance varied when we compared security with cost and location. Marić, Marinković, Marić, & Dimitrovski (2016) and Blokland & Reniers (2020) both demonstrate through their research that security is important and that tourists/guests want to avoid harm and disruptions at all costs. From the ranking exercise (Table 1), 40% of the respondents put security in the 1st position, meaning that security would be their most important criterion when making travel decisions. Another 30% placed security in 2nd position, meaning that either cost or location was more important to them. With regards to location, travellers tend to stay close to their activities or planned reasons for travel. This means if one was travelling for medical reasons, they would stay close to the hospital or if they were visiting to attend a concert or a conference, they would tend to find a hotel close to the venue. Cost and budgetary constraints will also dictate where one stayed, or the quality of the hotel selected. So, with 70% of the respondents placing security in either 1st or 2nd

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position, makes security an important consideration for travellers. So, hotels should be aware of this and work their best to make their property safe.

Table 1. Security ranking

Security	
1st choice	40%
2nd choice	30%
3rd choice	30%
Total	100%

Q7 - How do you rate accommodation security in New Zealand? Why is this so?

The seventh question looks to understand how guests rank New Zealand's hotel security. This is a key question to this study. The very essence of this study is to ascertain the perception of security in New Zealand. What do guests think about security and why? The ranking ranged between high, medium, and low. It is expected that guests will base their ranking on their knowledge and experiences. They should be able to explain to justify their responses.

High

G1 - Very high. Everything has been wonderful.
G2 - It's quite good.
G3 - It's perfect, I think.
G4 - High [standard].
G5 - 9 [out of 10]
G6 - I have just been to Huka Lodge which has a pretty high standard. They were all pretty good. And now I start going to other places, where I realise there is no [security] - a bit dodgy. But I think you can still keep your things safe.
G9 - I think it's very good but I am not aware that there are any concerns or alerts or anything like that. There are security cameras everywhere. It's very subtle.
G10 - It's very good

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The vast majority (80%) of the respondents in this study categorically stated that they considered the security to be high. Most of them arrived at this conclusion based on their own experiences, knowledge, and observations. To many, New Zealand feels safe and looks like a safe destination. Up until March 2019, New Zealand had not experienced any serious terrorist incidents that were noteworthy. So, the feeling is that New Zealand was generally terrorism free. Guests generally go about enjoying their country and their stay is relatively unimpeded. Generally, nobody bothers them. This gives a sense of security. Respondents used the words "wonderful," "perfect" and "good" to describe their time in New Zealand. When discussing Huka Lodge, Taupo (a luxury resort), G6 felt the security standard was very high. When staying at a smaller, lower standard, cheaper properties around the country, G6 said they were a little more concerned, but not so concerned that they decided to pack up and leave. G9 observed that there are a lot of security cameras within properties and all over the country. This again must provide some sort of sense of security. However, it must be noted here that when security cameras are unmanned, the recorded footage is only used after an event occurs. This means that when a complaint about criminal activity is made, the authorities can go back to a specific date and time and download the required evidence. This does not help anyone that is in danger and requires immediate help. Security cameras can be a deterrent in some cases. However, criminals and terrorists will make the extra effort to avoid these cameras where possible. But a suicide bomber, for instance, doesn't worry about being recognised. They have no intention of coming out alive from a mission. In many ways, it is an unfair fight. Terrorists do not seem to care about dying as a result of the mission, whereas counter-terrorism forces have to think about how to deal with the situation without any loss of lives.

Medium

The balance 20% ranked their security experience in New Zealand as a medium. They felt it was just right and quite average.

G7 - It's nice. For me, it's a pretty peaceful place.

G8 - The ones we are staying at. They are very average. The first place we stayed in Auckland, was dodgy. They would leave your luggage wherever and it wouldn't matter. They didn't give us tags. It was very dodgy.

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20% of the respondents described the security as being medium. This means that no one considered the security as bad or low. So, it is good that 100% thought the security was either high or medium. G8 made a very useful and important observation. This was regarding left luggage. G8 claimed that luggage can be seen left around with nobody taking any action.

This is very risky. All luggage must be accounted for. It is common for guests who are on a long visit in a country and planning to return to the same property later, to request to have their luggage stored by the property till their return. These are commonly known in the industry as 'left luggage.' Left luggage must be properly identified and tagged and stored in a separate area, a luggage storeroom. This luggage storeroom should ideally be checked regularly to make sure only properly tagged items are stored. Some hotels in Asia tend to use explosive detection dogs (EDD) to patrol the storeroom several times each day. The dogs will be checking to make sure that the left luggage does not contain any explosives.

In 1984, an incendiary device, which was meant for the then Prime Minister Margaret Thatcher, was planted in the Brighton Hotel. It was planted more than three weeks ahead of schedule utilising a long delay timer. When the bomb, planted by the Irish Republican Army (IRA), eventually exploded, it missed its intended target, instead killing five others and injuring a few dozen more. According to Carroll (2021), time-delay bombs are quite commonly used. Unfortunately, nobody found or noticed the bomb for more than three weeks.

Q8 - Do you think that it is the responsibility of the property to protect you? Why? Would you be willing to pay a higher room rate if a particular hotel had extra security?

This question also ended up forming a very important part of this study which was to find out from guests who they believed should be responsible for security. Specifically, did they think the hotel was solely responsible to look after them and provide all security measures? Also, the study hoped to find out whether guests valued security and whether they would consider paying a higher room rate for better protection.

100% of the respondents stated that they believed that the hotel should be responsible to look after them. It is logical in some ways in that the hotel knows its own property best and the hotel will know its client base and the type of security required. For instance, a business-class hotel will need different security protocols for a resort. G2 said that the hotel will be the first

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place they would turn to in the event they needed help. So, in a way, it makes sense that the hotel took care of the security arrangements. G9, while agreeing that the hotel should provide security and keep everyone safe, they felt that guests also should bear some responsibility. They should be careful and minimise risk.

G1 - Yes
G2 - Ya, of course. If I have some problem, they need to help me. If I can handle it, I will pay [pay extra for more secure accommodation]
G3 - Yea. Yea, maybe [pay extra for more secure accommodation].
G4 - Yes, I think so. I choose a more expensive hotel [extra security]
G5 - Yes. It depends on what the security is doing. Okay [will pay for extra security]
G6 - If there are any safety issues, definitely
G7 - Of course, it's their [responsibility]. Yes [will pay for accommodation with extra security].
G8 - To an extent. You get what you pay for. Depends on which country I am staying in [pay more for extra accommodation security]. I guess New Zealand - No [won't want extra security].
G9 - A bit of both. If you are paying to stay somewhere, there should be an implied sense of security, keeping your belongings safe and keeping yourself safe. But it's not entirely on the hotel. Yea [pay more for extra security].
G10 - I think so. That's true. Do you mean to protect me from a terrorist attack? Terrorism - maybe they don't consider that enough, but for fire and from stealing - ya. They can protect me from disasters. It will depend on the country where you live [pay more for extra security at accommodation]. If there [New Zealand], you probably won't pay that extra.

With regards to paying extra for a better-class hotel with better security arrangements, 70% said that they would be willing to pay extra if it's affordable. As Table 2 shows, this finding agrees with the literature where Kim, Brewer and Bernhard (2008), explain that guests expect better security and are willing to pay for it. However, the balance 30% feel refused possibly because they believe that the hotel should bear that cost. They expect good security anyway. Also, 30% claimed that since New Zealand is a safe destination, they don't expect any problems or safety issues. Hence, the refusal to pay anything extra.

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Themes

A few important themes came from these interviews, including a few that are significant and worth exploring further. In general, 100% of the respondents took security seriously and they all stated that security was important. Chan and Lam (2013) also express the importance of security and their study shows that guests want and, in some cases, demand certain security features. They claim that managers need to fully understand the sentiments and security requirements of their guests. Ritter (2020), describing the settlement of the Mandalay Bay Resort shooting case, stated that the parent company and their insurers paid about USD 800 million to the victim's families. The shooter was able to accumulate more than a dozen rifles and other weapons including about 1000 bullets. With these, he succeeded in killing 60 people and injured many more. How were these weapons brought into the hotel without anyone noticing or suspecting anything? Compensations and settlements as described in Ritter (2020) will become commonplace unless hotels take security seriously.

Table 2. Themes – Guests

	Code	Theme
GUEST	GT^1	Security is important
	GT^2	New Zealand is safe
	GT^3	Hotels responsible for guest's safety
	GT^4	No x-ray machines, bomb dogs
	GT^5	Insufficient security briefing
	GT^6	Security conscious
	GT^7	No need to ask about security
	GT^8	Security rating (High/Med)
	GT^9	Stay indoors/ No night outings
	GT^{10}	Avoid selected countries
	GT^{11}	Pay extra for security

With regards to making travel plans and decisions, 70% said that they made decisions with safety and security in mind. That would mean that they were security conscious even while travelling. Travelling often meant people were in unfamiliar territories and in some cases where even the language was unfamiliar. Respondents gave the impression that to them New Zealand was a safe destination and so they must have been wondering about the need for this study. This data was largely collected in 2018, before the March 2019 Christchurch terrorist attack.

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Respondents were also generally in agreement when it came to who should be responsible for the provision of security. They agreed that the hotel should ensure their safety. Anichiti, Dragolea, Hars, Haller, & Butnaru (2021) concluded from their research that hotels should consider providing a sufficient level of security and this agrees with the findings of this particular study. There wasn't any discussion or mention of local government or central government responsibility. The host hotels should take care of them. Aside from just one respondent, all other guests had never encountered x-ray machines, luggage checks or explosive detection dogs (EDD) during their travels. They might have seen them in some airports, but not in their accommodation. Security features such as encountered x-ray machines, luggage checks or explosive detection dogs are a common sight in Asia. In larger properties, cars are not even allowed near the hotel until they have been checked properly. This can include checking the boot (storage compartment), bonnet (engine compartment) and undercarriage of vehicles. Often explosive detection dogs are used to check the vehicles as well.

About 50% of respondents weren't given any security briefing nor were they expecting and by the sounds of things since they deemed New Zealand to be safe. They weren't told what to do in an emergency. Most (90%) didn't have any security-related questions either. Their key cards were issued, and they were shown where the elevators were.

If they felt unsafe in any destination, they said that they would opt not to go out of the hotel at night. Somehow, they believed that the threat was only outside the hotel. They did not think that the threat could come to the hotel or already be inside the hotel. In their minds, the threat is external to the hotel or the hotel would have taken steps to ensure the premises are safe. In reality, this may not always be the case. They also claimed that they would avoid selected countries due to security reasons.

100% of respondents said that security was important but only 70% of them said that they would pay extra for security. It seems that the remaining 30% said that New Zealand was already safe and there was no need for additional security. Considering the 70% that were willing to pay a higher room rate, it can be concluded that there is a large segment within the tourism population that want safer properties, and this means that hotels can use this as a point of difference to market their properties. It is a clear competitive advantage. Paying extra for security is consistent with the literature and it is a significant finding.

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Limitations and Opportunities for Further Research

While this is only an exploratory study, the sample size limits the ability to generalise the findings or make any business decisions based on them. However, given the findings and the recent terrorist events in New Zealand, it warrants a bigger, more in-depth study. The new research could also ascertain how much guests extra will guests be willing to pay for better security. This will help the hotel make investment decisions.

Conclusion

It can be concluded from this study that security is important and when travelling, guests place a huge emphasis on security and a large majority would pay extra for a safer stay. The willingness to pay extra is significant and hotels need to factor this into their thinking. So, it is safe to conclude that because of its importance, hotels can use security to differentiate themselves from the competition.

The two recent terrorist attacks (March 2019 and September 2021) would impact on any post-2019 research on New Zealand's hospitality security. It is possible, while New Zealand will still be classed as a safe destination, tourists would be more wary and careful when making travel plans. It is recommended that a more in-depth study be conducted.

References

Abulof, U. (2017). Introduction: Why we need Maslow in the twenty-first century. *Society. 54(6)*, 508-509.

Adeloye, D., Carr, N., & Insch, A. (2020). Conducting qualitative interviews on sensitive topics in sensitive places: the case of terrorism and tourism in Nigeria. *Tourism Recreation Research. 45(1),*, 69-79.

Anichiti, A., Dragolea, L. L., Hars, G.D. T., Haller, A. P., & Butnaru, G. I. (2021). Aspects Regarding Safety and Security in Hotels: Romanian Experience. *Information. 12(44)*, 1-23. https://doi.org/10.3390/info12010044.

Bac, D. P. (2015). Terrorism and its impact on the Tourism Industry. *Revista Română de Geografie Politică, 17(1),* 5-11.

Blokland, P. J., & Reniers, G. (2020). The Concepts of Risk, Safety, and Security: A Fundamental Exploration and Understanding of Similarities and Differences. In C.

Nova Science Publishers, Inc.

Bieder, & G. K. Pettersen, *The Coupling of Safety and Security.* (pp. 9-16. https://doi.org/10.1007/978-3-030-47229-0_2). Springer, Cham.

Brossman, C. (2016). *Building a travel risk management program: Traveler safety and duty of care for any organisation.* Oxford: Elsevier.

Bryman, A. (2016). *Social Research Methods.* Oxford: Oxford University Press.

Buigut, S., Braendle, U., & Sajeewani, D. (2017). Steven Buigut, Udo Braendle and Disna Sajeewani. *Asia Pacific Journal of Tourism Research, 22(10)*, 991-1004. https://doi.org/10.1080/10941665.2017.1359193.

Carroll, R. (2021, March 15). *IRA Brighton bomber 'scouted Labour conference seven years earlier.'* Retrieved from The Guardian: https://www.theguardian.com/uk-news/2021/mar/15/ira-brighton-bomber-patrick-magee-scouted-labour-conference-seven-years-earlier.

Chan, E. S., & Lam, D. (2013). Hotel safety and security systems: Bridging the gap between managers and guests. *International Journal of Hospitality Management. 32*, 202-216.

Cohen-Louck, K. (2019). Perception of the Threat of Terrorism. *Journal of Interpersonal Violence. 34(5),*, 887-911.

Cornejo, M., Rubilar, G., & Zapata-Sepulveda, P. (2019). Researching Sensitive Topics in Sensitive Zones: Exploring Silences, "The Normal," and Tolerance in Chile. *International Journal of Qualitative Methods. 18,*, 1-11.

Efendi, M. (2020). The Problems Faced by Hotel Security Managers: Antalya Case. *Journal of Tourism and Gastronomy Studies. 8(1)*, 388-403.

Fanelli, C. L. (2016). Protecting Hotel Industry Businesses from Liability for Terror Attacks. *Real Estate Finance. 32(4)*, 1-7.

Feickert, J. V. (2006). Safeguarding Your Customers: The Guest's View of Hotel Security. *Cornell Hotel and Restaurant Administration Quarterly, 47(3)*, 224-244.

Fenge, L. A., Oakley, L., Taylor, B., & Beer, S. (2019). The Impact of Sensitive Research on the Researcher: Preparedness and Positionality. *International Journal of Qualitative Methods. 18,*, 1-8.

Gurtner, Y. (2016). Returning to paradise: Investigating issues of tourism crisis and disaster recovery on the island of Bali. *Journal of Hospitality and Tourism Management. 28*, 11-19.

Hajibaba, H., Boztug, Y., & Dolnicar, S. (2016). Preventing tourists from cancelling in times of crisis. *Annals of Tourism Research. 60*, 48-62.

Henderson, J. W. (2016). *The facility manager's guide to safety and security.* London: Taylor & Francis Group.

Hilliard, T. W. (2008). Safety and security as part of the hotel servicescape for meeting planners. *Journal of Convention & Event Tourism. 9(1),* 15-34. doi: 10.1080/15470t40802t04557.

Hinton, T. (2022, January 14). *Total export revenue of the dairy industry in New Zealand from the financial year 2015 to 2023.* Retrieved from Statista: https://www.statista.com/statistics/1100950/new-zealand-export-revenue-of-dairy-industry/.

Kapuscinski, G., & Richards, B. (2016). News framing effects on destination risk perception. *Tourism Management, 57*, 234-244.

Kekovic, Z. &. (2009). Security as a factor of competitive advantage in tourism. . *Tourism and Hospitality Management. 15(2),* 291-303.

Nova Science Publishers, Inc.

Kim, J. B. (2008). Hotel customer perceptions of biometric door locks: Convenience and security factors. *Journal of Hospitality & Leisure Marketing. 17(1/2),* 162-183. doi:10.1080/10507050801978323.

Marić, D., Marinković, V., Marić, R., & Dimitrovski, D. (2016). Analysis of Tangible and Intangible Hotel Service Quality Components *Industrija. 44(1),*, 7-25. doiI: 10.5937/industrija1-8437.

Mekinc, J. &. (2013). The structure of security and safety crises in tourism. *Journal of Tourism & Services. 4(5/6),* 38-50.

Morakabati, Y., & Kapuscinski, G. (2016). Personality, Risk Perception, Benefit Sought and Terrorism Effect. *International Journal of Tourism Research. 18*, 506-514.

Nwokorie, E. C., & Igbojekwe, P. (2019). Security Challenges for the Hotel Industry: Implications for Selected Hotels in Owerri, Nigeria. *Academica Turistica. 2*, 193-205.

Paraskevas, A. (2013). Aligning strategy to threat: a baseline anti-terrorism strategy for hotels. *International Journal of Contemporary Hospitality Management, 25(1)*, 140-162. doi: 10.1108/09596111311290264.

Ritter, K. (2020, October 1). *Court OK's $800M settlement from MGM Resorts to 2017 Las Vegas Strip shooting victims.* Retrieved from USA Today: https://www.usatoday.com/story/travel/news/2020/10/01/las-vegas-strip-shooting-victims-get-800-million-settlement-mgm/5877222002/.

Sansani, S. (2018). Ethnicity and risk: a field test of the white-male effect. *Applied Economics Letters, 25(2)*, 74-77, doi: 10.1080/13504851.2017.1296540.

Seabra, C., Reis, P., & Abrantes, J. L. (2020). The influence of terrorism in tourism arrivals: A longitudinal approach in a Mediterranean country. *Annals of Tourism Research. 80*, 1-13. https://doi.org/10.1016/j.annals.2019.102811.

Tourism Industry Aotearoa. (2021, March). *Quick facts and figures.* Retrieved from Tourism Industry Aotearoa: https://www.tia.org.nz/about-the-industry/quick-facts-and-figures/#:~:text=Tourism%20was%20New%20Zealand's%20biggest,of%20New%20Zealand's%20total%20GDP.

Zeman, T. (2020). Soft Targets: Definition and Identification. *Academic & Applied Research in Military & Public Management Science, 19(1),* 109-119.

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Chapter 2

COVID-19 Pandemic, Risk-Reduction Strategies and Crisis Management in the Travel Insurance Sector

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Abstract

Travel has always been considered to be a risky affair as there are multiple uncertainties associated with it. Though the tourism industry has developed sophisticated methods to manage these risks, there are still certain uncontrollable and unforeseen circumstances that might affect the physical, emotional, and mental state of travellers. The result would be a huge financial burden for the traveller and increased frustration towards the tour operator. The concept of travel insurance was introduced to relieve travellers of such unforeseen risks while travelling. Moreover, the Covid 19 pandemic has instilled a sense of fear and doubt among the minds of travellers which affects their travel decision-making to a large extent. Destinations and tourism suppliers have introduced various risk reduction strategies and methods to resolve this issue. This paper focuses on understanding the concept of risk associated with travel, the various dimensions of risk management, and the key strategies adopted by tour operators and suppliers to minimize such risks.

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Keywords: travel risk, travel insurance, crisis, risk-reduction strategies, ethical dilemmas, agency stewardship

Introduction

In a global and ever-changing world, even if there is a large number of investments by the tourism and hospitality service providers in mitigating risk consequences, not all the potential risks and uncertainties can be controlled. The outcome of the uncertainties will not just be detrimental to the tourism industry but also to the local economy as a whole. The decision to travel largely depends on how the travellers perceive the risk. While some consider risks as an integral part of their travel experience and adapt to them, others try to avoid them by selecting destinations that are safer to travel to and involve less risk. Generally, risks are built on the theory of probability, but they cannot reveal the emotional state of the traveller at a given point in time. Hence, the way the risks are perceived does not reveal the fear of travellers (Larsen, 2007). Based on the age, gender, and staging of family factors of the traveller, certain personalities develop special tolerance or avoidance of risks. These indicators of risk have a direct correlation to how the risks are perceived by the tourists. Validation for this can be stated when a tourist sets on visiting a family or a friend along with their travel being envisaged which means that the tourist destination was seemed to be less risky because it assures travellers a safe expectation about their journey to the destination (Korstanje & George, 2013). The present book chapter interrogates furtherly not only the impact of risk perception in the tourism industry but also the future strategies to be adopted by the industry to achieve safer destinations. Although the literature has extensively expanded over recent years, less attention was paid to the role of insurance in risk perception theory (Korstanje & George 2013). This chapter fills the gap laying the foundations for a new understanding of risk perception theory.

Travel Insurance

Travel insurance is a form of insurance that provides coverage for travel, dental and medical expenses that are incurred during the travel. Under the specified condition of travel that is mentioned in the travel insurance policy,

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aeromedical evacuation for the traveller is provided. There is a need for travel insurance due to the high cost of medical and dental treatment abroad. As a result of this and to cut down on their medical expenses during their journey all travellers need to understand and be aware of the inclusions and exclusions contained in the policy chosen by them. On average, an estimated amount of 45% of travellers fall ill or face injuries while they are travelling from one place to another (Leggat et al.,1999). International travellers are more prone to injuries that are severe than domestic travellers who travel within the country. As per the study in the UK in 1980, the count of general practitioners is only about 4% in total (Leggat et al.,1999). Following this, the count of GPs in New Zealand is 60% and a total of 39% of travel clinics around the world insist on the need for traveller insurance for any level traveller from domestic to international. 19% of GPs in New Zealand recommend taking travel insurance for their medical guidance whereas 54% of GPs advise travellers to take medical assistance internationally. Travellers are required to purchase an insurance well in advance of their journey. The application forms for travel insurance can be taken from the airlines, travel agents, their doctors, health insurers, and the representative of the travel and tourism industry. Two factors determine the cost of travel insurance: duration of travel and stay; and of course, both are directly associated with the destinations of travel. The discounted policy is at the cost of exclusions of certain coverage and limitations. There are low premium policies available in markets for countries like Asia along with the private medical and dental care cost added too.

Another significant point seems to be that tourists must have realistic expectations of the travel insurance policy. The processing period for a policy is very minimal. The travellers who travel to war zones, the travellers with self-inflicted injuries, who perform acts that are against the law, the travellers infected by various infectious diseases such as AIDS (Acquired Immune Deficiency Syndrome) and other sexually transmitted diseases, the travellers who are pregnant and travellers taking part in a professional sport are not insured by the travel insurance company even at the highest level (Babu et al., 2014). In their travel insurance, an additional charge is paid by the travellers who expect themselves to be involved in any kind of sport that seems to be hazardous. These surcharges are assessed by travel insurance companies on a different case basis. As evidence of their insurance, an insurance card is provided to the travellers. Each card has a policy number printed on it which helps them gain access to dental, paramedical, and medical facilities provided in the abroad countries. Along with the policy number on the card, there is

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also a toll-free number printed on it to help travellers contact customer care in case of an emergency.

The time, duration, and lifespan of travel insurance are short-term and at times can be made for annual, business, or frequent travel purposes. There is no continuous coverage of travel insurance for internal travel by the tourist. This problem is compensated for by using long-term medical insurance in the host country of the traveller. The availability of aeromedical evacuation should be a must and the registration of the traveller with the local embassy or a local consulate of the traveller's destination should be a checked-upon factor. Whenever an emergency arises with the traveller, the process demands the insurer be informed and contacted on an immediate basis. The tourists must possess a record of original accounts, receipts, and medical reports for any medical or dental treatment as these expenses can be claimed back from a travel insurance policy, employer, or written off against tax (Lawton & Page, 1997). Any conflicts or problems that would arise from the claims can be resolved via a discussion with an official representative from the insurance company that issued the insurance to the traveller. After the discussion with the official, if the customer is not happy about the outcome, then the traveller has the right to take the insurance company to court. But this would turn out to be a very expensive form of dispute resolution. As and when the traveller is unclear about the insurance policy, he should check with the travel agent or travel insurer. Hence travel insurance must not give travellers a false sense of security. They should take every precaution against illness and injury (Leggat et al., 1999).

Beyond Agency Stewardship and Tourism for the Elderly

The aged population has a profound implication for the tourism industry. There is a trend that is followed in the 21st century by Stewardship among agents concerning the ageing factor, the life expectancy of the population, and a fertility decline rate within the population of the country (Travel and Tourism Competitiveness Report, 2017). In the history of tourism and information sourcing related to tourism, the concept of elderly and tourism has gained a mass amount of importance. These are also seen as a major base for marketing the tourism industry and forming company strategies. What brings senior citizens to travel often is their motivation to explore the world. There are a lot of similarities between the two extremes of travellers (Young and Aged) but they do not exhibit uniform behaviour (Lawton & Page, 1997). As

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a combination of this similarity, "New age elderly" is a differentiated subgroup that focuses on the orientation value rather than the age of the tourists. The people who belong to this subgroup exhibit self-confidence, and activeness and are always open and welcoming to simulation in the surrounding environment. The concept of elderly tourists in the field of tourism is usually neglected by insurance companies. The countries on the European continents, who are the major contributors of tourists in the world, have a special place held for the elderly tourists in their sector. (G, 1997). Schindler (2005) addresses this by focusing majorly on the outbound leading countries, where the tourist company has their business targeted at people who belong to a certain age group such as the retirement age (Allingham, J. D., 2013). They keep their businesses going by offering large discounts to the elderly during the off-peak season of travel. With new companies and organizations emerging, the companies that are now providing these services are expected to face heavy competition shortly. Tourism comes with a tax. There are always some kinds of not-so-familiar stress that a tourist is always subjected to. These are the physical and psychological stresses combined with the ageing process that leads to vulnerable health conditions of older travellers (Lawton & Page, 1997). As a result, with the increased difficulty of older people coping with these stresses, it is not a mandate that the elderly should quit tourism completely. But an alternative to this problem is necessary preparations and counselling for the journey by the elderly tourists (Schindler, 2005).

The travel and tourism industry plays a significant role in spreading awareness of travel health among the population. Knowing the standards of healthcare in the destination makes it very helpful, especially for elderly tourists to plan their holidays and travel itineraries. In previous years, advisory firms related to travel and tourism were not very popular as it was not seen as a major revenue-making sector (Allingham, J. D., 2013). But in recent times, there has been an instant growth in the involvement of health insurance in insurance companies. With the availability of the right information from a dependable source, a complete itinerary of the travel including the transport, accommodation, and fun activities can be planned and formulated taking into account the health and severe medical condition (Leggat & Leggat, 2002). With all these checks in place, elderly tourists can afford to travel with more confidence. They tend to reap the benefits from the travel policy in terms of physical and emotional well-being. Because of the medical health policies in the UK, states companies that are regular in size are elusive as the time their population reaches the late sixties (UN, 2005). Age matters for quotations of

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travel insurance in their travel. Almost 20% of the population aged about 75 years and 25% of 65 years old refused the need for travel insurance without a second thought. As per a study conducted the main reason for their denial of them is their lack of knowledge of the internet and the information contained in it about the other alternatives to it. Most of the insurance policies issued say about 95% are mostly targeted at the upper age limits of the population. In that one-third of the policies issued did not provide any coverage for tourists aged above 64 years and tourists who were 75 plus years were barred from taking any travel insurance policy in their name. The policies for a traveller's single trip did not include one-third of the people who were aged 65 years and above and 59% of 75 years of age and above. An in-depth analysis of the prices that are charged by the majority of insurers shows how expensive the premium of the insurance gets as the age of the insurance holder increases, sometimes wherein the policies double in its price for a traveller aged 66 years. An elderly tourist with an already existing medical condition is more complicated in obtaining insurance without being rejected. They tend to be potential candidates for partial recovery. However, these coverages can be made available to elderly tourists after special medical screening but at a higher cost than usual which would ultimately be a huge expense for the tourists to pay. Another drawback to this is that elderly tourists are not given insurance to pursue activities like car hire and sports such as winter sports and are automatically cut down on this genre of insurance (L & H, 2003).

The proximity of age and rate and level of claims in insurance is justified by the regulations and rules of an insurer. These proximities are usually connected to the health factors of the traveller which makes it hard for them to provide security for the underwriters. Some of the insurance companies focus more on the services that they provide to the elderly, and age constraints to avail the travel health insurance is immaterial to them (Allingham, J. D., 2013). Despite this, the age and medical health condition of a traveller are taken into account while considering them for insurance (Babu et al., 2014). With the existence of age and discrimination in providing travel insurance, the anxiety factor among uninsured travellers should be taken note of.

The representatives of the insurance companies along with the assorted civil society bodies in collaboration with the insurance companies are working towards developing a new set of processes to guide and help elderly tourists to pick the right kind of insurance which would suit them. To conclude, an effort must be made to understand the simplest of the needs of the elderly

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senior citizen traveller. These needs should not just be stuck to guiding them to pick the suitable travel insurance but their health needs as a whole. Also, access to obtaining a travel policy should be made simpler and without any burden to promote the growing market of travel insurance in the economy world (Henderson, 2015). Insurance includes a policy, a certificate, an interim receipt, and handwritten evidence of the contract (if the agreement was done orally by the insurer). Law states that insurance must contain: An insurable interest, A risk and a promise of indemnity, and A contract, of the "utmost faith" (Henderson, 2015). Tourism should have an insurance contract as per economic subjects which state that certain situations impose the need for an insurance contract. There are two types of legal insurance in the travel and tourism industry, and they are voluntary (contractual insurance) and legal action (compulsory insurance).

All the vehicles on the road must be insured compulsorily as stated by the Law of Obligatory insurance policy (Henderson, 2015). Not just this, the passengers travelling in public transport need to be insured by the owners of the public transport such as aeroplanes, trains, ships, and buses against accidents caused due to any crisis. Insurance has a major role to play in the development of tourist activities. For risks that are not covered by insurance policies, there is a dire need for voluntary insurance to cover the excluded risk. To be proactive, most tourists tend to take up insurance that covers risks that are otherwise not covered by a regular travel insurance policy. Hence, as a method of precaution, the providers of transport insure themselves. Voluntary insurance is a basic form of regulative insurance. The policy forms of insurance and the associated tariffs define the boundaries of Agency Stewardship with voluntary contract insurance. The entities of business, business materials, and the costs of nonmaterial factors are all the obligations of travellers that cannot be excluded. There are a couple of obligations of the travel agents and hotels which are related to compensation of the damages to the material and immaterial account of service takers which are associated with the development of tourist activities (Allingham, 2013). As a result of this, the tourist companies have their contracts bound to the insurance companies that are responsible for minimizing the compensation amount which is an obligation stipulated in the contract. As a good businessman idea, the tourism industry voluntarily tends to sign contracts for ensuring the risks that are said to be certain of occurrence.

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Crisis, Risk Coverage, and Global Practices

The risk coverage covers the general, additional, and supplemental conditions of a risk that are expected to occur in the tourism industry. An example of risk coverage would be to ensure a guest is in the hotel when an accident occurs. The company that covers insurance usually runs a business similar to the hotel business such as in the hospitality sector (Allingham, 2013). As long as the guest who is insured by the insurance company is within or outside the object, it becomes an obligation of the insurer to cover all the risks that the traveller is subjected to. These risks include the risks that are due to accidents caused by the hunting or fishing industry. This coverage of risks applies to only those organizations/companies that are stated in the insurance contract. They ensure their customers during the summer and fall break, especially students. Under special conditions as mentioned in the contract, insurance for skiing, swimming, and diving is offered to its customers. Sometimes insurance is provided for travellers taking public transport (Babu et al., 2014).

In Countries that showcase emissive tourism opportunities, the insurance policy is done keeping in mind the property of the traveller and the personality of the traveller. This is done to mitigate the risks and uncertainties related to a tourist's travel. It is also issued to make sure the traveller feels safe as he/she leaves an environment that is very familiar to him/her and moves into a different environment with unknown dangers. There are several offers issued by tourism and travel organization which includes, coverage for loss of baggage insurance, damage caused by the tourist during their time of travel, and damage by the automobile, ships, or aeroplanes to the passengers during their travel. Insurance is also provided for the sickness of the traveller and the cost of regular repair and service of the transport by which the tourists travel. It also provides insurance for the cost, if the traveller/tourists don't turn up during the trip (Allingham, 2013).

For service receivers, an insurance package is the best alternative which provides the best combinations of different varieties of insurance. The insurance becomes active after the first 24 hours of signing the contract until a different period is specified in the contract. The starting and ending date of insurance needs to be specified in the policy papers. If not specified, each party will take advantage of these and mend the dates as per their convenience. While deciding on what insurance to offer to the customers, the insurance companies need to consider all the potential losses and their consequences. An exposure of loss is defined as when an individual or in this case an organization is vulnerable to any loss, injuries, and damages that are in turn

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subjected to financial loss. The best way to be prepared for an unpredictable event is to know the complete details of risk and its coverages in and out. Knowing the terms and conditions of the policy issued to the customers and the coverage of those risks under the policy with exclusions that are incorporated with the policy is a big advantage to handling the insurance policy wisely. There are several companies providing insurance policies to their customers with varied customer benefits and risk coverage. These variations are due to changes incorporated by various plans and perils and the responsibility of the tourists of picking the right policy and knowing about what they think is needed for them.

Reading the policy statement clearly in and out without neglecting the fine print on the policy paper is advised for the traveller. As an example, to explain this, we take the airline industry, the insurance policy for flight delays may vary from one insurance provider to another. Some insurers don't cover war terrorism, delays due to strikes, civil riots, or disturbances in the flight schedule due to other operational factors but not due to mechanical reasons. Trip curtailment provides insurance coverage to its traveller once the traveller is abroad(overseas) or in situations where one must reduce the number of holidays planned due to serious reasons such as illness or a family or official emergency (Huang & Tsai, 2003).

It is an important thing to check for the existence of emergency evacuation in the insurance policy when the insured is suffering from an already existing medical condition. As per the law stated by the Financial Industry Disputes Resolution Center (Fidrec), if one needs immediate medical assistance or evacuation, the insurer or the official representative who is authorized by the country the traveller is currently residing in should be contacted. This is done as a result of obeying what is stated in the policy document. The policy document states that the opinion of the insurer must be taken to decide if medical assistance should be given, and that evacuation is necessary from one point of location to the other for treatment purposes. In a scenario where there is a flight delay, a claim can be made on the insurance by the insured only on the condition that the delay is for six consecutive hours or more. A claim is not considered if the delay of the flight is less than six hours. An event that is already known cannot be covered by the insurance policy. This in other words means that when civil riots or natural hazards occur, no coverage is provided by the insurance company. These are mostly published in the airline or hotel tickets or via media news or reports and majorly by the travel advisories run by the government before an insured buys the policy. This helps the traveller make a wise decision while buying the policy. But on the contrary, "the

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occurrence of the known events' 'happens after the insured buys the policy. In such cases, the claims can be made by cancelling the planned trip but on the given condition that this should have been specified in the contract during the signing process (purchasing of the contract). To be on the safer side, a check on the exclusion clauses is necessary to ensure the claims are as per that which is stated by the Fidrec. Theft coverage is provided by the policy chosen by the insured which covers the accidental loss of personal belongings during the time of travel under special terms and conditions agreed upon by both the insurer and the insured. The process of claiming involves filing a police complaint as theft of one's belongings at the local police station of the traveller's destination because this police complaint report should be provided as a must while submitting documents for the claims of the theft. Most travel insurance like health insurance policies does not provide coverage for already existing medical conditions of the traveller (insured). As a result of this, it is the complete responsibility of the insured to get to know about the exclusions that are present in the policy concerning the health of the traveller. Hence for buying a policy that covers you for your pre-existing medical conditions, you must do complete research about it in the insurance market before buying. An open discussion with the insurer about the complete terms and conditions of the policy and its coverage makes one buy the policy smarter.

The definition for travellers with already existing medical conditions varies from one insurance company to the other. Hence it should be advised to acquire a thorough knowledge of the policy document before purchasing one. This lists any complications that are present or expected to arise before the commencement of the journey. If the insured has been diagnosed with any ailment in the recent period (12 months), then that is a must to be included in the policy document before purchasing.

The working travel medical insurance policy in Singapore shows that, if the insured who is travelling to an overseas country experiences any sickness or meets with an accident, then that person can return to Singapore within 72 hours of the incident and can get medical assistance for free expenses. Whereas in a situation where the insured gets medical help overseas, then that person is given 30 days to recover his expenses as claimed as mentioned and agreed upon in the policy. If an individual is travelling alone then the best option for him is to opt for individual cover. But when you are travelling as a family then it is best advised to go for family insurance which supports everyone including children under the age of 18 years.

The choice of the best insurance plan depends on the nature of the trip. An annual insurance plan is more feasible if you are a regular traveller on

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almost a weekly basis. This makes it more cost-efficient as annual insurance covers round trips for 12 years. The restrictions to this are, when it comes to overseas travel, the trip cannot extend beyond 90 days at a stretch, and also there happens to be a restriction for a traveller who is aged above 70 years as they can buy only a single trip (Tan, 2017).

The Need for Insurance in Tourism

The need for insurance is very important in any risk management process. For a business that involves a risk management plan along with an emergency response plan in their business structure, there is a must for an insurance plan for its efficient working. The insurance plan of the company along with the risk management strategies, makes the decision regarding the hazards and assets to be insured and about the insurance policy that needs to be sold to its customers (Allingham, J. D., 2013). An important point to be noted is that buying insurance by the traveller will not reduce the occurrence of the risks or doesn't make the activities associated with it any safer than before. Insurance is a post-incident process. It acts mainly as a recovery of the process experienced by the traveller. This does not mean to say that all the customers will be willing to buy the insurance offered by the insurance company.

The types of activities that the travel company is involved in determine the decision-making concerning the purchase of travel insurance. To access the insurance policy obtained by the insured, he /she must carry the policy card along with them during the trip. A large number of properties are accumulated by travel companies who tend to protect their assets through insurance. The decision about whether to buy insurance or not completely depends on internal and external factors such as the quantity terms of coverages that can be purchased, the types and the associated terms and conditions of the insurance policy.

The internal factors also include the level of tolerance of risk that shows the measure of how much the owner is ready to take up the risk. It is very important to study how the insurance obtained by the insured complements the risk of tolerance experienced. Along with this, a keen observation needs to be put to see if business owners are exposed to the loss on a personal level or not, and if they are then they have capable measures to bear the losses experienced by them. Longevity is a very important factor to be taken into account when the business and business structure is studied to see if they provide supportive care to the owners and the assets of the company and the

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need for insurance is decided to keep in mind the studied business structure of the company. The last but one (the third) factor is to focus on the substitution cost of an asset. The final factor into consideration is the human resources and the shareholders of the company and also the moral and ethical issues of the company and its resources.

After the internal factors, it's now time to explore the external factors. And these statutory requirements also called for legal requirements along with the business requirements of the industry chosen. The insurance plan, the purchase of the insurance that was planned, reading and understanding the policy document of the insurance, maintaining the insurance policies throughout the year from starting till the end, building and maintaining good relationships with the customers and other firms, efficiently dealing with the claims, Building insurance expertise and the recordkeeping of the insurance-related documents, all of these combined form the insurance portfolio (Korstanje & George, 2015). The insurance portfolio also includes records of the accidents that happened during the period of consideration, information about the client, a medical questionnaire about the client, and the registration forms given to the insured at the beginning of the process (Taleski, 2011).

Travel Medical Insurance for Canadians

Travellers to Canada have a significantly high cost for their medical expenses. This makes travel medical insurance a necessity for those who are travelling to Canada. As per the reports of CBC's marketplace, it is seen that clients have coverage for certain risks when they don't own one (Allingham, J. D., 2013). It is believed that travel medical insurance is not just the responsibility of the patient or insured, but also the responsibility of the physicians who help the patients with the claiming process and the application process of the insurance at the initial stages. As physicians have an important role to play, they must stay up to date with travel insurance policies and coverages offered by the insurance company to support their patients.

The GHIP (Government health insurance plan) is an organization that lends a helping hand to travellers (Canadians) in terms of financial support in case of any emergencies while they are away from the country. They target the senior citizens of Canada because they tend to be more prone to suffer from injuries, sicknesses, or accidents of varying degrees. They provide immediate medical assistance to anything that they suffer even including the pre-medical conditions that necessarily may not be included in the policy

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bought by them. Multiple insurance firms are offering insurance to Canadian citizens for their medical expenses incurred during their travel to and from the country and also for domestic travel within the country. This shows that there are more than a dozen of travel insurance companies in specific that are present in Canada as it is a good area of business for Canadians. The sales made by CIBC as the applications and claims are directed to the Travel Insurance Coordinators (TIC). To name Medipac and Manulife are the two more ruling insurance firms in Canada and have gained significant popularity among the citizens of Canada. There are two types of travel insurance companies, and they are member-based and corporation based. They both work to maximize the profit of the shareholder in general (Allingham, 2013). The main method of the company trying to reduce their risk is to not cover the risks associated with the tourist's pre-existing conditions or accept those risks under special important qualifications. When there is an involvement of a physician in the travel insurance policy, he/she must understand the proper definition of the term "period" before the policy is activated, that is when the medical condition of the traveller who has taken up the insurance is very much in control and is stable. The standard period is for 3 months; however, it can vary from 2 months to one year. These 3 months are called the red zone which is a trouble-free period just before the policy is activated.

Analyzing the stability and control of any disorders can be done with the help of the medication proxy of risk. Any alteration which is done for the type of medication, format, dosage, and prescription and recommendation during the red-zone period, the period even before the insured period begins. The other proxies for stability and control that are relevant are emergencies of the symptoms, testing at the laboratory, and changes in the symptoms of the disorders. It is often assumed that all the applicants of the insurance policies pass the screening test (questions) where the insurance policy is converted into a contract between the insurer and the insured. It is not just a contract as it goes by word but is an agreement that both insurer and the insured come to terms with where the applicant (insurer/traveller) agrees to pay a premium amount for the insurance obtained by the traveller (Council et al., 2017). This is now successful after the agreement has been made and they can be covered by the traveller only when they are claimed under specified conditions.

There happen to be several ways where a person can be uninsured. For travellers with an already existing medical health, a thorough assessment of the individual premium set offered by all the insurance companies in the market must be evaluated to make a wise decision regarding the purchase of insurance at the cost of money and time (Allingham, J. D., 2013). By doing

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this the traveller will have all the required information at his fingertips. The other useful tip to make a wise decision is to sit along with a physician to complete the application process because, for those with an existing medical condition, it is an unacceptable risk to do it right away at the travel company or agent's office.

Travellers have the right to choose the insurer and it depends on their specific needs. A mixture of various risks that are acceptable along with the different variances that are present in the population and the rates are all required for a healthy and competitively based industry. For any travel insurance company to survive among the others in the market, clear-cut clarity and transparency are needed (Korstanje & George, 2015). These two characteristics are needed to maintain a good rapport and reputation with their clients. It is also one of the best solutions to avoid any sort of conflicts that can occur due to several legal and regulatory laws and actions (Allingham, 2013). In contrast to this, travel insurance in India is still not as popular and efficient as in Canada. This is surely expected to change in the coming future as the perceptions of travellers about travel insurance in India are set to change.

Ethical Dilemmas in the Leisure Business

The majority of travellers buy their travel tickets (e-tickets) online. One of the major reasons for this is because of the variety of discount rates offered for different destinations, schedules, and other additional services. In the airline industry, in particular, travel insurance is generally made available during the booking of air tickets. As a result of fraudulent activities, the Italian Antitrust Authority took major actions against Ryanair and Easyjet airlines with a fine of a large amount. These airline companies who are known for their low-cost travel were in the limelight for lack of transparency about their travel insurance options on their websites (Council et al., 2017). The core problem in transparency was that it did not specify the types of risks that are going to be covered when one takes their travel insurance policy. Several proceedings from January 2013 were concluded with administrative sanctions after numerous complaints from the different associations and customers who opted for their travel insurance policy. When matching as per the breach of laws, articles 20 and 22 of the consumer code were violated. The type of insurance that the company offered to their client was not to be seen mentioned on their website, also the number of exclusions in the policy document that they

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offered was not mentioned. As an outcome of this, there happened to be very minimal knowledge about the policy procedures and rules among its clients, especially when the policy was bought online. This was a serious issue because the number of exclusions on the medical expenses was almost twice as costly as the value of money of the insurance. There happened to be extra service charges at the airport that the travellers have to pay and they had no idea about it until they reached the airport because they thought these charges were already covered in the travel insurance policy already covered by them. These misleading strategies adopted by the two airlines made it very difficult for travellers to travel via their services and eventually made them lose their trust in their brand.

One of the strategies that Ryanair followed to compel its clients to buy their travel was to make it impossible to deselect the travel insurance option that came along with the booking of tickets. But as an escape from this trap, the travellers had to completely stop themselves from insuring at all by selecting the option that they don't wish to insure themselves. Such commercial practices followed by the airline were very much cruel and disrespectful to its client's liberty. Article (23) of the constitution states that there must be a complete form of transparency and certainty regarding the optional prices. In other words, there has to be an open mode of communication during the booking of their tickets. Customers should be given a choice to select their travel insurance and there must be no compulsion to or their choices. The refunds claimed by the customers are no longer an easy process because of such practices adopted by the airline company (Council et al., 2017). The money that was spent by the clients on compulsion was used by the company to pay off the expenses that were incurred by them to run the airline company. The certification cost was usually much higher than the insurance cost. The other illegal practices that airline companies adopted were to charge the telephonic conversation between the customers and customer-care support to the customers while the call was made to talk about the reimbursement of their cash. This came to an end after most of them claimed reimbursement of their money (Korstanje & George, 2015). Due to the adoption of such complex and fraudulent profit-making strategies that are in place for the reimbursement process, the number of travellers who opt for this option of reimbursement are very low in recent times. The economic and social inflation of the final cost of tickets is due to closed communication between

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airline companies and their customers. Most of the time the clients are not so sure of the traps they are put into by the airline companies because of their money-making motives. As a lesson learned by the EasyJet Company, they started having a system of booking airline tickets which were very transparent between them and the customers. They adopted an easy process for refunding as well. With these measurements in place by the airline industry, there has been the very little place for any misleading practices with the firm (Berti & Stramacci, 2014).

Advantages of World-of-Mouth

The short form of World of Mouth is eWOM. It is the most common determining factor of different behaviours of consumers. In other words, word of mouth can be defined as the interest showcased by the consumer in a product of the company by bringing it up in his or her everyday conversation. In the tourism industry, eWOM is studied by studying the characteristics of hotels and other accommodation facilities in tourist spots.

Volume and Valence are used to determine the measurement of the word of mouth. These matrices measure the number and nature of messages that are volume and valence respectively. These matrices can be positive, negative, or neutral depending upon the nature of the messages. The number of sales is determined by the volume of the message. The purchase of any product is mostly ruled by the negative value of eWOM. The positive value of eWOM has very little effect on its volume. Utilitarian products are benefited from this negative bias such as the insurance from the insurance company because when the customers plan to buy utilitarian products (insurance) they tend to go more by the negative reviews of the product than the positive ones. The other factor that determines the word of mouth is the matric of density. It is the ratio of the customers that post an insurance company review, (i) in the time (x) to the customers that had already purchased the travel insurance from the same company (i) in the same time (x). This ratio clearly shows the extent to which a product or service has succeeded and failed in the market (P.A & F.W, 2002).

The SquareMouth.com (e-commerce) company has developed a new strategy, which lets the buyers of the insurance compare the travel insurance in the market and then lets them decide to buy the insurance. This made the company outshine the market. This strategy showed that the sales of any travel insurance are mainly dependent on the review of the customers than anything else (Council et al., 2017). In a nutshell, the sales of travel insurance are

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directly proportional to the number of reviews of the product (insurance). This also at the same time states that when the negativity of the product performance increases (negative reviews), the sales of the same decrease. Therefore, word of mouth negatively impacts greatly the decision-making process of the customers whether to buy the product or not (Amblee, 2015).

Travel Insurance and E-Portal

The satisfaction of the customers is the driving factor in e-portal services. They can be enhanced by focusing on areas such as making easy access to customers on their web page, easy availability of the information of the products such as prices, fast loading of the website, and simple booking steps. All of this would uncomplicate the customer's work of buying travel insurance online (Werthner & Ricci, 2004). Travel insurance has gained an immense amount of popularity in today's world. Every person who travels knows how important insurance is for them. This paves a clear route for the success of e-travel strategies that are budding up in the market. This mainly focuses on an easy life for a person who chooses travel insurance during their travel where any financial loss is recovered by the settlements of refunds. The USA is the major buyer of travel insurance through an e-portal. But in the future, this is expected to decline and there happens to be a rise in the numbers among Asians. In another 5 years, India is going to top the Asian countries who are going to opt for travel insurance, especially for e-portal services (Jeniffer & Chandran, 2016).

E-Portal Customer Satisfaction

Customer contentment is an essential factor when it comes to both insurance and e-portal services. Customer contentment is composed of Attitudes toward the customer, Assurance towards the customer, and Awareness of the customer. The attitudes within the e-portal services tend to evolve over a while. The way of issuing the insurance and the security measures towards its customers and knowledge of accessibility all comprise the attitude of the e-portal insurance (Cave et al., 2016). The customer's attitude towards the e-portal includes the purchase and knowledge of internet usage to buy the insurance policy. It also includes transactional services, and the easy methods of downloads show the attitude of consumers towards e-portal usage in buying travel insurance.

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There is a loyalty factor that is very important on an e-portal platform. The main base for marketing e-business is the e-portal. Loyalty along with assurance and reliability is very important in e-portal services. The cost of the product has a direct proportionality with the quality of the product (Jennifer & Chandran, 2016). The more the cost paid the higher the quality of the product. The root of customer contentment is the assurance provided by the insurance company via the e-portal (technology). Reliability is related to the end-user security measures and earning the trust of its customer is known as assurance that is provided by the production company when one buys the product (insurance).

Awareness is a very important part of e-portal customer satisfaction. Awareness of the product and its associated terminologies is very important to deal with problems that arise in terms of claims and customer conflicts (Korstanje & George, 2015). Having faith is very important to the insurer and their products. This comes from building everlasting healthy relationships between them both. Trust is a guiding principle for having and providing good customer satisfaction. This trust comes from having an agreement between them both which asks them to abide by certain rules and regulations. This, in turn, means that there is no gap or hiding between the coverages or exclusions in the policy documents and there is transparent communication between them both. The insurance is mainly done as an alternative that a person or a traveller can depend on when the unfortunate occurs, hence keeping this in mind it is very much necessary to have that trust factor between both. All of this makes customer awareness an important measure of e-portal travel insurance for the best results and to reap all the benefits for both parties (Jennifer & Chandran, 2016).

There is constant and upward growth of the insurance policy in the travel and tourism department. Especially in the 21st century, there has been rapid growth in this industry. They offer a variety of different insurance products and services. There are a lot of mixed and combined forms of travel insurance available in the market these days (Werthner & Ricci, 2004). The risk factors are many during a trip. The demographic regions of the place of travel contribute a lot towards the risks in international travel. The social and health state of a person is a very important criterion to determine the type of risks one can be subjected to. Insurance is a must for people who are pregnant and are travelling (Larsen, S., 2007).

The risk of travel in countries like Malaysia which is the topmost tourist attractive country depends completely on a regulatory framework that is adopted by them. Hence, this kind of policy is purchased by travellers at the

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early stage of booking to abide by the rules of the country. This is done by the Malaysian government as they care for the lives of their tourists (Hasan & Abdullah, 2014).

Travel Insurance in the Future

EMEA

EMEA is the region that is the most famous for taking travel insurance. Bharath, in his paper, shows that travel insurance companies have a set of separate strategies for giving their customers specialized and custom-made travel insurance. There has been immense growth in travel insurance policy companies in Europe, more than in any other region in the world. There are a lot of emerging and budding vendors in the market who happen to use a direct form of the route into the travel industry to introduce their new products. Because of this, there are a lot of efficient methods of travel insurance methods (Cave et al., 2016). Age is the major driving factor of the insurance company, the popularity, and sales of travel insurance increase as and when elderly people find the motivation to travel around. In countries like Europe and Africa, with a population of seven hundred and forty-two million, there are about one hundred and forty-eight million people of age above 70 years. Hence most of the travel companies in EMEA are having the elderly population as their target for increasing their business (Research, 2016).

APAC

The target for the travel insurance policy in the Asia Pacific region is the growing middle-class population. The ever-increasing population rate in the APAC region, especially India is a boon to these companies. Countries like China and Australia which are major contributors to the GDP growth of the economy are the countries that the travel insurance companies are now targeting to increase their profit. E-portals are quite familiar in these countries to buy any kind of insurance, travel insurance in particular. Most travel insurance companies use banks as a medium to sell their products because people have more trust in banks in general and travel companies tend to take

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advantage of this. Airlines are another form of medium to sell travel insurance products by travel companies (Research, 2016).

Americas

The American population gives a lot of importance to vacations as a stress buster for them in their hectic work and business life. Travel insurance companies in America take advantage of this trend. The population is more excited to take up high-risk activities in their vacations which makes the travel company take further advantage of this to sell off their products. This lifestyle of Americans when they set out on a vacation makes it very easy for the travel industry to come up with varieties of travel insurance policies to match the needs of their clients (Research, 2016).

Profiling

An assessment of risk, which ensures an event during the event of unfortunate happenings such as accidents. It also includes a claim from a risk that has been insured by the insurance company to the insured. When profiling of risk is done it is nothing but the cost that would be charged for insuring that particular risk by the insurer. There are a lot of parameters in varying concentrations that are used to assess any form of risk by motor insurance companies (Cave et al., 2016). Risk profiling is usually done by the travel insurance company for their insurers. The risk profile built by them heavily depends on expertise, intelligence, technologies, and the assistance provided by the country. The expertise is more about having a good set of manpower working on the travel security of the travellers. Intelligence, on the other hand, is all about mitigating the anticipated risks at the planning phase of the travel and thereby reacting to them, keeping in mind the safety of the travellers (Larsen, S., 2007). The technology part of the risk profiling process depends on the intervention of the travel before the travel such as the online authorization process, the communication process in case an unfortunate event occurs, tracking of the whereabouts of the traveller including their mobile networks and debit/credit card transactions and the feedback from the customers. The final part of the risk profiling is the assistance provided in the destination country which includes medical care, transportation services, etc (Unger, 2015). Risk

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profiling in a travel organization makes its decision regarding profiling keeping in mind the best-leading safety strategies. While creating a profile, the major concern that is focused is on the threats that are potential to a traveller and the finance that takes to cover if a catastrophe occurs (PIAM, 2017).

Conclusion

By doing the literature review two important criteria regarding the perception of the traveller towards the buying of travel insurance and risk coverages can be seen. The first one is that the purchase of traveller insurance from the buyer completely depends on their trustworthiness, the understanding of the importance of travel insurance for the traveller, and the knowledge of travel insurance. The exchange of travel insurance between the insurer and the buyer for money completely depends on the attitude toward the perception of risk. The selling of travel insurance to the insured is all about the convincing capabilities of the travel insurance company. The purchase of travel insurance by travellers mainly depends on two things, firstly the traveller is aware of the need for travel insurance during their travel and then secondly, they buy it as an obligation. However, the actual reason is not known yet. This may largely depend on the trustworthiness of the company or the type of travel insurance policy that the insured will purchase.

References

Allingham, J. D. (2013). *Travel Medical Insurance.* 819-822.

Amblee, N. (2015). The impact of eWOM density on sales of travel insurance, *Annals of Tourism Research,* 56, 137–140, Indian Institute of Management, Kozhikode, India, Elsevier publication.

Babu, K. V., Gade, J. (2014). *Tourism in India.* 1-18.

Berti, I., & Stramacci, D. (2014). *Travel Insurance: Misleading Practices on Airline*. 229-230.

Cave, M. R., Schatz, S., Wolff, B. S. (2016). *Insurance.* 69-149.

Council, W. T. (2017). *The Economic Impact of Travel and Tourism March 2017.* Inside Cover: Prince Regent National Park, Australia - NASA. Retrieved from IBEF.

Hasan, A. A., & Abdullah, N. C. (2015). Compulsory travel insurance in Malaysia: some regulatory considerations. *Procedia-Social and Behavioral Sciences,* 172, 344-351. https://doi.org/10.1016/j.sbspro.2015.01.375.

Nova Science Publishers, Inc.

Henderson, J. C. (2015). *Tourism Recreation Research.* Population Ageing Tourism and Travel Insurance, 79-82, Ontario.

Huang, L., & Tsai, H. T. (2003). The study of senior traveler behavior in Taiwan. *Tourism management,* 24(5), 561-574. https://doi.org/10.1016/S0261-5177(03) 00008-6.

Jeniffer, M. S., & Chandran, A. (2016). Impact of e-travel insurance platforms on customization ventures: An explorative reportage. *International Journal on Global Business Management & Research,* 5(2), 8-15.

Korstanje, M. E., & George, B. P. (2015). What does insurance purchase behavior say about risks? A study in the Argentine context with special focus on travel insurance. *International Journal of Disaster Resilience in the Built Environment.* https://doi.org/10.1108/IJDRBE-09-2012-0030.

Larsen, S. (2007). Aspects of a Psychology of the Tourist Experience. *Scandinavian Journal of Hospitality and Tourism,* 7-18.

Lawton, G., & Page, S. (1997). Evaluating travel agents' provision of health advice to travelers. *Tourism management,* 18(2), 89-104. https://doi.org/10.1016/S0261-5177(96)00104-5.

Leggat, P. A., & Leggat, F. W. (2002). Travel insurance claims made by travelers from Australia. *Journal of Travel Medicine,* 9(2), 59-65.

Leggat, P. A., Carne, J., & Kedjarune, U. (1999). Travel insurance and health. *J Travel Med,* 6(4), 243-248.

Schindler, K. J. (2005, July). Travel counseling for the elderly traveler. In *Nursing forum* (Vol. 40, No. 3, pp. 107-115). Malden, USA: Blackwell Publishing Inc. https://doi.org/10.1111/j.1744-6198.2005.00015.x

Travel and Tourism Competitiveness Report (2017) Industry trends. World economic forum. Retrieved from Industry trends: http://reports.weforum.org/travel-and-tourism- competitiveness-report-2017/industry-trends/.

Werthner, H., & Ricci, F. (2004). E-commerce and tourism. *Communications of the ACM,* 47(12), 101-105.

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Chapter 3

Struggling to Move: The Effects of COVID-19 and the Radical Transformation of Tourism, Argentina as a Case Study

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Abstract

At the end of December 2019, a new virus outbreak baptized by scientists as COVID-19 (SARS-CoV2) paralyzed global commerce generating millionaire losses in the world. The virus was rapidly disseminated to the western cities through international travel and the tourism industry, a problem which led governments to cancel international flights while closing the airspace. The WHO (World Health Organization) recommended energetically the imposition of strict lockdowns and keeping social distancing as two valid forms to mitigate the pandemic. In the question of months, the virus wreaked havoc in the main economies of the world grinding the tourism and hospitality industries to an unparalleled halt. To put things straight, to date, more than 37 million people have been infected and one million have perished. Afrgentina, a southern Latin American country, which adopted a stricter and longer lockdown in the beginning, was gradually escalating to seventh place in the number of infected people (894.206) seconded by Peru and France. The socio-economic effects of COVID-19 on the tourism industry are not only manifold and complex but also denote a multifaceted dynamic. While some voices have alerted on the urgency to develop more resilient and eco-friendly forms of consumption, others have emphasized the need of changing the current research towards multidisciplinary methods. In

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the pre-pandemic days, tourists were valorized as an ambassador of "civilization," real global knights widely admired and objects of curiosity while nowadays tourists are negatively seen as potential enemies or carriers of a mortal disease, so to speak widely feared and demonized as never before. In this context, the present chapter discusses conceptually the effects and changes of the tourism industry in Argentina, particularly but with some broad strokes that illustrate the ways the industry is changing in the world.

Keywords: tourism, travel behaviour, fear, COVID-19, pandemic, feudalization process

Introduction

The end of December was the moment that exactly marked the start of a nightmare for policy-makers, specialists and professionals in the tourism and hospitality industries. The outbreak of a new version of SARS –SARSCOv2- known as COVID-19 (Coronavirus disease) shocked and paralyzed global trade affecting negatively some service sectors like hospitality, tourism, recreation, restaurants, theatres, events and festivals only to name a few (Prayag, 2020; Prideaux, Thompson & Pavel 2020). The paradox lies in the fact the industry served not only as a facilitator of the contagion but at the same time operated for a rapid recovery in a post-pandemic context. Worried by the fast dissemination accelerated by international travel and tourism, governments unilaterally disposed of countless restrictive measures associated with the closure of borders and airspace. These steps were unfortunately accompanied by a strict lockdown to impede the free circulation of streets (Sigala, 2020; Rogerson & Baum, 2020). The WHO (World Health Organization) extended a set of suggestions which oscillated from social distancing to the wearing of masks. Despite these initiatives, in the question of months, the pandemic wreaked havoc in the largest economies of the world grinding tourism to an unparalleled halt. To put things straight, to date, more than 37 million people have been infected and almost one million have invariably perished. Among the most affected countries, we have the US (219.933 victims) followed by Brazil (150.555), India (109.894), Mexico (83.781), the UK (42.875), Italy (36.000), Spain (33.124), Peru (33.305), France (32.779), and Argentina (27.000) only to new a few.

In the mid of this mayhem, the present chapter narrates and describes the case of Argentina, a Southern Latin American country which initiated a strict

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and long lockdown which affected its socio-political administration, if not gradually escalating in the number of infected cases and victims positioning in the seventh-place seconding Peru and France. This point suggests not only do we have much to learn from this virus but also the future of tourism remains –at least- uncertain. To some extent, the lack of standardized protocols or programs by the side of WHO obscured the medical diagnoses and programs of control. At the same time, each country encouraged assorted –but different- measures to mitigate the pandemic. Beyond this controversy, it is noteworthy that a whole portion of global economies slumped down because of COVID-19 creating serious durable effects. To cut the long story short, COVID-19 led the tourism industry towards its worse crisis in history (Radic et al. 2020).

Let's comment to readers that the paper was mainly organized into three parts. In the first section, we discuss the interplay between virus outbreaks and tourism, the ebbs and flows of literature as well as its strengths and weaknesses. The second section is reserved to evaluate a methodological discussion and sampling details. The third and fourth sections enumerate the research results, limitations and challenges for a Post COVID tourism industry.

Tourism and Virus Outbreaks

Initial Discussion

Over recent days, tourism-related scholars devoted their efforts and attention to deciphering the complexity and dynamic of the phenomenon evaluating to what extent the industry has possibilities to subsist (Zheng, Hog & Wen 2020). Theories and works revolving around the effects of COVID-19 on the tourist system abound but they can be very well classified into two clear-cut families. Some studies alert on the need of developing more resilient and eco-friendly destinations to resolve the problem of climate change (Gossling, Scott 6 Hall, 2020; Prayag, 2020; Prideaux, Thompson & Pabel, 2020). Other voices acknowledge the urgency to embrace new multidisciplinary research to overcome the next obstacles (Wen, Wang & Kozak 2020; Wen et al. 2020). It is important not to lose sight of the fact that the discipline cultivated a strange fascination for the figure of the tourist as a key player of the system while probably other agents have been relegated to the dust of oblivion. Scholars certainly acknowledge –citing A. Franklin- that the tourist-centricity which

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stems from the economic-based paradigm- has some problems to study tourism in a world without tourists. The question whether of John Urry (1992) imagined "the tourist gaze" as a motivational force of global capitalism (consumption), the COVID-19 sets the pace for a new feudal world where a new version of this tourist gaze prevails. We have dubbed this the "wicked gaze" to symbolize the demonizing process and hostility shown against foreign –if not Chinese or Asian- tourists in the West. In the days earlier than the virus outbreak tourists were esteemed as "ambassadors of peace and prosperity" whereas now they are seen as "ambassadors of the disaster," potential carriers of a fatal disease (Korstanje 2020).

Having said this, the present chapter explores the substantial changes in the tourism industry in Argentina while laying the foundations towards a new radical understanding of the role played by the alterity in the stage of new normality.

As the previous backdrop, the term pandemic is often associated with the presence of infectious disease, most probably because of a virus outbreak, which cannot be contained and rapidly expands to infect people in multiple continents and countries. Pandemics usually made significant changes in culture and the economic organization of society. History witnesses how pandemics not only accelerate conquests but also the rise of chauvinist expressions and nationalism. The radical transformations of pandemics open the doors to new situations and contexts. In this context, scholars should trace back to the history of pandemics to mitigate their negative aftermaths (Hall, Scott & Gossling, 2020). The nature of crisis often captivates the attention of scholarship on some risks while relegating other major risks (Hall 2010), in which case a clear diagnosis of the situation is always due. As Cass Sunstein (2005) puts it, the term risk is a concept very hard to grasp but also human emotions distort the causalities of tragedies. We are educated to maximize some minor risks –echoing our emotions- while others are minimized. The net of experts, jointly with the authorities, should make future decisions with a firm basis in scientific reports. The role of activists, and pressure groups should be at least undermined. In a hyper-connected and globalized world, the virus travels with us. Needless to say that this applies very well to the virus outbreak and spreading of COVID-19, which today affects not only the tourism industry but also global commerce as never before (Qiu, et al. 2020; Sheller 2020; Gossling, Scott & Hall, 2020; Zenker & Kock, 2020; Higgins-Desbiolles, 2020). What is more important, this global emergency evinces the urgency to adopt new strategies and methods leading the current epistemology towards a more hybridized form, or so to speak a multidisciplinary perspective

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(Gretzel et. al 2020). Furthermore, affordable digital technologies allow new forms of virtual tourism where social contact and physical movements are dispensable. If the future of tourism research was originally marked by technology no less true is that COVID-19 potentiates interesting novel fields of exploration in Artificial intelligence (Zeng, Chen & Lew, 2020), information technologies (Xian, Fesenmaier, Werthner 2020; Cai, Mckenna & Wassler 2020), virtual tourism (Kwok & Koh, 2020; Sigala 2020) and so forth.

Tourism, Mobilities and Virus Outbreaks

As the previous argument is given, the high levels of mobility which characterized global capitalism pave the ways for innovation and economic progress but at the same time shortens travel timeframe. This means that far-away geographical points can be touched in hours, a fact that probably revolutionized the travel industry. To some extent, the same means of transport which energize the global economy act as carriers of the virus (Hall 2010; Korstanje 2019). Social distancing, as well as the closure of borders and international travel, was a radical measure adopted by almost all governments leading the industry next to collapse (Gretzel et al. 2020; Fernando 2020). As Bob McKercher (2003) puts it, the world should be prepared to face a great variety of virus outbreaks resulting from the global expansion of tourism without mentioning the overcrowded cities and the current conditions of life in urban areas. Different studies have eloquently documented the impacts of SARS and H1N1 on the tourism industry and local economies worldwide (McKercher 2003; McKercher & Chon, 2004; Monterrubio 2010; Novelli, et al. 2018). In this perspective, experts call attention to developing reliable methods of research which help policymakers to mitigate the effects of pandemics, reducing not only the global threats but also giving some insight into the sensibility of the industry to pandemics. As above discussed, the cancellation of international travel and tourism activity seems not to be new, similar measures have been promoted in past outbreaks such as SARS or Swine Flu. This happens simply because tourism rests on a philosophical paradox. At the same time, the industry needs social contact and mobilities to prosper in the same way the virus is widely disseminated. Killing the virus means killing tourism (Jamal & Budke, 2020; Nepal 2020). In consequence, countless administrations dispose of border closures, and the suspension of commercial activities to protect their respective health systems. What is equally important, those economies which depend exclusively on tourism are

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more affected than others which are more diversified. This is exactly one of the troubling aspects of lockdowns in classic tourist destinations (Mariolis, Rodousakis, & Soklis, 2020; Polyzos, Samitas & Spyridou 2020). The dimension of the crisis varies by country and economy. The effects are particularly different in the First and the Third worlds. While scholars in the global North have taken an active position in writing theoretical essay reviews to expand the current understanding of the impacts, in the global South fieldworkers are limited to evaluate specific study cases giving the flesh to the bones (Niewiandomski 2020; Karim et al. 2020; Edwards 2020). The urgency of under-developing economies to stop the contagion while leaving the lockdown was of vital importance for the survival of the tourism industry (Karim et al. 2020). Rogerson & Rogerson (2020) analyze the socioeconomic impacts of COVID-19 on the African economies. Centring on South Africa as a main study case, they allude to the idea that some spaces of vulnerability created by persistent inequalities bear serious material losses because of the pandemic. To put the same bluntly, these so-called areas of vulnerability depend exclusively on tourism to control poverty. In the same way, those metropolitan areas which adopt tourism as the main actors are not only more vulnerable but face the most devastating effects leading the industry toward an unparalleled crisis. In consonance with this, Gaffney & Eeckles (2020) affirm that those countries dependable on the tourism economy are more sensitive to the negative effects of a global quarantine or the closure of borders. Tourists are vivid agents of prosperity and economic wealth fare for some under-developing countries but at the same time the carriers of the virus. This creates a contradictory situation which is very hard to resolve. To expand the understanding of this quandary, the authors suggest the enumeration of low and high-risk countries affected by the pandemic. In consonance with this, Farzanegan et al. (2020) hold the thesis that those nations characterized by high levels of mobility are prone to experience more deaths and infected cases than low-mobile countries. Those economies dotted with inbound and outbound international travel had serious problems coping with the virus outbreak. The denial to close airports, borders and airspace aggravated the situation accelerating inevitable mass contamination. To wit, Sah et al. (2020) validate these assumptions in Nepal while Korstanje (2020) proffers the case of Argentina where thousands of tourists stranded abroad were expatriated to Buenos Aires. In Nepal, the virus placed the health and tourist industry in jeopardy increasing the health budget to 6% for the coming fiscal year (Sah et al. 2020). In Argentina, the tourism industry went through a paralleled crisis which slumped down almost 80% of accommodation offers. At a closer look,

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tourists are being demonized and suspected to disseminate the virus whereas chauvinist and racist expressions against neighbouring migrants emerged in the core of metropolitan Buenos Aires (Korstanje 2020). To the devastating economic effects of COVID-19, scholars claim that new racist expressions or discourse against Chinese communities have been brought into the foreground. Racism situates as a major danger not only to human rights but also to the future of tourism (Yu et al. 2020; Carr 2020). The incipient literature seems to be clear about the untrammelled expressions of a much deeper hostility against Chinese tourists in western cities (Park, Kim & Kim 2020; Zheng, Hoh & Wen 2020). Sometimes these discourses are affirmed by misleading news about foreign tourists while in other long-dormant geopolitical disputes or rivalries –among neighbouring countries- are certainly revived. The present chapter discusses the different discourses of tourism staff, tourists most of them stranded abroad or expatriated who were forced to come back to their homes because of the pandemic. This descriptive research should be understood in the limits of an exploratory approach and course not extrapolated to other universes. Anyway, we are confident the results are illustrative and innovative.

Methodology

On 20 March 2020, Argentinean President Alberto Fernandez ordered the lockdown closing not only borders, public transport and commercial activity but airspace. In consequence, thousands of Argentinean tourists were stranded in the world, pressing the Ministry of Foreign Affairs to conduct a program of repatriation at a higher cost absorbed by the government. The presidential decision included not only the cancellation of flights but the closure of universities, schools and public edifices generating serious economic impacts. At the same time, the government bailed out many corporations absorbing part of the workers´ salaries. Many hotels were recycled as hospitals to give attention to infected patients with mild symptoms. These measures were similar in the entire world less -for this case- some Argentines turned a deaf ear to the presidential decree flying abroad in the lapse of time between the ends of March to May of 2020. As a result of the restrictive measures, thousands of Argentinean tourists were stranded abroad while foreign tourists who spent their time vacationing were trapped in the country. In social media, foreign tourists and expatriates were demonized as potential carriers of the virus while popular opinion claimed Alberto Fernandez to adopt stricter steps

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of control at airports and borders. In this way, police –supported by migration officers- were encouraged to scrutinize travellers who potentially violate the lockdown. All incoming visitors who come from Brazil, the US or Europe should be confined to 14 days of lockdown. The first point of entry in this discussion appears to be the figure of the tourist as a new *undesired guest.* The question of whether John Urry coined the term tourist-gaze to denote the rise of a new form of consumption based on ocularcentrism sets the pace to a new conception, where gazing was simply banned. This was called a "wicked gaze" (Korstanje 2020). The "Other" is any more an object of curiosity in these new times; rather it is a clear source that inspires hostility and fear. Doubtless, the right of traveling in the territory was temporarily suspended while the country plunged into a state of chaos where the provinces (States) closed their internal frontiers. The lack of standardized protocols and programs of mitigation associated with an extreme panic led governors to adopt different measures which oscillated from new requisitions and documents to the rejection of Argentinean travellers coming from other states. To date, almost 4.000 persons are stranded in the borders between Chaco and Formosa. In the days of COVID-19 the provincial borders, at least as they are drawn in the law, suffered radical transformations. We come across a type of feudalization process which suggests a political condition of segregation where units move with autonomy respecting the central administration. COVID-19 ignited a feudalization process marked not only by racism and chauvinism but for separatism. This, so to speak, goes from barricades to migratory expenses and restrictions for the entrance of outsiders, a point considered unconstitutional by experts. Each Province (state) not only reserved the rights of police but surely contradicted the constitution, each one regulated the borders at their discretion. States such as San Luis, San Juan and Mendoza banned the entrance of other Argentinean tourists and travellers. Only food transport, which was tightly scrutinized, was permitted to enter to leave out the state during the day. The Province of Formosa remains impermeable to receive travellers –no matter their profession- even to date. Some lawsuits were presented before the Supreme Court of Justice because of the unconstitutionality of travel-ban local dispositions. Hundreds of Argentinean tourists, drivers and travellers were stranded in Provinces for months without assistance, shelter or food. In other cases, drivers were subject to strict protocols of control and surveillance. In the third stage, some states, which were pressed to boost their local economies through the tourism industry, opened their frontiers but with strict travel bans or migratory requisitions. Whereas visitors should present the respective COVID test certifying they are

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healthy, other requirements such as an all-inclusive tour or round-trip tickets without mentioning a certificate of residence or health insurance for travels were strongly requested upon arrival. In normal conditions, all these noted measures are requisitions for travelling abroad but hitherto applied for domestic tourists.

In this chapter, we employ the neologism *of pandemic tourism* to denote the decision or curiosity to travel to destinations seriously affected by COVID-19 and other pandemics. *Pandemic tourism* should be understood as a new trend of tourists who travel to zones affected by pandemics or highly infected by the virus(es) to get an outstanding experience. Although the results of this research should not be extrapolated to other scenarios, no less true is that they apply to other study cases associated with SARS, H1N1 or Ebola. Methodologically speaking, we have selected 55 participants (from 25 to 55 years old) divided among 30 males and 25 females. The participants were organized into two samples: a) those who have been stranded abroad by tourism or for working purposes (i.e. pilots, cruise workers, postgraduate students and businessmen, only to name a few) and b) those who voluntarily overlooked the risks of COVID19 and started a journey abroad ignoring the presidential decree. Both were named cluster A and cluster B. The Snowball method was used as the main criterion of sampling. Because of confidentiality issues, the real names of the interviewed people have been changed. It is important to mention that the obtained outcomes, far from being extrapolated to other universes, should be understood within the limits of the sample.

Findings and Discussions

Because of the lockdown remains, personal meetings –or face-to-face interviews- are not allowed in Argentina. Hence, the used method was snowball while the interviews were conducted through Zoom and Skype. Both samples keep commonalities and serious differences. The first common-thread point in both samples is "the fear of being infected by COVID-19 abroad." This suggests the impossibility to receive the correct medical support and follow-up, in a foreign country. Claudio (male, 27 years old) is a flight attendant and says "*I have a great experience in travelling and particularly I am not afraid to be sick out of Argentina, but in this case, I was terrified to think in the odds of being infected by COVID-19. If you ask me, hospitals and health system in the UK suddenly collapsed and the information was poor, we know nothing when and under what conditions we would return home."* A

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similar testimony is found in Maria (female 39 years old) who works as a historian and was surprised while attending to a Conference in Spain: "*I was surely terrified when Covid19 spread; we had neither information to the details of flight to Buenos Aires nor any idea if the government will open the airspace to allow our repatriation. What is worse, all this resembles a horror history and apocalyptic genre where the bottom days are around the corner."*

In sharp contrast to panic sentiment, those who flew after the lockdown showed a manifest indifference to "Coronavirus disease" which was accompanied by political hostility against President Fernandez. Carlos (male, 37 years old), who works as an agricultural engineer, travelled to Paris accompanied by his sons:

> "I have no fear, this is an invention of China and the media to paralyze the industry in the West, this is like little flu which is being magnified by journalism. I do not share the decision of President Fernandez to close the airspaces, I have rights, and have the right to move as I want, from here to there, he is a dictator and this virus allowed him to impose a regime in my country. I made the decision to travel anyway and I am proud of that, this is an act of resistance!

The second element, which distinguishes the two samples, is the worries about losing the job or the company falling into bankruptcy. Interviewed participants in cluster A showed a much deeper concern about being laid off once returned home. This sentiment is particularly observed in tourism or hospitality workers. As Joaquin eloquently remarks:

> "Unemployment is one of my greatest fears, I am a tour operator in Buenos Aires, and COVID-19 evinces the end of tourism. The lockdown not only limits public circulation but also mobilities and tourism. The system should face a serious crisis, probably like we have in 2001 in Argentina. Thousands and Thousands of Argentineans will be impoverished because of COVID-19. The government should assist rapidly in the industry and implement efficient policies of recovery... the enemy is not the virus but poverty.

Rather, in cluster B, the worries stem from the possibility to weaken the democratic institutions taken advantage of the fear, the crisis generates. Fabiana (female, 27 years old) utters: "*I am afraid of the Argentine government, not the virus. The fear, this government is manipulating, facilitates things to undermine the check and balance forces that make*

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democracy strong, Fernandez wants to impose fear and the lockdown because his policies are not to be widely rejected. Like in the case of terrorism, where the "terrorist" is demonized to impose economic policies that in other circumstances will be rejected, now Fernandez is adopting the lockdown to impoverish the private sector and in this way, introducing Chavism expropriating private fortunes, and properties (like in Venezuela now in Argentina).

Both testimonies agree poverty caused by the economic crisis is an important factor of COVID-19, but they differ in their reactions. Fabiana seems to adopt a partisan (if not ideological) position blaming President Alberto Fernandez for the crisis, while Joaquin signals the risks of collapse in the tourism industry as well as service sectors. For both something is in danger. Joaquin alludes to the economic factor while Fabiana to the democratic institutions.

The third factor of analysis appears to be linked to the need to feel special experiences. Like in post-disaster or dark tourism, there is a segment of thrill-seekers who move to zones of disaster, war or conflict only to feel outstanding experiences. Almost 10 participants of cluster A replied that they were suddenly trapped after March and never would fly abroad after the lockdown while 12 in Cluster B were enthused to travel to understand what was happening in the world. This is the case of Juan (male, 45 years old), a sociologist, who acknowledged that:

> "COVID-19 offers an apocalyptic scenario where things will not be normal any longer, this is an outstanding time, I loved to live. I am not frightened to travel abroad, I needed to be closer to this dark experience I needed to feel the adrenaline to be in destinations highly infected by COVID-19. My first destination was China, preferably Wuhan but it was impossible, so I bought a ticket towards New York. I am not an unconscious guy... this historical event should be lived with great intensity!.

Instead, Adriana (a postgraduate student) offered a different viewpoint: "these are sad days, I was studying anthropology in Australia when this happens. I thought I would never come back to my country, to be with my parents and sisters. This event will change me forever I will not see travel and tourism, in the same way, I loved to travel and study worldwide, understand other cultures and nations, and be in contact with different people. Now, I have suffered from insomnia, and some irrational phobias to take a bus or a train. I stay at home now, and probably will be a long time without planning holidays.

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Another interesting sub-cluster, which we have not typified in this note of research is reserved for the expatriates –which means professionals -who even if working abroad- opted the decision to come back to Argentina. This is the case of Emanuel who is the hotel´s concierge in Portugal. He gives a romantic answer when this interviewer asked for what he felt once expatriated.

> "Difficult to say I am sad, the feelings on my side are mixed ... I decided to study tourism in Europe and this goal was successfully achieved, but COVID-19 allowed me to come back to my home. Believe me, though you work hard, you will be never a European guy. An expatriate feels a half side is emptied, you are happy with your achievements but here is not your home, they do not speak your tongue, and they do not think like you, after all, you will be always a stranger. I note my compatriots are very tough when they return to Argentina. They come back temporarily on holidays or to visit friends and take a lodge at a hotel or rent a car. They scornfully treat badly to the staff, often comparing the service in a third-world country with first-world ones. To your question, I must confess, now I reckon they are hostile to them because they hate they will never be native of the society they admire, their half remains emptied. I am complete and it is a merit of COVID-19."

After further review, this chapter innovatively explores the emotions and expectations of expatriate tourists who remained abroad for days or weeks just after the lockdown affected thousands of Argentinean tourists. The information permits us to draw off an exploratory model centred on three different characters (so to speak or forms of adaptation to a risky situation) which are detailed: *Stranded tourists, Pandemic seekers, nostalgic travellers or expatriates.*

Dilemmas and Limitations

To sum up, and in an exploratory dimension, the gathered preliminary results evince a promising hypothesis which may be very well continued in a future approach. However, these outcomes cannot be extrapolated to other universes and situations. The obtained outcome permits to draw of three different grids or psychological characters, which are based on the factors that remain coadjuvant to deciding to travel in a pandemic context:

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1. Stranded tourists: this segment represents all tourists who were involuntarily trapped by the global lockdown administered by the nation-state because of COVID-19. These tourists develop a "precautionary character" with serious problems to bear the uncertainty.
2. Pandemic seekers-deniers: this segment is mainly drawn by those tourists who are motivated to defy the government or to be closer to the infected epicentre, and make the decision to travel abroad despite the imposed travel bans. These tourists develop a "defying character." They bode well with the climate of uncertainty.
3. Nostalgic expatriates: the segment is formed by expatriates who work abroad but are emotionally or economically forced to return home. These tourists emotionally instil a "relational character."

Last but not least, the present research ignites a new discussion –that starts a novel methodological insight- in the fields of post-COVID-19 contexts. The specialized literature was historically marked by the interplay of tourists vs. locals, but little attention was paid to expatriate or stranded travellers, this investigation intends to be an initial contribution.

Conclusion

COVID-19 has not only changed global commerce and the world but also placed the tourism industry upside down. Experts and colleagues of all pundits agree tourism research should coordinate efforts on a clear diagnosis that helps to mitigate the economic effects of the pandemic as well as the opportunities to reverse climate change. It is safe to say that the pandemic ushered the industry into a state of crisis and chaos as never before. However, less attention was given to the psycho-sociological effects of the pandemic. These include racism and separatism to a much deeper hostility against foreign tourists. To fill the gap, the present chapter reviewed not only the incipient literature –in its infancy- but also the behavioural changes in travel patterns. Last but not least, three sub-segments have been identified: *stranded tourists* who developed a precautionary logic, *pandemic deniers* who are often associated to be critical of President Alberto Fernandez, and *Romantic expatriates,* a cluster characterized by a sentiment of nostalgia to be forced to return to their country. Each one has developed different tactics to deal with risk and

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uncertainty. Although illuminating –if not fresh- to some extent, the obtained outcomes cannot be extrapolated to other cases and universes.

References

Bauman, Z. (2017). Tourists and vagabonds: Or, living in postmodern times. In *Identity and social change* (pp. 19-32). Abingdon, Routledge.

Cai, W., McKenna, B., Wassler, P., & Williams, N. (2020). Rethinking knowledge creation in Information Technology and Tourism. *Journal of Travel Research*, 0047287520946100.

Carr, A. (2020). COVID-19, indigenous peoples and tourism: a view from New Zealand. *Tourism Geographies*, 1-12.

Derrida, J., & Dufourmantelle, A. (2000). *Of hospitality*. Stanford, Stanford University Press.

Dixon, D. P., & Jones III, J. P. (2015). The tactile topologies of Contagion. *Transactions of the Institute of British Geographers*, *40*(2), 223-234.

Edwards, R. B. (2020). Bubble in, bubble out: Lessons for the COVID-19 recovery and future crises from the Pacific. *World Development*, *135*, 105072.

Farzanegan, M. R., Gholipour, H. F., Feizi, M., Nunkoo, R., & Andargoli, A. E. (2020). International Tourism and Outbreak of Coronavirus (COVID-19): A Cross-Country Analysis. *Journal of Travel Research*, 0047287520931593.

Fernando, J. L. (2020). The Virocene Epoch: the vulnerability nexus of viruses, capitalism and racism. *Journal of Political Ecology*, *27*(1), 635-684.

Gaffney, C., & Eeckels, B. (2020). COVID-19 and Tourism Risk in the Americas. *Journal of Latin American Geography*, *19*(3), 308-313.

Gössling, S., Scott, D., & Hall, C. M. (2020). Pandemics, tourism and global change: a rapid assessment of COVID-19. *Journal of Sustainable Tourism*, 1-20.

Gretzel, U., Fuchs, M., Baggio, R., Hoepken, W., Law, R., Neidhardt, J., & Xiang, Z. (2020). e-Tourism beyond COVID-19: a call for transformative research. *Information Technology & Tourism*, 1.

Guidotti-Hernández, N. M. (2011). Unspeakable violence. *Remapping Us and Mexican National Imaginaries*. Durham, UNCS Press.

Hall, C. M. (2010). Crisis events in tourism: subjects of crisis in tourism. *Current issues in Tourism*, *13*(5), 401-417.

Hall, C. M., Scott, D., & Gössling, S. (2020). Pandemics, transformations and tourism: be careful what you wish for. *Tourism Geographies*, 1-22.

Higgins-Desbiolles, F. (2020). Socialising tourism for social and ecological justice after COVID-19. *Tourism Geographies*, 1-14.

Jamal, T., & Budke, C. (2020). Tourism in a world with pandemics: local-global responsibility and action. *Journal of Tourism Futures*.6(2): 181-188.

Jayathilaka, G. K. (2020). The Worldmaking Agency of the Sri Lankan Travel Blogger. *Tourism Culture & Communication*, *20*(2-3), 117-127.

Nova Science Publishers, Inc.

Karim, W., Haque, A., Anis, Z., & Ulfy, M. A. (2020). The movement control order (mco) for covid-19 crisis and its impact on tourism and hospitality sector in malaysia. *International Tourism and Hopitality Journal*, *3*(2), 1-7.

Korstanje M. E (2017) *Tourism, Terrorism and the End of hospitality in the West.* Basingstoke, Palgrave Macmillan.

Korstanje, M. E. (2018). *The Challenges of democracy in the War on terror: the liberal state before the advance of terrorism*. Abingdon, Routledge.

Korstanje, M. E. (2019). Interrogating on the Essence of the Zombie World. In *Terrorism, Technology and Apocalyptic Futures* (pp. 19-43). Cham, Palgrave Macmillan.

Korstanje, M. E. (2020). Passage from the tourist-gaze to the wicked-gaze: a case study on COVID19 with special reference to Argentina. *International Case Studies in the Management of Disasters: natural–manmade Calamities and Pandemics. In George B & Qamar-ud-Din Mahar. Wagon Lane, Emerald Group Publishing*.

Kwok, A. O., & Koh, S. G. (2020). COVID-19 and Extended Reality (XR). *Current Issues in Tourism*, 1-6.

Lashley, C. (2008). Studying hospitality: Insights from social sciences. *Scandinavian Journal of Hospitality and Tourism*, *8*(1), 69-84.

Lynch, P, Germann-Molz J, McInthosh A, Lugosi, P & Lashley C. (2011). "*Theorizing hospitality." Hospitality & Society,* 1(1): 3-24.

Lyon, D., & Bauman, Z. (2013). Liquid surveillance: A conversation. *Cambridge, Malden: Polity*.

Mariolis, T., Rodousakis, N., & Soklis, G. (2020). The COVID-19 multiplier effects of tourism on the Greek economy. *Tourism Economics*, 1354816620946547.

McKercher, B. (2003). SIP (Sars induced Panic) a greater threat to Tourism than Sars (Severe acute respiratory Syndrome. *E-revise of Tourism Research (ERTR)*, *1*(1), 17-18.

McKercher, B., & Chon, K. (2004). The over-reaction to SARS and the collapse of Asian tourism. *Annals of tourism research*, *31*(3), 716-730.

Monterrubio, J. C. (2010). Short-term economic impacts of influenza A (H1N1) and government reaction on the Mexican tourism industry: an analysis of the media. *International Journal of Tourism Policy*, *3*(1), 1-15.

Nepal, S. K. (2020). Travel and tourism after COVID-19–business as usual or opportunity to reset?. *Tourism Geographies*, 1-5.

Niewiadomski, P. (2020). COVID-19: from temporary de-globalisation to a re-discovery of tourism?. *Tourism Geographies*, 1-6.

Novelli, M., Burgess, L. G., Jones, A., & Ritchie, B. W. (2018). 'No Ebola… still doomed'–The Ebola-induced tourism crisis. *Annals of Tourism Research*, *70*, 76-87.

Park, E., Kim, W. H., & Kim, S. B. (2020). Tracking tourism and hospitality employees' real-time perceptions and emotions in an online community during the COVID-19 pandemic. *Current Issues in Tourism*, 1-5.

Polyzos, S., Samitas, A., & Spyridou, A. E. (2020). Tourism demand and the COVID-19 pandemic: an LSTM approach. *Tourism Recreation Research*, 1-13.

Prayag, G. (2020). Time for reset? COVID-19 and tourism resilience. *Tourism Review International*, *24*(2-3), 179-184.

Nova Science Publishers, Inc.

Prideaux, B., Thompson, M., & Pabel, A. (2020). Lessons from COVID-19 can prepare global tourism for the economic transformation needed to combat climate change. *Tourism Geographies*, 1-12.

Qiu, R. T., Park, J., Li, S., & Song, H. (2020). Social costs of tourism during the COVID-19 pandemic. *Annals of Tourism Research*, *84*, 102994.

Radic, A., Law, R., Lück, M., Kang, H., Ariza-Montes, A., Arjona-Fuentes, J. M., & Han, H. (2020). Apocalypse now or overreaction to coronavirus: The global cruise tourism industry crisis. *Sustainability*, *12*(17), 6968.

Ritzer, G. (2019) *Inhospitable hospitality.* In *Experiencing hospitality. Rowson, B & Lashley C.* Hauppauge, Nova Science Pp. 73-91.

Rogerson, C. M., & Baum, T. (2020). COVID-19 and African tourism research agendas. *Development Southern Africa*, 1-15.

Rogerson, C. M., & Rogerson, J. M. (2020). COVID-19 and tourism spaces of vulnerability in South Africa. *African Journal of Hospitality, Tourism and Leisure*, *9*(4), 382-401.

Sah, R., Sigdel, S., Ozaki, A., Kotera, Y., Bhandari, D., Regmi, P, & Dhama, K. (2020). Impact of COVID-19 on tourism in Nepal. *Journal of Travel Medicine*, *27*(6), taaa105.

Selwyn, T. (2000). An anthropology of hospitality. *In search of hospitality: Theoretical perspectives and debates*, Lashley C & Morrison, A. (eds), Oxford, Butterworth-Heinemann, 18-37.

Selwyn, T (2019) "Hostility and Hospitality: connecting Brexit, Grenfell and Windrush." In *Experiencing hospitality. Rowson, B & Lashley C.* Hauppauge, Nova Science Pp. 51-72.

Sheller, M. (2020). Reconstructing tourism in the Caribbean: connecting pandemic recovery, climate resilience and sustainable tourism through mobility justice. *Journal of Sustainable Tourism*, 1-14.

Sigala, M. (2020). Tourism and COVID-19: impacts and implications for advancing and resetting industry and research. *Journal of Business Research 117: 312-321*.

Sunstein, C. R. (2005). *Laws of fear: Beyond the precautionary principle* (Vol. 6). Cambridge, Cambridge University Press.

Tzanelli, R., & Korstanje, M. (2020). Introduction: Critical Thinking in Tourism Studies. *Tourism Culture & Communication*, *20*(2-3), 59-69.

Urry, J. (2002). *The tourist gaze*. London, Sage.

Wen, J., Wang, C. C., & Kozak, M. (2020). Post-COVID-19 Chinese domestic tourism market recovery: potential influence of traditional Chinese medicine on tourist behaviour. *Anatolia*, 1-5.

Wen, J., Wang, W., Kozak, M., Liu, X., & Hou, H. (2020). Many brains are better than one: the importance of interdisciplinary studies on COVID-19 in and beyond tourism. *Tourism Recreation Research*, 1-4.

Yu, M., Li, Z., Yu, Z., He, J., & Zhou, J. (2020). Communication related health crisis on social media: a case of COVID-19 outbreak. *Current Issues in Tourism*, 1-7.

Zeng, Z., Chen, P. J., & Lew, A. A. (2020). From high-touch to high-tech: COVID-19 drives robotics adoption. *Tourism Geographies*, 1-11.

Zheng, Y., Goh, E., & Wen, J. (2020). The effects of misleading media reports about COVID-19 on Chinese tourists' mental health: a perspective article. *Anatolia*, *31*(2), 337-340.

Nova Science Publishers, Inc.

Xiang, Z., Fesenmaier, D. R., & Werthner, H. (2020). Knowledge Creation in Information Technology and Tourism: A Critical Reflection and an Outlook for the Future. *Journal of Travel Research*, 0047287520933669.

Zenker, S., & Kock, F. (2020). The coronavirus pandemic–A critical discussion of a tourism research agenda. *Tourism Management*, *81*, 104164.

Zheng, Y., Goh, E., & Wen, J. (2020). The effects of misleading media reports about COVID-19 on Chinese tourists' mental health: a perspective article. *Anatolia*, *31*(2), 337-340.

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Chapter 4

East African Tourism Policies Review and Crisis Preparedness in Pandemic Situations

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Abstract

The COVID-19 pandemic has had a profound negative impact on the economies of the Eastern Africa Region and particularly the tourism sector which contributes hugely to the GDPs of these countries. The shock of the pandemic has already reduced growth in service sectors related to tourism and caused massive job losses. Under the current conditions, Ministries of Tourism were confronted with various challenges that will impact long-term development and set the agenda for public policy action. The chapter seeks to address the challenge in the East African Region which requires broad mitigation measures to counteract the consequences of the outbreak as well as specific policies to support local tourism-related businesses and affected communities. The study will examine the preparedness of the region in handling pandemics and offer various scenarios of possible interventions. This chapter addresses this problem by drawing on literature from different literature to recommend generic strategies for crisis preparedness during pandemic situations. The study situates the current outbreak within prior

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pandemics and offers some directions for research and practice. Due to the human desire for travel, pandemics affecting the sector will manifest when least expected. It is the role of every government to be ready and reduce its impact by implementing progressive policies.

Keywords: crisis, East Africa, pandemic, policy, preparedness

Introduction

Over the past decades a growing number of natural hazards and disasters, caused by the susceptibility of tourism to biosecurity risks and health scares. As observed by Cioccio and Michael (2007) it is the nature of the tourism environment which is often hazardous or offers experiences in volatile settings. Despite the increasing threat of natural disasters to tourism businesses and destinations, few tourism destinations were prepared to handle the impacts of such threats (Cassedy, 1991), yet disaster planning is a core competency of tourism managers (Faulkner, 2001; Hystad & Keller, 2006). According to the Worldometer (2020) globally, the COVID-19 pandemic has led to 446,707 deaths, 8,290,232 confirmed cases as of 18th June 2020, an unprecedented decline in international tourism as well as travel restrictions globally, therefore sparking fears of global economic recession, large-scale quarantines and crises, (Worldometer, 2020; Nicola et. al., 2020). During the pandemic period, movement control orders (MCOs), widespread suspension of transport connectivity, travel restrictions and national lockdowns have grounded the tourism industries to a halt, therefore, providing a very negative effect on the tourism and travel sectors globally. The World Health Organization has noted with concern that despite the preventive measures, most of the countries affected were not adequately prepared for the COVID-19 pandemic in terms of limited testing capacities and public health control measures, therefore increased human-to-human infections as well as diminished effectiveness of response measures, (World Health Organization [WHO], 2020). At the global scale, the level of tourism preparedness has been problematic owing to the reported disparities in destinations' socio-economic abilities to cope with and recover from the COVID-19 pandemic, (United Nations Development Programme [UNDP], 2020). The Global Health Security Index collaborates these findings by noting that an overall GHS index score of 40.2 out of 100 in terms of international preparedness for the COVID-19 pandemic in terms of Anti-microbial resistance (AMR), biosecurity, biosafety, early detection, rapid

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response, health sector capacity, financing and risk environment, (Global Health Security Index [GHSI], 2020).

In the African context, the virus had been confirmed to have spread to Africa on the 14th of february 2020. Currently, the pandemic has resulted in 348,871 infected cases and 9,098 deaths as of 26th June 2020, [African Centre for Disease Control and Prevention, (Africa CDC, 2020)]. Before the COVID-19 pandemic African healthcare systems and infrastructure had been in a deplorable state as indicated by African nations were working towards slowing down and ultimately halting the spread of the virus through a coordinated and integrated approach as guided by the AU Africa CDC Emergency Preparedness and Response Programmes and Plans. Most of these pandemics historically such as the Influenza, SARS, bird flu, bubonic plague, swine flu, and Ebola were zoonoses and arise from chimeric viruses spread from wild animals to humans, (Waltner-Toews, 2020). Supply and Demand shocks related to the COVID-19 pandemic were expected to slow down GDP growth in many countries in the African context. Studies by Ozil, (2020) show a significant disconnect between the socio-economic impact of the COVID-19 pandemic as well as the policy responses in African countries. An analysis of the Global Health Security Index in 2019 by the Nuclear Threat Initiative in collaboration with the Centre for Health Security, John Hopkins Bloomberg School of Public Health, NTI, (2019) shows that all East African countries were not fully prepared for pandemics or epidemics (NTI, 2019). In terms of epidemics preparedness, the report indicated that Kenya has a comparatively higher capacity in terms of epidemic preparedness within the region with a GHSI score of 45.9 compared to Uganda (GHSI index score of 42.7), Rwanda (GHSI index score of 33.8) and Tanzania (GHSI index score of 33.5) respectively. Similarly, in terms of early detection and reporting of epidemics, Kenya has had higher GHSI index scores compared to the other respective countries in the region. However, in terms of rapid response and mitigation of the spread of epidemics, the report noted that Uganda has had higher GHSI index scores compared to the other respective countries in the region.

The Problem in East African Context

Over the recent past, large-scale natural and human-induced crises have increased in frequency and impacted the disappointment of governments around the world. (Becken & Hughey, 2013; Buchanan & Denyer, 2013; Mair, Ritchie, & Walters, 2016; Ryu et al., 2013). During periods of crisis,

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governments have an integral role to sustain tourism which contributes 7.5% to 10% to the GDP of the East African States. Currently, measures of Disaster response in East Africa are yielding temporal results as compared with the huge costs related to the COVID-19 pandemic. Despite tax and fiscal relief measures as well as the extensive National Disaster preparedness fund allocations, the tourism economy in the East African region had been hard hit. In 2019, Kenya's tourism sector risks losing a sector worth KES 163.6 bn, 1.6 million jobs and 8.8% of Kenya's GDP while Ethiopia risks losing USD 3.6 bn, 1.1 million jobs and 5% of Ethiopia's GDP, while Tanzania supports 1.5 million jobs and a sector worth 6.5% of the country's GDP and Uganda's tourism sector risks losing 700,000 jobs in the sector and about 7.7% of Uganda's GDP, (Delloite 2020; Government of Tanzania, 2022). The general observation is the lack of local-level preparedness, which results in interruptions in normal operations and damage to tourists' sense of destination safety and appeal (Biran, Liu, Li, & Eichhorn, 2014; Paraskevas & Altinay, 2013). The specific problem is that during the ongoing COVID-19 pandemic, the governments of the East African region unfortunately lacked strategies for crisis preparedness that could reduce business interruptions and improve their destination's image.

The Concept of Crisis and Pandemic Preparedness in the Tourism Sector

The term pandemic crisis arises from certain triggered viral outbreaks within a society. It presents itself as a significant disruptor to the economic and social organizations of a society, (Jordan-Meier, 2011). Crisis preparedness during pandemic situations has become a fundamental concern for most tourism enterprises and local communities worldwide. In the wake of recent global crises, crisis preparedness has become a key part of destination planning, (Pennington-Gray et al., 2014). Different studies focused on the different approaches towards effective crisis preparedness. Conaghan and Hanrahan, (2009) and Harris, (2007) focussed on supply-side certification systems, Lew (2013) advocated for resilience planning as an effective approach to crisis preparedness, Morakabati, Page and Fletcher, (2020) centred on emergency management paradigms in tourism. Crisis preparedness is all about developing capacities and capabilities in terms of personnel, logistics, national legislation, technologies, resources, equipment and funding that were all aimed at

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reducing the impacts of the pandemic crisis on a region. In the realm of pandemic preparedness, the scale and scope of preparedness are further escalated by the recurring nature of the outbreak. There have been organizations such as the World Health Organization in 2018 which developed essential steps for developing a national influenza-like pandemic preparedness plan, (WHO, 2018). However, as noted by Glaesser (2020), the tourism industry is characterized by a subjective risk perception factor, where tourism products are information products that are highly immaterial and produced in future and therefore highly vulnerable to negative information during the pandemic. Visitors were also not prepared for extended quarantine stays and unfamiliar with the risks and emergency systems within the destination and therefore were highly vulnerable to pandemic-related restrictions. It is worth noting that there is an increasing number of studies in the tourism field on tourism disaster management. However, most have highlighted and indeed researched, reactive response and recovery efforts of the tourism industry at the expense of reduction and readiness strategies and initiatives. Yet more proactive, and more strategic planning approaches to tourism crisis and disaster management have been proposed (Ritchie, 2004). The lack of focus on tourism disaster planning by researchers is a concern, especially considering that reduction and readiness strategies have been the focus of the natural hazards and emergency planning field for some time. In this regard, tourism managers must change their thinking from a reactive approach to tourism disaster management toward a proactive planning approach. Furthermore, researchers should focus more effort on understanding the current level of industry reduction and readiness efforts as well as potential barriers or impediments in tourism disaster planning to ensure more effective planning and management were undertaken. According to Nickelson and Robinson (2014) there has seen an intense focus worldwide in the last two decades towards global action on disaster risk reduction and preparedness. The World Conference on Natural Disaster Reduction, held in Yokohama, Japan, from the 23rd to 27th of May 1994 provided more of the beacons for disaster prevention, mitigation and preparedness which will make a significant contribution towards sustainable development futures. These aspects were noted in the strategy for the year 2000 and beyond that is focused on developing a global culture of prevention as an essential component of disaster reduction and the adoption of the policy of self-reliance in each country and community.

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Attempts to analyze policy were made complex not only by decisions, actions, and events, but by the knowledge that there is no coherent or universally accepted theory of public policy processes, and no single means of explaining events' (Hall & Jenkins, 2004, p. 527). Policy development involves ideological beliefs and political philosophy. All tourism stakeholders operate within the ideological beliefs and political philosophy of the government; therefore, this ideology determines whether tourism development will be given financial support; it can set the style of tourism, and the nature and extent of government involvement. Normally the ideology reflects the national political culture and political parties (Elliott, 1997, p. 56). As these ideologies change, a government's tourism policy 'will differ in forms and means in relation both to the form of political economy that prevails in the country and to the degree of development reached' (Sessa, 1976, p. 238). Thus, policy and the policy process will change over time, and what is a 'good' policy must be determined by argument, not scientific information. The policy implementation process may also require several other steps such as administrative coordination and policy coordination (Hall, 1999, p. 278) as well as support from effective legislation. Policy implementers require the power to 'make and enforce decisions which were binding upon their members', they have responsibilities which were interpreted by ideologies in shaping objectives (Elliott, 1997, p. 56). Swain (1999, p. 1008) suggests that the study of policy and power in tourism 'includes a broad range of concepts from ideology to exchange rates and visa control'. Thus, policy involves the exercise of power (Marzano & Scott, 2009). Currently, there is only a small methodological literature concerning tourism policy. There is some agreement that the study of tourism policy involves complexity, dynamism and change, and as a result, Stevenson, Airey and Miller (2008) recommend the use of multiple approaches to understanding policymaking. Tourism policy involves collective action and how collective choices were made, implemented and enforced in and for society (Buhrs, 2000). The tourism policies in the East African nations were similar. The government has set the tone and therefore has the power to decide which areas to support. All the governments have not supported crisis preparedness and indeed, Uganda and Tanzania do not have crisis management in their tourism policies. On the other hand, Kenya has a crisis management policy statement with suggested interventions. The policy involves actions, decisions, politics, values and ideological beliefs, and social processes involving communication and outcome such as legislation and

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implementation. This is complex and requires strategic collaboration locally, regionally and internationally. A combination of regional pandemic policies and crises in tourism research studies and online resources were used to demonstrate the importance of preparedness before pandemics and ready-to-use tourism-specific policies to reduce the impact on tourism businesses. This chapter provides a context and viewpoint on the possible implications of post-COVID-19 reflection for pandemic preparedness and policies for the East Africa region in the future. This viewpoint chapter captures only the East African region in a broad sense, a snapshot of rapidly emerging online perspectives but at the same time draws together relevant research that emphasises the importance of preparedness during a pandemic.

Post-Pandemic Tourism Policies

The tourism industry is one of the most directly affected sectors in this current crisis and this calls for immediate and long-term responses. In the case of China, the first country to go through the various stages of the COVID-19 pandemic, McKinsey and Company (2020b) found consumers were regaining confidence, and interestingly, a greater interest in environmentally friendly products. Again, the demand from clients, who are tourists, should compel governments to include sustainability practices in tourism policies across the region. Currently, all policies mention sustainability but the practice is negligible. According to Downs (1972), the modern public cyclically attends to many issues. A problem "leaps into prominence, remains there for a short time, and then, though still largely unresolved, gradually fades from the centre of public attention" (1972, p.38). The 2003 SARS outbreak illustrates this well, as tourism growth in Asia picked up very quickly once the perceived threat diminished (McKercher& Chon, 2004). Tourism policies in the region were not consistent or long-term. Tanzania is now reviewing their tourism policy in 2020 since the 1980s. Domestic tourism is expected to play an important role in leading the initial recovery phase, given the uncertain outlook for international travel. Countries, where domestic tourism is developed, were likely to see recovery in the sector more quickly than countries that were heavily dependent on international tourism flows. Many countries, and the tourism sector, have moved to promote domestic travel and cater to visitors from their own countries. At the regional level, the East African Tourism strategy needs to factor in response to crisis and preparedness and also how to capture neglected markets after crises, notably their domestic

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markets and then the regional market. Regrettably, none of the East African countries has a strategy to promote the region to each other's citizens, yet South Africa promotes their country specifically to each East African country, with specific tailor-made marketing strategies.

Since pandemic impacts were felt throughout the tourism ecosystem, reopening and rebuilding destinations require a collaborative approach, (Gowreesunkar, et al., 2022; Gowreesunkar, et al., 2021). Tourism businesses and workers were benefiting from economy-wide stimulus packages, with many governments also introducing tourism-specific measures. In late August 2020, Kenya was awarded the "Safer Tourism Seal," this was done under the Rebuilding Travel umbrella, a global pro-tourism industry group composed of members of tourism boards, ministers of tourism, professional associations, industry stakeholders, researchers and academics as well as travellers. Countries were currently taking steps to introduce tourism-specific measures to address the immediate impacts on the sector and to facilitate its recovery. Governments were also adjusting the measures put in place to take better address the needs of tourism businesses, and the sector as a whole. The travel and tourism industry governments of the East African region should continue to reinforce their coordination mechanisms to accompany the businesses, notably the smallest ones, and the workers. The Governments should also consider the long-term implications of the present COVID-19 crisis, and stay ahead of the digital curve by supporting a low-carbon transition, and promoting the structural transformation needed to build a stronger, more sustainable and resilient tourism economy. This crisis is an opportunity to rethink tourism for the future. It has been a concern to governments that there is a risk of as many as 50% collapses of SMEs across the globe. This has been the case in the East African region as well. This widespread occurrence could have a strong impact on these fragile economies. Most governments have been quick to acknowledge the specific circumstances of SMEs, and have put in place policies to support them; health measures, and information on how to adhere to them, measures to address liquidity by deferring payments, measures to supply extra and more easily available credit to strengthen SME resilience, measures to avoid the consequences of lay-offs, and structural policies. These general SME measures have also been accessible to SMEs in the tourism sector. During health pandemics, there should be cooperation between tourism and the health sector to support the containment effort. In Kenya, on several instances, the hospitality sector supported the medical personnel with meals, helped the needy with food and provided spaces for people needing quarantine. The pandemic has brought about opportunities with the potential

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to develop the previously unseen sector. The current crisis is accelerating the digital transformation of the sector. Digital solutions were being developed to create virtual tourism experiences. There is a need for policy in this area and a code of ethics to pre-empt any underhand dealings by cyberspace criminals. Domestic tourism numbers have gone up in the region and notably in Kenya judging from the influx of locals at Masai Mara National Reserve to witness the Wildebeest migration. This is due to new entrants in the Domestic tourism business and collaboration with tour operators and hotels and lodges. Government should identify these opportunities and pitch them to the local population to encourage them to invest in tourism.

Crisis Preparedness in the East Africa Region

Kenya, Tanzania and Uganda have been dealing with one another under the umbrella of one regional entity or another for more than a century. There was a customs union between Kenya and Uganda in 1917, an East African High Commission from 1948 to 1961 and an East African Common Services Organisation from 1961 to 1967. As one of the fastest-growing regional blocs in Africa, the EAC has a population of approximately 168.2 million people with a combined GDP of US$155.2 billion. The three countries share similar cultures and histories with minor variations. Currently, there are concerted efforts to make the region fully integrated. Kenya and Uganda are members of the Common Market for Eastern and Southern Africa (COMESA), which has 385 million consumers, while Tanzania belongs to the Southern African Development Community (SADC), which groups 13 countries with 215 million people. Concerning the current pandemic, projections indicate that economic growth in the region will decline from 2.4 per cent in 2019 to between -2.1 to -5.1% in 2020 (World Bank predictions) depending on the measures taken to mitigate the pandemic's effects. Other estimates show that the pandemic is costing the region between US$37 billion and US$79 billion in output losses. The result of business closures means mass losses of livelihoods. In aviation, tourism and hospitality industries, entire sector value-chains have been rendered indefinitely dysfunctional. Indeed, when the pandemic broke out in early March 2020, the East African governments were caught unawares. This means that lessons have not been learnt from past pandemics. Looking at the Tourism Policies of the East African Region, there is no mention of how to handle pandemics, although security is covered slightly in the policies of Tanzania, Rwanda and Uganda but nothing on crises

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and pandemics, (Kimunio and Maingi, 2022). In the Kenyan tourism policy, the issue of security and crisis are covered. All the policies do not contain pandemic, disaster or crisis preparedness. This is a gap that needs to be addressed to reduce the vacuum created in decision-making when a crisis occurs. After the outbreak, it would have been comforting and calming to citizens if they saw their leader meet their counterparts from the region, however, there was no urgent meeting of the leaders to chart a way forward together. Instead, each leader worked independently. A lack of synergy and a common approach to working as a team against a common enemy was observed. This tends to create a hostile environment affecting all sectors of the economy. During the current pandemic of COVID-19, it was clear that the governments of the east african region were not working together. While some were sharing crucial data on numbers, other countries were withholding data or not testing for infections. This causes hostilities to flare up. This has been a work in progress since normalcy has yet to be restored. Timely sharing of data can help in decision-making for the region. Instead, each country closed itself in and looked inwardly. A pandemic should be confronted and dealt with openly regardless of missing knowledge. This is a position of strength. This would have been the opportune time to revive the East African regional crisis committee to guide the various heads of state as they waded through the pandemic while trying to keep their citizens safe. However, it was clear that there was no continuous dialogue between the regional leaders. During the crisis of both ebola, terrorism bombings and COVID-19, people of the region experienced contradicting policies from the different governments coming from their ministries of health and ministries of tourism. Many issues were shrouded in mystery and there was a lack of clear communication from the media of the three countries. Even during the current pandemic, there was no data from two countries except Kenya. Uganda shared data later on but Tanzania has not been free to share data. As mentioned earlier, tourism and movement act as a vector for the distribution of the virus locally, regionally and globally. This shows that tourism indirectly supports pandemics. Tourists are large consumers of food and many businesses purchase their food from global markets. Tourism, therefore, supports industrialized food production. Also, tourism is a major source of greenhouse gases, which impact climate change, affecting the environment with ensuing floods and drought further increasing the risk of pandemics. It follows then, that any policy developed for these areas will affect tourism, hence the need for synergies and harmonization. Despite an increase in meetings to deliberate on matters of environment, health, tourism, infrastructure and others in the East African

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region; positive results have remained few and far apart. There seems to be a lack of commitment from the East African countries on how to act on the United Nations Sustainable Development goals and integrate them into their policies. Although frequently mentioned and talked about in meetings and conferences, currently, there is no evidence-based strategy for climate change mitigation or for achieving the SDGs. Instead, there is an overall silence regarding pandemics and other risks the global tourism system imposes on itself and the global economy (Scott et al., 2019).

The current COVID-19 pandemic should lead tourism stakeholders to critically reconsider the much-talked-about volume growth model for tourism. This perspective has already been criticized and questioned in the context of the global financial crisis (Hall, 2009) and as the challenges of over-tourism, climate change and the COVID-19 pandemic further illustrate, this perspective is outdated. Volume growth agendas are driven by individuals and large businesses profiting from such growth models. This specifically includes international tourism organisations, the platform economy (e.g., Booking and AirBnB), aircraft manufacturers such as Boeing and Airbus, national Destination Management Organisations, and individual large tourism corporations. Sadly, the UNWTO is responsible for advancing the SDGs in their entirety, yet in its current form, represents a growth advocacy platform (Gössling et al., 2016; Hall, 2019). Decisions by policymakers will play an important role in shaping the tourism sector in the post-COVID-19 context. As recovery plans were being designed, countries identified key priority areas and ensuing challenges. One of them is re-thinking the tourism sector. The pandemic has allowed tourism leaders and experts to rethink the tourism system for a more sustainable and resilient future. Policy interventions will be required to address structural problems of the sector, avoid the return to issues of tourism management (e.g., over-tourism), and advance key priorities, such as encouraging new business models, embracing digitalization and promoting connectivity. The other key area is rebuilding destinations and the tourism system. This will take time; therefore, support and recovery measures will need to be comprehensive across the value chain that contributes to the tourism experience. Accessibility, connectivity and transport should be high on the agenda just as accommodations, restaurants, resorts, events, travel associations, travel tech companies, tour operators, and tourism associations. Another key area is Innovating and investment in tourism. Government policies here should ensure that the sector is ready to resume and keep on innovating and transforming. Investments will be needed to make structural and physical changes to address health requirements and visitors' expectations

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in the first phase of recovery and the long term. Some countries have also put in place measures to support innovation in SMEs to ensure stronger long-term economic resilience.

Conclusion

In conclusion, governments need to take a proactive role in matters crisis management in tourism. The East African experience has shown that, to restore traveller confidence and stimulate tourism demand, governments need to collaborate with the private sector and put in place new recommended standards of safety, hygiene, testing, and procedures. At the same time, governments will need to take steps to ensure that the destination community were comfortable that the benefits associated with the return of visitors outweigh any concerns over the potential health risks. Kenya has been currently developing a war-room strategy for the sector especially during crises and pandemics. This strategy enables leadership to make critical decisions without full information. The next market for tourism lies with Regional and Domestic tourism. Governments need to develop specific tourism strategies for these previously ignored markets. This calls for diversification of markets and transformation of marketing methods and styles. Further, the tourism policies of all the countries should be reviewed to reflect the new reality. Crisis and pandemics in tourism should be addressed and a Crisis preparedness strategy developed. Beyond the immediate responses needed, policymakers will need to learn from the lessons of the COVID-19 crisis, to improve crisis management strategies to better prepare destinations and the sector more broadly to respond to future shocks. The COVID-19 pandemic provides striking lessons to the tourism industry, policymakers and tourism researchers about the largely ignored effects of global change.

References

African Centre for Disease Control and Prevention, Africa CDC, *(2020) COVID-19 African CDC Dashboard Infections and Death Rates*. Assessed through: https:// africacdc.org/covid-19/.

Nova Science Publishers, Inc.

Becken, S. & Hughey, K, F. D., (2013). Linking tourism into emergency management structures to enhance disaster risk reduction, *Tourism Management,* 36, 77–85. doi: https://doi.org/10.1016/j.tourman.2012.11.00.

Biran, A., Liu, W., Li, G., & Eichhorn, V. (2014). Consuming post-disaster destinations: The case of Sichuan, China. *Annals of Tourism Research*, 47, 1–17. doi: https://doi.org/10.1016/j.annals.2014.03.004.

Buhrs, T. (2000). The environment and the role of the state in New Zealand. In P. A. Memon & H. Perkins (Eds.), *Environmental Planning and Management in New Zealand (pp. 27-35)*. Palmerston North: Dunmore Press.

Cassedy, K. (1991) *Crisis Management Planning in the Travel and Tourism Industry: A Study of Three Tourism Destinations and a Crisis Management Planning Manual*. San Francisco, CA: PATA. [Google Scholar].

Cioccio, L. and Michael, E. J. 2007. Hazard or disaster: Tourism management for the inevitable in Northeast Victoria. *Tourism Management*, 28: 1–11.

Conaghan, A., and J. Hanrahan. (2009). "Global Conformity of Indicators for Eco-Certification Programs." *Tourism and Hospitality Research in Ireland Conference: Dublin Institute of Technology*.

Downs, A. (1972). Up and down with ecology – the issue attention cycle. *Public Interest*, 28, 38–50. [Google Scholar].

Elliott, J. (1997). *Tourism, Politics and Public Sector Management.* London: Routledge.

Faulkner, B. 2001. Towards a framework for tourism disaster management. *Tourism Management*, 22: 135–147.

Glaesser, D. (2020) Pandemic Preparedness Planning for Travel and Tourism. *World Tourism Organization (UNWTO)* Assessed through: https://www.icao.int/SAM/Documents/2009/MEDSEM/Pandemic%20Prep%20Planning%20for%20T%20and%20T%20v4%20UNWTO.pdf.

Gössling, S. (2002). Global environmental consequences of tourism. *Global Environmental Change*, 12(4), 283–302. https://doi.org/10.1016/S0959-3780(02)00044-4 [Crossref], [Web of Science ®], [Google Scholar].

Government of Tanzania, (2022) *Tourism Policy and Strategies in Tanzania*. Retrieved from: http://www.tanzaniagateway.org/docs/tourismpolicyandstrategies.pdf.

Gowreesunkar, V. G., Maingi S. W., Roy H. and Micera R. (2022) Rebuilding tourism post pandemic – Policy recommendations from global case studies [version 1; not peer reviewed]. *Emerald Open Res* 2022, 4:2 (document) (https://doi.org/10.35241/emeraldopenres.1114919.1).

Gowreesunkar, V. G., Maingi, S. W., Roy, H. and Micera, R. (2021), "Conclusion: Rebuilding Tourism Post Pandemic: Some Reflections on Destination Management Solutions!," Gowreesunkar, V. G., Maingi, S. W., Roy, H. and Micera, R. (Ed.) *Tourism Destination Management in a Post-Pandemic Context* (*Tourism Security-Safety and Post Conflict Destinations*), Emerald Publishing Limited, Bingley, pp. 329-334. https://doi.org/10.1108/978-1-80071-511-020211023.

Hall, C. M. (1999). Rethinking Collaboration and Partnership: A Public Policy Perspective. *Journal of Sustainable Tourism*, 7(3/4), 274-289. Kerr, W. (2003).

Nova Science Publishers, Inc.

Hall, C. M. (2009). Degrowing tourism: Décroissance, sustainable consumption and steady-state tourism. *Anatolia*, *20*(1), 46–61. https://doi.org/10.1080/13032917.2009.10518894 [Taylor & Francis Online], [Google Scholar].

Hall, C. M. (2019). Constructing sustainable tourism development: The 2030 agenda and the managerial ecology of sustainable tourism. *Journal of Sustainable Tourism*, 27(7), 1044–1060. https://doi.org/10.1080/09669582.2018.1560456 [Taylor & Francis Online], [Web of Science ®], [Google Scholar].

Hall, C. M. (2020). Biological invasion, biosecurity, tourism, and globalisation. In D. Timothy (Ed.), *Handbook of globalisation and tourism* (pp. 114–125). Edward Elgar. [Google Scholar].

Hall, C. M., & Jenkins, J. (2004). Tourism and Public Policy. In A. Lew, C. M. Hall & A. Williams (Eds.), *A companion to tourism* (pp. 425-540). Oxford: Blackwell.

Harris, S. M. (2007). "Green Tick™: An Example of Sustainability Certification of Goods and Services." *Management of Environmental Quality: An International Journal,* 18 (2): 167-78.

Jordan-Meier, J. (2011) *The Four Stages of Highly effective Crisis Management: How to manage the media in the digital age*. CRC Press, Taylor and Francis Group, LLC.

Kerr, W. (2003). *Tourism Public Policy, and the strategic Management of Failure*. New York: Pergamon.

Kimunio, I. and Maingi, S. W. (2022), "A Markov regime-switching (MS) approach to modeling the effects of fiscal policies and COVID-19 pandemic on tourism destination competitiveness in Kenya," *Journal of Hospitality and Tourism Insights,* Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/JHTI-09-2021-0245.

Lew, A. (2014) Scale, change and resilience in community tourism planning, *Tourism Geographies*, 16:1, 14-22, doi: https://doi.org/10.1080/14616688.2013.864325.

Mair, J., Ritchie, B. W., & Walters, G. (2016). Towards a research agenda for post-disaster and post-crisis recovery strategies for tourist destinations: A narrative review. *Current Issues in Tourism,* 19(1), 1–26. doi: https://doi.org/10.1080/13683500.2014.932758.

Marzano, G., & Scott, N. (2009). Power in destination branding. *Annals of Tourism Research*, 36(2), 247–267.

McKinsey and Company. (2020b). C*autiously optimistic: Chinese consumer behavior post-COVID-19*. Retrieved April 6, 2020, from https://www.mckinsey.com/business-functions/marketing-and-sales/our-insights/global-surveys-of-consumer-sentiment-during-the-coronavirus-crisis. [Google Scholar].

Morakabati, Y. Page, S. J. and Fletcher, J. (2020) Emergency Management and Tourism stakeholder responses to crises: AA Global survey. *Journal of Travel Research*, 56 (3), 299-316.

Nickelson, G. and Robinson, R. (2014) Yokohama and Hyogo: A springboard for Caribbean action in disaster risk reduction, *Association of Carribbean States (ACS).* Assessed through: https://www.preventionweb.net/news/view/42112.

Nicola, M., Alsafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., Agha, M. and Agha, R. (2020) The socio-economic implications of the coronavirus pandemic (COVID-19): A review. *Int J Surg.* 78 (2020): pp. 185–193.

NTI, (2019) Global Health Security Index: Building Collective Action and Accountability. *NTI and John Hopkins Bloomberg School of Public Health*, USA.

Nova Science Publishers, Inc.

Pennington-Gray, L., Schroeder, A. Wu, B., Donohoe, H. and Cahyanto, I. (2014) Travelers' perception of Crisis Preparedness Certification in the United States, *Journal of Travel Research. Vol*. 53 (3), 353-365 doi: https://doi.org/10.1177/0047287513496470.

Scott, D., Hall, C. M., &Gössling, S. (2019). Global tourism vulnerability to climate change. *Annals of Tourism Research*, *77*, 49–61. https://doi.org/10.1016/j.annals.2019.05.007 [Crossref], [Web of Science ®], [Google Scholar].

Sessa, A. (1976). The Tourism Policy. *Annals of Tourism Research,* 3(5), 234-247.

Stevenson, N., Airey, D., & Miller, G. (2008). Tourism Policy Making: The Policymakers' Perspectives. *Annals of Tourism Research*, 35(3), 732-750.

Swain, M., Brent, M., & Long, V. (1999). Annals and Tourism Evolving: Indexing 25 years of publication. *Annals of Tourism Research,* 25(Index to Volume 25), 991-1014.

UNWTO. (2020a). *COVID-19: UNWTO calls on tourism to be part of recovery plans*. https://www.unwto.org/news/covid-19-unwto-calls-on-tourism-to-be-part-of-recovery-plans. [Google Scholar].

Waltner-Toews, D. (2020) *On Pandemics: Deadly Diseases from Bubonic Plague to Coronavirus Greystone Books*.

World Health Organization, (2020) 2019 Novel Coronavirus (2019-nCoV): Strategic Preparedness and Response Plan. *World Health Organization*.

Worldometer (2020) *Global Coronavirus cases as at 17th June 2020,* Worldometer. Assessed through: https://www.worldometers.info/coronavirus/

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Chapter 5

New Morbid Forms of Tourism: The Case of Dark Tourism in Perspective

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Abstract

The COVID-19 pandemic not only whipped the Western countries affecting seriously the GDP and the economic performance, but also interrogated on the nature of the tourism industry. The tourism industry was the main carrier but at the same time the main victim of the COVID-19. Having said this, the present proceeding concentrates efforts in discussing the effects of virus outbreak in the industry as well as laying the foundations towards a new understanding of safety and security in tourism. Over the recent years, the precautionary logic which culturally enrooted in the Western reasoning, punctuated on the importance to detect and eradicate those threats which affect the industry. This leading paradigm which opened the doors for the adoption of risk perception theory, so to speak just after the attacks to WTC (2001) set the pace to a new aradigm. Nowadays, as many specialists alert, the concept of precaution has been replaced by adaptancy. New forms of tourism such as Dark tourism, Thana tourism, post disaster tourism speak us of a new (morbid) taste where the "Other`s pain" situates as the main commodity to exchange. In my earlier book (Korstanje 2016), this epoch has been baptized as "thana-capitalism." These new forms or faces of the industry are mainly marked by a consumption given just after the tragedy takes hit.

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Keywords: risk perception theory, dark tourism, consumption, security, adaptancy

Introduction

Dark tourism has become a more than interesting topic and object of study for many academic circles worldwide. Doubtless, dark tourism situates as a leading point of debate in top-ranked journals. As Hooper & Lennon observe, one of the problems of dark tourism seems to be associated with higher levels of fragmentation, which means a dispersion in the used definitions. What is more important, different circles use different academic paradigms in applied research (Hooper & Lennon 2016). Philip Stone (2012) has convincingly argued that dark tourism represents an anthropological attempt to domesticate one of the mysteries of life, death. Per his viewpoint, "the Other´s finitude" speaks to us of our own life calling attention to the proper expectancies. To put this simply, dark tourism serves as a catalyst instrument which helps us imagine our death through the lens of the "significant Other." Over recent years, some voices have emphasized the need of defining dark tourism as a type of dissonant heritage (Light 2017; Hartmann 2016) or a significant sacred pilgrimage that builds a bridge between the past, the present and the future (Olsen & Korstanje 2019). Having said this, dark tourism is many things and at the same time, something very hard to precise (Korstanje 2016).

As the previous backdrop, some studies have focused on dark tourism as an efficient instrument for economic revitalization in a post-disaster or conflict context. At a first look, dark tourism not only enhances resiliency but also accelerates the post-disaster recovery timeframe (Isaac, Cakmak & Butler, 2019; Tucker, Shelton & Bae, 2017; Kelman & Dodds, 2009). Although these works are not new simply because some of them have seen the light of publicity earlier than the turn of the twentieth century (Seaton, 1996; Lennon & Foley 1999), their proliferation has been witnessed just after 2010. Like post-disaster tourism, dark tourism occupied a central position in the planning process assisting policymakers to put the obliterated areas in further value. Furthermore, dark tourism was certainly implemented as a mechanism of resiliency very helpful for the recovery facet (Dresler 2022; Sy & Yu Park 2022). In this vein, some scholars have proclaimed the commonalities between dark tourism and post-disaster tourism (Pottorf & Neal 1994; Lin, Kelemen & Tresidder, 2018). At a closer look, dark tourism engages with thanatosis which (like post-disaster tourism) put the visitors directly before the "Other`s pain"

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(Martini & Buda 2020). To some extent, the change of paradigm which situated dark tourism as a main object of study has invariably remained as untouched. In a recently-released book, Maximiliano Korstanje (2020) holds the thesis that dark or thana-tourism is far from being a new trending topic but the scholarly-given attention has been triplicated just after 2010. Public opinion has been captivated by this new niche igniting a hot debate within scholarship. While some voices alert on the ideological distortion of dark tourism discourses, others applaud enthusiastically dark tourism as a valid instrument to enhance resiliency. The fact seems to be that the triumph of dark tourism as a dominant paradigm entails the failure of risk perception theory to give a firm conceptual background to policymakers. The risk perception doctrine (which emerged from cognitive psychology) has been borrowed from the fields of tourism research just after the 2001s. The attacks on the US as well as other global risks such as natural disasters and recent virus outbreaks led policymakers to question to what extent the industry is still safe. Risk perception theory rested on the precautionary doctrine which punctuates the importance to use forecasting and planning to detect and eradicate global risks which threaten the industry. The escalation of these global risks in an ever-changing world has resulted in the adoption of a new paradigm where mass destruction is taken as usual. This is the context where the post-disaster studies emerge from (Korstanje 2020). In the mid of this debate, the present book chapter interrogates the nature of dark tourism as well as the necessary conditions to replace the precautionary logic with other paradigms. With the benefits of hindsight, the book chapter holds the thesis that post-disaster studies certainly exhibit the failure of risk perception theory to understand and prevent the negative impacts of global threats in the tourism industry (Korstanje & Olsen 2020).

The first section is a short companion on the changes accelerated by the terrorist attacks in 2001. The risk perception theory, a leading paradigm in the cognitive psychology, was widely adopted in the tourism research. Unfortunately, the failure of risk perception theory to give answers to the global threats led scholars in the need to employ new paradigms such as post-disaster and dark tourism. The second and third section explore the commonalities and differences between dark tourism and post-disaster tourism respectively. It is not otiose to say both paradigms have strengths, and weaknesses. The conclusion gives a snapshot for applied research in the fields of dark tourism for the next years to come. Of course, this is a theoretical approach which should be empirically validated in future studies.

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Terrorism, Risk Perception Theory and the Turn of the Century

As stated in the earlier section, the turn of the twentieth century witnessed the multiplication of countless risks, which include terrorism, natural disasters, virus outbreaks as well as the rise of a climate of political instability without mentioning economic crisis globally (Ritchie 2009; Laws, Prideaux & Chon, 2007). The tourism research adopted the concept of crisis management as well as risk perception as the main leading paradigms (Yang & Nair, 2014; Fuchs & Reichel, 2006). Although the risk perception doctrine is far from being new simply because it was alive in cognitive phycology for more than four decades, no less true was that the turn of the century and the terrorist attack perpetrated by the radicalized cell Al-Qaeda to the US paved the pathways for the introduction to the notion of risk in tourism (Jonas et al. 2011). The theory was certainly based on the precautionary principle which means that rational planning helps policy-makers to detect and eradicate those global dangers which can threaten the industry. At the same time, the risk perception theory expands the current understanding of travel behavior as well as the consumers` reactions to certain risks (Korstanje 2009). What is equally important, demographic characteristics, features or affiliation as well as the psychological character explain why some consumers are prone to risk perception while others are more insensitive. From its outset, the goals of risk perception theory were twofold. On one hand, it is inscribed in the urgency of anticipating the potential dangers -earlier than they happen-. On another, it predicted the effects and tendencies of the market in a new stage of complexity and danger. Those consumers or segments oriented to bear higher levels of uncertainness are less sensitive to risk perception than other groups (Liu-Lastres, Schroeder & Pennington-Gray, 2019; Floyd et al, 2004; Reisinger & Mavondo, 2006). At a first glimpse, the risk perception doctrine was a fertile ground which populated the content of leading tourism-related journals from 2001 to 2010 (Chen et al. 2022). However, since 2010 year, this hegemonic paradigm sets the pace for a new theoretical background, post-disaster tourism (Korstanje 2016; Tzanelli 2016).

As the previous argument is given, the complexity of an ever-changing and globalized world or a much deeper chaotic scenario, makes the risk perception theory fall short. Far from placating, the effects of climate change have been accelerated by greenhouse gas emissions. Besides, the action of radicalized groups and terrorism affected not only the US but entire Europe

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expanding the violence to countries such as Germany, France, Spain and the UK. Recently, the COVID-19 virus outbreaks have wreaked havoc in the global trade as well as in the tourism and hospitality industries. To some extent, it is important to add, that the precautionary logic -as an old-fashioned paradigm- needed serious changes. Just after 2010, some scholars claimed that the current academic paradigm does not suffice to give firm answers to the problems of the industry (Miller 2008; Korstanje 2020). One of the grounding differences between post-disaster tourism and risk perception theory rests on the capacity for adaptation (not prevention) (Cakar 2020). The tourist experience is created just after the disaster takes a hit. Also, the process of consumption is certainly determined by the urgency to recover the affected zone, not to prevent the aftermaths of the traumatic event. This means that post-disaster tourism and dark tourism operate in the shades of tragedy providing not only a lesson to survivors (heritage) but also the material resources to fasten the recovery stage (Miller, Gonzalez & Hutter, 2017). It is important not to lose sight of the fact that the natural curiosity of visitors seems to be an essential part of the resilient mechanism as well as relief in a post-disaster context (Zhang 2021). Having said this, natural and man-made disasters occupy a central position in the configuration of human and in-group identity (Zhang 2022). Some studies suggest that disaster tourism is an inherent part of the dark tourism spectrum (Rucinska, 2016) or dark heritage formation (Roberts & Stone 2014; Biran, Poria & Oren, 2011). The question of identity and tragedy has no clear guidelines though it offers a fertile ground for future layouts (Farmaki 2013). Quite aside from this controversy, dark tourism and post-disaster tourism have inherently some basic differences which need to be discussed in the next lines.

Dark Tourism Studies

Although there is a serious discrepancy revolving around the origin, nature and evolution of dark tourism, as well as its homogeneity with other associated terms, it is safe to define dark tourism as a new tendency originated in secular societies which helps visitors to understand the proper finitude through the "Other`s death" (Stone & Sharpley, 2008; Dale & Robinson 2011; Ryan & Kohli 2006). Visitors, so to speak, to these dark sites look not only for outstanding and authentic experiences but also understanding of their own lives (Barton & Brown 2012; Stone 2012). Some voices have recognized that dark tourism is mainly associated with heritage consumption or sacred

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pilgrimage. Visitors are culturally motivated to move to traumatic spaces to deal with their troublesome past. Since dark consumption cements national heritage, it is safe to say culture, heritage and dark consumption are inextricably intertwined. To put the same in other simpler terms, dark tourism engages with a spiritual journey symbolically enrooted in a much deeper traumatic landscape, where the self certainly debates between the past and the present (Light 2017; Hartmann 2014; Strange & Kempa 2003; Collins Kreiner, 2016; Olsen & Korstanje 2019). In some of her earlier works, Maria Buda acknowledges that dark tourism has a polysemic nature mainly marked by its association with other derived topics which include prison tourism, thana tourism, and mourning tourism (only to name a few). Doubtless, dark tourism captivated the attention of countless scholars in recent years. However, as she alerts, the nature of dark tourism, as well as the profound psychological motivations of visitors, remain unclear. In this respect, psychoanalysis plays a leading role in unpacking the nature and evolution of this social phenomenon. Psychoanalysis has indeed been overlooked systematically by the applied research in the fields of tourism. In this vein, dark tourism should be contemplated as a part of effective tourism simply because it gives the opportunities to visitors to dive into their emotional inner world. The self often moves between love and death drives, in which case, the curiosity for death is naturally intricated in our psychology. Having said this, dark destinations are selected or rejected according to our biography and the emotional world which looks for answers that explain death. She gives a convincing argument alluding to dark tourism as a conflictive ritual where the emotionality before death confronts with pleasure (Martini & Buda, 2020; Prayag, Buda & Jordan, 2021; Cave & Buda, 2018; Buda 2015). In consonance with this, Philip Stone (2006) develops a conceptual model to understand the spectrum of dark sites. Per his viewpoint, dark sites oscillate between lightest to darkest typologies. This spectrum is given not only by the type of infrastructure disposed to welcome visitors but also by how fresh the memory is. Those sites characterized by extreme pain or mourning are often oath to be open to mass tourism (unlike fun dark factories). The shared emotionality occupies an important space in the configuration of shared discourse. The interplay between demand and supply in dark tourism has been widely explored in different works (Sharpley 2006; Farmaki 2013; Stone & Sharpley 2008). This point leads other authors to discuss the issue from the lens of critical sociology. As Joy Sather-Wagstaff (2016) eloquently observes, beyond the hegemony of the economy, dark tourism appeals to human reciprocity. Based on her auto-ethnography on Ground-zero, she argues that

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death not only jolts culture from a lingering complacency but also opens the doors to solidarity with victims. The intervention of the state to impose a fabricated discourse (heritage) of the traumatic event leads to ideological forms of distortion, where the real reasons behind the disaster remain covert. At the same time, dark heritage situates as a complex space of conflict and politics. Last but not least, Rodanthi Tzanelli, Senior Professor at Leeds University (UK). Per Tzanelli, dark tourism moves in the shades of a much deep colonial discourse where first-world tourists are unfamiliar with the crimes and brutalities perpetrated by European nations in the colonial period. Following this, dark tourism should be seen as an ideological mechanism of indoctrination that affirms the centre-periphery dependency culturally forged in the colonial expansion. For Tzanelli, dark tourism and post-disaster tourism can be used exchangeable as similar terms. In the next section, we will discuss the commonalities and differences between post-disaster tourism and dark tourism.

Post Disaster Tourism

Like dark tourism, post-disaster tourism is not a new term but scholarship paid attention to this emerging topic just after the 2000s decade. Post-disaster tourism is framed into the constellations of disaster management or disaster resilient management (Rahayu, Haigh & Amaratunga, 2018; Korstanje & Ivanov, 2012). At a closer look, the aims of post-disaster tourism are threefold. Firstly, it offers a conceptual framework useful to policymakers to accelerate the recovery facet just after a disaster (Seraphin, Korstanje, & Gowreesunkar, 2020). Secondly, it enhances the collective resiliency supporting locals to rememorate their victims while laying the foundations for a new re-start. Resilience should be understood as the capacity proper in each human group or culture to deal with traumatic events (Korstanje & Ivanov, 2012; Kato 2018). Third, post-disaster tourism enacts new gentrification processes which re-cycle the old-fashioned urban dynamism and social maladies. Most certainly, post-disaster consumption attracts new foreign investors interested in funding local communities (Katsinas, 2021). Chew & Jahari (2014) lament that there is a certain disconnection between risk perception theory and post-disaster studies. This happens simply because the promotion of risky destinations or destinations whipped by disasters is relatively new in the planning process. To this end, Chowdhury, Prayag & Orchiston (2018) said overtly that relational capital, which means the skills and capacities to show

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empathy for the "Other", has a direct impact on adaptative resiliency while optimizing business performances. Tucker, Shelton & Bae (2017) hold that tourism assists locals to transform traumatic experiences into hope. This change appeals to a process of transition where narratives are moulded by a combination of destruction and renewal. To some extent, this type of empathy for the victims is what has in common with dark tourism and post-disaster tourism. Zhang (2021) equates dark tourism to disaster tourism insofar as both are successfully employed as a part of economic relief while placating the devastating effects of trauma. Per his obtained outcomes, disaster ignites cognitive and emotional dimensions which lead to the creation of relational experiences. Like dark tourism, post-disaster consumption revolves around the "Other`s pain" engaging with the victims. The second element in common lies in the fact both construct a shared narrative (heritage) which is packaged, commoditized and exchanged with visitors. Dark tourist sites offer a lesson about the disaster which is cannot be forgotten. Dorota Rucinska toys with the belief that post-disaster tourism is part of the dark tourism spectrum. There is a wide range of niches which are psychologically motivated to gaze at spaces obliterated by disasters and catastrophes. This thanatological drive is commoditized and channelized by specialized tour operators which makes disaster a cultural product. Jordan & Prayag (2022) evince how disasters often are thought of within the fields of dark tourism attractions representing a limonoid space where locals and tourists interact with each other. Even if the intensity of the experience in these sites varies on culture and time, no less true seems to be that dark tourism empowers and stimulates consumption with positive direct consequences on the locals` lives. However, both views depend on how the event is interpreted. For tourists, the dark side is seen as a lesson of what can happen in their societies, while for survivors it is a space of mourning and emotional engagement. Sometimes, communities affected by disasters are not empathic with the idea of developing tourism. In consonance with this, Korstanje & Baker (2018) have explored the case of Cromañon and ESMA in Argentina. Both sites are spaces of memory dedicated to the victims of an accident and the violent repression of the Juntas in the 70s decade. In both cases, survivors are reluctant to accept mass tourism because they strongly believe the economic factor played a vital role in the traumatic event. It is safe to say that mass tourism, far from being a healing instrument (at least for them) is part of the problem because it ignites corruption and conflict. These findings very well coincide with Stone`s darkest spectrum widely described in many other studies (Stone 2006; Biran & Hyde 2013; Raine 2013; Huermann & Chhabra 2014).

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As the previous argument is given, this does not authorize to say that all dark tourism sites are related to disaster consumption. Some cemeteries, prisons, concentration camps, and spaces of mass death are not strictly associated with natural disasters. Not surprisingly, the main difference between dark tourism and disaster tourism rests on the fact that dark tourism harps on the "significant Other`s death", no matter the context whereas disaster tourism operates in the shadows and clouds left by a natural or made-man disaster. Lastly, Richard Butler (2017) focuses on the concept of resiliency as the touchstone of post-disaster tourism. This element which leads to responsibility and ethics not necessarily is present in dark tourism consumption. Echoing this, Isaac, Cakmak & Butler (2019) alert the fact the category of dark tourism is very complex and hard to grasp. Some of the elements are circumscribed to suffering, but not limited to. The motivation of dark tourists ranges from curiosity about mass death and destruction to heritage consumption. This is not exactly what occurs in disaster tourism. Last but not least, Korstanje (2020) exerts a caustic critique of dark and post-tourism studies. Methodologically speaking, the obtained results are derived from the administration of open or closed-end questionnaires, where the visitors are seen as the main source of information. This seriously confronts a basic assumption in applied research which says that subjects often lie to protect their interests or are unfamiliar with their inner world. As he puts it if I ask a gangster about his profession, what does he supposedly answer? he surely will say I am a respectable businessman, but is he a businessman? Interviews -unless combined with other methods - rarely show a scientific correlation among variables (Korstanje 2016; 2020). Farfetched as it may sound, other derived problems in both (dark and post-disaster tourism) are associated with the urgency towards economic alleviation. The commoditization of dark sites (which makes tragedy an exchangeable product) paves the way for a kitschification of the tragedy (Potts, 2012) prone to create a spectacle. When this happens, not only the real reasons for the event are forgotten or biased but also the probability to face a new tragedy turns higher. What is more important, the vital -if not ethical- the question is whether post-disaster tourism and dark tourism need human suffering to prosper, in which case some scholars call attention to the dependency between death and profits. To put the same bluntly, dark and post-disaster sites are systematically orchestrated around the "Other`s suffering" as the main commodity, to what extent does this means that the structural conditions that led to disaster are corrected is a point of discrepancy that exegetes of post-disaster tourism fail to respond. At the time these dark spaces multiplicate less intention to change

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the cultural background that made the disaster possible. As a result of this, -it is not simplistic to say- disasters [far from being reduced] are sold and exchanged as commodities in a macabre form (Korstanje 2016; Tzanelli 2016; Bowman & Pezzulo, 2009).

Conclusion

Without any doubt, the present chapter has discussed the vulnerability of the tourism industry to external threats. Since 2001, several dangers have placed the industry in jeopardy. In this context, the risk perception doctrine emerges as a leading paradigm that helped policymakers to identify and eradicate global threats. The escalation of violence and the systematic failures to deter the effects of climate change has invariably led to the adoption of new paradigms mainly linked to post-disaster consumption. Dark tourism and post-disaster tourism are certainly inscribed as new niches oriented to make from the disaster the main commodity. The present chapter explored the ebbs and flows of both trends while laying the foundations for a new understanding of what we dubbed the spectacle of the disaster. In the first section, we shed light on the 11 Sept of 2001 as a foundational event that marked a new epoch. The terror and political violence traversed all nations worldwide. The failure of risk perception theory sets the pace for a new paradigm centered on adaptancy and resiliency. However, the question of adaptancy has some ethical problems which beg the question: to what extent we can solve the conditions that generate disasters if we adapt to them? Or how we can fix the background that led to a state of disaster if the reasons are biased or theatricalized? There is no clear answer to these questions, in which case they represent the launching platform for the next layouts or interrogations.

References

Barton, A., & Brown, A. (2012). Dark tourism and the modern prison. *Prison Service Journal*, *199*, 44-49.

Biran, A., Poria, Y., & Oren, G. (2011). Sought experiences at (dark) heritage sites. *Annals of tourism research*, *38*(3), 820-841.

Biran, A., & Hyde, K. F. (2013). New perspectives on dark tourism. *International Journal of Culture, Tourism and Hospitality Research*. 7(3): 191-198.

Bowman, M. S., & Pezzullo, P. C. (2009). What's so 'dark'about 'dark tourism'?: Death, tours, and performance. *Tourist Studies*, *9*(3), 187-202.

Nova Science Publishers, Inc.

Buda, D. M. (2015). *Affective tourism: Dark routes in conflict*. Abingdon, Routledge.

Butler, R. W. (2017). *Tourism and resilience*. Wallingford, CABI.

Çakar, K. (2020). Investigation of the motivations and experiences of tourists visiting the Gallipoli Peninsula as a dark tourism destination. *European Journal of Tourism Research*, *24*, 2405-2405.

Cave, J., & Buda, D. (2018). Souvenirs in dark tourism: Emotions and symbols. In *The Palgrave handbook of dark tourism studies* (pp. 707-726). Palgrave Macmillan, London.

Collins-Kreiner, N. (2016). Dark tourism as/is pilgrimage. *Current Issues in Tourism*, *19*(12), 1185-1189.

Chen, S., Xu, Z., Wang, X., & Škare, M. (2022). A bibliometric analysis of natural disasters and business management in tourism. *Journal of Business Economics and Management*, *23*(2), 305-326.

Chew, E. Y. T., & Jahari, S. A. (2014). Destination image as a mediator between perceived risks and revisit intention: A case of post-disaster Japan. *Tourism management*, *40*, 382-393.

Chowdhury, M., Prayag, G., Orchiston, C., & Spector, S. (2019). Postdisaster social capital, adaptive resilience and business performance of tourism organizations in Christchurch, New Zealand. *Journal of Travel Research*, *58*(7), 1209-1226.

Dale, C., & Robinson, N. (2011). Dark tourism. In *Research themes for tourism* (pp. 205-217). Wallingford UK: CABI.

Dresler, E. (2022). Dark souveniring: just a souvenir or something more complex. *Journal of Marketing Management*, 1-21.

Farmaki, A. (2013). Dark tourism revisited: A supply/demand conceptualisation. *International Journal of Culture, tourism and hospitality Research*. 7(3): 281-292.

Floyd, M. F., Gibson, H., Pennington-Gray, L., & Thapa, B. (2004). The effect of risk perceptions on intentions to travel in the aftermath of September 11, 2001. *Journal of Travel & Tourism Marketing*, *15*(2-3), 19-38.

Fuchs, G., & Reichel, A. (2006). Tourist destination risk perception: The case of Israel. *Journal of Hospitality & Leisure Marketing*, *14*(2), 83-108.

Hartmann, R. (2014). Dark tourism, thanatourism, and dissonance in heritage tourism management: new directions in contemporary tourism research. *Journal of Heritage Tourism*, *9*(2), 166-182.

Hooper, G., & Lennon, J. (2016). *Dark tourism*. London, Taylor & Francis.

Heuermann, K., & Chhabra, D. (2014). The darker side of dark tourism: An authenticity perspective. *Tourism analysis*, *19*(2), 213-225.

Isaac, R. K., Çakmak, E., & Butler, R. (Eds.). (2019). *Tourism and hospitality in conflict-ridden destinations*. Abingdon, Routledge.

Jordan, E. J., & Prayag, G. (2022). Residents' cognitive appraisals, emotions, and coping strategies at local dark tourism sites. *Journal of Travel Research*, *61*(4), 887-902.

Jonas, A., Mansfeld, Y., Paz, S., & Potasman, I. (2011). Determinants of health risk perception among low-risk-taking tourists traveling to developing countries. *Journal of Travel Research*, *50*(1), 87-99.

Nova Science Publishers, Inc.

Kato, K. (2018). Debating sustainability in tourism development: Resilience, traditional knowledge and community: A post-disaster perspective. *Tourism Planning & Development*, *15*(1), 55-67.

Katsinas, P. (2021). Professionalisation of short-term rentals and emergent tourism gentrification in post-crisis Thessaloniki. *Environment and Planning A: Economy and Space*, *53*(7), 1652-1670.

Kelman, I., & Dodds, R. (2009). Developing a code of ethics for disaster tourism. *International Journal of Mass Emergencies and Disasters*, *27*(3), 272-296.

Korstanje M. E (2009). "Re-visiting risk perception theory in the context of travel." E-Review of Tourism Research, 7(4): 68-81

Korstanje M. E (2016) *The Rise of Thana Capitalism and Tourism.* Abingdon, Routledge.

Korstanje, M. E. (2020). The dark tourist: Consuming dark spaces in the periphery. *Tourism, terrorism and security*. Korstanje M. & Seraphin H (eds). Bingley, Emerald Group Publishing.

Korstanje, M. E., & Baker, D. (2018). Politics of dark tourism: The case of Cromanon and ESMA, Buenos Aires, Argentina. In *The Palgrave Handbook of Dark Tourism Studies* (pp. 533-552). London, Palgrave Macmillan.

Korstanje, M. E., & Ivanov, S. H. (2012). Tourism as a form of new psychological resilience: The inception of dark tourism. *CULTUr-revista de Cultura e Turismo*, *6*(4), 56-71.

Korstanje, M. E., & Olsen, D. H. (2020). Negotiating the intersections between dark tourism and pilgrimage. *Dark Tourism and Pilgrimage*, Olsen D & Korstanje M. (eds), Wallingford, CABI, 1-15.

Martini, A., & Buda, D. M. (2020). Dark tourism and affect: Framing places of death and disaster. *Current Issues in Tourism*, *23*(6), 679-692.

Miller, D. S. (2008). Disaster tourism and disaster landscape attractions after Hurricane Katrina: an auto-ethnographic journey. *International Journal of Culture, Tourism and Hospitality Research*. 2(2): 115-131.

Miller, D. S., Gonzalez, C., & Hutter, M. (2017). Phoenix tourism within dark tourism: Rebirth, rebuilding and rebranding of tourist destinations following disasters. *Worldwide Hospitality and Tourism Themes*. 9(2): 196-215

Laws, E., Prideaux, B., & Chon, K. S. (Eds.). (2007). *Crisis management in tourism*. Wallingford, Cabi.

Lennon, J. J., & Foley, M. (1999). Interpretation of the unimaginable: The US Holocaust Memorial Museum, Washington, DC, and "dark tourism." *Journal of Travel Research*, *38*(1), 46-50.

Liu-Lastres, B., Schroeder, A., & Pennington-Gray, L. (2019). Cruise line customers' responses to risk and crisis communication messages: An application of the risk perception attitude framework. *Journal of travel research*, *58*(5), 849-865.

Light, D. (2017). Progress in dark tourism and thanatourism research: An uneasy relationship with heritage tourism. *Tourism management*, *61*, 275-301.

Lin, Y., Kelemen, M., & Tresidder, R. (2018). Post-disaster tourism: building resilience through community-led approaches in the aftermath of the 2011 disasters in Japan. *Journal of Sustainable Tourism*, *26*(10), 1766-1783.

Nova Science Publishers, Inc.

Olsen, D. H., & Korstanje, M. E. (Eds.). (2019). *Dark tourism and pilgrimage*. Wallingford, CABI.

Potts, T. J. (2012). 'Dark tourism'and the 'kitschification'of 9/11. *Tourist Studies*, *12*(3), 232-249.

Pottorff, S. M., & Neal, D. D. M. (1994). Marketing implications for post-disaster tourism destinations. *Journal of Travel & Tourism Marketing*, *3*(1), 115-122.

Prayag, G., Buda, D. M., & Jordan, E. J. (2021). Mortality salience and meaning in life for residents visiting dark tourism sites. *Journal of Sustainable Tourism*, *29*(9), 1508-1528.

Rahayu, H., Haigh, R., & Amaratunga, D. (2018). Strategic challenges in development planning for Denpasar City and the coastal urban agglomeration of Sarbagita. *Procedia engineering*, *212*, 1347-1354.

Raine, R. (2013). A dark tourist spectrum. *International Journal of Culture, tourism and hospitality Research*, *7*(3), 242-256.

Ritchie, B. W. (2009). Crisis and disaster management for tourism. In *Crisis and Disaster Management for Tourism*. Bristol, Channel View Publications.

Roberts, C., & Stone, P. (2014). Dark tourism and dark heritage: Emergent themes, issues and consequences. In *Displaced Heritage: response to disaster, trauma and loss. Covenry I*, Corsane G & Davis P. (eds). Newcastle, Newcastle University Press. 9-18.

Rucińska, D. (2016). Natural disaster tourism as a type of dark tourism. *International Journal of Humanities and Social Sciences*, *10*(5), 1458-1462.

Ryan, C., & Kohli, R. (2006). The Buried village, New Zealand–An example of dark tourism?. *Asia Pacific Journal of Tourism Research*, *11*(3), 211-226.

Sather-Wagstaff, J. (2016). *Heritage that hurts: Tourists in the memoryscapes of September 11*. Abingdon, Routledge.

Seaton, A. V. (1996). Guided by the dark: From thanatopsis to thanatourism. *International journal of heritage studies*, *2*(4), 234-244.

Sharpley, R. (2006). Travels to the edge of darkness: Towards a typology of "dark tourism." In *Taking tourism to the limits* (pp. 239-250). Abingdon, Routledge.

Séraphin, H., Korstanje, M., & Gowreesunkar, V. G. (Eds.). (2020). *Post-disaster and post-conflict tourism: Toward a new management approach*. London, CRC Press.

Stone, P. R. (2006). A dark tourism spectrum: Towards a typology of death and macabre related tourist sites, attractions and exhibitions. *Tourism: An International Interdisciplinary Journal*, *54*(2), 145-160.

Stone, P. R. (2012). Dark tourism and significant other death: Towards a model of mortality mediation. *Annals of tourism research*, *39*(3), 1565-1587.

Stone, P., & Sharpley, R. (2008). Consuming dark tourism: A thanatological perspective. *Annals of tourism Research*, *35*(2), 574-595.

Strange, C., & Kempa, M. (2003). Shades of dark tourism: Alcatraz and Robben Island. *Annals of tourism research*, *30*(2), 386-405.

Su, R., & Yu Park, H. (2022). Negotiating cultural trauma in tourism. *Current Issues in Tourism*, 1-17.

Tucker, H., Shelton, E. J., & Bae, H. (2017). Post-disaster tourism: Towards a tourism of transition. *Tourist studies*, *17*(3), 306-327.

Nova Science Publishers, Inc.

Tzanelli, R. (2016). *Thanatourism and cinematic representations of risk: Screening the end of tourism*. Abingdon, Routledge.

Yang, C. L., & Nair, V. (2014). Risk perception study in tourism: Are we really measuring perceived risk?. *Procedia-Social and Behavioral Sciences*, *144*, 322-327.

Zhang, Y. (2021). Unpacking visitors' experiences at dark tourism sites of natural disasters. *Tourism Management Perspectives*, *40*, 100880.

Zhang, Y. (2022). Experiencing human identity at dark tourism sites of natural disasters. *Tourism Management*, *89*, 104451.

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Chapter 6

Selection, Adaptation and Survival: A Case Study on the Impact of the COVID-19 Pandemic on the Tourist Sector of Juiz de Fora (MG)

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Abstract

This book chapter aims to analyze the impacts of COVID-19 Pandemic on the tourism sector in Juiz de Fora (Brazil) based on the perspective of organizational ecology. The main argument developed here is that the pandemic has imposed a new condition over all the existing firms through two main forms: 'selecting' the survival firms through an extreme and severe scarceness of resources by a long period, and then, acting over the remaining firms imposing them a diverse set of strategies and actions to 'adapt' themselves to the 'new conditions. A field research was conducted between October 2020 and August 2021 focusing on the inter-organizational relationship among some

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important structural components of the tourism supply chain (lodging, food, travel agencies, cultural equipment, and transportation firms). Methodologically, a case study method was used to guide the mixed research, with a random but not stochastic sample of 66 firms, whose data were analyzed qualitatively by Content Analysis and quantitatively by Descriptive Statistics. The results show that 15% of the firms have closed the operations [selection variable] due to the pandemic; all remaining firms needed to adapt themselves in terms of legal compliance (restrictive laws), managerial practices (human resources and labor routines) and strategies (new technologies and new markets) [adaptation variable]; also, all of the remaining firms have kept their business in online mode, total or partially, even in the current period of pandemic decline [retention variable]. We conclude that all companies needed to reinforce their attention on the external environmental impositions to a greater or lesser degree.

Keywords: COVID-19, tourism, supply chain, Organizational Ecology Theory/OET, Judge of Fora-MG, Brazil

Introduction

Over decades, researchers dedicated to the theme of tourism needed to give numerous proofs of its theoretical and practical importance in order to counterbalance the scenario imposed by the *Doxa* of an apparent superficiality and absence of seriousness that, consequently, was refracted in the eyes of a commonsense observer (Krippendorf, 1999). Nowadays, however, the importance of tourism is out of the question. This activity crosses the four corners of the world, and is settled in both the economically central and peripheral countries of the capitalist system, involving labor and income generation, ideological and political borders, as well as different forms of border establishment, social markers and distinctions in the ways that ordinary citizens use their free time (Pimentel, 2022).

Despite this, the world has been invited - or better, was imposed- to reflect on the role of tourism in contemporary society, due to its continuous growth (of more than 56 times) since the decade of 1950 (Our World in Data, 2022[1]) However, the tourism activity has been reduced to virtually zero in the short

[1] The United Nations World Tourism Organization (UNWTO) estimates that internationally there were just 25 million tourist arrivals in 1950. 68 years later this number has increased to 1.4 billion international arrivals per year. This is a 56-fold increase. (see: https:// ourworldindata.org/tourism).

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period of nearly 2 years precisely in the emergency, growth, peak and decline of the global COVID-19 pandemic (Baum & Hai, 2020; Gössling, Scott & Hall, 2020). Studies in all areas of knowledge have been discussing the underlying issues, assumptions, and conditioning factors related to impacts of this pandemic as well as prospections of future scenarios to deal with its impositions. In this sense, several terms have been coined, and, among them, one is perhaps the best to capture today's *zeitgeist*: the 'new reality' (Korstanje, 2020; Korstanje & George, 2021; Mediotte et al., 2021).

Thus, among all the productive activities, tourism was perhaps the most impacted by the pandemic started in China in 2019 (Flaxman et al., 2020). Directly dependent on the mobility of people, both nationally and internationally, the impacts were immediately seen through the movement of closing borders to contain the pandemic and, hinder its spread, to control its outbreaks by restricting mobility (Niestadt, 2020; UNWTO, 2020).

Brazil was not aside from this scenario, being, instead, one of the central places where the pandemic was developed in its greatest severity, computing today almost 687,962 deaths (Our World in Data, 2022[2]). The peak of the pandemic in this country occurred precisely between the years of mid-2020 to mid-2021, when worldwide health agencies recommended measures of social distancing and/or isolation, stoppage of the tourist trade, suspension of events, postponement of travels, and the establishment of sanitary barriers. In addition, Brazil has witnessed the largest outbreaks of spreading disease and increasing death tolls (Mediotte et al., 2021), exactly when measures were adopted by the national, state and municipal governments to restrict work in companies as well as the operation of these (Brazil, 2022[3]).

Taking into account the aforementioned context, the present study focuses on the analysis of the impacts of the COVID-19 pandemic on the tourist sector of the city of Juiz de Fora, taking this as a case study in a way it represents a synthesis of a reasonably common context in Brazil due to the size of the city, turnover, number of inhabitants, and the intermediate degree of development of the tourism sector (Pimentel, 2022).

Specifically, this paper aims to analyze the impacts of COVID-19 on the tourism sector in Juiz de Fora (Brazil) based on the perspective of Organizational Ecology Theory (OET). The main argument developed here is that the pandemic has imposed new conditions on all existing companies in

[2]https://ourworldindata.org/coronavirus/country/brazil?country=~BRA#what-is-the-cumulative-number-of-confirmed-deaths

[3] https://www.gov.br/cgu/pt-br/coronavirus/governo-federal

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this sector and, in doing so, has mainly impacted them in two ways: first, by 'selecting' the surviving companies through an extreme and severe scarcity of resources for a long period; and second, by imposing on them a diverse set of strategies and actions to 'adapt' to the 'new conditions.

From the theoretical point of view, this study is justified because the perspective of OET is particularly interesting to analyze this context, since its emphasis lies precisely on the influences of environmental variables on organizations, in this case, taking into account the amplitude and magnitude of the disruptive event of the COVID-19 pandemic, which universally and intensely 'stopped' the whole world. So, this became 'the' event of the greatest importance, worthy of being analyzed in a way that it could heuristically represent the apex of the force of environmental selection over a given niche.

The OET lays mainly into the following premises: on the analysis of a multidimensional space (Liu; Van Witteloostuijn, 2020; Carrol et al., 2002; Hannan; Freeman, 1989, Hutchinson, 1978), the constant changes in scenarios (Koller, 2016), and the various components and factors of the environment that intensify the integration/ competition among organizations, resulting in their survival or failure. Thus, the OET is understood as a theory that defends the multiplicity of organizations that *must* to adapt to the environment in different aspects (social, economic, among others) to survive in the market and deal with competition through alliances with other companies with similar processes. The theory also contradicts the perspective that the management should only be focused (just or mainly) on internal factors because the external pressures determine the environmental conditions in which organizations behave and, in doing so, their possibilities of action, including their eventual (need for) restructuration in order to adapt to the changing conditions.

From the empirical point of view, even before the pandemic, there was already a pattern, in terms of the performance of the tourism sector on screen, showing "[...] existence of a traditional, mechanical production process with low added value and the possibility of stagnation" (Pimentel, 2020b, pp. 1-2), that, in the case, could be aggravated by a situation of crisis and exacerbated by restriction of resources, operating capacity and customers. In this sense, the study intends to shed light on the new 'standard' of operation imposed on companies that is marked by a minimum level of efficiency, and check how it was implemented, as well as the economic survival strategies adopted by the companies analyzed.

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Organizational Ecology in Perspective

The twentieth century was the century of organizations, both from a practical and theoretical point of view. Several organizational theories emerged and developed in this period[4]. However, a special attention is deserved to those arisen from the late 1950s and early 1960s, because this period is marked by an intense economical restructuration based on the post-Fordist mode of production (*lean production*) (Harvey, 2008), with unprecedented implications for the accumulation of capital.

Since the 1960s, organizations have been subsumed into a rationalized and automated system of mass production and consumption of material goods (Harvey, 2008). At the theoretical level, organizational theories substantiated by the ideas of structural-functionalism and economic determinism emerged to support the reproduction of this new scenario, as in the case and the predominancy of the Institutional Theory, Contingency Theory and OET (Lounsbury & Ventresca, 2003), in attempts to articulate the efficiency of the network of actors and the combination of several behavioral and structural factors (Motta, 2001). All these theories have in common a relationship with the organizational environment[5].

The OET arose influenced by biological models on natural selection, adaptation and survival, appropriating them to the structural analysis and the view of complex systems in the post-industrial administration stage, characterizing itself as a postmodern discursive approach. As Montoya Restrepo et al. (2012, p. 47) ponder, the "concept of organizational ecology was coined to confirm the fact that all organizations are essentially complex ecological systems characterized by social interdependence and changes in

[4] Several classifications have been made and can serve as a reference for organizational theories and their approaches (cf. Angeloni; Fernandes, 1999; Pimentel, 2012).

[5] Organizational Ecology has similarities with other theories created contemporarily to them, such as, for example, the (a) Contingency Theory, which departs from environmental assumptions to show how this environment (the environment) draws the organizational structure, which appeared in the '60s, with the evaluation of factors that directly interfere in the structure. In this theory, the most effective structures to achieve the organization's objectives are evaluated. Therefore, the factors of the environment are related to the most appropriate techniques of management; (b) the theory of organizational economics where the functionalist character, exposes the rationalism and positivism present in organizational thinking, whereas the Economist theory focuses on the analysis of competitive advantages (Vasconcelos; Cyrino, 2000) and in it, the organization is seen as an arrangement of contracts (Caldas; Cunha, 2005); and also with institutional theory (Oliveira; Heber, 2020) institutional theory, which arises as a response to the external environment and permeates processes and strategies for interaction and adaptation to the environment (Selznick, 1996; Santos, 2011), although this appears poorly defined in Organizational Ecology theory.

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physical systems." Many aspects of contingency can be considered evaluation factors of the response of organizations to external environmental factors such as age, size and the internal distribution of tasks. In this sense, the OET can be seen as a model of selection while the theory of contingency is more focused on models of adaptation (Zapata Rotundo & Mirabal Martinez, 2011), even if, in essence, they show more similitudes and complementarities than divergences.

The *Theory of Population Ecology of Organizations* emerged in the wake of this process, in the 1970s. It is traditionally credited to the work '*The Population Ecology of Organizations*' by sociologists Michael T. Hannah and John Freeman (1977). These authors were inspired by biological models on the selection and adaptation of species populations to seek explanations about the causes of the wide diversity of population fields of organizations and their variations in density, focusing on the impacts of environmental causalities (whether they being social, economic or political nature) in determining and complexing the field, and the structures of opportunities and competition for scarce resources, in which organizations arise, enter, develop, or even become extinct (Hannan & Freeman 1989; Hannan & Carroll 1992; Carroll & Hannan, 2000).

The basic premise underlying *Population Ecology* is that of Darwin's natural selection law (Aldrich and Pfeffer, 1976; Morgan, 2002; Yoshida, 2011) defending that organizations operate in specific niches (market segments) performance levels vary according to the internal structure of a niche in which they operate. This selection process assumes that organizations adapt to the different contexts to which they are inserted, to respond to the demands of society, and, in these concrete responses, survive (Hannah & Freeman, 1977). Therefore, they defend the natural selection model as an examiner of the distribution of resources in the environment, a factor that, when evaluated, involves an environmental perspective that generates, as a consequence, better adaptation of the organization to the environment, which, in the end, selects those organizations 'more able' to it.[6]

[6] In biology, the Darwinist Theory "[...] it is constructed from three basic phenomena: reproduction (replication), selection and mutation. For evolution to occur, a given population of individuals needs to reproduce." (Silva Junior, 2014: 16), admit going, therefore, two orders of facts: "1) existence of small organic variations, which occur in living beings at regular intervals of time and which, by the law of probabilities, can be advantageous for the individuals who present them; 2) Struggle for life that living individuals, which is due to the tendency of each species to multiply according to a geometric progression." (Caputo, 2011: 23).

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In this theoretical framework, the environment exerts a *suis generis inertial pressure*[7] on organizations settled in a particular niche, sector or institutional field, that occurs in a relatively homogeneous and inescapable way (Geroski, 2001; Morgan, 2002; Holzmann, 2009), and pushes organizations to improve their internal policies, to specialize personnel and equipment, as well as to improve the information passed on to managers (Morgan, 2022). This may lead to inflexibility of some organizations (Holzmann, 2009), but it can also -and more frequently- be seen as being derived from their success in the market since organizations that are in leadership positions are less likely to persist for a long time since the demand for innovation is intermittent (Geroski, 2001).

Thus, OET emphasizes the dynamics of population growth and decline and has the Darwinian model of selection as the examining principle of the distribution of resources in the environment (Sutherland et al., 2013), appropriated in three types of analysis: (1) that focusing the organizations as an analysis unit *per se*, (2) that related to the environment and (3) and which uses multiple populations in a competition character (Whole & Brittain, 1986).

To Aldrich and Pfeffer (1976), this model of natural selection consequently generates a better adaptation of the organization to the environment, which is a theme of greatest concern of the Contingency Theory. However, many aspects associated with contingency are taken as evaluation criteria of the organization's responses to external environmental factors by authors of OET, such as the impacts of age, size and the internal distribution of tasks. Thus, although the OET predominantly focuses on 'selection' processes, while contingency theory prioritizes adaptation, there are more similarities and complementarities between them than divergences (Zapata Rotundo & Mirabal Martinez, 2011), and both ends dealing, to a greater or lesser extent, with both sides of the question.

Although much is said about selection in the OET, it is perceived that adaptation is also an important concept. Whole and Brittain (1986) point out that the OET research's strategy focuses on specialization, that, in turn, collaborates with the emergence of adaptive strategies. Hannan and Freeman (2005) see the perspective of adaptation in the literature on management as an influencing factor in the survival of the organization and consequently the

[7] According to Xu (2020), OET treats legitimacy as a central factor and focuses on competition inter-organizational in the research of the legitimacy of the social enterprise. In addition to this idea, Carrol & Hannan (1989) point out that the OET emphasizes that organizational legitimacy originates from structural characteristics of the context, such as the number of similar organizations, and the so-called population density.

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selection of the organization to remain in the market. Therefore, adaptive advantage arises from the responses to environmental imperatives, and induces strategic behaviors that help the organization's survival because "[...] organizations need to adjust to face the challenge and align their internal resources with the external demand in the organization's attempt to increase the company's growth and adaptability in survival." (Koller, 2016, p. 839). The authors argue, from the perspective of adaptation, that:

> subunits of the organization - usually coalitions of managers or dominant coalitions - scan the relevant environment for opportunities and threats, formulate strategic responses, and adjust the organizational structure appropriately. [...] Contributors to this usually assume a hierarchy of authority and control that determines decisions regarding the organization as a whole at the top. It follows, then, that organizations are affected by their environments according to how managers or leaders formulate strategies, make decisions, and implement them. (Hannan; Freeman, 2005: 71).

Briefly, three characteristic themes of OET stand out, which are evidenced by the authors (Hannah; Freeman, 1977; Baum, 2012; Rocha, 2015) as being central: the demographic process – since this information is taken based on the failures of a given organizational population –; ecological processes – as they serve as the basis for the analysis of the relationship between the environment and the organization –; and, finally, environmental processes – which deal with the effects of institutional environments on a given organizational population. Additionally, Hannan and Freeman (1984) highlight some characteristics of OET: high rate of variation between forms of organization; high rates of organizational mortality, high competition in the sector; and non-abundant sources. According to Baum (1998), OET authors raise and use data about the creation and death of populations in order to understand that demographic process including their birth, development and failure. He adds that three indicators should be considered when dealing with OE analysis: the diversity, the difficulty and the instability of the organizations. In Table 1 (below) the main points of OET are summarized.

In addition to these factors, the need for adaptive advantage (Koller, 2016) is visible in the analysis of the strategic behavior adopted by managers to seek for the organization's survival. As Smith & Sidorova (2003) point out, there are some factors related to organizational survival within the theory of OET, namely: reliability, which is defined as the production capacity of collective products capable of attracting critical resources; size, because larger

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organizations transmit greater reliability than the smaller ones (Peli et al., 1994); age, because the older the time of existence tends to be related to a greater the credibility given to managers, employees and clients, especially in the case of service organizations; niche, because the competition acts as the main factor where those with characteristics less suitable to a given target are eliminated. Thus, OET is seen as an evolutionary perspective regarding the adaptability of organizations. One of the main forms that the theory proposes, throughout the study of Hannah and Freeman (1977), is the coupling of individual and organizational intentions transforming them into one.

Table 1. Main points of Organizational Ecology Theory (OET)

Scope	**Population of Organizations**
Central question	Why are there so many types of organizations?
Analysis unit	Population
Population concept	Organizations with the same form of resource-use; populations are likely to be delimited by market segment.
Population analysis	In three dimensions: (1) belonging to an industry (i.e., producing the same product) and limited by market segment; (2) sharing the same resource-rich fundamental environment; (3) sharing the same organizational attribute (Hannan and Freeman 1987; Hannan and Carroll 1995; Carroll and Hannan 2000).
Measures and criteria	Shape, density and diversity
Basic idea	The environment influences the organization's disposition
Study objective	Variation of the population of organizations (birth, growth and mortality), diversity, size and density of organizations, as well as structural inertia of the field and forms of selection, adaptation and retention
Main characteristics of the group	Diversity among organizations; difficulty in adapting to the environment by organizations; variability in organizations.
Basic change process	Variation; retention; competition.
Main assets	Structural inertia; Changes; density of organizations; use of resources; competitive and legitimizing factors; institutional environments; technological cycles.

Source: Own elaboration from the literature review, especially based on Hannah & Freeman (1977), Holzmann (2009) and Halpin (2015).

Looking outside organization, to the environment, OET is founded on a multidimensional space (Liu; Van Witteloostuijn, 2020; Carrol et al. 2002; Hannah; Freeman, 1989, Hutchinson, 1978), given the constant changes in scenarios (Koller, 2016), to the various components of the environment where

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organizations are established beyond the various factors that intensify the integration/ competition between them and result in their survival or failure. Carroll (1984) completes this idea by defending that there are three levels of analysis within OET and that they are respectively: the organizational level- which is based on the perspective of development; the population level – which uses the selection approach and finally the Community level, which handles macro-evolution as a strategy. In the author's view, the OET emphasizes the multilinear and probabilistic nature of evolution.

Complementarily, Aijie (2011) argues that OET is done through the following composition: internal structures (organizations are an organic unit with complex group relationships); composition of species (equal or related industrial economic units that form clusters); sharing of resources (results from associations between companies, companies and research institutions and services and intermediaries, in addition to the production and trade relationship between suppliers and customers and users of the *ecological chain of upstream* and *downstream*); external environment (a cluster-filled environment is a fertile space for rapid business growth) and, ultimately, dynamic resources.

Table 2. Variation and characteristics of Organizational Ecology Theory (OET)

Possibilities for generating the environment	**Key points of each variation**
High rate of variation between forms of organization	As individuals learn about the past, they better adapt to the future by making individual behavior interfere with the characteristics of the organization, differentiating them from each other as a result. Therefore, there is a coupling of individual and organizational intentions.
High organizational mortality rates	Organizations respond relatively slowly to the occurrence of threats and opportunities in their environments. Thus, due to the structural inertia in the skeleton of the organization, such a response often does not occur under the time required by the external environment, causing many organizations not to resist.
High competition in the sector	With non-adaptation over time, new organizations are created by increasing competition between existing ones.
Non-abundant sources	The resources – raw material, labor, use of political support – according to the authors are scarce and organizations that have more access to them are the ones that have the greatest reliability and the greatest influence in the market, thus limiting the use of resources.

Source: Own elaboration (2022).

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In this analysis of organizations, the niches are seen as complementary to each other and are classified into three dimensions, i.e., space dimension (that is responsible for the size and life cycle of companies), resource dimension (that determine the use of internal and external environment resources) and role dimension (that determine the functions of organizations) (Hutchinson, 1978). Therefore, according to Oliveira & Heber (2020, p.103) the virtue of this multidimensional field's analysis lays in the fact that "organizational foundation and failure are influenced by environmental, demographic and ecological processes. Environmental processes, specifically, are categorized as institutional and technological."

In this sense, Hannan (2022, p. 5) emphasizes the impressive diversity of themes and the generality of studies that were influenced by authors and applied the analytical structure of OET, that to several organizational populations: "airlines, auditors, automobile producers, banks, breweries, credit unions, electricity suppliers, electronics producers, labor unions, life insurers, newspapers, semiconductor producers, social movement organizations, social service agencies, software producers, terrorist organizations, venture capital groups and wineries."

Currently, the influence of the OET has been furthered in the United States, followed by the Netherlands, England, Germany, Australia, Canada and France. In Brazil, and other Latin American countries, this influence is beginning to gain space. In developed countries, the theory has been used in environmental science studies, mainly focused on sustainability factors of organizations. In Brazil, researchers are centered on the scope of organizational management[8]. Thus, OET has been applied in the perspective of the "ecology of governance organizations", which seeks to identify what is or what is not governed, what are the legitimate powers of a governor and how their political preferences can be instantiated in rules (Lake, 2020).

Several authors (Dawkins, 1976; Hawley, 1986; Palmaka, 2010), as well as Silva Junior (2014), understand that the OET deals with the theme of variation, selection and retention. On Morgan's perspective (2002), the internal pressure itself is the trigger for the development of the organization itself, which causes it to improve internal policies, the specialization of personnel and equipment, and the information passed to managers. Such

[8] In the 171 records of studies related to OET overviewed in the bases Web of Science and Scopus, only 4% refer to the Brazilian context Available At: https://www-webofscience.ez25.periodicos.capes.gov.br/wos/woscc/analyze-results/f92d4f96-7b3b-466c-9751-14eb8748ac8d-482eabe4, access on 11/08/22.

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pressure can be understood as the inflexibility of organizations (Holzmann, 2009).

Geroski (2001) corroborates the idea of inertial pressure by understanding that it can derive from the success of the organization in the market, and that market leadership positions have fewer possibilities to persist for long since innovation is always occurring. Holzmann (2009) complements this by addressing that the factors that create inertia can be sources of competitive advantages, and Caldas & Cunha (2005) see inertial pressure as a facilitating mechanism for the survival of organizations.

Gathering the conceptualization of previous authors, Lopes (2017, p.249) argues that "organizational ecology seeks to understand a set of factors that explain organizational success or failure, considering that companies are seen from the perspective of the organizational population". Melo (2002) adds to this discussion arguing that OET is based on the principles of self-regulation opposed, consequently, to hierarchical, centralized and external factors. As Melo (2002, p.8) points out

> Socio-ecological regulation is based on the interdependence of organizations, which, to survive in an environment with a high degree of uncertainty, need to rely on a constant negotiation of roles, objectives and mutual advantages, defined from shared values. This is achieved with the support of a learning process.

While OET has been useful to analyze the influence of the environment on organizations, it has, on the other hand, not without its critics. According to Oliveira (2016), the decisions of organizations obey a deterministic and conservative order that is negotiated, emphasizing normative aspects, enabling consensus and reacting to divergent interests. Conversely, Miguel Cunha (1999), sharing Donaldson's (1995) ideas, understands OET as an *anti-management perspective*, as it highlights the functions of the external environment and diminishes the functions of the manager. Managers, according to the author, are not necessarily 'heroes', as shouldn't be treated as 'anti-heroes': they are organizational actors constrained by context, but not to the point that their action is determined "by the external environment" (Cunha, 1999, p.5).

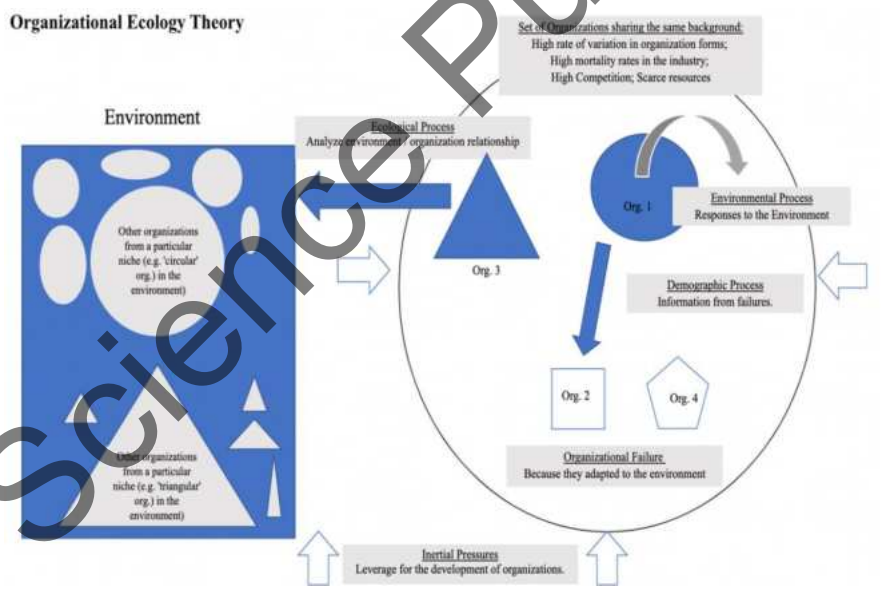
In addition, Caldas & Cunha (2005) argue that change, although possible at the organizational level, is an eminent population phenomenon, instead of a continuous adaptation process directed to individual organisms. To the authors (Caldas; Cunha, 2005, p. 66), "this supra-organizational view of

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change repositions the role of managers, exposing the limitations of their actions".

Thus, this theory analyses a multiplicity of organizations that are apt to the environment in different aspects (social, economic, among others) so that these organizations can survive in the market, and deal with competition through alliances with companies that deal with similar processes. The theory also contradicts the perspective that the management of a company is only about internal factors because external pressures determine the organizations to restructure and suit the new conditions of the environment.

Therefore, based on literature above reviewed, it is possible to realize that the OET has several implications for practice. However, many of them are directly linked to the adaptation of the organization to the environment. This research becomes plausible if there is the understanding that the theory of OET helps to analyze several factors that influence an organization's survival in the market and the environment in which they are included, in addition to the competitive factors among the organizations.



Source: Reproduced from Freesz & Pimentel (2022: 6).

Figure 1. Characteristics of OET about the environment.

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Thus, the set of categories listed above is present in Figure 1, above, provides an overview of the main characteristics of OET about the environment. Through them, it is possible to identify the processes that mark the relationship between an organization and its environment, respectively in the ecological, environmental and demographic levels. In addition, the inertial pressures and situations of organizational failures are involved and verified by the impact of the pandemic on the tourism sector of Juiz de Fora, which is the central focus of this study.

Methodology

Characterization of the Research

Given the drastic and unprecedented impacts of the global pandemic crisis of COVID-19 in the history of humanity, and the absence of reasonably stable and valid parameters of previous situations on which to rely this study, we opted to use the method of *grounded theory*, because it prioritizes empirical data as a starting point for research guidance, gives its necessary flexibility and allows the researcher to investigate the phenomenon in its course. By doing so, we could adapt different methods and data collection techniques, ways of contacting the actors and identify the practices adopted by the companies (Glaser & Strauss, 1967; Strauss & Corbin, 1998; Bryant & Charmaz, 2007; Bianchi & Ikeda, 2008; Bryant & Charmaz, 2019; Morse et al., 2021).

The event of COVID-19 required rapid answers in terms of policies, strategies, and actions from public and private organizations to maintain standard operations. In this context, this article focuses on the impacts of this event on the companies of the tourism sector and this sector in general, particularly in the period between October 2020 to August 2021. A mixed research method of qualitative-quantitative character was used, but the general methodological approach was based on *the grounded theory*. In a way, the case study combined the specific techniques and procedures of a semi-structured questionnaire for data collection, Content Analysis for the qualitative analysis and Descriptive Statistics for the quantitative one.

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Characterization of the *Locus* and Object of Study

As a *locus* and empirical object of study, we used the analysis of the case of the tourist sector[9] of Juiz de Fora (Minas Gerais, Brazil)[10], only as an illustrative example of the dynamics that are believed to be taking place, in other realities, in a reasonably similar way, even with different extensions and intensities. Additionally, it is believed to be this "[…] a very representative case of the dynamics and profile of medium and small supply chains in the context of domestic tourism in Brazil." (Pimentel et al., 2022:98).

Juiz de Fora is located in southeastern Brazil, in the state of Minas Gerais (Figure 2). It is a medium-sized city, with 516,247 inhabitants (IBGE, 2021), and has a high Human Development Index [HDI] – reached 0.778 according to IBGE (2010) – so it is considered a representative city in the region, with high economic development capacity. Among the industrial sector, the main activities are the production of textile products, food and beverage processing, metallurgy, furniture manufacturing and vehicle assembly (JFMinas, 2022). Specifically, the city is one of the main commercial centers of Minas Gerais. Similarly, it has a concentration of important services, mainly health and high school services.

In terms of tourism, Juiz de Fora has a large number of services and tourist offers and is considered one of the inducing destinations of Minas Gerais (SETUR, 2017). Your reputation can be witnessed in several ways, as you're seeing according to different stakeholders, governments, and outside agencies:

> It is ranked 11th among the Brazilian cities that receive the most international fairs and events (PMJF). According to studies by the Convention Visitors Bureau de Juiz de Fora, the Brazilian Institute of Geography and Statistics (IBGE) and the Getúlio Vargas Foundation (FGV), the city is ranked as one of the 100 best in the country for investments. Currently, it is in the process of updating the municipal tourism plan, according to the basic instrument of planning and management of tourism activities created by the Ministry of Tourism and SETUR (MG), intending to offer a quality service to visitors and the juiz-forana community (Pimentel, 2020, p. 20).

[9] Structural Standards of Tourist Services deal with aspects of lodging, food, travel agencies, cultural equipment and transportation. This delimitation was previously stipulated by taking into account the classification of essential tourism activities of the Ministry of Tourism (Brazil - Ministry of Tourism, 2015).

[10] This study is tributary of a series of previous researches conducted by the Economic and Social Observatory of Tourism (UFJF) on the tourist sector of Juiz de Fora (Minas Gerais, Brazil). It is based on a previously existing data set from an industry database, that were already formed by previous studies, and periodically expanded by the aggregation of new data.

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The tourist system of Juiz de Fora was officially made up of about 337 organizations in 2021. However, empirical data suggests that this number may be underestimated. This universe is formed by individual entrepreneurs (8.6%), micro-enterprises (74.8%), small businesses (10.4%) and other types of business (6.2%) (Cadastur, 2021). Its components include lodging, food, travel agencies, cultural equipment and transportation services.



(1) (2)



(3)

Source: Mosaic composition of images based on (1) Abreu (2006), (2) Juiz de Fora on *google maps* at the scale of 5km, (3) Municipality of Juiz de Fora (2022), reproduced from Pimentel et al. (2022:99).

Figure 2. Location of the city of Juiz de Fora.

Concerning the subsectors of tourists, transport is the most representative (29.7%). The tourist agencies are very significant (27.9%) among the tourist business, which means that the destination is also a generator of tourist flows

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to other locations. The services provided to tourists themselves are distributed among restaurants and other food services (16.3%), events (9.2%), tour guide services (8.6%), lodging (4.7%) and services especially related to entertainment (3.6%).

Table 3. Tourism subsectors that make up the production chain

Tourist components	Frequency	Percentage
Events (cultural equipment)	31	9.2
Accommodation	16	4.7
Other services (entertainment-related)	12	3.6
Restaurants (food services)	55	16.3
Tourism agency	94	27.9
Tour guide services*	29	8.6
Transportation services	100	29.7
Total	337	100.0

Note: * Tour guide services were presented disaggregated from the services of the tour agency.
Source: Cadastur (2021).

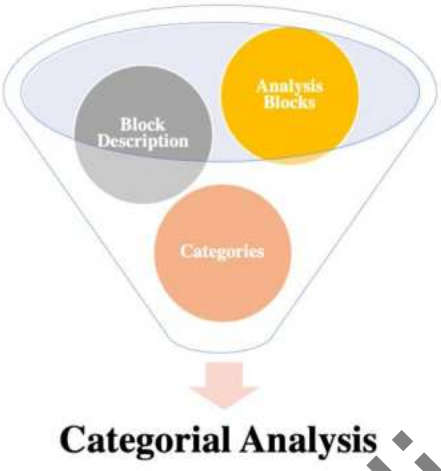
Data collection occurred between October 2020 and July 2021 and counted a random, non-representative and convenience-selected sample consisting of 66 companies in the on-screen tourism sector, that was submitted to a semi-structured electronic questionnaire (research instrument), consisting of 65 open and closed questions, divided into 6 blocks, namely: (i) General profile of the company; (ii) Management operations; (iii) Inter-organizational relationship; and (iv) Internal Management Process (Table 3).

Data Analysis: its Logic and Structure

According to the list of data presented in the methodology, the analysis of this study was structured according to the 4 steps described in the following and represented in Figure 3, below.

In this sense, the first step was the presentation of the blocks related to the organization and structuring of the article, that refer to the analysis of the empirical study. These blocks were dimensioned into 6 types of institutional Profiles: –1 - Sociodemographic Profile of the Interviewee; –2 - Organizational Demographic Profile; –3 - Employee Profile; –4 - Economic Profile; –5 - Production and Logistics Management Profile; 6 – Interorganizational Relations.

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Source: Own elaboration from the research data.

Figure 3. Data analysis structure.

The second step was the presentation of the description of the Blocks, based on the answers obtained by the representatives of the organizations mapped to this study. Therefore, the dimensions and constituent variables of each Analysis Block are displayed. Regarding the dimensions, we relate–1 - Sociodemographic Profile of respondents (Data of Representatives);–2 - Organizational Demographic Profile (Institutional Data);–3 - Employee Profile (Human Resources);–4 - Economic (Financial) Profile;–5 - Production management and logistics profile (Management);–6 - Interorganizational Relations (Strategic). In this sense, the variables are the details of each dimension, both presented in graphs and/or tables.

In the third step, we approached the constitution of categories (and subcategories), followed by their specific questions to the context of the study, relating them to the OET, focusing on the 3 main indicators: *selection, adaptation and survival.*

In the end is performed the Categorial Analysis, presenting the primary data of the research through graphs and statistical percentages, that were based on the sample collected and on the discussions about the context of the pandemic and its impacts on the tourism sector in Juiz de for in the period analyzed. In Table 4, the Analysis Blocks that originated the categories (and subcategories) of this study are presented.

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Table 4. Blocks of analysis and scope of study dimensions/variables

Blocks	Description	Dimensions	Variables
Block 1	Sociodemographic Profile	Representative data	Age
			Gender
			Education
			Professional Occupation
Block 2	Organizational Demographic Profile	Institutional Data	Market Time
			Operation Branch
			Specific Subarea
			Space Type
			Size (qt. It worked)
			Coverage (Local x National)
Block 3	Employee Profile	Human resources	Employment Situation
			Average Remuneration
			Training
			Place of Residence
Block 4	Economic Profile	Financial	Billing
			Market Share
			Sales Volume
			Products Sold
Block 5	Production and Logistics Management Profile	Management	Operations Control
			Planning
			Stock Replacement
			Disclosure
Block 6	Interorganizational Relationships	Strategic	Innovations
			Partnerships
			Shares

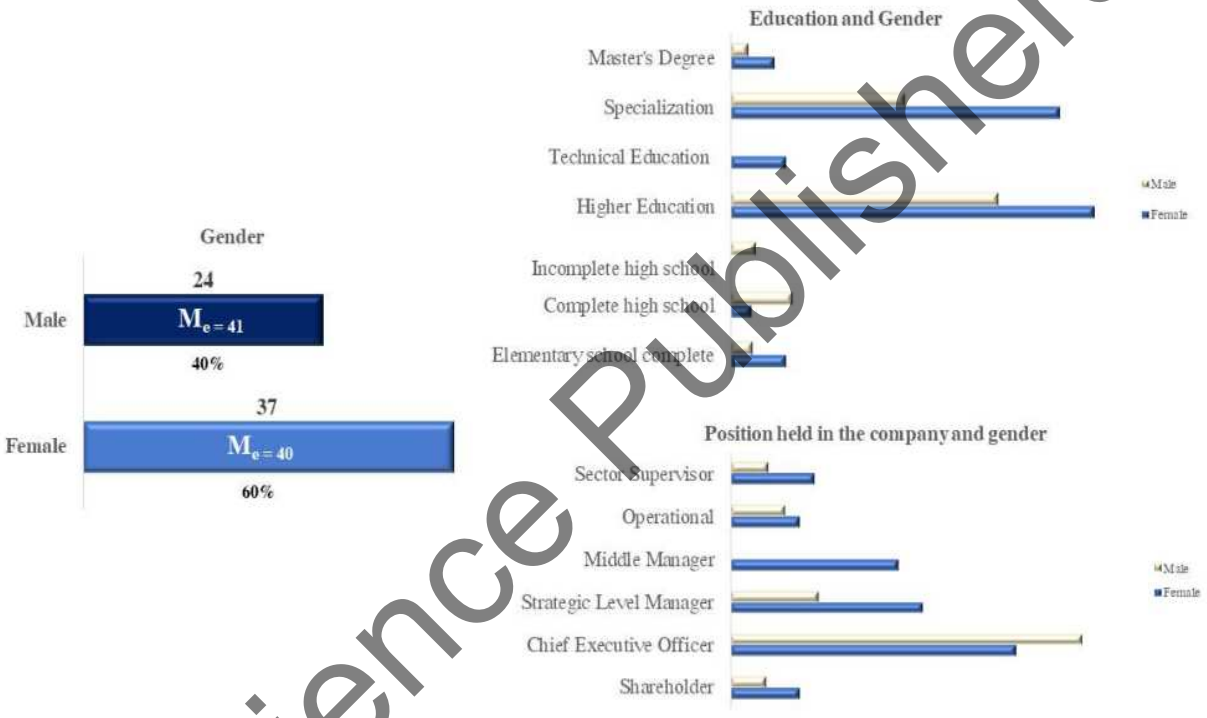
Source: Own elaboration from the research data.

Analysis and Discussion

Data Presentation

Because the research sample is consisted of a mapping of 16 companies directly and indirectly linked to the tourism activity in Juiz de Fora, it is necessary to demonstrate, as an illustration, the composition of the interviewees, namely Representatives [Block–1 - Sociodemographic Profile], as well as their organizations of origin [Block–2 - Institutional Data]. It is important, therefore, to recognize these profiles and their nuances, and correlate them with the then pandemic scenario so that we could demonstrate their impacts on the aspects stated in the following Blocks. In this way, we start with Block–1 - Sociodemographic Profile, presented in the following Figure 4.

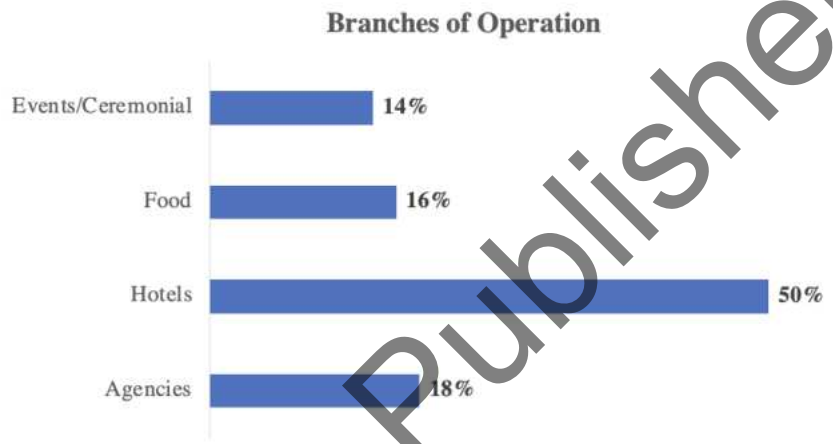
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Source: Own elaboration based on the empirical data of research.

Figure 4. Representatives' Sociodemographic Profile.

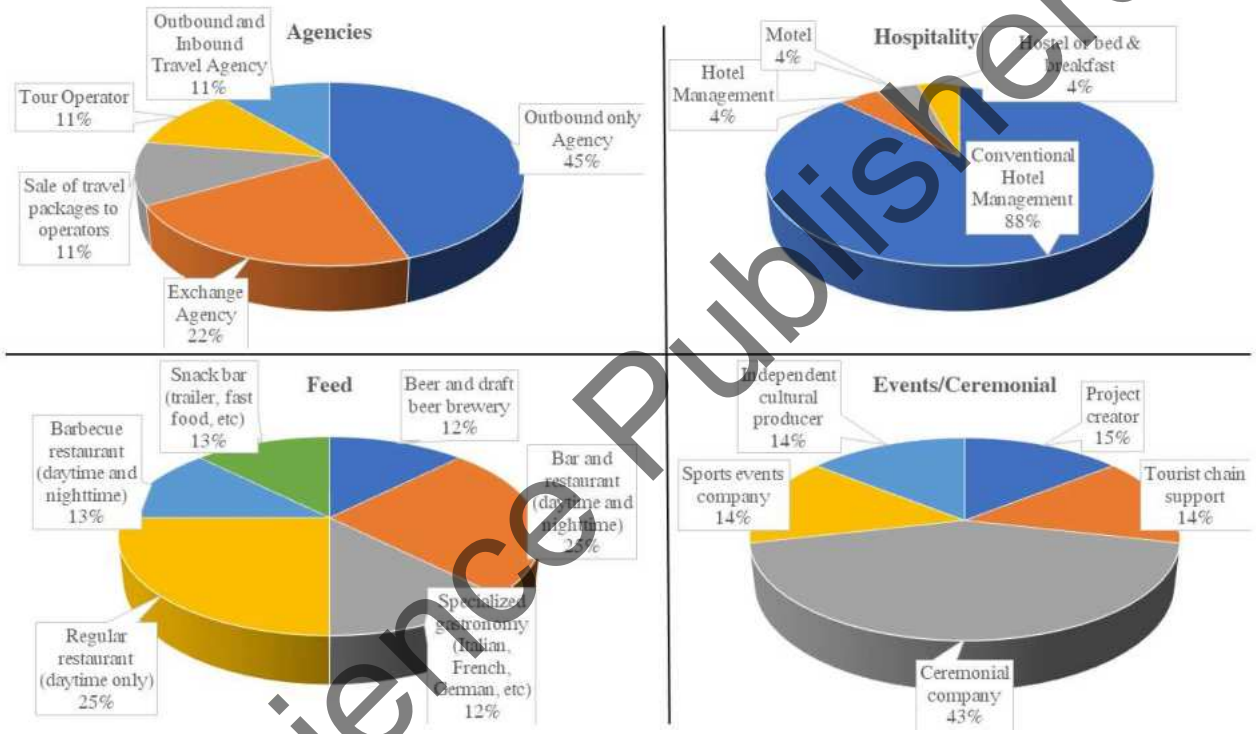
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Source: Own elaboration based on the empirical data of research.

Figure 5. Branches of operation of the companies.

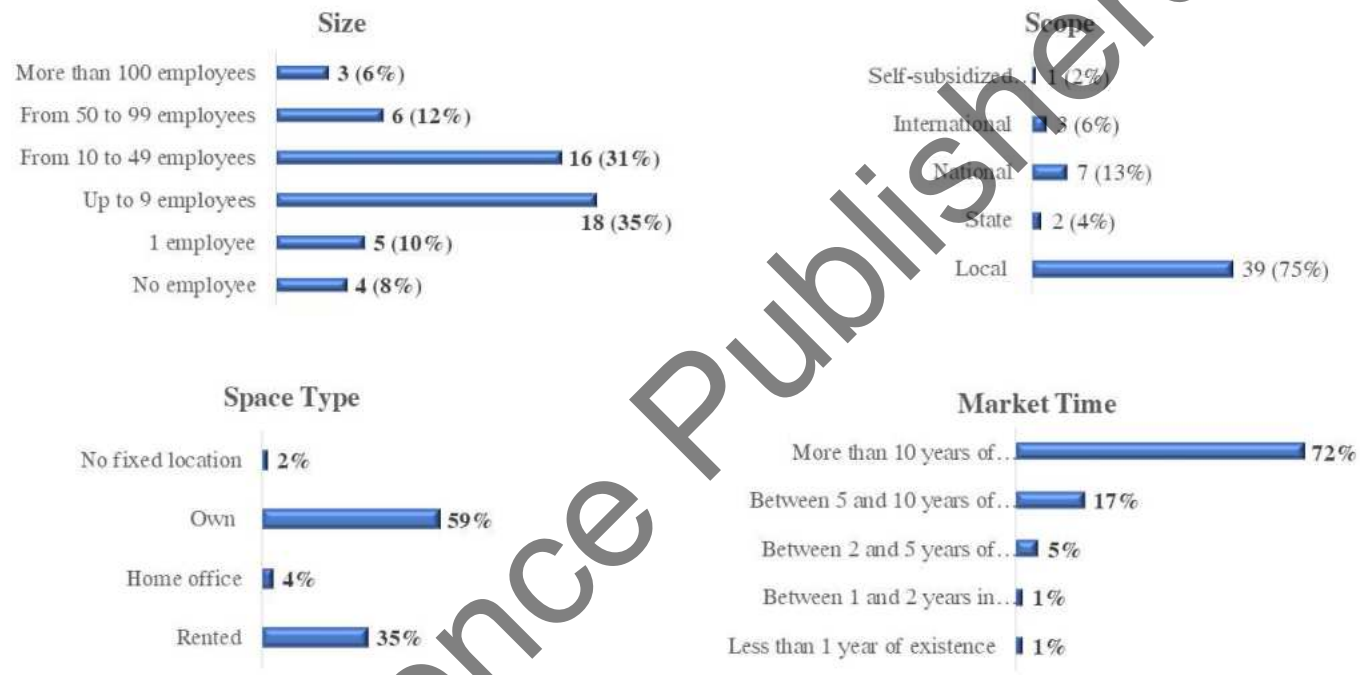
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Source: Own elaboration based on the empirical data of research.

Figure 6. Subareas of companies' operations.

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Source: Own elaboration based on the empirical data of research.

Figure 7. Size and scope of the analyzed companies.

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It was observed of the total of 61 respondents, 37 of them are female, which corresponds to 60% of the sample, and their main age is around 40 years. The sample of male respondents consists of 24, totalizing 40%, and their main age is around 41 years. Regarding the list of positions held in the companies, 43% of them hold a university degree of formation and 34% have a master in business administration (MBA). Furthermore, it is perceived that the degree of specialization of women is higher than that of men, reflecting, mostly, the occupation of executive (CEO), strategic and managerial positions in the companies analyzed. In general, 49% of them hold executive positions, 39% hold managerial and strategic positions– while 11% are occupying operational positions.

Next, we present Block–2 - Organizational Demographic Profile. First, we highlight, in Figure 5, the variable Operation Branch.

According to the sample obtained, of the total of the companies mapped, 50% belong to the hospitality industry. The others show the following rates: 18% consisting of travel agencies, 16% of food companies and 14% of companies that operate with Events/Ceremonial. Graph 2 situates the subareas of these companies' activities (Figure 6).

As observed, the Agencies subarea has a higher concentration in the Exchange Agencies (22%), while the majority corresponds to half of this, especially for Emissive and Receptive Tourism Agencies, with 11%. In the Hotel industry, we identified that the performance in Conventional Hospitality (regular accommodation firms) constitutes the majority of the lodging sector in Juiz de Fora, totaling 88% of the mapped companies. Also, in the context of Food, daytime restaurants and day and night bars and restaurants correspond to 50% of the total sample, 25% for each one. Finally, about Events/Ceremonials, we identified that ceremonial companies are the ones with the highest predominance in the city, totalizing 43% of the companies focused on this type of operation.

Next, we present the other variables of analysis: Size and Scope, followed by the Type of Space and Time on the Market (Figure 7).

Note from this figure that the number of companies classified as Small Enterprises (From 10 to 49 employees) corresponds to 31%, and Microenterprises (Up to 9 employees) 35% of the sample. As for coverage, the companies mostly operating at the local level (75%), followed, with 13% at the national level. Although not very expressive, 6% of the companies analyzed operates at the international level.

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In this sense, it is important to highlight that, according to the sample data of the companies considered as Microenterprises, 82% of them have operations at the local level, followed by 18% at the national level. On the other hand, for companies considered as 'Small' the result maintains the same perspective, 63% performing at the Local level, 25% at the National level and 12% at the international level. Most of the companies analyzed operate in their own spaces (59%) and 35% of them in rented spaces.

Finally, in reference to the Market Time of tourism companies in Juiz de Fora, most of them are already solidified in the local territory. Thus, 72% of the sample have more than 10 years of existence, followed by 17% with performance between 5 and 10 years. Later, we will make considerations about the research concerning the aspect of market time with the closing moment of the tourist trade in the city, resulting (or not) from the pandemic, in contrast to the correlation with the OET, especially about the Survival indicator.

After presenting some of the institutional aspects, it is important to understand the organizational dynamics of the tourism activity in Juiz de Fora considering now, the relations of the Blocks of Analysis and Scope of the Dimensions/Variables of the Study selected with the listed the categories of analysis (Table 5), focusing on the context of the COVID-19 pandemic, and during the time's horizon of this research.

Table 5. Analysis of categories

Categories	**Description**	**Discussion**
Category 1	Trade Closing	Was there a company closure? - Cause for closure?
Category 2	Impacts on the Tourism Sector and Subsector	What is the impact of the Pandemic on Companies? - Impacts on Workers - Impacts on the Wage Bill - Economic Impacts on Sales Volume
Category 3	Type of Customers	-Legal entity -Natural person - Customer Card
Category 4	Suppliers	- Supplier Card - Purchased Products -Relationship

Source: Own elaboration based on the empirical data of research.

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Analysis of Categories and according to the Impact of the Pandemic

Category 1: Trade Closing

On the first category of analysis, on the closing of the trade during the pandemic period, the respondents were intended to answer the following questions: "Was there a closing of the Companies? And if there was, what was the reason for the closure? In congruence with the literature (Boto-García & Mayor, 2022; Grimmer, 2022; Mediotte et al., 2021; Ntounis et al., 2022; Robin et al., 2022, among others), several respondents reported that the interruption of tourism was due to the pandemic of COVID-19. Nevertheless, it was asked whether this action was applied in Juiz de Fora, due to such an epidemiological crisis. Using the data collection instrument, of the 66 representatives of the companies analyzed, 85% stated that the companies continued to function. On the other hand, only 15% attest that companies closed during the above-mentioned period. Of these percentages, we highlight that of the companies that maintained their operation, 63% have more than 10 years of experience in the market of Juiz de Fora, 44% of them operating at the local level. On the other hand, of the companies that closed, 100% claim to have been due to the pandemic, which endorses the arguments proposed by the literature.

Category 2: Impacts on the Tourism Sector and Subsector

On the impacts of the pandemic on the Tourism Sector and its Subsectors, we identified that the pandemic did not bring severe impacts for companies, specifically addressing the period of analysis of this research, because we realized that most of these organizations have many years of existence e were established at the local level, which guarantees some reliability and legitimacy in times of crises, reinforcing the OET concerns about the adaptation indicator. Corroborating to this perspective, we emphasize that companies with longer time of existence, as a rule, have fewer problems, in crises, as happened in the pandemic, because they have already been through other tough moments, and already experienced other situations of crises. Moreover, companies with greater financial and asset of resources also seemed to be, in this case, faced the crises with fewer problems.

The impact on workers' life was, first of all, on regime of work itself. Those who do not have official employment ties were the most affected, as liberal, autonomous professionals, individual microentrepreneurs, among others. However, in the empirical case of this work, we verified that of the companies that remained functioning, 68% of the staff belongs to the Labor

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Law Consolidation System (CLT), which guarantees, minimally to employees, certain security in situations such as that reported in this study. Another aspect to be highlighted is the place of residence of the employees, an aspect that can be positive in times of crisis. According to the sample of this research, 96% of the workers of the companies analyzed are residents of the city of Juiz de for a and neighboring cities, which facilitates the journey to work, including, to a lesser extent, the burden of companies.

On the salary, we found that 71% of employees receive between 1 and 2 minimum wages, and the closing of the companies could cause negative impacts on the family life of these professionals. Furthermore, for the volume of sales, companies would suffer irreparable damage in case of the total closing of the trade. We identified that most of them would no longer profit from 80% to 100% on the sale of their products and/or services, regardless of seasonality, because the dynamics of the trade occur throughout the year.

Category 3: Type of Customers

Based on the instrument of data collection adopted in this research, we identified that, among the main clients of the companies, individuals and legal entities are concentrated, corresponding to 72% of the customer's portfolio. Within this parameter, 32% companies serve, monthly, in the range of 0 to 200 customers; 18% in the range of 201 to 500 customers; 32% in the range of 501 to 1000 customers; 10% in the range of 1001 to 2000 customers, and 2% in the range above 2000 customers. The evidence suggests the closing of the companies in the period analyzed could correspond to losses about 60% of the services related to non-fixed customers and 40% for companies that have a fixed customer base. Exclusively for legal entities, the data indicate that 27% of the total companies serve this client card. In case of a total suspension of their activities, those organizations would lose 21% of the services directed to non-fixed customers and 79% to companies that have a fixed portfolio of customers.

Category 4: Suppliers

The list of suppliers of the companies of the tourist trade of Juiz de Fora consists of 29% of Small/Medium enterprises located in the city or surroundings, and 22% of the individual service providers. This amount totals 51% of the suppliers for the companies analyzed. It is noteworthy that of the total number of suppliers in the city, most of them are small producers or smaller companies dealing with individual service providers in the city or surroundings. In this sense, if companies stopped functioning, these suppliers

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would lose up to 50% of the supplies marketed to the contracting companies. Of these, 50% of the main products supplied consists of cleaning and food materials. It is worth mentioning the arguments used by the respondents when they were asked about the advantages of maintaining relationships with suppliers. 43% of them claim that the Quality factor is the most important to keep business with these suppliers, 29% say that the Price factor is the most important, and 28% the Loyalty factor.

In short, we can understand that the pandemic impacted the organizational environment in different ways. In this sense, different levels of selection were seen, since a part of them stopped acting (15%), and a greater part survived (85%). And considering the latter, the OET advocates the analysis of the level of adaptation. Therefore, we demonstrated through the Blocks of Analysis and Scope of the Dimensions/Variables of the Study, what these surviving companies did to maintain themselves during the scenario of Pandemic, especially referring to the temporal horizon of this research. Moreover, this context contributed to identify the operational profile of these companies, which makes it possible to understand empirically some aspects of the organizational reality of the tourist trade of the city of Juiz de for a during this period.

Conclusion, Contributions and Recommendations

This study analyzed the impacts of COVID-19 on the tourism sector in Juiz de Fora (Brazil) influenced by ideas that fundaments the perspective of Organizational Ecology Theory (OET), in particular, evidencing how the pandemic affected the population of companies in the city's tourism sector based on three fundamental categories: (a) through selection, given by the mortality of firms due to the demands and restrictions imposed on the firms' environment by this disruptive event; (b) through adaptation, verified by the measures, practices and strategies adopted by firms due to the pandemic and in that context; and (c) through retention, that is, the maintenance of some of those measures, practices and strategies, making them permanent even after the pandemic's 'strength' diminished.

The main argument developed here is that the pandemic imposed a new condition on all existing businesses in the tourism sector and, in doing so, impacted them inexorably, severing the possibilities for individual exit or exemption. As observed by the results of the study, from the sample surveyed, we verified the mortality of 15% of the companies. This is high considering

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the short period and especially if we consider the fact that this number may be under-reported as it was not possible to survey all the existing companies and the limitations of the number of responses (39%).

Additionally, regarding the companies that continued operating in the market, it was possible to observe that almost all of them mention having been affected by the pandemic in terms of their management, labor and performance practices. The main measures adopted, also due to legal restrictions, were the reduction of the period of operation and modification in the working hours and work routine of employees; modification of management practices regarding human resources, in particular concerning the reduction of working hours, layoffs and management of the work of online teams; while the strategies adopted, some reactively (such as, for example, having to change their business environments to the virtual mode, even those companies that do not operate in these environments and were forced to do so) or proactively (such as, for example, the creation of new products and the search for new customer niches), were essentially concerned with the gradual and marginal (only the minimum necessary) incrementation, for most companies, of actions that would allow them to keep their businesses running. Some of these actions, especially the simplest and without additional costs (such as the use of 'free' social media, e.g., Facebook, Twitter, etc.) were maintained even with the decline of the pandemic.

In short, there was a selection of companies by the environment through the elimination of the supposedly 'less competitive' companies, the maintenance of those survivors that were able to withstand the extreme and severe shortage of resources for a long time, and then imposing a diverse set of strategies and actions to 'adapt' to the 'new conditions. The results show that 15% of the firms were closed [selection variable] due to the pandemic; all the remaining firms needed to adapt themselves in terms of legal compliance (restrictive laws), managerial practices (human resources and labor routines) and strategies (new technologies and new markets) [adaptation variable] and all of them have kept their business in online mode, even in the current period of pandemic decline [retention variable]. We conclude that an unpredictable and universal disruptive pandemic event determined all companies to reinforce their attention to the environment to a greater or lesser degree, especially in a globalized and unified world.

This study has intrinsic limitations related to the method used, predominantly qualitative, which does not allow the results obtained here to be extrapolated to all the companies in the sector or even to other locations and scales (state or national). The results presented here are valid only for the

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companies in the study sample. Additionally, it is worth mentioning that only a portion of the companies contacted responded and participated in the survey, which implies that many other non-participating companies may have been equally (or even more drastically) affected by the pandemic, and the mortality rate identified here might be underestimated. Finally, it is worth mentioning that specific characteristics of the studied context may influence the sample and the data obtained, since the predominant profile of the companies in the sector is consisted of micro and small companies, with a low level of professionalization and adoption of sophisticated planning and management techniques (Pimentel et al. 2016). It certainly influences the degree and type of selection, adaptation and retention forms mobilized.

Finally, future studies may explore elements that were beyond the scope of this work, such as, for example, delving deeper into the study of other variables within the theoretical framework of the OET, such as the shape, density, and diversity of all organizations in the sector (which would imply a survey); or studies based on related theories of environmental influence (such as Contingency Theory or Institutional Theory) or a combination of theories, for example, between Organizational Ecology and Contingency Theory. Studies along these lines of research are still scarce and potentially promising especially when related to disruptive environmental events of such magnitude as the COVID-19 pandemic.

References

Aijie, Y. (2011). Niche competitive strategy of hi-tech industrial cluster enterprises based on organization ecological system. In: *Proceedings… of International Conference on E-Business and E-Government (ICEE)*. Available at: https://www.infona.pl/resource/bwmeta1.element.ieee-art-000005881547 accessed em 20/07/22.

Aldrich, H. E., Pfeffer, J. (1976). Environments of Organizations. *Annual Review of Sociology,* v.2, p.79-105.

Baum, H. S. (2012). *The organization of hope: Communities planning themselves.* SUNY Press.

Baum, T., & Hai, N. T. T. (2020). Hospitality, tourism, human rights and the impact of COVID-19. *International Journal of Contemporary Hospitality Management, 32*(7), p. 2397-2407. https://doi.org/10.1108/IJCHM-03-2020-0242

Boto-García, D., & Mayor M. (2022). Domestic tourism and the resilience of hotel demand. *Annals of Tourism Research, 93,* 103352. https://doi.org/10.1016/j.annals.2022.103352

Nova Science Publishers, Inc.

Carroll, G. R. Organizational ecology. (1984). *Annual review of Sociology,* v. 10, n. 1, p. 71-93. Available at: https://www.annualreviews.org/doi/abs/10.1146/annurev.so.10.080184.000443, accessed em 12/03/22.

Carroll, G. R., Dobrev, S. D., Swaminathan, A. (2002). Organizational processes of resource partitioning. *Research in organizational behavior,* v. 24, p. 1-40. Available at: https://www.sciencedirect.com/science/article/abs/pii/ S0191308502240022, accessed em 20/07/22.

Chengalur-Smith, S., Sidorova, A. (2003). *Survival of open-source projects: A population ecology perspective.* Available at: https://aisel.aisnet.org/icis2003/66/, accessed em 22/03/22.

Flaxman, S., Mishra, S., Gandy, A., Juliette, H., Unwin, H., Couplan, H. & Bhatt, S. (2020). *Report 13: Estimating the number of infections and the impact of non-pharmaceutical interventions on COVID-19 in 11 European countries*. Imperial College COVID-19 Response Team, p. 1-35. https://doi.org/10.25561/77731. Acesso: 12 fev. 2021.

Freesz, S. & Pimentel, T. D. Ecologia Organizacional: Explorando a Teoria. In: *Proceedings… Encontro Da Associação Nacional De Pós-Graduação E Pesquisa Em Administração*, 46., 2022, on-line. Anais eletrônicos [...]. Maringá: Associação Nacional de Pós-Graduação e Pesquisa em Administração, 2022. Disponível em: http://www.anpad.org.br. Acesso em: 28 out. 2022.

Geroski, P. A. (2001). Exploring the niche overlaps between organizational ecology and industrial economics. *Industrial and corporate change,* v. 10, n. 2, p. 507-540. Available at: https://academic.oup.com/icc/article-abstract/10/2/507/678623, acessed em 08/01/22

Gössling, S., Scott, D., & Hall, C. M. (2020). Pandemics, tourism and global change: a rapid assessment of COVID-19. *Journal of Sustainable Tourism, London, 29*(1), p.1-20. https://doi.org/10.1080/09669582.2020.1758708

Grimmer, L. (2022). Lessons from the COVID19 pandemic: The case of retail and consumer service firms. *Journal of Retailing and Consumer Services*, *68*, 103012. https://doi.org/10.1016/j.jretconser.2022.103012

Hannan, M. T., Freeman, J. (1977). The population ecology of organizations. *American journal of sociology,* v. 82, n. 5, p. 929-964. Available at:< https://www.jstor.org/stable/2777807>, acessed em 14/10/21.

Hannan, M. T., Freeman, J. (1984). Structural inertia and organizational change. *American Sociological Review,* 49, 1984, p. 149-164. Available at:< https://www.jstor.org/stable/2095567?&seq=1>, acesso14/10/21.

Hannan, M. T., Freeman, J. (1989). *Organizational ecology.* Harvard university press.

Hannan, M. T., Freeman, J. (2005). Ecologia populacional das organizações. *RAE-Revista de Administração de Empresas,* v. 45, n. 3, p. 70-91. Available at: https://bibliotecadigital.fgv.br/ojs/index.php/rae/article/download/37253/36019, acesso em 01/10/22

Hannan, M. T. (2022). *Rethinking Organizational Ecology in Light of Developments in Cognitive Science and Natural-Language Processing*. Stanford University.

Holzmann, P. F. (2009). *Evolução das franqueadoras de serviços no Brasil: um estudo das variáveis que influenciam a taxa de sobrevivência das empresas sob a ótica da Ecologia Organizacional* [*Evolution of service franchisors in Brazil: a study of the*

Nova Science Publishers, Inc.

variables that influence the survival rate of companies from the perspective of Organizational Ecology]. 2009. Dissertação (Mestrado em Administração) – Universidade Presbiteriana Mackenzie, São Paulo. Available at:< http://tede. mackenzie.br/jspui/handle/tede/731>, acesso em 08/01/22.

Hutchinson, G. E. (1978). *An introduction to population ecology.* Yale University Press, New Haven, Connecticut, 1978, USA.

Koller, M. R. T. (2016). Exploring adaptability in organizations: Where adaptive advantage comes from and what it is based upon. *Journal of Organizational Change Management.* Available at: https://www.emerald.com/insight/content/doi/10.1108/JOCM-01-2016-0008/full/html?casa_token=bHyC1fmNIVoAAAAA:BzktzNc0UABZKTUWkC2_4wgSViqQoL8pYMMtN0uFSGzpIreDyI9_ZUocmo01ubHrMg1DAgDmqaLvT8AchntjewXk_H4NrKH_Z8EoqjpIauWbszZz2t0j, accessed em 20/07/22.

Krippendorf, J. (1999). *The Holiday Makers: Understanding the Impact of Leisure and Travel.* London & New York, Routledge, Taylor & Francis.

Lake, D. A (2021). The organizational ecology of global governance. *European Journal of International Relations,* 27(2), p. 345-368.

Liu, M., van Witteloostuijn, A. (2020). Emergence of entrepreneurial populations: a feature dimensionality approach. *Small Business Economics,* 54(4), 971–989, https://doi.org/10.1007/s11187-018-0126-1

Mediotte, E. J., Emmendoerfer, M. L., Santos, Y. T., & Fraga, B. O. Planejamento público e gerenciamento de crises no contexto da pandemia da COVID-19 em destinos turísticos no Brasil: Ações sustentáveis ou reações econômicas? *Dos Algarves: Tourism, Hospitality & Management Journal (DATHMJ), 40*. Special Issue, 1-30, 2021. doi:10.18089/damej.2021.40.1

Morgan, G. (2002). *Imagens da organização: edição executive* [*Organization Pictures: Executive Edition*]. 2ª. ed. São Paulo: Atlas.

Niestadt, M. (2020). *COVID-19 and the tourism sector. European Parliamentary Research Service (EPRS)*. 1-2. Disponível em: https://www.europarl.europa.eu/RegData/etudes/ATAG/2020/649368/EPRS_ATA(2020)649368_EN.pdf. Acesso: 12 mar. 2021.

Ntounis, N., Parker, C., Skinner, H., Steadman, C., & Warnaby, G. (2022). Tourism and Hospitality industry resilience during the COVID-19 pandemic: Evidence from England. *Current Issues in Tourism*, *25*(1), 46-59. https://doi.org/10.1080/13683500.2021.1883556

Oliveira, R. T. D., Heber, F. (2020). Condicionantes ambientais da avaliação da Pós-Graduação em Administração 2013-2016 [Environmental constraints for the evaluation of the 2013-2016 Graduate Program in Business Administration]. *Revista Pensamento Contemporâneo em Administração,* v. 14, n. 3, p. 98-119. Available at: https://www.redalyc.org/journal/4417/441764512018/movil/, acesso em 07/02/22.

Peli, G., Bruggeman, J., Masuch, M., and O'Nuallain, B. (1994). A Logical Approach to Formalizing Organizational Ecology, *American Sociological Review* (59), pp. 571-593. Available at: https://www.jstor.org/stable/2095932, accessed em 22/08/22.

Nova Science Publishers, Inc.

Petry, J. F., Silva, M. Z., Machado, D. P. N. (2016). Sinal dos tempos: o ambiente da organização que transcende [Sign of the times: the organizational environment that transcends]. *Revista Alcance,* 23(2), p.214-235

Robin, M., Rasel, S., Prayag, G., & Chowdhury, M. (2022). Did Closing Borders to Tourists Save Lives? Tourist Arrival, Self-protective Leadership, and COVID-19 Casualties. *Tourism Review International*, *26*(2), 215-221. https://doi.org/10.3727/154427221X16317419620237

Rocha, C. F. (2015). *Mortalidade empresarial: um estudo sobre a relação entre idade, tamanho e ambiente na indústria de alimentos da Bahia* [*Corporate mortality: a study on the relationship between age, size and environment in the food industry in Bahia*]. Dissertação (Mestrado em Administração) – UNIFACS Universidade Salvador. Available at:< http://teste.tede.unifacs.br:8080/tede/handle/tede/553>. acesso em 10/01/22.

Wholey, D. R., Brittain, J. W. (1986). Organizational ecology: Findings and implications. *Academy of Management Review*, v. 11, n. 3, p. 513-533, 1986. Available at: https://journals.aom.org/doi/abs/10.5465/amr.1986.57140723, acesso em 11/03/22.

World Tourism Organization (UNWTO). (2020). *Tourism is back to 1990 levels as arrivals fall by more than 70%.* Madrid: UNWTO. Disponível em https://www.unwto.org/news/tourism-back-to-1990-levels-as-arrivals-fall-by-more-than-70. Acesso: 15 fev. 2021.

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Chapter 7

The Crisis in Tourism Research: A Critical Insight on Bibliometric Studies

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Abstract

The culture of metrics as well as the obligations of some researchers to publish in top-tiered journals is gradually devastating the professional applied research. Of course, there are some disciplines such as geography or anthropology which are insensitive to the bibliometric culture, but others like tourism or management are highly determined by these types of pressures. The culture of publishing or perishing is wreaking havoc in the fields of tourism and hospitality. The present piece interrogates furtherly on the problems, advantages and limitations of bibliometric studies in the constellations of tourism research. At the same time, we lay the foundations for understanding the future of the discipline in the years to come.

Keywords: tourism research, indiscipline of tourism, epistemology, culture of metrics, critical insight, tourism research crisis

Introduction

Doubtless, bibliometric studies have gained great recognition and traction over recent years. In the horizons of tourism and hospitality, these studies have been

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multiplicated since the turn of the twentieth century (Barrios et al. 2008; Zhao & Ritchie 2007). As an emerging literary genre, the bibliometric analysis provides specialists and policymakers with an updated review not only on the problems that the industry comes across but also on the different academic waves and their respective objects of study. The growth of tourism research has invariably led to a climate of great dispersion where scholars remain unfamiliar with what is being published in other circles (Agapito 2020). Hazard Adams (1988) coins the term *academic tribe* to denote a shared behavior and common academic practices followed by in-group members. These academic practices are mainly based on a specific authority emanated by a group of scholars as well as educational institutions. Of course, needless to say, these groups move not only in specific territories but they keep their concrete frontiers.

In the constellations of tourism, the term is adopted by John Tribe (2010) who refers to the academic tribes as a circle of scholars working in a climate of indiscipline and academic dispersion. Such knowledge fragmentation, which Tribes conceives as a state of indiscipline, depends on the interest gradually captivated other disciplines for the study of tourism. As an object of study, tourism has certainly sparked different academic circles forming disciplines such as sociology, economy, geography, laws, and psychology [only to name a few]. In this vein, Evren & Kozak (2014) understand that the maturation of tourism research coincides exactly with the burgeoning growth of the tourism industry. To wit, Beckendorff & Zehrer (2013) acknowledge that the academic tribes need bibliometric studies to have a snapshot of what is investigated. The agenda of researchers not only is subject to internal and external factors but also is sometimes diffuse or more abstract. Academicians have often the liberty to move in different directions while ignoring the advice of Academia. For that reason, it is vital to develop efficient and accurate engines to understand the evolution of tourism research in the threshold of time. Per these authors, there is a network of scholars who have shed light on the discipline while paving the pre-conditions for the rise of different tribes, that operate in specific territories. The correct identification of the most important authors, as well as the global trends, is very helpful for the consolidation of tourism epistemology but [as authors alert] this should transcend the hegemony of the current bibliometric techniques. The knowledge production [far from being immutable] seems to be subject to countless global forces and trends, bibliometric studies should at the best describe with accuracy. In this vein, relational techniques allow a better fluid

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understanding of the intersection of impact factors with the emergence of new research techniques and methods.

Bibliometric Studies in Tourism

Today's bibliometric studies focus on the position of authors regarding two important variables: the number of publications that are placed in leading journals and the citation factor. Having said this, the number of citations is often measured through two indexes: the Hirsch index and the I-10 index (Law et al. 2009; Gursoy & Sandstrom, 2016). The H-index signals the maximum value of h given to an author who has published papers that have been cited at least h times. To put this simply, the H-index is centered on an interplay between the number of publications and citations. An author who had published extensively but has received few citations decreases in the H-index, while an author who is widely cited but not much prolific has further possibilities to rank higher. Plausibly, H-index not only explains the correlation between publications and citations but also recreates a hierarchal pyramid of scholars globally (Sheldon, 1991; McKercher 2007). I-10 index, in this discussion, has given further clearer insights on author impact than H-index. I-10 index allows measuring the number of publications with at least 10 citations. Although I-10 index is very simple to calculate and exact regarding the author performance it is not being used by the culture of metrics or the bibliometric studies. This means two important things. On one hand, bibliometric studies are useful but they are limited to standardized forms of measurements. It is important to mention that the utility of bibliometric studies is far from question. It is more than a matter of wording; bibliometric studies help understand how the scholars' networks ultimately operate as well as the trending topics of the discipline. On another, the future of the tourism industry depends on the emergence of new discussions, solutions, and implementations to face global challenges in the years to come (Evren & Kozak 2014). Jafar Jafari's term scientification of tourism speaks to us of a state of maturation of applied research which is mainly marked not only by the number but also by the credibility of the publication. A mix-balanced insight, escaping any partisan commentary, should characterize the scientific tourism research, as Jafari ultimately adheres (Jafari 2005). Jafari's legacy illuminated the paths of a great gamut of scholars who strongly believed that the impact of tourism research in other disciplines is a clear sign of maturation and evolution (Xiao & Smith, 2006; Wardle & Buckley, 2014; Butler 2015). Therefore, the culture

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of metrics has strongly gravitated toward the configuration of tourism epistemology from its inception (Beckendorff & Zehrer 2013; Law et al. 2009). This does not prevent some voices develop a critical approach. Some critical works lamented that the bibliometric studies may very well open the doors towards a new obsession for publishing [known as the culture of publishing-or-perishing] (Korstanje 2021; 2023).

Although the bibliometric literature review abounds [most of them located in the national and international contexts or different subsectors of the industry] (Palmer, Sese & Montano, 2005; Leong et al. 2020; Beckendorff 2009; Jiang, Ritchie & Beckendorff 2019; Ye, Li & Law 2013; McKercher 2007), no less true seems to be that few approaches center efforts to discuss its advantages and disadvantages of such technique (Korstanje 2022). At a closer look, one of the pioneering scholars who exerted a radical critique on these studies was Michael C. Hall. Per his viewpoint, the bibliometric assessment over-valorizes the number of publications [even the citation factor] overlooking other hybridized methods. Under normal conditions, private organizations take the lead monopolizing the evaluation protocols over professional fieldworkers and professors. As a result of this, the obsession with productivity and journal impact put the quality factor into a marginal position. What is equally important, bibliometric studies are based on quantitative methods that measure the impact of the paper but not its quality. There is a moment in the discipline where a manuscript published in a highly-ranked journal has more recognition than its real contribution to the specialized literature (Hall 2011). Are contribution and recognition two sides of the same coin?

Answering this vexed question seems to be a complex task to perform. While recognition signals the authors' legacy which is drawn by the stable prestige, the contribution is a specific updating that helps to expand the existing understanding of a certain issue. Whatever the case may be, we give some hints in the next lines. Let us start with the role played by the language in tourism knowledge production. The language [in this case English] occupies a central position in the configuration of current tourism epistemology. Some studies have emphasized the importance of English as an international language. As lingua franca, English not only has been enthralled because its hegemony in business and management issues but also to standardize the applied protocols in tourism research (Oktadiana & Pearce, 2017). Per Douglas Pearce (2014), the internationalization of English has direct and positive consequences on discipline maturation. The adoption of English in non-native communities is explained not only by the expansion of

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the tourism industry but also by the necessity to convene common practices revolving around tourism research. This poses an interesting dilemma on the tension between internationalization [which leads towards a homogenized sub-culture] and diversity. Contrariwise, Graham Dann (2011) argues convincingly that the Anglophone world has monopolized not only knowledge production but also the review process in the leading journals. For Dann, the use of English as a lingua franca excludes a whole portion of scholars who are not native speakers. In this respect, reviewers serve as real gatekeepers taking the lead in what can be or is not published. One of the troubling aspects of the lingua franca, as Dann observes, remains in the impossibility to reverse mechanical thinking [most of them originated in the Global North]. Knowledge production is centered on a set of pre-assumed stereotypes, beliefs, and hypotheses which cannot be validated beyond the Anglophone world. This creates a state of dissociation between policy and theory. Many scholars [living in the global South] are certainly forced to adopt external theoretical frameworks for their research. Dann toys with the belief that this happens simply because researchers are pressed to publish works in a foreign language. John Tribe goes beyond the power of language emphasizing what he dubbed *the indiscipline of tourism.* As he puts it, the growth of tourism publications in English had unfortunately no direct impact on the consolidation of the discipline. There is a great dispersion in the published material as well as a certain indifference by the side of the Academia to re-organize the academic production (Tribe 1997; 2010). It is not difficult to resist the impression that Tribe lays his fingers on the influence of the economic-based paradigm which evaluates tourism as a source of economic growth and prosperity while overlooking other variables (Airey, et al. 2015).

Strengths and Weaknesses of the Bibliometric Culture

The present piece adopts a more nuanced argumentation. Of course, one must confess that bibliometric analysis has strengths and weaknesses. Among the strengths, we can mention the fast and accurate identification of those themes which are being discussed in academic circles worldwide. This doubtless recreates the condition to bolster a fluid dialogue among the involved stakeholders or simply works as a guideline to resolve the problems that place the industry in jeopardy (Koseoglu, 2016). Nevertheless, the bibliometric studies show some limitations which should be at least discussed.

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At first glimpse, the priority for H-index as the only valid key impact factor not only evinces a philosophical quandary but also a dilemma for tourism research. H-index evaluates the impact of a certain author on the literature but rarely it reflects the real contribution to the field [or even says little about the paper quality]. H-index, rather, measures the correlation between the citation factor and the author's productivity. For the sake of clarity, Albert Einstein would get a low H-index with only 4 papers published in his academic life. This reminds me that some of the most recognized or awarded scholars are not the most cited ones. Some scholars have alerted to the inconsistency of the H-index in scientific research. Waltman & Van Eck (2012) argue convincingly that the academic community should re-think the usage of the H-index as the only reliable instrument to measure an author's performance. Originally stimulated to measure the overall scientific impacts of authors, H-index has many inconsistencies and limitations which need to be re-considered. In many ways, H-index is unsystematic at the time of creating the authors' rankings. As the authors go on to write:

> "We argue that to measure the overall scientific impact of a scientist (or some other unit of analysis) the h-index exhibits counterintuitive behavior. More specifically, we assert that the mechanism used by the h-index to aggregate publication and citation statistics into a single number leads to an inconsistent way of ranking scientists. The conclusion that we draw from this is that the h-index cannot be considered an appropriate indicator of the overall scientific impact of a scientist" (Waltman & Van Eck, 2012: 2).

The main problem of the H-index started when epistemologists wonder: who are the most prestigious scholars in a field?

Let's explain this better with an example, two researchers A & B work for the same university for a lapse of 5 years. The premise of the H-index overtly said that if two scientists achieve the same performance improvement also their ranking position will remain untouched. Scientist A published 20 papers nine with twelve citations each and three with four citations each [the rest remains uncited]. In parallel, scientist B produced 12 publications seven with ten citations each and three with five citations each. Applying H-index, scientist B has a higher impact than A. In normal conditions, this assumption restricts the prolificacy of scientist A to the detriment of the number of citations. B scientist who had been less prolific has invariably had a higher impact on the ranking. At the same time, being cited does not mean a genuine contribution to the discipline, so to speak it can be a critical insight. It is argued

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that some disciplines [such as anthropology, cultural studies, or mobility theories] are less sensitive to citation factors than marketing or management (Korstanje 2016, 2022). The standardized productivity of an ethnographer [since ethnographies take considerable time] goes from one to two papers per year. This leads us to think twice about the impact factor as a social construe that varies by time, language, discipline, and culture. An interesting debate has certainly been put recently into the foreground. There is no clear basis to say that the highly cited papers now will pass the proof of time tomorrow. It is important not to lose sight of the fact that the impact factor [under some conditions] recreates a hierarchy of authors [most of them living in English-speaking countries] who act as real gatekeepers of what can be published or discarded. It is not otiose to admit that authors are often cited fashionably without understanding or reading the entire paper. Some scholars who work in developing countries have no access to published material. As a result of this, their papers lack the necessary bibliographic background or simply are out of focus respecting their object of study. They should limit to reading part of the papers or simply the abstract. There is an interesting point of debate in the global South and North and how access to published material is simply managed. Here an additional problem surfaces; Since the work of reviewers is not paid, some reviewers force authors to cite their papers falling into unethical behavior. Some journals have implemented a new system of reward for reviewers [to solve this problem] but not less true is that the review process puts the author in a situation of dependency. The selection of databases or sampling in the bibliometric studies remains an alternative point of discrepancy for Academia. The sampling process or selection of the material to construct the bibliometric reports is based on top-tiered journals excluding books, doctoral theses, or book chapters. At the same time, there are notable discrepancies with the citations in selected databases like WOS or Scopus, and Google scholar. To wit, even though some books or book chapters are highly cited, they are systematically ignored in these studies. Coming back to Hall's concerns, if we toy with the belief that the number of citations does not suffice to indicate the research quality, why Scimago or WOS are preferably selected in many of these bibliometric works?

Michael Hall (2006) calls on the need to go beyond the Scopus and Web of science datasets in the evaluation of tourism-related journals. This does not authorize to say that scholars should calibrate efforts to find reliable bibliometric tools that successfully combine evaluations [and reviews] based on publication quality. In some cases, citations are incorrectly credited, or engines fail to attribute to the correct authors. For some leading voices, the

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criterion to mark what is a most cited author or a paper is subject to arbitrary decisions which are unilaterally made or even obscured by unscientific reasoning. As Hall brilliantly notes, impact factors started to be used for purposes that have been not originally imagined. What is more important, estimating the number of citations of an author says little about its prestige or legacy, it rather corresponds with its popularity. In a nutshell, the opportunity of maximizing the value of research is simply given by the community of researchers as well as the possibility to formulate the correct questions.

With the benefits of hindsight, it is tempting to note that Scopus and WOS represent a small portion of the academic tribe. This point merits further debate in scholarship (Hall 2006; Moed, Bar-llan & Halevi 2016). The process of quality evaluation is very complex to perform. It devotes considerable resources, time, and effort to the side of scholarship. Recent studies have widely shown that reviews aimed at evaluating the ranking of publishers or journals obtain different results depending on the used method. Those studies which are based on impact factors or metrics have different outcomes than those centered on the evaluation of experts (Jacso, 2010; Siler & Lariviere, 2022). Just after the 2000s, some critical voices have alerted that the bibliometric studies reaffirm the hegemony of the leading publishers that impose the pay-for-journal logic (Kristensen 2015). It is important to remind that pay-for-journal have restricted access to the published material. This affects particularly those professional researchers in developing economies who have no financial resources to pay for the downloaded manuscripts. Many institutions press their professors to publish in top-tiered journals while they are restricted to the necessary access to update their state of art. The opposite is equally true, far from being original the proposed work is simply rejected by the peer-review process or by editors. Part of these low-skilled academicians falls in the hands of predatory journals that promise faster publications with a pseudo-scientific review. Predatory journals are pseudo-scientific outlets that often violate academic practices with fraudulent practices. In most cases, authors are charged back expensive handling fees while in others the review process is inadequate and poor. Exegetes of predatory journals acknowledge that the handling fee is for ensuring open access. The popularity of predatory journals is explained by two combined factors. On one hand, the exaggerated time the review process takes. Another is the lack of open access for the authors by the side of the most recognized publishers. Universities have devoted considerable financial resources to pay the open access subscription for students but at the same time the professors' wages. This happens because universities are annually evaluated by the

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number of publications placed by their professors in leading journals. Some professors even are pressed to publish one or two papers in the year to keep their tenure. More ranked the university, more financial resources, and students. This has invariably inspired some academicians to exert a caustic critique on the publishing-or-perish culture as the precondition for the commoditization of higher education (Van Raan 2005). Some of the most important universities have recently called to make a boycott against the leading publishers because of what they considered inappropriate open access policies. Some publishers have come into effect policies to keep open access, but the fees which are charged to authors are very hard to be paid. As stated, bibliometric studies have a direct impact on higher tourism education. Pressed to be more productive, professional fieldworkers leave their courses to less skilled or amateur professors. One of the more concrete effects of this behavior explains the methodological limitations students daily face to end successfully their theses. Additionally, the culture of publishing or perishing put authors in a new dilemma: writing for vocational issues [finding new instruments and topics] or simply writing for the topic of the moment.

Last but not least, another point of discrepancy is associated with *fragmentary coauthors.* Bob McKercher has extensively criticized the fragmentary co-authors as a direct aftermath of the institutional pressure for locating publications in top-tiered journals (McKercher & Tung 2015). This practice consists in submitting a manuscript authored by more than eight authors [some of them having no direct participation in the text] to gain further credits. Although this practice has been [to some extent] accepted, some journals imposed strict protocols to accept manuscripts authored by more than 5 authors. Plagiarism seems to be an added problem of the obsession with metrics and impact factors. Some authors deliver the same paper to more than one journal. Since reviewers are hand-tied to detect plagiarism, journals have concentrated efforts on the adoption of new software. The opposite is equally true, authors claim that they are not paid by journals for their publications. The assigned copyright forms impede the same text, theme or licensee can be republished at a later day. These scholars [though they represent a small portion of the academicians] not only are not in agreement with the current copy-right policies applied by journals because these protocols re-align with the hegemony of larger publishers but also are unwilling to pay the penalties of the missing bus, they submit the same material in various journals. Here, we have discussed the pro and cons of the current metric culture as well as laying the foundations for a new understanding of tourism research for the years to come.

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Conclusion

The culture of metrics has imposed some burdens and obligations of some researchers to publish in leading journals seems to be gradually devastating the professional applied research affecting for sure higher tourism education. Some well-versed scholars leave their classrooms to amateur researchers to embrace their professional career. In other cases, professors are certainly pressed to publish in some journals to keep their tenure. Of course, there are some disciplines such as geography or anthropology which are insensitive to the bibliometric culture, but others like tourism or management are highly determined by these types of pressures. The culture of publishing or perishing is wreaking havoc in the fields of tourism and hospitality. The present piece interrogates furtherly on the problems, advantages and limitations of bibliometric studies in the constellations of tourism research. At the same time, we lay the foundations for understanding the discipline in a not so long-distant future.

References

Adams, H. (1988). *The academic tribes*. Chicago, University of Illinois Press.

Agapito, D. (2020). The senses in tourism design: a bibliometric review. *Annals of Tourism Research*, *83*, 102934.

Airey, D., Tribe, J., Benckendorff, P., & Xiao, H. (2015). The managerial gaze: The long tail of tourism education and research. *Journal of Travel Research*, *54*(2), 139-151.

Barrios, M., Borrego, A., Vilaginés, A., Ollé, C., & Somoza, M. (2008). A bibliometric study of psychological research on tourism. *Scientometrics*, *77*(3), 453-467.

Benckendorff, P. (2009). Themes and trends in Australian and New Zealand tourism research: A social network analysis of citations in two leading journals (1994–2007). *Journal of Hospitality and Tourism Management*, *16*(1), 1-15.

Benckendorff, P., & Zehrer, A. (2013). A network analysis of tourism research. *Annals of Tourism Research*, *43*, 121-149.

Butler, R. (2015). The evolution of tourism and tourism research. *Tourism Recreation Research*, *40*(1), 16-27.

Dann, G. M. (2011). Anglophone hegemony in tourism studies today. *Enlightening Tourism. A Pathmaking Journal*, *1*(1), 1-30.

Evren, S., & Kozak, N. (2014). Bibliometric analysis of tourism and hospitality related articles published in Turkey. *Anatolia*, *25*(1), 61-80.

Gursoy, D., & Sandstrom, J. K. (2016). An updated ranking of hospitality and tourism journals. *Journal of Hospitality & Tourism Research*, *40*(1), 3-18.

Hall, C. M. (2006). The impact of tourism knowledge: Google scholar, citations and the opening up of academic space. *EReview of Tourism Research*, *4*(3), 119-36.

Nova Science Publishers, Inc.

Hall, C. M. (2011). Publish and perish? Bibliometric analysis, journal ranking and the assessment of research quality in tourism. *Tourism Management*, *32*(1), 16-27.

Jacsò, P. (2010). Pragmatic issues in calculating and comparing the quantity and quality of research through rating and ranking of researchers based on peer reviews and bibliometric indicators from Web of Science, Scopus and Google Scholar. *Online information review*. 34(6): 972-982.

Jiang, Y., Ritchie, B. W., & Benckendorff, P. (2019). Bibliometric visualisation: An application in tourism crisis and disaster management research. *Current Issues in Tourism*, *22*(16), 1925-1957.

Korstanje, M. E. (2016). Why citation impact is so important for tourism researchers?. *Advances in Hospitality and Tourism Research (AHTR)*, *4*(1), 26-31.

Korstanje, M. E. (2021). The decline of book reviews in tourism. *Published online: 15 February 2021 Free full-text access available at: www. jthsm. gr*, *76*.

Korstanje, M. E. (2022). Tourism imagination: a new epistemological debate. *Current Issues in Tourism*, ahead of print. 1-13.

Kristensen, P. M. (2015). Revisiting the "American social science"—Mapping the geography of international relations. *International studies perspectives*, *16*(3), 246-269.

Koseoglu, M. A., Rahimi, R., Okumus, F., & Liu, J. (2016). Bibliometric studies in tourism. *Annals of tourism research*, *61*, 180-198.

McKercher, B. (2007). A study of prolific authors in 25 tourism and hospitality journals. *Journal of Hospitality & Tourism Education*, *19*(2), 23-30.

McKercher, B., & Tung, V. (2015). Publishing in tourism and hospitality journals: Is the past a prelude to the future?. *Tourism Management*, *50*, 306-315.

Law, R., Ye, Q., Chen, W., & Leung, R. (2009). An analysis of the most influential articles published in tourism journals from 2000 to 2007: A Google Scholar approach. *Journal of Travel & Tourism Marketing*, *26*(7), 735-746.

Leong, L. Y., Hew, T. S., Tan, G. W. H., Ooi, K. B., & Lee, V. H. (2020). Tourism research progress–a bibliometric analysis of tourism review publications. *Tourism Review*, *76*(1), 1-26.

Oktadiana, H., & Pearce, P. L. (2017). The "bule" paradox in Indonesian tourism research: issues and prospects. *Asia Pacific Journal of Tourism Research*, *22*(11), 1099-1109.

Palmer, A. L., Sese, A., & Montano, J. J. (2005). Tourism and statistics: Bibliometric study 1998–2002. *Annals of Tourism Research*, *32*(1), 167-178.

Pearce, D. G. (2014). The internationalization of tourism research. *Journal of Travel Research*, *53*(3), 267-280.

Sheldon, P. J. (1991). An authorship analysis of tourism research. *Annals of Tourism Research*, *18*(3), 473-484.

Siler, K., & Larivière, V. (2022). Who games metrics and rankings? Institutional niches and journal impact factor inflation. *Research Policy*, *51*(10), 104608.

Tribe, J. (1997). The indiscipline of tourism. *Annals of tourism research*, *24*(3), 638-657.

Tribe, J. (2010). Tribes, territories and networks in the tourism academy. *Annals of tourism research*, *37*(1), 7-33.

Van Raan, A. F. (2005). Fatal attraction: Conceptual and methodological problems in the ranking of universities by bibliometric methods. *Scientometrics*, *62*(1), 133-143.

Nova Science Publishers, Inc.

Waltman, L., & Van Eck, N. J. (2012). The inconsistency of the h-index. *Journal of the American Society for Information Science and Technology*, *63*(2), 406-415.

Wardle, C., & Buckley, R. (2014). Tourism citations in other disciplines. *Annals of Tourism Research*, *46*(3), 163-184.

Xiao, H., & Smith, S. L. (2006). The making of tourism research: Insights from a social sciences journal. *Annals of Tourism Research*, *33*(2), 490-507.

Ye, Q., Li, T., & Law, R. (2013). A coauthorship network analysis of tourism and hospitality research collaboration. *Journal of Hospitality & Tourism Research*, *37*(1), 51-76.

Zhao, W., & Ritchie, J. B. (2007). An investigation of academic leadership in tourism research: 1985–2004. *Tourism management*, *28*(2), 476-490.

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Chapter 8

Responsible Management Practices as Strategic Tools to Avert Crisis Situations in Tourism: The Case of Wellness Centres in Kerala, India

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Abstract

Responsible Tourism (RT) is a strategy for sustainable destination development. One central promise of sustainability is avoiding disasters, calamities, and crises. In this book chapter, the authors highlight how responsible wellness tourism contributes to sustainability. In doing so, it highlights the crisis dimension. Policy implications are also presented. This study also evaluates wellness providers' economic, socio-cultural, and environmental responsibilities and how these practices avert tourism crises. The case study of a wellness tourism center shows how responsibility principles are implemented there and contribute to preserving the destination's culture and legacy. Responsible tourism practices also result in economic growth, product differentiation, job creation, landscape preservation, and environmental protection. These outcomes forestall crisis situations in allied sectors as well.

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Introduction

Due to abundant recreational opportunities and suitable accessibility, tourism has steadily grown over the last two decades, significantly boosting the local economy (Wang et al., 2020). The development of the tourism sector also benefits the enhancement of work opportunities, thereby raising household incomes, and presrving cultural heritage (Mohamadi et al., 2022). However, if wrongly managed, tourism can create numerous crises for the tourism industry stakeholders, the broader economy, and society (George, 2020; Korstanje & George, 2020). Wellness is associated with prevention and health, whereas well-being is associated with happiness (Thal, Smith, & George, 2021). Wellness tourism must entail much more than a trip to a spa facility. It has to do with creating a holistic healing experience for tourists, both physically and spiritually. It is about giving genuine experiences that allow people to recharge their batteries and return home as healthier and more active people (Dillette et al., 2020; Santhi & Nithya, 2011). Wellness tourism is a specialized segment of the tourism industry that has just undergone rapid growth and is expected to continue (Csirmaz & Pető, 2015). Indeed, the growth rate of wellness tourism continues to outpace global tourism (Nel-lo Andreu et al., 2021). As a result of this expansion, resorts, hotels, wellness retreat amenities, and unique travel packages are increasingly offering health and wellness services through various activities (George & Henthorne, 2009; Koncul, 2012). Accepting these mechanisms enables wellness tourism operators to improve develop, and implement programs that significantly impact tourists, stakeholders, and the local community, in addition to after their vacation is over. Technology and telemedicine are enablers of newer forms of wellness tourism (George, Bucatariu, & Henthorne, 2020).

The idea of responsible tourism has recently drawn scholars' interest. The interaction between tourism and the environment has led to the scholar-practitioner community developing the concept of sustainable tourism. Responsible tourism is concerned with travelling in a manner that has the least amount of negative impacts and damage (Mihalic, 2016). It has been on the rise recently due to a growing desire of travelers to be environmentally conscious inside and outside their homes. As a result, both forms of tourism

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can be combined to create a more sustainable tourism model that benefits travelers, the environment, the host community, and stakeholders. For the benefit of future generations, a high-quality environment and service sector must be established. It is also essential to pursue sustainable growth by utilizing current commercial trends. To achieve this goal, the tourism and hospitality sector chose responsible tourism as a strategy under community social responsibility. The mode of reliable tourism operations is influenced by the destination's economic, social, and environmental characteristics. (Markose & Tazhathethil, 2022). With the three sustainability pillars of environment, local community, and economy, the word "RT" refers to all stakeholders' activities and understanding of sustainable travel. The RT is considered a means of attaining Sustainable Development Goals and has proven to be a powerful unifier among tourism stakeholders.

As the previous backdrop, Kerala is known for its scenic beauty, cultural attractions, and thriving wellness tourism industry (Nair, 2019). Kerala has established itself as a global healthcare destination, which can be enhanced by cooperating with other sectors, particularly in the tourist industry. (Pordié, 2013), More people are combining their vacations with health travel to revitalize bodies and minds. Experts in the wellness business believe this might pave the way for creating a new type of tourism that is both beneficial to travelers and friendly to the environment and local community: responsible tourism. Many responsible tourism levels have been established in India, Southeast Asia, and Africa. Kerala state aims to embrace RT practices in various locations, including Kovalam, Kumarakom, Thekkady, and Wayanad (Ranjith, 2021).

Background

Wellness Tourism

The Global Wellness Institute defines wellness as the proactive pursuit of behaviors, decisions, and lifestyles that lead to overall healing. Significant problems have arisen as a result of the influx of wellness tourists. The topic of wellness tourism was controversial among locals who opposed its demonization. However, they were worried about the negative impacts of wellness travel. Residents purposefully removed themselves from wellness tourist sites to manage and prevent spatial stigma (Wang et al., 2020). A wellness tourism experience (apart from the entertainment component) can

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inspire tourists, leading to increased tourist involvement (He et al., 2021). Communities and the national economy are influenced by wellness spa tourism. By enabling the development of wellness practices based on typical elements of local cultural heritage, natural landscapes may also support efforts at product differentiation. Kerala, primarily a rural region with abundant natural resources, can form the core element of this type of strategic approach by combining traditional Ayurvedic practices with other local resources to create a competitive "augmented product" deeply ingrained in local resources and communities. However, implementing such a strategy for the development of wellness tourism requires careful coordination among numerous parties (Page et al., 2017). Wellness travel is a fast-expanding industry that provides outstanding business opportunities through products that enhance or preserve health (Kelly, 2012). People rely on entrenched private sector solutions to Globalization due to several factors, including the aging of the world's population, rising general understanding of health issues, and financial difficulties at traditional medical institutions (Voigt & Pforr, 2013). Wellness has grown into a more comprehensive idea. Wellness tourism increasingly encompasses activities like camping, retreat centers, and rural or environmental tourism (Nawijn, 2010; Brooker & Joppe, 2014). It has been demonstrated that wellness tourism lowers poverty by providing funding for the preservation and conservation of local history and the revival of traditional skills. Its international temples and centers for meditation and yoga draw a lot of wellness tourists (Choe & Seputra, 2020). The authors added that a specific approach must be established for a sustainable expansion of wellness tourism (about developmental policy and plan concerns, entrepreneurial management issues, financial restrictions issues, advertisement/promotion issues, and time-scheduling issues). It might positively affect the area's economy (Hundric et al., 2020). By adhering to sustainable tourism principles and helping to preserve a nation's culture and history, wellness tourism brings about several benefits, including productivity expansion, product diversification, employment generation, landscape conservation, and environmental protection (Smith& Puczko, 2009; Hartwell, 2014).

Responsible Tourism

Responsible tourism encompasses all tourist activities that respect the host country's natural and cultural ecosystems and the needs of all parties involved (Burrai et al., 2019). It can also mean enhancing local populations' quality of

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life through more significant socioeconomic benefits and better natural resource management (Spenceley et al., 2002). The authors strongly connect responsible tourism and taking steps to make tourism more sustainable. It says that embracing responsibility leads to clear-cut acts, subsequently called sustainable activities. On the other hand, responsible tourism is not synonymous with sustainable tourism (Wall, 2013). According to the definition, responsible tourism is "a behavioral attribute founded on the basic principles of respect for others and their environment," and it also assumes that "Being responsible in one's conduct, as well as in the actions of others'" business administration and management." Responsible tourism attempts to reduce the negative impacts of tourism on people, the environment, and communities by offering travel that enhances working conditions, includes the local community, preserves cultural heritage, and is ecologically friendly (Mondal & Samaddar, 2021). Responsible tourism aims to increase positive social, economic, cultural, and environmental impacts (Eyisi et al., 2021).

Responsible Tourism Initiatives in Kerala

Kerala began its Responsible Tourism initiative in February 2007 with the 'Better Together' state-level consultative gathering. Responsible Tourism (RT), a ground-breaking and far-reaching concept in Kerala tourism, was piloted in four destinations: Kovalam, Kumarakom, Thekkady, and Wayanad, with Kumarakom emerging as a model. A stakeholder workshop was organized on May 6, 2007, to begin the district's responsible tourism activities. All regional stakeholders – people's representatives, government officials, local governments, the tourism sector, civil society organizations, academics, and the media – were invited to participate in the activities. Later, the operations picked up speed, and in January 2008, the Responsible Tourism projects began. The activities primarily concentrated on three dimensions of tourism: social, economic, and environmental.

According to industry experts, both wellness and responsible tourism can be combined to produce more sustainable tourism that helps the traveler and the environment, even though this distinguishes each of these industries. The common aspect that binds them together is the cause of their existence. As a result, wellness and responsible tourism are driven by a desire to eliminate pollution, economic inequities, and overcrowding, among other things. The success of RT initiatives in various tourism industry segments has yet to be determined. To fill this gap in the literature, this study shows how much

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responsible tourism initiatives contribute to a local community's economic, sociocultural, and environmental development through the activities of wellness tourism stakeholders and to find out the methods of promoting RT through activities of wellness providers.

The COVID-19 Crisis

The COVID-19 pandemic is a global threat that has impacted all aspects of human life. The tourism and hospitality businesses have been particularly hard hit by travel prohibitions, health regulations, and the second and third waves of the pandemic (Jangra & Gupta, 2021). The lockdown/Quarantine resulted in ongoing physical, material, and mental health challenges, resulting in widespread dissatisfaction among ordinary people and an array of severe emotional consequences, including a mix of great anxiety, bewilderment, and explosive emotions, as well as trust and anticipation. The impact was intense for those countries that rely mainly on tourism (Dileep & Nair, 2021). Push-pull factors are predicted to change inadvertently after COVID. Tourism and travel activities have long been considered stress relievers, energizing people. Push incentives following COVID include the urge to de-stress, rest, and rejuvenate. Visiting tranquil and natural locations to soothe and relax the protracted unsettled state of mind after months of anxiety is predicted to be a significant driving element. Travel motives would steer travelers toward real tourism experiences. In the current context, remoteness and inaccessibility would be viewed as advantages. As a result, people would be willing to explore unexplored areas. The remoteness of a destination may emerge as a crucial 'pull' factor post-COVID, as unknown, distant destinations are often thought to be pollution-free (Chugh, 2021). UK surveys show that the demand for wellness activities accelerated by Covid 19, understanding the need for rest and mental health. Healthier food options for the public still adjusting to the lifestyle changes forced by Covid 19 allow a business to serve their customers better and help to make up for lost revenue earned by the stakeholders (Mtapuri & Giampiccoli, 2021) and host the community during the pandemic (Monk, 2020). The planned immplimentation of new strategies enables the tourism industryto thrive post pandemic (Chugh, 2021).

Research Problem

This study has been carried out to answer the following questions:

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1) What are the methods to promote responsible tourism through wellness tourism practices?
2) How might responsible tourism practices at wellness centers help minimize the tourism crisis and contribute to sustainable development?

Research Method

The current study is a case analysis of 'Ayurveda Yoga Villa, Holistic Research Centre' in Wayanad, Kerala, to gather information about responsible tourism initiatives at the wellness center. The researcher conducted interviews with practitioners of the Ayurveda yoga villa. This study also makes use of data obtained from the Internet. Internet-based research is becoming more common, particularly in tourism (Janta et al., 2011). Secondary data were gathered from the websites of numerous wellness centers and the Kerala tourism organization's Responsible tourism website, as well as from various journals, periodicals, and newspapers, and by reviewing multiple research papers on the topic. This examination leads to the resolution of the research problems.

Study Area

Wayanad district is one of Kerala's hill stations, with altitudes ranging from 700 to 2100 meters (Rajeevan et al., 2019). Four destinations in Kerala were picked for responsible tourism initiatives, with Wayanad being one of them (Thimm & Karlaganis, 2020). The government initiated considerable efforts to ensure the region's tourism industry's long-term viability, implementing various programs through Responsible Tourism initiatives. The initiatives taken here make Wayanad a better place to live and explore.

Results and Discussion

Analysis of qualitative interviews interspersed with an extensive review of literature helped the researchers identify certain specific themes related to wellness tourism practices and how this helps avert crises.

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Promoting Local Products

Supporting local or natural products is one way that wellness resorts can aid in the promotion of responsible tourism. For example, providing visitors with natural bath soaps purchased from local craftspeople can have a significant environmental impact both within and outside the destination. Consumption of certified high-quality regional products can contribute significantly to the economic development of the region in which they are produced (Frisvoll et al., n.d.). It is still widely assumed that wellness tourism consists solely of visits to spas. It encompasses a far more extensive range of activities. Quality local food, a rich cultural offer, authentic local experiences, excellent lodging, mild adventure activities, and mind or body classes are likely to appeal to wellness travelers (Kurniawan, 2018). From a crisis management perspective, they sustain local economic vitality and reduce poverty in the destination areas. There are numerous beneficial multipliers to this as well.

Purchasing Foods That Are Supplied Locally

Wellness resorts are cautious about the cuisine provided to visitors, ensuring that only the freshest and healthiest ingredients are used in their dishes. They may preach and practice responsible tourism by choosing fresh foods from local farms and markets. The food sourced locally to reduce carbon emissions while maintaining health and flavor. People believe that eating functional foods and utilizing herbs as ingredients to replenish the body and mind could improve their health. As a result, it is a must-have for a healthy lifestyle. Wellness tourist operators deliver healthy and proper diets using local products and services. Herbs help the body work better. Some hotels have teamed up with organic farmers in the area. Farms, herbalists, and chefs create and serve functional and healthful cuisines suitable for both the body and the mind (Chen et al., 2013). From a crisis management perspective, this means economic opportunities for the local farming community and minimizing the chances for the agricultural sector to fail. In many mass tourism destinations, there is a crisis in the agriculture sector because of the massive drift of resources, workers, and management attention to tourism. Win-win growth of complementary sectors of the economy is a significant positive step in averting crisis.

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Recycling Initiatives Should Be Supported

In addition to onsite recycling services, wellness locations can assist guests in having a more ecologically conscious vacation. These recycling programs help these places substantially reduce waste and assist tourists in being more conscientious of keeping their surroundings clean and recycling objects rather than discarding them. Recycling classes can be held in wellness locations to raise awareness about the need for recycling for interested visitors; this allows visitors to take these habits home with them. Switching to energy-efficient appliances and water systems are just a few additional steps wellness locations may take to promote responsible tourism. From a crisis management perspective, this means minimizing wastage and even trash. This helps maintain the destination neat and clean.

Travelers Are Left with Subliminal Messages

At its best, wellness tourism can give customers subtle pointers about having a more responsible and environmentally friendly wellness vacation. Hotels and resorts that offer wellness tourism vacations, for example, might place messages in the rooms instructing guests not to waste paper or wash towels to help save the environment. Previous studies show that such messages can help avoid the destructive conduct of travelers, thus avoiding crises.

Eradicate Poverty throughout the World in All Its Form

Poverty is a global crisis. Well-being tourism can be generated by wellness, particularly in places where local cultural traditions promote wellness, such as meditation, good cuisine, a diverse range of local employment, and entrepreneurial prospects. The wellness tourism service provides various direct and indirect job opportunities for the workforce's kids, women, and the disabled. Wellness tourism not only contributes to promoting guest well-being, but it may also serve as a model of well-being and generate local revenue.

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Ensure That All People of All Ages Have Healthy Lives and Are Well-Adjusted

Illness is a crisis, and programs that support health and well-being, thus, contribute to crisis management efforts. Health and well-being are essential at all stages of life, beginning with childhood. This addresses all main health goals, including reproductive, maternal, neonatal, child, and adolescent health; communicable and no communicable diseases; universal health care; and provision of safe, effective, high-quality, and reasonable medications and vaccinations for all.

Continuing Education That Is Inclusive and Equitable

Lack of inclusivity leads to numerous consequences, including social distrust and unrest. These crises could be overcome by planned Diversity, Equity, and Inclusion (DEI) efforts. Wellness tourism activities frequently incorporate educational components, which provide opportunities for visitors to learn about local culture and customs and for locals to learn about and get more active in this rapidly increasing market.

Ayurveda Yoga Villa Holistic Research Centre: A Mini Case Study

The Ayurveda Yoga Villa Holistic Research Centre and Hospital is a green leaf-certified Wellness Centre located on the Kabani River's shores and bordered by the Nilgiri Biosphere Reserve's evergreen forest, which is the principal source of medicinal herbs. Individualized remedies are delivered after a comprehensive assessment by Ayurvedic doctors with years of experience. Ayurveda therapies, Yoga practices based on yogavaivartha sidhi, Marma treatments, Kalari practices, and Kalari treatments are all included in the treatment process.

Ayurvedic diets, Agnihotrams, and daily routines combine cleansing and balancing an individual's physical, mental, and spiritual health. Ganapathi temple, Ayurvedic herbal manufacturing unit, Gosala, and organic garden are all on campus. Food and dairy products and medicine are produced on their own organically maintained farms to boost the efficacy of Ayurvedic treatments. This research center also works to save indigenous cattle breeds

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that provide dairy. Medications for Ayurveda therapies are prepared within the research center. Ayurveda therapies are supplemented with spiritual activities and an enlightened atmosphere to purify an individual's physical, mental, and spiritual dimensions while also boosting immunity. Activities of the Centre in the areas of environmental, economic, and social responsibility are presented below:

Environmental Responsibilities

Wellness centers have taken appropriate steps to conserve and safeguard the environment, indirectly and directly. This research center aims to preserve indigenous cattle breeds, which supply dairy and plants for herb collecting. Food cultivated in the retreat center's organic garden is used to prepare food for the guest. Organic fertilizer is is primarily used in agriculture. Environmental efforts have been made. The center's infrastructure is entirely environmentally friendly, as it is created in a lush green location without hurting the entire flora and Fauna.

Economic Responsibilities

Various Responsible activities have been initiated to bring the local community forefront, fulfilling the economic responsibility. When choosing employees equally for men and women, preference is given to the local people. Yoga villa receives foreign people from around the world for various treatments. While acquiring foreign customers, the exchange earnings automatically increase in the district. They bought local products to prepare medicine and empower communities to help grow the local economy. The wellness tourist is also attracted to the various products produced within the district during their wellness trip, like woodcraft, tea powder, honey, ethnic food items, and paper bags.

Socio-Cultural Responsibility

The Ayurveda Yoga Villa administration places a high value on social responsibility. They ensure that the local community is involved in all of their activities. The Ayurveda herbal manufacturing unit, Gosala, Organic farm,

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Events, and Ganapathi temple are all maintained by locals. Tribal communities are offered the opportunity to participate in cultural events and traditional rituals. Furthermore, the wellness center provides free treatments to locals as a support form. In the ayurvedic manufacturing unit, an Ayurvedic drug for immunity building during the pandemic was prepared and supplied to inhabitants. They maintain the local tradition by prohibiting cross-massages and other activities. Educate worldwide wellness visitors and locals unfamiliar with Vedic culture, which has ancient roots. Food, dairy products, and medicine are produced on their own organically managed farms to increase the efficacy of Ayurvedic therapies. Traditional clothing is used as treatment uniform.

Table 1 summarizes the various responsible wellness tourism practices at the Centre.

Table 1. Responsible wellness tourism practices in the wellness centre

SI No	Responsible wellness tourism activities	Indicators
1	Environmental Responsibility	• Protection of flora and fauna • Recycling • Use of organic fertilizers in farming • Eradicate waste and emission • The retreat center serves meals grown on organic farms inside the campus.
2	Economic Responsibility	• Employment opportunities for local people equally for males and females • Foreign exchange earnings to the district • Buying local products and empowering communities to help to grow the local economy.
3	Socio-cultural Responsibility	• Offering free treatments to the residents • Building and sustaining decent work for the poor. • Reduced inequality • Serving ethnic food Freshly collected indigenous cow's urine in the morning from the Gosala situated inside the campus. • Performing various traditional rituals inside the Centre • Tradition protection (Example: Restricting Cross massages) • Educate international wellness tourists and locals who are unfamiliar with Vedic tradition. • Food and dairy products and medicine are produced on their own organically • Traditional costume as a uniform to perform the treatment.

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Conclusion

Responsible tourism is a globally opted strategy for sustainable destination development and lights up for new policymaking (Markose, Vazhakkatte Tazhathethil, & George, 2022; Okech, Haghiri, & George, 2015). In this study, we have analyzed wellness centers' economic, social, cultural, and environmental responsibilities and Methods for promoting responsible tourism through wellness tourism Activities. Wayanad district is marked as the responsible tourism destination in Kerala, and the activities were initiated in Wayanad in 2007 in Vythiri village and Ambalavayal in 2012. It is among the place where responsible tourism practices are implemented strategically. The destinations' envisaged execution of the measures for RT would aid in the growth of the tourism industry. Wayanad's responsible tourism program seeks to lessen tourism's harmful effects while respecting the local environment. A single segment, like the wellness industry, tried its best to help and obey the RT initiatives of the district. From the study, it is evident that responsible tourism activities of wellness centers are advantageous for tourism in all ways. Suppose more effort is put into making the destination economically and culturally sustained. In that case, responsible tourism may be a helpful strategy for sustainable visitor development in and around the wellness center and for safeguarding the environment.

This study contributes to the potential of the best responsible wellness tourism practices and strategies. The service providers' responsible practices have added multiple dimensions to the policymakers. The outcomes of this study should not be applied to all wellness centers in other growing areas for several reasons, such as differences in geographical locations, policy, and employers. If the government is serious about developing the industry, the initiatives are vital to supporting RT. As a result, empowerment, funding, increased security, and the implementation of tourism rules are necessary for RT to occur in every wellness center in every region. The findings of this article are critical for promoting responsible travel in areas where tourism is still in its early stages after a pandemic. The suggested strategies aid in the development of a resident-tourist-friendly destination in Kerala. The success of RT is within the hands of stakeholders, and tourism stakeholders need to consider these results so that getting resident support and attaining responsible tourism may be easier. This study has certain limitations. First, the data are collected only from one authorized organization, and the findings cannot be generalized. Hence future research suggests conducting an empirical study to

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determine the impact of responsible tourism initiatives in the wellness center during the post-COVID-19 pandemic.

References

Burrai, E., Buda, D. M., & Stanford, D. (2019). Rethinking the ideology of responsible tourism. *Journal of Sustainable Tourism*, *27*(7), 992–1007. https://doi.org/10.1080/09669582.2019.1578365.

Chen, K. H., Chang, F. H., & Kenny, C. W. (2013). Investigating the wellness tourism factors in hot spring hotel customer service. *International Journal of Contemporary Hospitality Management*, *25*(7), 1092–1114. https://doi.org/10.1108/IJCHM-06-2012-0086.

Chugh, S. R. (2021). Changing Travel Preferences Post-COVID: The New Normal? *International Journal of Hospitality and Tourism Systems*, *14*(C), 15–22.

Csirmaz, É., & Pető, K. (2015). International Trends in Recreational and Wellness Tourism. *Procedia Economics and Finance*, *32*(15), 755–762. https://doi.org/10.1016/s2212-5671(15)01458-6.

Dileep, M. R., & Nair, B. B. (2021). COVID-19 and the Future of Tourism: Back to Normal or Reformation? *International Journal of Hospitality and Tourism Systems*, *14*(C), 10–14.

Dillette, A. K., Douglas, A. C., Andrzejewski, C., Dillette, A. K., Douglas, A. C., & Dimensions, C. A. (2020). Current Issues in Tourism Dimensions of holistic wellness as a result of international wellness tourism experiences. *Current Issues in Tourism*, *0*(0), 1–17. https://doi.org/10.1080/13683500.2020.1746247.

Eyisi, A., Lee, D., & Trees, K. (2021). Developing responsible tourism in emerging economies: the case of Nigeria. *Journal of Tourism and Cultural Change*, *0*(0), 1–16. https://doi.org/10.1080/14766825.2021.2019262.

Frisvoll, S., Forbord, M., & Blekesaune, A. (n.d.). *Scandinavian Journal of Hospitality and An Empirical Investigation of Tourists ' Consumption of Local Food in Rural Tourism*. *July 2015*. https://doi.org/10.1080/15022250.2015.1066918.

George, B. (2020). *International Case Studies in the Management of Disasters: Natural-Manmade Calamities and Pandemics*. Emerald Group Publishing.

George, B. P., & George, B. P. (2004). Past visits and the intention to revisit a destination: Place attachment as the mediator and novelty seeking as the moderator. *Journal of Tourism Studies*, *15*(2), 51-66.

George, B. P., & Henthorne, T. L. (2009). The incorporation of telemedicine with medical tourism: A study of consequences. *Journal of Hospitality Marketing & Management*, *18*(5), 512-522.

George, B., Bucatariu, L., & Henthorne, T. L. (2020). Technology in medicine: COVID-19 and the "coming of age" of telehealth. In *International Case Studies in the Management of Disasters*. Emerald Publishing Limited.

Nova Science Publishers, Inc.

He, M., Liu, B., & Li, Y. (2021). Tourist Inspiration: How the Wellness Tourism Experience Inspires Tourist Engagement. *Journal of Hospitality and Tourism Research*, 1–21. https://doi.org/10.1177/10963480211026376.

Henthorne, T. L., & George, B. P. (2009). Transformation of Tourism Business in the Communist Cuba: A Critical Analysis. *International journal of business insights & transformation*, *3*(1), 18-29.

Jangra, P., & Gupta, M. (2021). Internet of Medical Things (IoMT) Based Framework for Smart Healthcare Tourism Sector. *International Journal of Hospitality and Tourism Systems*, *14*(C), 173–178.

Janta, H., Ladkin, A., Brown, L., & Lugosi, P. (2011). Employment experiences of Polish migrant workers in the UK hospitality sector. *Tourism Management*, *32*(5), 1006-1019.

Kelly, C. (2012). Wellness tourism: Retreat visitor motivations and experiences. *Tourism Recreation Research*, *37*(3), 205–213. https://doi.org/10.1080/02508281.2012.11081709.

Koncul, N. (2012). Wellness: A new mode of tourism. *Ekonomska Istrazivanja*, *25*(2), 525–534. https://doi.org/10.1080/1331677X.2012.11517521.

Korstanje, M. E., & George, B. P. (2020). Education as a strategy to tackle over tourism for overtourism and inclusive sustainability in the twenty-first century. In *Overtourism* (pp. 341-359). Palgrave Macmillan, Cham.

Kurniawan, L. (2018). Promoting Indonesia as a Wellness Tourism Destination. *KnE Social Sciences*, *3*(10), 250–260. https://doi.org/10.18502/kss.v3i10.3378.

Markose, N., Vazhakkatte Tazhathethil, B., & George, B. (2022). Sustainability Initiatives for Green Tourism Development: The Case of Wayanad, India. *Journal of Risk and Financial Management*, *15*(2), 52-67.

Mihalic, T. (2016). Sustainable-responsible tourism discourse - Towards "responsustable" tourism. *Journal of Cleaner Production*, *111*, 461–470. https://doi.org/10.1016/j.jclepro.2014.12.062.

Mohamadi, S., Abbasi, A., Ranaei Kordshouli, H. A., & Askarifar, K. (2022). Conceptualizing sustainable–responsible tourism indicators: an interpretive structural modeling approach. *Environment, Development and Sustainability*, *24*(1), 399–425. https://doi.org/10.1007/s10668-021-01442-9.

Mondal, S., & Samaddar, K. (2021). Responsible tourism towards sustainable development: literature review and research agenda. *Asia Pacific Business Review*, *27*(2), 229–266. https://doi.org/10.1080/13602381.2021.1857963.

Mtapuri, O., & Giampiccoli, A. (2021). Beyond COVID-19: An Opportunity for a New Tourism Sector. *International Journal of Hospitality and Tourism Systems*, *14*(C), 23–33.

Nair, B. B. (2019). Emerging trends in Wellness Tourism in Kerala. *Global Developments in Healthcare and Medical Tourism*, *February*, 220–235. https://doi.org/10.4018/978-1-5225-9787-2.ch012.

Nel-lo Andreu, M. G., Font-Barnet, A., & Espasa Roca, M. (2021). Wellness tourism-new challenges and opportunities for tourism in Salou. *Sustainability (Switzerland)*, *13*(15), 1–13. https://doi.org/10.3390/su13158246.

Nova Science Publishers, Inc.

Okech, R., Haghiri, M., & George, B. P. (2015). Rural tourism as a sustainable development alternative: An analysis with special reference to Luanda, Kenya. *CULTUR-Revista de Cultura e Turismo*, *6*(3), 36-54.

Page, S. J., Hartwell, H., Johns, N., Fyall, A., Ladkin, A., & Hemingway, A. (2017). Case study: Wellness, tourism and small business development in a UK coastal resort: Public engagement in practice. *Tourism Management*, *60*(September), 466–477. https://doi.org/10.1016/j.tourman.2016.12.014.

Pordié, L. (2013). Spaces of connectivity, shifting temporality. Enquiries in transnational health. *European Journal of Transnational Studies*, *5*(1), 6–26.

Rajeevan, S., Kunnath, S. M., Varghese, T., & Kandambeth, P. P. (2019). Spider Diversity (Arachnida: Araneae) in Different Ecosystems of the Western Ghats, Wayanad Region, India. *South Asian Journal of Life Sciences*, *7*(2). https://doi.org/10.17582/journal.sajls/2019/7.2.29.39.

Spenceley, a., Relly, P., Keyser, H., Warmeant, P., McKenzie, M., Mataboge, a., Norton, P., Mahlangu, S., & Seif, J. (2002). Responsible Tourism Manual for South Africa, Department for Environmental Affairs and Tourism, July 2002. *Responsible Tourism Manual for South Africa*, *2*(July), 3. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.114.1494&rep=rep1&type=pdf.

Thal, K. I., Smith, S. L., & George, B. (2021). Wellness tourism competences for curriculum development: a Delphi study. *Journal of Teaching in Travel & Tourism*, *21*(3), 205-220.

Thimm, T., & Karlaganis, C. (2020). A conceptual framework for indigenous ecotourism projects–a case study in Wayanad, Kerala, India. *Journal of Heritage Tourism*, *15*(3), 294–311. https://doi.org/10.1080/1743873X.2020.1746793.

Wall, G. (2013). Taking responsibility for tourism: Responsible tourism management. *International Journal of Contemporary Hospitality Management*, *25*(2), 299–300. https://doi.org/10.1108/09596111311301658.

Wang, J., Huang, X., Gong, Z., & Cao, K. (2020). Dynamic assessment of tourism carrying capacity and its impacts on tourism economic growth in urban tourism destinations in China. *Journal of Destination Marketing and Management*, *15*(December 2019), 100383. https://doi.org/10.1016/j.jdmm.2019.100383.

Wang, K., Xu, H., & Huang, L. (2020). Wellness tourism and spatial stigma: A case study of Bama, China. *Tourism Management*, *78*(January 2019), 104039. https://doi.org/10.1016/j.tourman.2019.104039.

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Chapter 9

The Use of Reflexive Thematic Analysis in Tourism Research: The Case of Responsible Pet Lovers

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Abstract

This chapter highlights the knowledge production of pets on vacation. Pet on vacation introduces the pet as a nonhuman tourist and responsible pet lover by influencers on Instagram, demonstrating the existence of crisis-resistant travellers during the pandemic and highlighting the inclusion of pets as members of families and the importance of vacation for quality of life. Further, sharing of visual content on Instagram socializes the politics of the tourism future which raise the right to travel for nonhuman tourists (pets) and highlights the notion of responsible pet lovers. The uses of the reflexive thematic analysis approach with constructive theoretical perspectives of Braun and Clarke (2019) as methods for the case study. This research advances the idea of reclaiming the political dimension of the epistemic endeavour and presents a paradigm of promoting the multiple pieces of knowledge to build the alternative platforms of knowledge production that is encouraged by Ana Maria Munar in her seminal work on the house of tourism studies (2016). The use of the reflexive thematic analysis approach within this study context is proposed as making a theoretical contribution because it was found to provide unique insights into these theoretical perspectives.

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Keywords: pets, nonhuman tourists, responsible pet lover, Instagram, reflexive thematic analysis

Introduction

Although tourism studies as a branch of social sciences have highlighted the importance of a non-single perspective for its knowledge production, the uses of (reflexive) thematic analysis in tourism research seem to be limited. It has been noted that knowledge production is not only embedded with the research paradigms but also importantly, it urges cutting-edge approaches, e.g., the researcher's creativity and knowledge based on less-explored issues (Braun & Clarke (2022). To date, cutting-edge strategies of tourism studies are associated with the advancement of Information Communication Technology (ICT) and global trends such as the Covid19 pandemic. These trends urge the inclusion of discourses that are embedded with multi-discipline intra-discipline, inter-discipline, or even indiscipline perspectives (Tribe, 1997). Further, tourism studies standpoints such as tourism politics are noted to build the house of tourism studies (Munar, 2016). In the house of tourism studies, Ana Maria Munar recommends more different investigations of knowledge production, that is, to advance tourism scholarship by promoting multiple pieces of knowledge and building alternative platforms of knowledge production, cooperation, and dissemination. The purpose of this book chapter is to locate the emerging trend of nonhuman tourists and their responsible pet lovers in the field of tourism studies. The use of reflexive thematic analysis is applied to support the claims.

Background and Research Objective

To date, the record of tourism research literature concerning the building of the house of tourism studies seems to be in slow progress (Munar, 2016; Walters, 2016). This is partly due to the occurrence of tourism politics. Tourism politics, for instance, the resistance from the stakeholders and pressure groups about specific issues embedded with the new topic such as inanimate tourists, make it hard to be researched (Winter, 2020). This resistance goes along with some of the schools of thought that are reluctant to open the discourses for knowledge production. Further, tourism scholars seem to be too idle to wake up from the lullaby given by quantitative paradigms,

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which are testing theories, not theory development. For example, Braun and Clarke (2022) propose using reflexive thematic analysis approaches that allow researcher subjectivity to be used as a research resource. However, some of the ongoing research that is about the inclusion of sustainable tourism includes but is not limited to responsible tourists, and tourism stakeholders have received positive attention (Winter, 2020; Hoarau-Heemstra & Kline, 2022). The most popular tourism research to date has been exploring the responsible prosumption in hospitality, e.g., food waste, responsible guests in the hotel and resort, and smart tourism for sustainable tourism and the hospitality industry (Dolnicar & Grun, 2020; Gretzel, Murphy, Pesonen, & Blanton, 2019). On the contrary, tourism politics of inanimate tourists, e.g., the animals on vacation and their responsible pet lovers, received less attention (Carr & Cohen, 2009).

Research about animals in tourism, i.e., as a tourist attraction and animal-related leisure activities is documented in the literature (Rickly, 2018; Carr, 2017; Markwell, 2015; Fennell, 2012; Carr, 2005). Research also suggests inanimate tourists or nonhuman tourists as a trend in tourism, and have been recorded in the tourism futures studies (Kogan, Hazel, & Oxley, 2019; Ivanov, 2018; Carr, 2017; Gretzel & Hardy, 2015; Carr & Cohen, 2009; Carr, 2005). Not only are inanimate tourists might be less-explored, which makes these issues less popular, but also, it is alleged that some of these emergent trends in tourism are considered problematic e.g., the notion of nonhuman tourists (Ivanov, 2018). Although interesting the question of non-human tourism has been remained as unexplored in the literature. As a rational behavior, tourism is culturally limited to humans whilst non-humans are systematically debarred from any leisure activity [at least in the Western social imaginary] (Korstanje & Seraphin 2022). Fortunately, the manifestation of hashtags such as likes, shares, and re-posts on Instagram could popularize inanimate tourists and their responsible pet lovers (Tang, Ying, & Ye, 2022). As a result, Instagram can be regarded as a medium of tourism politics that shapes tourism futures, such as the cute economy, particularly for nonhuman tourists (pets), and the concept of responsible pet lovers (Maddox, 2020).

Tourism politics raise the right to travel for nonhuman tourists (pets) and highlights the notion of responsible pet lovers. As noted, the sharing of visual content on Instagram may enhance, validate, promote, entertain, personalize, negotiate, and socialize the politics of tourism of the tourism future (Ge & Gretzel, 2018; Tang, Ying, & Ye, 2022). The literature also documents how influencers use content such as pictures of vacationing pets in the age of social media and crisis. It is noted as a method for engaging audiences, brands, and

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health authorities, in addition to demonstrating the existence of crisis-resistant travellers during the pandemic #quarantine @staycation and highlighting the significance of vacations for improving quality of life and pets as integral members of families (Femenia-Serra, Gretzel, & Alzua-Sorzabal, 2022; Hajibaba, Gretzel, Leisch, & Dolnicar, 2015; Dolnicar, Yanamandram, & Cliff, 2012).

In terms of methodology in the house of tourism studies, the use of constructivism and thematic analysis seems to be limited. Studies about inanimate tourists from other disciplines have implicitly noted the animal tourism futures, e.g., the research about pet insurance and pet health information (e.g., Abrahams et al., 2009; Kogan, Hazel, & Oxley, 2019), the inclusion of pet as a family member in quality-of-life studies, e.g., the research of Albert & Bulcroft (1988); pet and pet owners in social media (Kogan, Hazel, & Oxley, 2019). These are the shreds of evidence for giving voice to the notion of a pet and their responsible pet lovers on vacation (Tang, Ying, & Ye, 2022; Hoarau-Heemstra & Kline, 2022). With this in mind, themes generated from the research into pets and their responsible pet lovers on vacation may enrich the studies of tourism politics of pets on vacation and inanimate tourists in general.

Along with positivism, presumably, houses of tourism studies and the notion of pets and responsible pet lovers on vacation can be developed from the critical paradigm derived from post-positivism, i.e., qualitative approaches and post-positivism such as netnography and reflexive thematic analysis. The nonhuman tourist occurrence in social media as non-influencers and the notion of pets accompanying their humans, i.e., pets as a member of the family explicate the tourism trends in relation to the ICT and sustainable tourism (Albert & Bulcroft, 1988; Abrahams et al., 2009; Kogan, Hazel, & Oxley, 2019). Therefore, the notion of nonhuman tourists e.g., pets as a tourist and their responsible pet lovers are proposed to be added to the house of tourism studies.

Research Philosophy

The reflexive thematic analysis approach, especially the constructive theoretical perspectives of Braun and Clarke (2019), highlights the importance of deep reflection and the role of researcher subjectivity in the qualitative paradigm. The reflexive thematic analysis approach in knowledge production requires active participation, such as reading between the lines of the

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phenomenon. The reflexive thematic analysis reflects the values of a qualitative paradigm, centring researcher subjectivity but not atheoretical (Braun & Clarke, 2019). Researcher subjectivity includes analysis based on organic and recursive coding processes, and the importance of deep reflection on, and engagement with, data (Braun & Clarke, 2006; Braun & Clarke, 2019). In line with this, a coder's subjectivity includes theoretical sensitivities, interests, and experiences, which act as filters in thematic analysis. The importance of theme conceptualization and whether themes are viewed as (a) summaries of topics or categories, or (b) encapsulating a central idea or meaning and providing an interpretive narrative are both emphasised by Braun and Clarke (2022). Thematic analysis findings are considered ongoing revisions rather than being finished (McAllum, Fox, Simpson, and Unson, 2019).

Thematic analysis explicitly indicates the steps taken by the researcher, which acts as a filter for familiarization of the text (which in this research context includes pictures), coding, and revision-to themes generated from the analysis. Within the tourism studies, thematic analysis was used to explain written and visual texts about luxury in the spectrum of a second home in New Zealand, and the use of thematic analysis is encouraged for future research (Walters, 2016). In this sense, social media posts about pets and pet lovers on vacations can be useful subjects to map the position of the pet as nonhuman tourism and responsible pet lovers. In doing so, potential posts were examined from their underlying meaning-based concept and shared meaning. The use of a deductive approach indicates the basis for employing a deductive approach and is aimed to generate the themes for a pet on vacation movement. Consequently, past studies that revolved around pets as family members, nonhuman tourists when accompanying their families on vacations, and the importance of vacation for family health and quality of life are the basis for the deductive approach (Dolnicar, Yanamandram, & Cliff, 2012).

Empirical Material

A purposive sample derived from the trending topics about responsible pet lovers on Instagram's postings that have led to specific hashtags including #petlover #petinfluencer; were selected and classified into Instagram posts solely about pet(s) on vacation or posts concerning pets and pet lover(s). To examine the effect of postings of these hashtags to the Instagram viewers

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(active and passive), and what those meanings of the hashtags constructed by responsible pet lovers represent.

The hashtags reflect the inclusion of pet lovers' social behaviour and are considered themes generated for responsible pet lovers. Responsible pet lover behaviour is depicted in travel and vacation experience that includes situations, attributes, choices, actions, and issues on Instagram posts. The themes of tourism politics advocate the nonhuman tourist and the responsible pet lover. They are exposed by the Instagram posts of travel-related and vacation related-experiences by maximizing the value-content production, e.g., giving voices to their pet by translating the behaviour of their pet as a member of the family on vacation. Likes, shares and re-posts on Instagram postings bridge the notion of the right to travel for human pet lovers and nonhuman tourists (pets). The value-content production includes the type of leisure and experience activities, outfits, mode of transportation, accommodations, and facilities which are visualised. Posts frequently use filters to perfect images, which seems to highlight the importance of the structure of the message meaning of the postings. The posts are used as the central (social) meanings, i.e., the use of Instagram as a medium for the pet as a nonhuman tourist movement and responsible pet lovers, and the new age of family vacation, family health, and quality of life.

Concluding Remarks

The results of this study suggested two themes as topic summaries of responsible pet lovers leading tourism politics. The desire of obedient pet owners to bring their household pets along on vacation with them as members of the family, as well as the promotion of animals as nonhuman influencers, are two of the issues at hand. Contrarily, it is discovered that empowering veganism for animals serves as a central theme unifying the meaning of interpretative stories. This study backs up previous research that found pets play an important role in both family life and family vacations, suggesting that the tourism industry considers this business opportunity.

References

Abrahams, A. S., Becker, A. B., Sabido, D., D'Souza, R., Makriyiannis, G., & Krasnodebski, M. (2009). Inducing a marketing strategy for a new pet insurance

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company using decision trees. *Expert Systems with Applications*, *36*(2), 1914-1921. doi:10.1016/j.eswa.2007.12.032.

Albert, A., & Bulcroft, K. (1988). Pets, families, and the life course. *Journal of Marriage and the Family*, *50*(2), 543. doi:10.2307/352019.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77-101. doi:10.1191/1478088706qp063oa.

Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, *11*(4), 589-597. doi:10.1080/2159676x.2019.1628806.

Braun, V., & Clarke, V. (2022). Toward good practice in thematic analysis: Avoiding common problems and be(com)ing a *knowing* researcher. *International Journal of Transgender Health*, 1-6. doi:10.1080/26895269.2022.2129597.

Carr, N. (2017). Recognising the position of the pet dog in tourism. *Annals of Tourism Research*, *62*, 112-113. doi:10.1016/j.annals.2016.10.011.

Carr, N., & Cohen, S. (2009). Holidaying with the family pet: No dogs allowed! *Tourism and Hospitality Research*, *9*(4), 290-304. doi:10.1057/thr.2009.10.

Carr, N. (2005): Holidaying with the family pet: no dogs allowed! In T. Delamere, C. Randall and D. Robinson (eds) *Abstracts of Papers Presented at the Eleventh Canadian Congress on Leisure Research*. Nanaimo, B.C.: Malaspina University-College.

Dolnicar, S., Yanamandram, V., & Cliff, K. (2012). The contribution of vacations to quality of life. *Annals of Tourism Research*, *39*(1), 59-83. doi:10.1016/j.annals.2011.04.015.

Femenia-Serra, F., Gretzel, U., & Alzua-Sorzabal, A. (2022). Instagram travel influencers in #quarantine: Communicative practices and roles during COVID-19. *Tourism Management*, *89*, 104454. doi:10.1016/j.tourman.2021.104454.

Fennell, D. A. (2012). *Tourism and animal ethics*. London: Routledge.

Fennell, D. A. (2013). Tourism and animal welfare. *Tourism Recreation Research*, *38*(3), 325-340, DOI: 10.1080/02508281.2013.11081757.

Ge, J., & Gretzel, U. (2018). A taxonomy of value Co-creation on Weibo – a communication perspective. *International Journal of Contemporary Hospitality Management*, *30*(4), 2075-2092. doi:10.1108/ijchm-09-2016-0557.

Gretzel, U., & Hardy, A. (2015). Pooches on Wheels: Overcoming Pet-related Travel Constraints Through RVing. In Markwell, K. (Ed.). (2015). *Animals and tourism: Understanding diverse relationships* (Vol. 67) (pp. 274-287) Channel View Publications.

Gretzel, U., Murphy, J., Pesonen, J. & Blanton, C. (2019). Food waste in tourist households: A perspective article. *Tourism Review*, https://doi.org/10.1108/TR-05-2019-0170.

Hajibaba, H., Gretzel, U., Leisch, F., & Dolnicar, S. (2015). Crisis-resistant tourists. *Annals of Tourism Research*, *53*, 46-60. doi:10.1016/j.annals.2015.04.001.

Hoarau-Heemstra, H., & Kline, C. (2022). Making Kin and making sense of human-animal relations in tourism. *Ecological Economics*, *196*, 107396. doi:10.1016/j.ecolecon.2022.107396.

Ivanov, S. (2018). Tourism beyond humans – robots, pets, and Teddy bears. Paper presented at the International Scientific Conference "Tourism and Innovations," 14-15th September 2018, College of Tourism – Varna, Varna, Bulgaria.

Nova Science Publishers, Inc.

Kogan, L. R., Hazel, S. J., & Oxley, J. A. (2019). A pilot study of Australian pet owners who engage in social media and their use, experience and views of online pet health information. *Australian veterinary journal*, *97*(11), 433-439.

Korstanje M. E & Seraphin H (2022) "A problem called Alterity: the position of the Other in HBO Saga Westworld". In *Tourism Through troubled times: challenges and opportunities of the tourism industry in 21st century.* Korstanje M. Seraphin H & Maingi S (eds). [7-20]. Bingley, Emerald Publishing.

Maddox, J. (2020). The secret life of pet Instagram accounts: Joy, resistance, and commodification in the internet's cute economy. *New Media & Society*, *23*(11), 3332-3348. doi:10.1177/1461444820956345.

Markwell, K. (2015). *Animals and tourism: Understanding diverse relationships*. Channel View Publications.

McAllum, K., Fox, S., Simpson, M., & Unson, C. (2019). A comparative tale of two methods: how thematic and narrative analyses author the data story differently, Communication Research and Practice, DOI: 10.1080/22041451.2019.1677068.

Munar, A. M. (2016). The House of Tourism Studies and the Systemic Paradigm. In A. M. Munar, & T. Jamal (Eds.), *Tourism Research Paradigms: Critical and Emergent Knowledges.* (pp. 131–153). Chapter 8. Bingley: Emerald Group Publishing Limited. (Tourism Social Science Series, Vol. 22). doi: 10.1108/S1571-50432015 0000022014.

Rickly, J. M. (2018). Considering service animals in tourism. *Annals of Tourism Research*, *71*, 57-58. doi:10.1016/j.annals.2017.12.012.

Tang, J., Ying, T., & Ye, S. (2022). Chinese pet owners traveling with pets: Motivation-based segmentation. *Journal of Hospitality and Tourism Management*, *50*, 31-43. doi:10.1016/j.jhtm.2021.12.006.

Tribe, J. (1997). The indiscipline of tourism. *Annals of Tourism Research*, *24*(3), 638-657. doi:10.1016/s0160-7383(97)00020-0.

Walters, T. (2016). Using thematic analysis in tourism research. *Tourism Analysis*, *21*(1), 107-116. doi:10.3727/108354216x14537459509017.

Winter, C. (2020). A review of research into animal ethics in tourism: Launching the annals of tourism research curated collection on animal ethics in tourism. *Annals of Tourism Research*, *84*, 102989. doi:10.1016/j.annals.2020.102989.

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Conclusion

In the introductory section, we have mentioned that tourism researchers and epistemologists have no few problems taking the concept of crisis in their respective scopes of study, or at the best as a valid object of study (Ritchie & Jiang 2019). For some reason, an apologetic discourse focuses on tourism as a formidable instrument that potentiates economic growth, prosperity and political instability in established democracies (Somnez, Apostolopoulos & Tarlow 1999). To some extent, the classic literature recognizes that there are some glitches or caveats which often threaten the future of tourism research. These problems are not seen as part of the system but as anomalies that should be rapidly found and eradicated (Hall, 2010). The socio-economic negative effects involuntarily generated by the tourism industry include the acceleration of climate change and environmental pollution, real-estate speculation, inflation, acculturation process, economic unemployment, and inter-ethnic conflict if not warfare (only to name a few) (Smeral 2009; Blake & Sinclair, 2003). No less true seems to be that the concept of crisis has occupied a central position in social science but in tourism, the term remains uncovered (Papatheodorou, Rossello & Xiao 2010). The limitations of applied research to reverse the negative consequences of tourism are given by two combined factors. On one hand, the precautionary doctrine, which is understood as an academic paradigm based on the importance to locate and eradicate risks that threaten the service sectors, failed to give firm answers to the challenges posed just after the turn of the century. The radicalization of political violence adjoined to the impossibility of governments stopping greenhouse gas emissions has created a chaotic and unpredictable climate. As a result of this, some voices say overtly that post-disaster theory has been adopted as the main leading paradigm to recycle devastated destinations while optimizing resources to fasten the recovery facet (Tucker, Shelton & Bae 2017). On another, experts are systematically trained to believe the tourism industry is a multiplying factor which triggers economic growth. Needless to say, it is part but not the full story. Its negative impacts on the community very well can be

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imagined as collateral damage that planning can resolve. This invariably behoves us to overlook those variables that probe the industry situates as a real obstacle towards sustainability (Richards & Hall, 2002; Gossling, Hall & Weaver, 2009). At first glimpse, scholars have been oath to adopt crisis as a part of the tourist system over years. To put things bluntly, the figure of crisis connoted serious failures and miscalculations in the planning process (Singh 2004).

Let´s clarify for readers first that the term crisis suggests a period or a moment that not only happens abruptly but also put society or community in jeopardy. Some voices equate the concept of crisis to emergency or disaster. What is important to say is that any crisis escapes to the natural forms of control of society. Like disasters, crises interrogate furtherly the status quo and the dominant institutions (Cohen 2012). Some studies have alerted on the fact that crises resulted from unperceived or exaggerated risks, or serious errors in the decision-making process (Ritchie 2004; Pappas 2018). Whatever the case may be, crises frequently open the doors to new stages and situations mainly marked by evolutionary growth. To set an example, the modern tourism industry resulted from the crisis precipitated by the two World Wars. Accompanied by the globalization process, the technological breakthrough in the 90s decade paved the way for the expansion of the tourism industry worldwide. At the same time, the attacks perpetrated in WTC, the acceleration of climate change as well as the economic downturn and the latest COVID-19 pandemic mainly marked a new state of crisis for the industry (Korstanje & George 2021; 2022). To what extent COVID-19 indicates the end of tourism or simply the mutation towards new forms is a complex answer this book tries to answer. Citing Norbert Elias, the civilizing process derives not only from the discipline orchestrated to regulate life but also from how successful crises are managed (Elias 1969).

As the previous argument is given, Lash & Urry (1993) speak to us of the decentralization of tourism in their seminal book Economies of signs and space. Per their viewpoint, the globalization process ignites a new stage of capitalism characterized by an aesthetic reflexibility. This process leads to a system where cultures, peoples and merchandise are mutually exchanged and commoditized. Gazing at others, outstanding landscapes or looking for authentic experience is a way of possessing the “Other”. In this context, capitalism is gradually mutating towards a decentralized form of production and consumption culturally enrooted in the power of the sign. Experts shape the border of global geography in two main grids: safe and unsafe destinations. It is noteworthy that in Lash and Urry´s conceptualization, experts keep the

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monopoly in the understanding of risk. Their legacy shed the light on the way tourism is constantly changing to new forms and shapes.

With the benefits of hindsight, we have been educated to think of tourism as an all-encompassing and immutable institution. At a closer look, tourism has been historically subject to countless shifts and moments of political instability. Here we present a conceptual model which distinguishes three clear-cut moments or historical stages: a) classic tourism, b) sustainable tourism c) new forms of morbid tourism. Each stage is based on a foundational event that changed the economic means of production and travel behavior. The first stage, dubbed classic tourism, ranges from 1920 (or the interwar period) and 1970. The economic paradigm ruling modern society is the economy of scale. Per this model, products are fabricated in a standardized way. While optimizing resources, the economy of scale recreates mechanical means (and forms) of production while consumerists are not moving with specific preferences. Of course, tourism was not an exception. For this period, the tourist destinations, which are simply cloned, follow the sun-sand-and-beach archetype. Based on the bubble model, these products have been designed to avoid host-guest interaction. At the same time, the top-down planning process appears to be insensitive to the negative effects of tourism on the hosting community.

In 1972, a disrupting event changes this form of production putting the industry upside down. The Arab-Israeli war resulted in an important Oil Embargo by the side of the Arab League that led Western capitalism into a gridlock. A new economic crisis known as stagflation places West between the wall and the deep blue sea. Economists, policymakers and experts agree that Western capitalism should alter the basis and means of production simply because the Oil resources are plausibly compromised. It is not difficult to resist the impression that centralized planning and economy set the pace for a decentralized form of production/consumption. Experts introduce the notion of segmentation while consumers are seen as liberal agents dotted with different (countless) preferences. There is a strong empathy with the locals as well as concerns revolving around the negative effects of tourism on the environment. It is the time for the emergence of Sustainable tourism which crystallises in the Brundtland Report in 1979. From that moment onwards, the problem of resource regeneration as well as sustainability occupies a central position in academic discourses. This period oscillates from 1972 to the 2000s decade. Unlike classic tourism which is closed to the local demands, sustainable tourism not only devotes resources to reverse the negative effects produced by the industry but also revitalizes the host-guest relations. Tourists

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are in quest of unique and outstanding experiences based on the "understanding of culture and the Other´s lifestyle". Last but not least, the attacks perpetrated by Al-Qaeda on the US in 2001 starts a new epoch where all certainties simply withered away. This epoch is marked by a state of alarmism, high anxiety and uncertainness. Since risks cannot be regulated or eradicated (originally as they have been planned), adaptancy emerges as a leading paradigm. New forms of morbid tourism, include dark tourism, thana tourism, grief tourism, war tourism, slum tourism, and surfaces. These novel forms of consumption confront directly the apollonian sense of beautiness. Although these forms of tourism vary in psychological motivations, there is a clear common component oriented to the consumption of the "Other´s pain" (Korstanje & George 2022). As discussed, tourism is mutating into new shapes and evolving to unknown dynamics all the time. For that, the present book, which invited well-versed and global scholars specialized in the study of the tourism crisis, gives a snapshot of the past, present and future of tourism in a post-COVID-19 context. To put things simply, the current tourism crisis is not limited to the economic downturn, or ostensibly to the effects of COVID-19, it encompasses broader aspects that affect higher-tourism education, the economy, society and even the epistemological issues -without mentioning tourism research. One of the priorities of researchers consists in setting new objects of study in a world traversed by geopolitical tensions, ethnic cleavages, travel bans and regulations, that take in essence part of a much deep re-feudalization process. The end of tourism and hospitality (at least as we know them) is a focal point of entry in this debate which needs to be continued in the next layouts.

References

Blake, A., & Sinclair, M. T. (2003). Tourism crisis management: US response to September 11. Annals of tourism research, 30(4), 813-832.

Cohen, E. (2012). Globalization, global crises and tourism. Tourism recreation research, 37(2), 103-111.

Elias, N. (1969). The civilizing process: Sociogenetic and psychogenetic investigations. New York, Willey Blackwell.

Gössling, S., Hall, C. M., & Weaver, D. B. (2009). Sustainable tourism futures: Perspectives on systems, restructuring and innovations. In Sustainable tourism futures (pp. 21-36). Abingdon, Routledge.

Hall, C. M. (2010). Crisis events in tourism: Subjects of crisis in tourism. Current issues in Tourism, 13(5), 401-417.

Nova Science Publishers, Inc.

Korstanje, M. E., & George, B. (2021). Mobility and globalization in the aftermath of COVID-19: Emerging new geographies in a locked world. Basingstoke, UK: Palgrave Macmillan.

Korstanje, M. E., & George, B. (2022). The Nature and Future of Tourism: A Post-COVID-19 Context. London, CRC Press.

Lash, S. M.,& Urry, J. (1993). Economies of signs and space (Vol. 26). London, Sage.

Papatheodorou, A., Rosselló, J., & Xiao, H. (2010). Global economic crisis and tourism: Consequences and perspectives. Journal of Travel Research, 49(1), 39-45.

Pappas, N. (2018). Hotel decision-making during multiple crises: A chaordic perspective. Tourism Management, 68, 450-464.

Richards, G., & Hall, D. (2002). The community: a sustainable concept in tourism development?. In Tourism and sustainable community development (pp. 19-32). Abingdon, Routledge.

Ritchie, B. W. (2004). Chaos, crises and disasters: a strategic approach to crisis management in the tourism industry. Tourism management, 25(6), 669-683.

Ritchie, B. W., & Jiang, Y. (2019). A review of research on tourism risk, crisis and disaster management: Launching the annals of tourism research curated collection on tourism risk, crisis and disaster management. Annals of Tourism Research, 79, 102812.

Singh, S. (2004). India's domestic tourism: Chaos/crisis/challenge?. Tourism Recreation Research, 29(2), 35-46.

Smeral, E. (2009). The impact of the financial and economic crisis on European tourism. Journal of Travel Research, 48(1), 3-13.

Sönmez, S. F., Apostolopoulos, Y., & Tarlow, P. (1999). Tourism in crisis: Managing the effects of terrorism. Journal of travel research, 38(1), 13-18.

Tucker, H., Shelton, E. J., & Bae, H. (2017). Post-disaster tourism: Towards a tourism of transition. Tourist studies, 17(3), 306-327.

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INDIA'S G20 PRESIDENCY: SCOPE FOR STRENGTHENING PEACE AND SUSTAINABLE DEVELOPMENT

EDITED BY:

Dr. LIJI GEORGE

INDIAN COUNCIL OF SOCIAL SCIENCE RESEARCH (ICSSR)

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WATER CONSERVATION FOR SUSTAINABILITY: A LIFESTYLE FOR ENVIRONMENT

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Abstract

Water, a limited and indispensable resource, is essential to human welfare. Only when properly handled it is renewable. Within few years two-thirds of the world's population will reside in water-stressed countries due to the fact that human usage exceeds than natural recharge. Water is essential for sustainable development and its crucial for socio-economic development and for the survival of human life. It reduces disease and improveshealth, welfare and productivity. It is essential to the creation and maintenance of a wide range of advantages and services for people.The study investigates about the need for sustainable ideas for water conservation where the worlds situation makes it a high demand. Sustainable development goals have also given high prominence on water and related matters to achieve development. In this behalf the research is highly important. The study uses qualitative approach in nature and intends to use both primary and secondary data. Primary data related to the research will be collected from reports of Water ministries at center and state on their initiatives. Secondary data will be collected from books and journal articles authored by scientists and academicians. It gives light to the need of sustainable approaches for environment through water.

Keywords: Water, Life for Environment, Sustainability, Water Conservation

Introduction:

Water the elixir of life, is a finite resource essential for the survival of every living being on Earth. As our global population and climate change exaggerates the water scarcity, the need and importance of conservation is been more critical.

Water conservation is very much integral to every living being for sustainable development and environmental equilibrium. It protects ecosystems, biodiversity and also ensures a reliable distribution of clean water for future generations. Water scarcity has far reached socio- economic implications, Affects agriculture, industry and health of every individual. By conservation we can reduce over exploitation of water resources, and it also reduces the livelihood conflicts on this precious resource. As it is an essential resource effort for sustainable usage has to be implemented in every aspect including participation from every governmental and non-governmental organisation. Implementation of new interventional programmes can be included at regional and national level to promote sustainability.

Our common future in its definition of sustainable development defines it as the kind of development that attends the need of present, without compromising the need and possibility of future generations to satisfy their needs. We are well aware that the need and necessity of water will be increasing day by day according to the increase in population. As the world population is increasing continuously it arises the high need of sustainable thinking for water and its conservation for sustainable living in the environment of every living organism.

Efforts for conservation is very crucial but even though efforts towards it are very limited. It might be because that the people are not well aware about the importance of conservation as of the same aspect of environment conservation. The ideas of Water conservation and scarcity and not much implemented in every individual's life. We are living in a pattern that the idea of conservation is only applicable during the time of scarcity and its used abundantly during the times of easy availability.

Literature Review

Silva et al., 2020, in their work "Water sustainability assessment from the perspective of sustainable development capitals: Conceptual model and index based on literature review" explains how the idea of water sustainability can be used to contextualize the larger issue

of sustainable development from the viewpoint of one of the most important natural resources and a recipient of anthropogenic waste. Such a viewpoint acknowledges interferences with numerousinterconnected socio-environmental factors and covers the planned contribution of integrated river basin management (IRBM) to the larger promotion of sustainable development. Aiming to show ways for communities to profit from such ecosystems' activities rationally and sustainably, it also offers a focused framework to stop anthropogenic actions from endangering aquatic ecosystems beyond their resilience limitations.

Armstrong, A. (2006). "Ethical issues in water use and sustainability"says the assumption underlying the current discussion of water use and sustainability is that safeguarding the water environment is morally required. To talk about and resolve problems and disputes that come up in the management of water, whether they be between competing human users, present and future users, or human and non-human users. Water quality and availability protection for all current and future users is one criterion for assessing environmental activity and policy.

Rogers et al., 2002, in their work "Water is an economic good: How to use prices to promote equity, efficiency, and sustainability"says Water pricing is perhaps the simplest conceptually, but may also be the most politically challenging, strategy to improve justice, efficiency, and sustainability in the water industry. For instance, the traditional command and control strategy used in the majority of countries to manage water results in significant government participation due to the necessity for in-depth manual monitoring and measurement. However, using price strategies still necessitates a large amount of government involvement to guarantee that fairness and public goods concerns are appropriately addressed.

Methodology

The study uses qualitative approach in nature and intends to use both primary and secondary data. Primary data related to the research will be collected from reports of Water ministries at center and state on their initiatives. Secondary data will be collected from books and journal articles authored by scientists and academicians.

Water Conservation for Sustainability

One of the most fundamental andimportant needs is water: for the biosphere's life forms and living things, for natural processes, for communities, for society, for the nation's

economy, and for future generations. Although the amount of water on Earth (>71%) is constant, the hydrological cycle—which includes evaporation, precipitation, runoff, infiltration, and other natural processes—occurs continuously.

As a result, rainfall may not be consistent across different locations, leading to a water deficit as a result. Even though the majority of the surface of the world is covered by water (97% of it is in the oceans), only freshwater (approximately 3% of it, of which 85% is in the form of glaciers) is suitable for living things like humans. The water table has been seriously threatened in recent years by factors including rapid population growth, industrial and urban development, excessive water use, climate change, global warming, glacier retreat in the Arctic and Antarctic, natural disasters (such as shifting precipitation patterns and reduced snowpack), sloppy water use, and the slowly replenishing natural waters. In addition, rapid economic growth, energy consumption, and the decrease of refilled waters are key causes for concern.

Between 1950 and 2005, water withdrawals in the USA significantly grew across all sectors, including public (municipal), rural or residential, livestock, irrigation, and thermoelectric power generation. In comparison to a few decades ago, there is now twice as much of a drought as there was. The current years' rainfall has varied, and in many nations, the amount of precipitation being captured has decreased. The preservation of water resources has increased recently due to the rising demand for water. It is projected that if the water level drops further, their need will only grow.

The need for humans to care for water resources, regulate their use, and practice sustainable management and conservation is paramount. Therefore, in order to save the planet and increase the quality and quantity of sustainable water, water conservation can be accomplished throughlogical policy, from existing resources, mechanical auditing, rainwater harvesting, increased de-salination projects (to get additional sustainable water from ocean), water re-use, and strict regulations to adopt safe and conservative water adaptation policy by individuals.

Conclusion

As the world is moving fast towards scarcity of every resource it's the duty of each and every individual to conserve and protect these resources. So for a sustainable living and life style we need to sort out life styles for environment.

Reference

Silva, J. da, Fernandes, V., Limont, M., Dziedzic, M., Andreoli, C. V., & Rauen, W. B. (2020). Water sustainability assessment from the perspective of sustainable development capitals: Conceptual model and index based on literature review. *Journal of Environmental Management*, *254*, 109750. https://doi.org/10.1016/J.JENVMAN.2019.109750

Armstrong, A. (2006). Ethical issues inwater use and sustainability. *Area*, *38*(1), 9–15. https://doi.org/10.1111/J.1475-4762.2006.00657.X

Rogers, P., De Silva, R. D., & Bhatia, R. (2002). Water is an economic good: How to use prices to promote equity, efficiency, and sustainability. *Water Policy*, *4*(1), 1–17. https://doi.org/10.1016/S1366-7017(02)00004-1



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Alzheimer Disease Severity Prediction using Response Rate of Five-Word Test

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***Abstract*— Alzheimer's is a rapidly growing disease that affects approximately 50 million people worldwide. A person suffering from an illness may be unable to recall recent conversations or events. As the condition progresses, the person with Alzheimer's disease (AD) may forget even their name, spouse's name, and so on. The main idea of this project is to create a web-based application that uses a five-word test's response rate to estimate the severity of AD. The five-word test includes the name, phone number, spouse name, child name, and favorite food. A web form collected these data along with other personal information. The collected data is then analyzed to provide an efficient and non-invasive method for severity prediction of AD.**

Keywords*— *Alzheimer's disease, Five-word test, MySQL, HTML, CSS

I. INTRODUCTION

AD is a brain condition that gradually kills brain cells. AD and its complications should be detected early. The first stage of the condition is characterized by problems in choosing the appropriate words, forgetting names, and misplacing or losing valuable objects. Then the development continues and one becomes unable to recall one's personal history, which confuses concerning the day and location. The third stage of severity is then thought to entail physical ability changes and communication difficulties. After China and the United States, India is third in the world for the number of AD patients, and by the year 2030, 7.5 million people are predicted to have this illness. To reduce the risk of death, several techniques have been attempted to predict and categorize the disease in advance [1]. Among men and women age between 65 to 70, AD prevalence averages 1.4%, while above 85, it averages 24% [3]. Alzheimer's disease severity prediction using a web form involves developing a user-friendly interface that patients and caregivers can use to provide knowledge about the patient's diagnostics, medical record, and other relevant factors. This detail can then be used to predict the rigidness of the condition.

Predicting the severity of Alzheimer's syndrome is important for several reasons. First, it can help patients and their families plan for the future and make informed decisions about care options. Knowing the likely progression of the disease can help patients and caregivers prepare for the increasing level of care that may be required as the disease advances. Second, predicting the severity of Alzheimer's disease can aid in the evolution of customize treatment plans. Different patients may experience different symptoms and progress at different rates, and understanding the likely course of the disease can help clinicians tailor treatment to each individual patient. Third, predicting the severity of Alzheimer's disease can also be important for research purposes. By identifying patients who are likely to experience more rapid disease progression, researchers can focus on developing new treatments and interventions that may be particularly effective in these patients.

Predicting the degree of Alzheimer's illness can, in general, have important ramifications for individuals and loved ones, and additionally for medical professionals and researchers trying to create better therapies and care alternatives for this debilitating condition. The goal of this work is to establish a web-based tool, to predict the severity of AD using response rate of five-word test. This paper is structured in such a way that it first describes the related works, then describes the block diagram, and finally presents the results and makes a conclusion based on the results.

I. EXISTING WORKS

In [1], the system is created in such a way that it will detect the severity prediction using machine learning algorithms. While machine learning algorithms can help in predicting Alzheimer's disease, there are several potential disadvantages that should be considered. Machine learning algorithms may not always provide accurate predictions. There are difficult to account for in the algorithms. Machine learning algorithms need large amounts of data to train effectively.

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If the training data is biased or incomplete, this can impact the accuracy of the predictions. There are ethical concerns associated with the use of machine learning algorithms in healthcare. For example, patients may feel uncomfortable with the idea of their data being used for prediction purposes without their explicit consent.

In [2], the proposed system is developed; it will find the severity prediction using assistive technologies. While assistive technologies can aid in quick prediction and detection of Alzheimer's disease, there are several potential disadvantages that should be considered. Some assistive technologies can be expensive to develop, purchase, or maintain, which may limit their availability and accessibility to some healthcare providers and patients. Some patients may be reluctant to use assistive technologies, or may find them difficult to use, which can impact their effectiveness in predicting and detecting Alzheimer's disease. Some assistive technologies may not be widely available, or may only be available in certain regions or healthcare settings, which can limit their usefulness in predicting and detecting Alzheimer's disease. Some assistive technologies may produce false positives or false negatives, which can impact their accuracy in predicting and detecting Alzheimer's disease. This can lead to unnecessary anxiety or missed opportunities for early intervention.

Chiara Fornari [3] investigated whether MCI brought on by Alzheimer's disease might be predicted using the mini-mental state evaluation (MMSE) and the five-word test (FWT). A total of 96 individuals who attended the ambulatory care treatment Neurological Clinics for intellectual disability and Disease participated in this study. The FWT and MMSE were the two cognitive tests administered to participants. The FWT test is performed by showing a list of five words to the patient. This list is printed on an A4 sheet. Biomarker Assessments such as Amyloid-PET Imaging and CSF (Cerebro Spinal Fluid) analysis are carried out to evaluate cognitive assessment. It is found that FWT examination is more suitable for discover amyloidal plaque pathology at PET imaging.

Elisabetta Farina [4] proposed a work, consisting of the rendering, reconstruction and confirm of FWT in an Italian sample. This is for recognition of AD, forgetful MCI and functional memory disorders (FMD). The MMSE and the clock-based drawing test (also known as the CDT) are two cognitive screening tests that are compared to the FWT. Translating the examination into Italian was the first step. The list of five words includes the following: truck, funnel, firefly, orangeade, and museum. Then, the test was adapted for Italian. At last, the test was validated in a large sample of 264 patients. Each patient underwent a standardized screening test, the MMSE, the CDT, and the FWT. Diagnostic accuracy was excellent for the FWT.

A study [5] was conducted to validate the FWT test for the Italian language and assess its discriminative power between Alzheimer's disease patients and those with mild neurocognitive dysfunction. An entire group of 217 patients—127 controls, 47 individuals with AD-related MCI, and 43 individuals with AD—participated in the study. The patient is given a list consisting of five words, such as "colander," "lemonade," "orthopteron," "museum," and "lorry," as part of the FWT test. This list is printed on an A4 sheet. In all participants, the FWT was used to assess episodic verbal memory. The Remembering Level and the Missed Recall Score are added to determine the Total Recall Score. The results show that AD individuals and MCI may be distinguished from control matches with accuracy using the TRS for the FWT by applying a cut-off of below or equal to 9/10.

Ammar [6] developed a technique for the early detection of AD using a spontaneous speech. Language-related disorders are the most typical sign of AD. The Dementia Bank, one of the biggest extant databases of spontaneous speech, provided the data utilized in this study. Many people with language impairments are monitored using picture-description exercises. The Boston Cookie Theft visual description task is described in the dataset's voice samples. From the CHAT files, transcribed patient voice samples are taken out and pre-processed for feature extraction. For the AD prognosis, 62 features are considered. Binary classification is done using SVM.

A study [7] aimed to determine whether all word list identification can enhance the foretell AD dementia progression in MCI patients over and above caught up recall for the already used material in the past. There were eighty MCI patients in the sample. After twelve, twenty-four, and thirty-six months, the MCI individuals were invited for monitoring investigations, where they had additional clinical, neuropsychological, behavioral, and functional assessments. A list of fifteen words pertaining to actual objects makes up the test material for an identification and recall activity. MCI individuals who transitioned to AD mental disease fared lower than normal controls and non-converters in word list free recall and identification tests.

This approach is suggested as a quick way to assess elderly people's memory and sensitivity for diagnosing AD patients [8]. A reliable test for verbal episodic memory is the FWT. Distinguishing dementia, particularly AD, from discrete subjective problems is helpful [9]. This method's goal was to assess elderly MD patients' memory abilities in comparison to controls and AD patients [10]

Wearable outdoor and indoor navigation system for blind people assistance using LIDAR and ultrasonic sensor [11]. A non-invasive sensor based wearable socks is proposed to diagnostic and therapeutic varicose vein problem using vibration and thermal therapy [12]. IoT based robot is designed and implemented to detect the alive humans inside collapsed building during nature disaster [13]. The UWB radar-based system is used to identify and detect the human is alive or dead. The system is used to diagnosis the problem of the human for the treatments [14]. It is recommended to use a method known as Canny Edge Detection to take out the feature from the image. Text characters are detected utilizing the Naïve Bayes classifier[15]. A model image based segmentation is proposed to perform high accuracy in CT scan application [16].

I. METHODOLOGY

In this work, a web-based tool is proposed for predicting the severity of Alzheimer's disease using the response rate of a five-word test and the EEG signal of the patient is predicted based on the analysis. The tool is developed using web development technologies such as HTML, CSS, PHP, MySQL, and JavaScript. The tool is presented in the form of a web form that collects the user's personal information such as name, phone number, spouse name, child name, and favorite food. The response rate of the five-word test and EEG signal are also collected through the web form .

The collected data is stored in a MySQL database and analyzed using the formula. The output of the tool is an improvement/severity graph that shows the severity of the syndrome over time, based on the input given. The graph can be used by healthcare professionals to monitor the progress of the disease and adjust treatment plans accordingly. The severity and improvement can be calculated from the time taken to submit the web form, as the response rate of the five-word test and EEG signal is predicted based on the severity and improvement of Alzheimer's disease.

Fig. 1 represents the overall data flow of proposed work. First, the test has been started by collecting 5 word test questions from patients using web form. The responses with time taken to submit the form are stored to MySql databases. The above process will be repeated again after particular time interval. The time taken to finish the form is compared with the initial time taken to submit the form (master time).

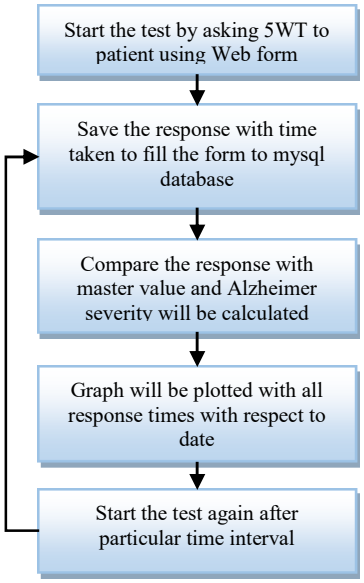


Fig.1 Dataflow diagram

The formula used to calculate improvement or severity in percentage is given in equation (1). Chart will be plotted every time after getting response from patients.

$$\frac{MST-CST}{CST} \times 100 \qquad (1)$$

MST-master response time

CST-current response time

The suggested web-based tool has the ability to provide an efficient and non-invasive technique for predicting the severity of Alzheimer's disease. This can aid in the severity prediction and management of the disease, that can significantly improve the standard of life for patients and their families. The tool can also help healthcare professionals to monitor the progress of the disease and adjust treatment plans accordingly.

IV. Results And Discussions

In the proposed work, the web form is created to collect the five word test question from the patient. The tool is developed using HTML, CSS, PHP, MySQL, and JavaScript.

The suggested work's general database table structure is shown in Fig. 2. The primary password (id), answer_1, answer_2, answer_3, answer_4, answer_5, response date, and response time are all included in the database table.



Fig.2 Database table



Fig.3 5WT Web form

Fig.3 shows the frontend web form which is developed for getting response from patients. Table 1 shows all the responses from the patient. The date of the test taken, time taken to finish every tests and the % of improvement/severity are displayed.

TABLE I. 5WT History

Sl.No	5WT History		
	Date	*Time Taken*	*Result*
1.	06/03/2023	30 seconds	0% Improvement
2.	06/03/2023	15 seconds	50% Improvement
3.	06/03/2023	47 seconds	56.67% Severity
4.	06/03/2023	34 seconds	13.33% Severity
5.	08/03/2023	22 seconds	26.67% Improvement
6.	08/03/2023	23 seconds	23.33% Improvement
7.	09/03/2023	11 seconds	63.33% Improvement
8.	09/03/2023	15 seconds	50% Improvement

Fig.4 represents the improvement / severity graph. By comparing the each five-word test history with master response, the % value will be calculated and based on the % value, the graph has been plotted.

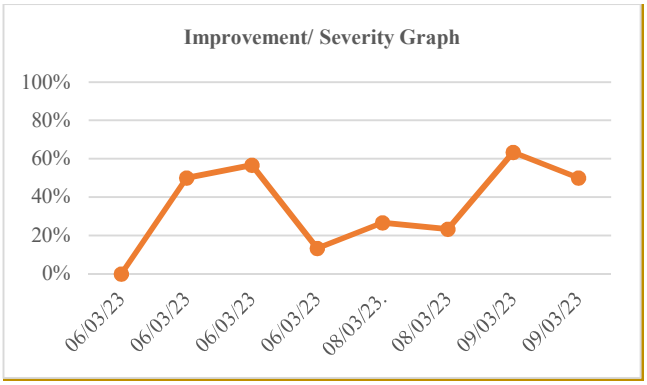


Fig.4 Improvement/Severity graph

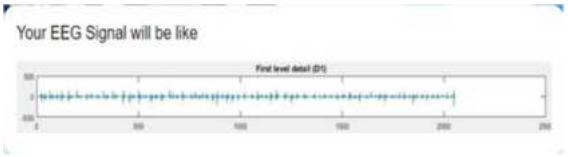


Fig.5 EEG Signal Prediction

The Fig.5 shows the EEG signal prediction based on the last response time and master response time. EEG signal is predicted after each response of the patient based on the severity and improvement.

V.CONCLUSION

It is important to diagnose AD early on in the course of the disease. This study provides evidence that the response rate of the five-word test can be useful predictors of AD severity. The use of an HTML form on the frontend and PHP and MySQL on the backend allowed efficiently collecting and analyzing the data, and the calculation of severity using a formula provided a novel approach to analyzing the data. The use of charts and graphs to present the results made them more accessible and easier to interpret. Further research is needed to explore the potential of the web based five-word test as a diagnostic tool for AD and to investigate its usefulness in combination with other cognitive tests.

REFERENCES

[1] Neelaveni, J., and MS Geetha Devasana. "Alzheimer disease prediction using machine learning algorithms." 2020 6th International Conference on Advanced Computing and Communication Systems (ICACCS). IEEE, 2020.

[2] Subetha T, et al., "An Early Prediction and Detection of Alzheimer's Disease: A Comparative Analysis on Various Assistive Technologies." 2020 International Conference on Computational Intelligence for Smart Power System and Sustainable Energy (CISPSSE). IEEE, 2020

[3] Chiara Fornari, et al., “Diagnostic accuracy of the five-word test for mild cognitive impairment due to Alzheimer’s disease,” Neurology International, Vol. 14, pp. 357-367, 2022.

[4] Farina, et al., “Translation, Adaptation and Validation of the Five-Word Test (Test Delle 5 Parole, T5P) in an Italian Sample: A Rapid Screening for the Assessment of Memory Impairment,” Geriatrics, Vol. 7, Issue2, pp. 49-56, 2022.

[5] Rozzini Luca, et al., “The Italian version of the five-word test: A simple diagnostic test for Dementia due to Alzheimer’s Disease in routine clinical practice,” Behavioural Neurology , pp. 1-6, 2020.

[6] Randa Ben, et al., “Language-related features for early detection of Alzheimer disease,” Procedia Computer Science, Vol. 176, pp. 763-770, 2020.

[7] De Simone, et al., “Predicting progression to Alzheimer’s disease in subjects with amnestic mild cognitive impairment using performance on recall and recognition tests,” Journal of neurology, Vol. 266, pp. 102-111, 2020.

[8] Croisile B, et al., “The five-word test in three age-groups of mild Alzheimer's disease (60, 70 and 80 year-old patients),” Revue Neurologique, Vol. 8, Issue 9, pp. 711-720, 2019.

[9] Mormont, et al., “Validity of the five-word test for the evaluation of verbal episodic memory and dementia in a memory clinic setting,” Journal of Geriatric Psychiatry and Neurology, Vol. 25, Issue 2, pp. 78-84,2017.

[10] Croisile B, et al., “The 5-word test in 37 depressed patients compared with 36 normal controls and 35 patients with mild Alzheimer's disease,” L'encephale, Vol. 37, Issue 2, pp. 127-132, 2017.

[11] R.Divya et al, “Indoor & Outdoor Navigation system for Visually Impaired People using Visible Light Communication and Image Processing” in International Journal of Innovation in Engineering Research & Management,Vol 05 ,Issue 02,April 2018,ISSN: 2348-4918

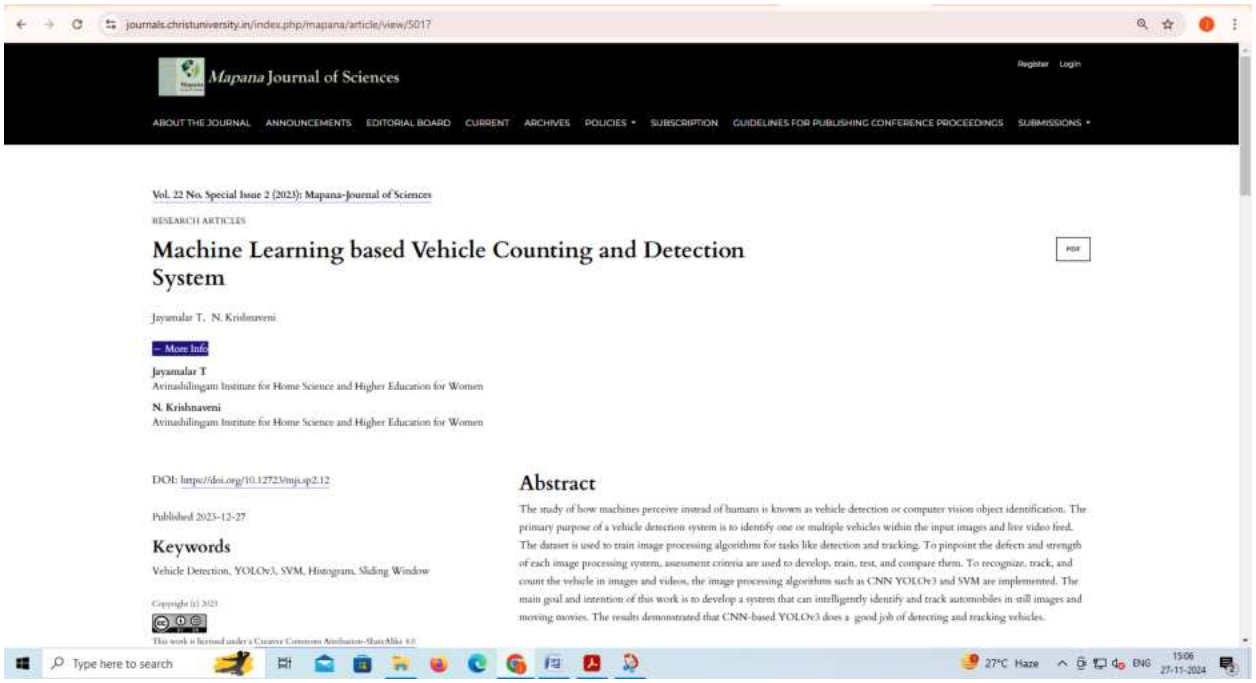
[12] Varadharajan G et al,”Smart Therapeutic treatment for varicose disease”, in International journal for research in applied science & engineering technology, Vol 9, Issue 1,page 161,Jan 2021.

[13] J.Anish Kumar et al “IoT Based Human Detection Robot for Rescue Operations” in Design Engineering , Vol 2021, Issue 8,page 4243,Oct 2021

[14] Madhavan G et al,”An UWB Radar for Trapped Human Detection and Vital Sign Extraction”, in International Journal of Applied Engineering Research 10 (29), 22448,2015

[15] Kalaiselvi U et al,”Camera based Assistive Text Reading System using Gradient and Stroke Orientation for Blind Person”, in International Journal of Latest Trends in Engineering and Technology 4 (1), 325,2014

[16] J GodlyGini et al,” A Model-Based Validation Scheme for Organ Segmentation in CT Scan”in International Journal Research in Electrical Engineering, Volume 04, Issue 02, Year 2017, ISSN No: 2349-2503 Page no: 4-9



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RESEARCH ARTICLES

Machine Learning based Vehicle Counting and Detection System

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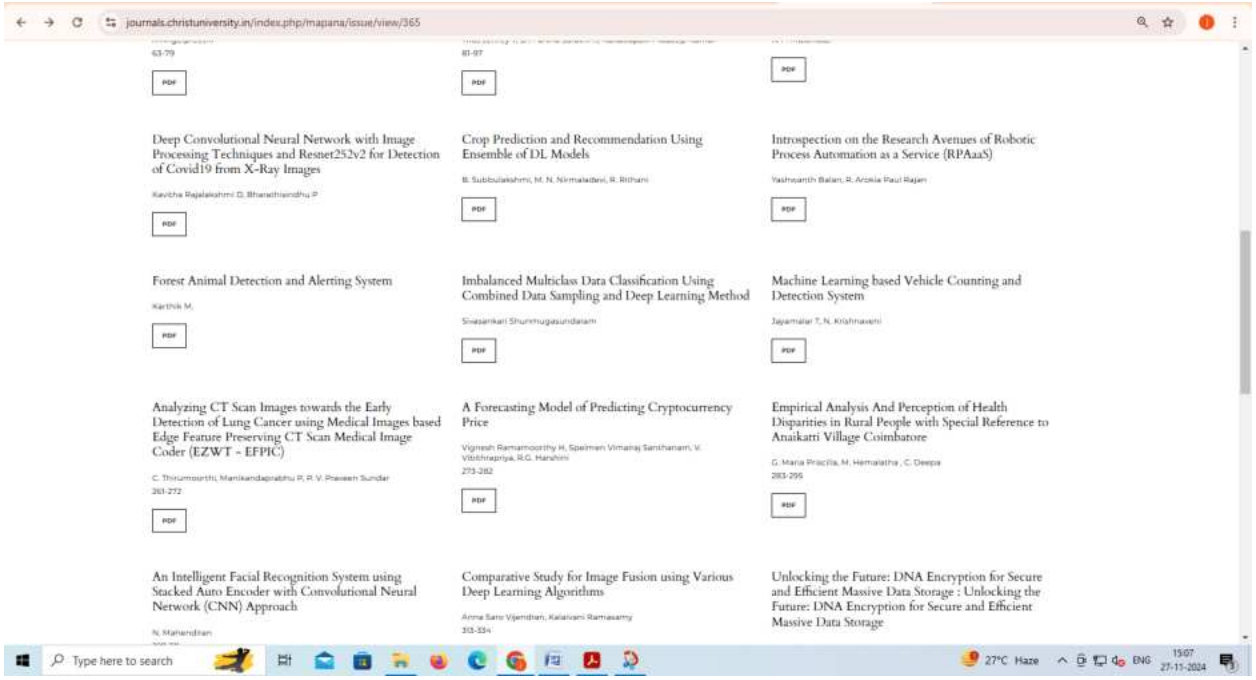
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Abstract

The study of how machines perceive instead of humans is known as vehicle detection or computer vision object identification. The primary purpose of a vehicle detection system is to identify one or multiple vehicles within the input images and live video feed. The dataset is used to train image processing algorithms for tasks like detection and tracking. To pinpoint the defects and strength of each image processing system, assessment criteria are used to develop, train, test, and compare them. To recognize, track, and count the vehicle in images and videos, the image processing algorithms such as CNN YOLOv3 and SVM are implemented. The main goal and intention of this work is to develop a system that can intelligently identify and track automobiles in still images and moving movies. The results demonstrated that CNN-based YOLOv3 does a good job of detecting and tracking vehicles.

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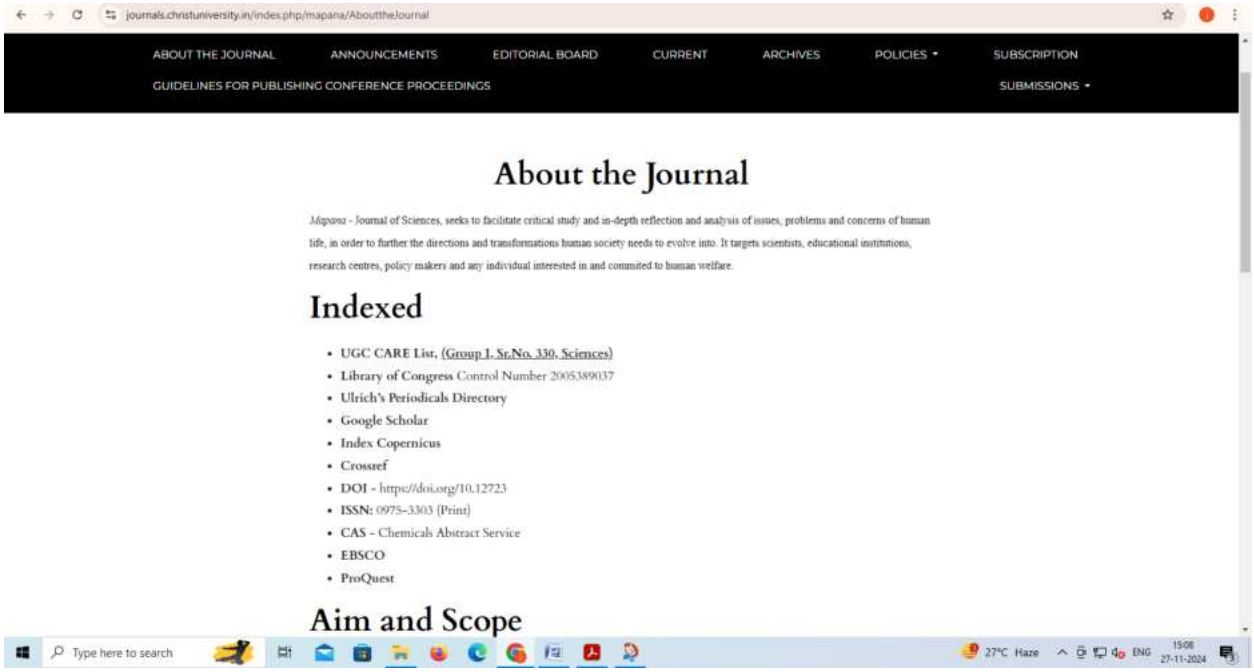
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DIGITALIZATION OF THE INDIAN FINANCIAL SECTOR

Volume - 4

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DIGITALIZED TOLL PAYMENT SYSTEM: EXAMINING THE CONSTRAINTS IN NETC FASTAG

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Abstract

The Digital Era is defined as a period in which technology increases the speediness and extensiveness of knowledge incomings within the economy. As digital technologies improve and scalability becomes ubiquitous, technology has been integrated to transform almost all sectors of the Indian economy rapidly and radically. India is making progress towards becoming a digitally advanced country through a series of actions. The Government prioritises digital strategies and initiatives on their policy agendas, with the authorities tackling a wide range of policy concerns to ensure the smooth development of the digital economy. The National Highway Authority of India (NHAI) introduced National Electronic Toll Collection (NETC) program FASTag, An RFID-based technology, to the toll plazas in India. In many aspects, it is more favourable to the economy than the traditional system. Today's technological advancements offer great promises, but they also bring new challenges. Similarly, there are various issues with this modern digital toll collection system. The primary goal of this study is to identify the obstacles that passengers encounter in using FASTag to cross the tolls, and a survey was conducted among the general public to gauge their satisfaction level with its implementation. The findings revealed some of the users' frequent challenges and 53% were satisfied with this application. In addition, the study sheds light on ways to improve the public acceptability of the FASTag application.

Keywords: *NETC FASTag, RFID Technology, Digital, Toll Collection System, NHAI*

Introduction

In our history, digital technologies are advancing faster than any innovation within two decades it has reached around 50 per cent of the developing world's population and transformed societies. By increasing connectivity, access to public services and trade and financial inclusion, technology will be better balanced. When the COVID-19 pandemic erupted, most of the world moved online, accelerating the digital transformation that has been going on for decades (Tregua et al., 2021). Technology has become a significant part of many fields even before the pandemic. Now-a-days all organizations are working through their digital services and providing more digital services as well. During pandemics, customers have expressed their desire to receive services with no or little contact with people or engage in contact-limited activities.

Digitization has spread to several areas. The Ministry of Road Transport and Highways' key body, the National Highways Authority of India has introduced FASTag,

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RECENT TRENDS AND CHALLENGES IN MULTI-DISCIPLINARY RESEARCH

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TRANSFORMATIVE PARADIGMS: DIGITAL REVOLUTION RESHAPING INDIA'S PAYMENT LANDSCAPE

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ABSTRACT

India has experienced a tremendous digital revolution, with greater connection and technological prowess resulting in greater digital accessibility and inclusivity for its people. There has been a noticeable shift in the nation towards digital transactions, which may be attributed to a number of factors, including government initiatives, technological improvements, rising smartphone adoption rates, and shifting consumer behaviour. India's retail payment system has undergone a substantial and continuous digital revolution. India has seen a sharp increase in retail digital payments in recent years. As per the RBI data, the percentage of digital transactions in all non-cash retail payment volumes increased to 98.5% in 2020–21. According to a study report, "India Payments Market Report 2021-2027: Digitization in Payments has Gained Significant Momentum," it is anticipated that the Indian payment market will attain a valuation of Rs 280.84 trillion through 2027. There are a few important facets of India's retail payment system's digital revolution, and they have been discussed in this paper.

Keywords: *Digital Transformation, Retail Payments, Digital Payments, Cashless*



EMERGING BUSINESS TRENDS AND MANAGEMENT PRACTICES

Editors

Dr.A.Anitha

Mrs.R.C.Shantha Kumari

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TECHNOLOGICAL ADVANCEMENTS IN THE TOLL COLLECTION SYSTEM IN INDIA

Sukritha K R
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Abstract

The Indian economy has grown as a result of technologies, which are a vital component of the economy. They range from manufacturing and agriculture to communication and transportation. The quality of life will also be enhanced by technological progress, which also enables more ecologically conscious decision-making. The expansion of the economy is fueled by emerging technologies. The adoption of new technologies has played a significant role in the recent rapid economic expansion of India. The economy is undergoing technical advancements in every industry. In India, a fee is levied for each toll road, toll highway, etc. in order to recoup the cost of building and maintaining the toll facility. As a result, it levies a toll tax and other fees to cover the costs of operating and maintaining newly built toll roads. India has a vast network of 480+ toll roads that span 23 states and union territories. The National Highway Authority of India (NHAI) owns the majority of them, while private concessionaires have been given the responsibility of maintaining and collecting tolls on some of them. The toll collection system in the country has seen technical advancements, moving from a manual toll collection system to an electronic toll collection system. This study also addresses new advances in the Indian toll-collecting system.

Keywords: FASTag, RFID, ETC, Banks, Technology, Digital

Introduction

Human society has been impacted by every single technological advancement, even those that have failed. As "Necessity is the mother of invention", every technology has been built in order to meet societal demands, and as a result, it is inextricably related to the culture and behaviour of the people who inhabit the civilization. (Brainspire, October 24, 2019). A society makes social progress when it can develop new technologies and incorporate them into its social and cultural activities(Younus, Ahmed Muayad 2021).

Digital banking has advanced significantly in the current era with reduced turnaround time. The extraordinary rise of many digital payment systems, including card payments, E-payments, payment gateways, electronic fund transfers, wallets, mobile money, smart cards, etc., is primarily responsible for the success of e-commerce(Jacob 2018). India's tale of digital transformation is one of digital empowerment and inclusion, as digital transformation is founded on technology that is accessible, inclusive, and developing. All of this makes sure that the residents' ease of living is at the centre of Digital India, which has the goal of Minimum Government, Maximum Governance. Technology to transform a connected nation: Digital India, a report from the McKinsey Global Institute, emphasises the nation's hasty adoption of electronic technologies and their potential economic worth by 2025. If the public and commercial sectors collaborate to establish new digital

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Trends in Business, Economics and Management

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Dr. Arjun Gope
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RUPAY: INDIAN MULTINATIONAL FINANCIAL SERVICE PAYMENT NETWORK: A DOMESTIC SUBSTITUTE TO VISA AND MASTERCARD

Sukritha K R

V.Vimala

Abstract

According to estimates, the value of card payments in India rose by a significant 26.7% in 2022 due to improving economic circumstances and a post-pandemic boom in consumer spending. The Reserve Bank of India (RBI) introduced RuPay, a global payment network for Indian financial services, in 2012. It is an effort to increase retail payments in India by the National Payment Corporation of India (NPCI). It was established as a domestic substitute for international real-time payment processing companies like Visa and MasterCard. RuPay has gained a sizeable market share in the Indian card industry since its inception. It provides

Dr. Arjun Gope, Ph. D., M. Com (Gold medalist), MBA (Finance), works as Associate Professor at Ramthakur College, Tripura. He has been teaching different subjects of Commerce and Management for more than last nineteen years. He has authored eight books till date among which three are edited volumes. He has several research paper publications in various journals and edited books. He has delivered lectures at different state and national level programmes being a resource person. He has acted as Organising Secretary of different seminars and workshops. Dr. Gope has been awarded prestigious best paper awards at both National and International conferences.

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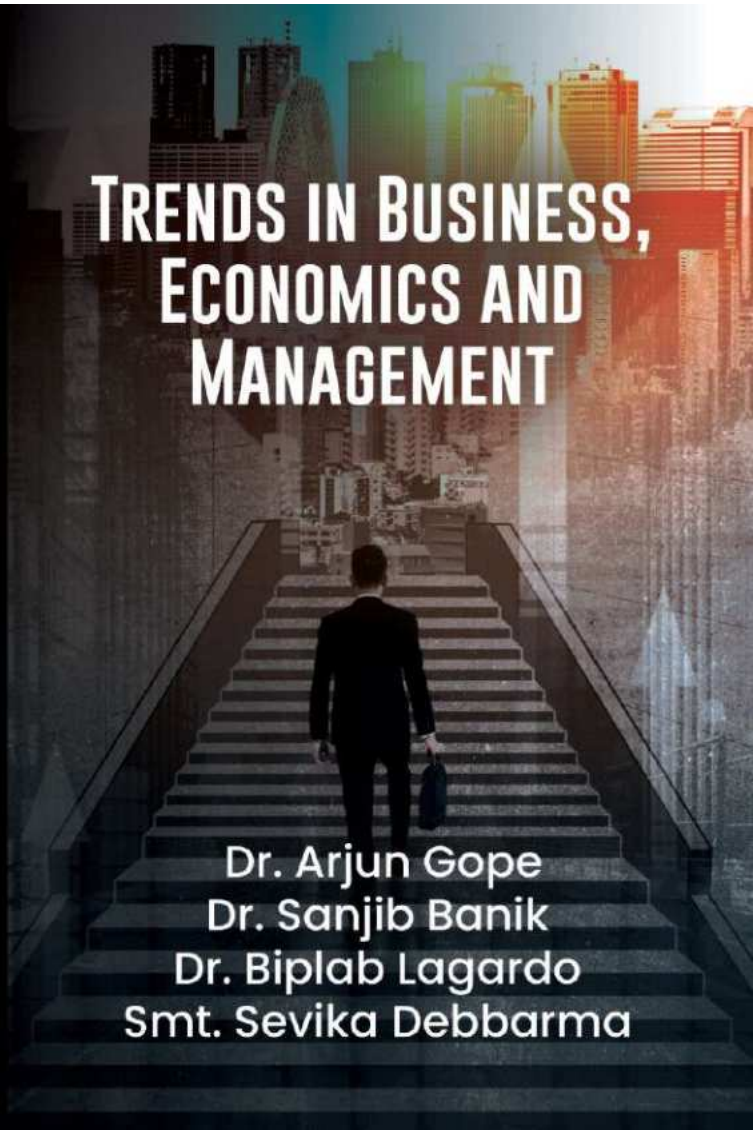
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TRENDS IN BUSINESS, ECONOMICS AND MANAGEMENT



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Dr. M.Sumathy currently working as Professor & Head, Department of Commerce, Former Dean, School of Commerce, Bharathiar University, Coimbatore, Tamil Nadu has taught Commerce and Management Subjects for three decades. Under her Supervision, 52 M.Phil. and 22 Ph.D Scholars have been awarded. She authored 16 Books including edited Volumes and Textbooks. She has published 206 research papers including Chapters in various National, International, Refereed, Peer-Reviewed, Scopus, and Web of Science Journals with high impact factor. She has been registered six copyrights. She acted as a resource person in 135 national and international invited lectures. She is a member of the Editorial Board and Review Board for 15 National and International journals and the Life Member of All India Commerce Association, (ICA) TN 029 Association of Economists of Tamil Nadu, (AET) All India Accounting Association, Indian Institute of Public Administration, New Delhi (IPA) Regional Association for Women Studies (RAWS) Indian Academic Researchers Association (IARA). In recognition of the outstanding contributions made, the Tamil Nadu State Council for Science and Technology is privileged to confer her Esteemed TANSA Award in the Social Sciences Category for the year 2019 and also bestowed Winner in 1st ICSI Gurushreshtha Award 2022 under the Commerce Category.

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CONTEMPORARY ISSUES AND TRENDS IN DIGITAL MARKETING

Dr.G.Anitha Rathna **Dr. M.Sumathy**



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INITIATIVES TOWARDS SUSTAINABILITY: A STUDY ON THE INDIAN BANKING SECTOR

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ABSTRACT

The banking sector contributes significantly to the development of a sustainable ecosystem. We can achieve sustainable development with a practical framework of economic tools and cost-effective regulation. Stringent environmental policies, customer boycotts, or lawsuits can threaten a firm's survival. Therefore, it is always preferable for businesses to function within a framework that promotes sustainable development. This study emphasizes the significance and dominance of Sustainable banking, promoting sustainable financial practices and economic growth in India. The perception of clients and bankers toward Sustainable development in Indian banks has not been the subject of much research. This research focuses on comprehending both the customer's and bankers' perceptions of green banking services and their degree of satisfaction, efficacy, advantages, and limitations of Sustainable banking. The study's findings are meant to assist policymakers in comprehending the effectiveness of green banking services. They will also help them identify areas that need development, and this paper opens up many opportunities for learning about the client. The study will assist the government in creating better regulations that will aid the banking sector in implementing these technology-based services successfully.

Keywords: Banking sector, Sustainable Development, Green sustainable, Strategies, Policies

I. INTRODUCTION

For sustainable development adaptation, the banking industry is a significant key drive in any country's economy. Banks have been focusing on more proactive strategies for the last two decades for handling sustainability issues in banking worldwide(Jeucken & Bouma, 1999). Sustainable practices adaptation is the growing demand, creating more business opportunities for the banking system. Similarly, adopting sustainable banking practices becomes authoritative in the banking sector(Rehman et al., 2021). Specifically,

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ESG REGULATION AND COMPLIANCE

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BUSINESS RESPONSIBILITY AND SUSTAINABILITY REPORTING: ALIGNING ESG FRAMEWORK TO TRACE SUSTAINABLE DEVELOPMENT GOALS

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The increasing global focus on Sustainability and Climate Change has prompted businesses to embrace their responsibility towards Environmental, Social, and Governance (ESG) factors. As part of the environmental and social commitments, corporates are voluntarily adopting sustainability reporting to communicate their efforts in aligning with the Sustainable Development Goals (SDGs). Environmental, Social, and Governance factors have become increasingly important in investment and financial decision-making, resulting in the emergence of ESG Rating Providers (ERPs) that assess and rate companies based on their ESG performance. However, the lack of standardization, transparency, and accountability in the ERP industry raises concerns about the reliability and credibility of ESG ratings and scores. Business Responsibility and Sustainable Reporting (BRSR) has emerged as a vital tool for promoting transparency, accountability, and sustainability in corporate practices. This paper provides a conceptual framework by analysing the significance of BRSR in integrating ESG frameworks into sustainability reporting to effectively trace progress of the economy towards the attainment of SDGs. It examines the challenges faced by businesses in aligning their ESG practices with the SDGs and emphasizes the mandatory reporting requirement of BRSR introduced by SEBI that enables transparent and measurable impact assessment. Besides, it provides valuable insights for the corporates, investors, policymakers, and other stakeholders interested in advancing corporate sustainability practices, promoting responsible business conduct and thereby contribute towards accomplishing SDGs. In addition, it intends to encourage the Mid-cap and Small-cap Corporates to adopt voluntary ESG Reporting to reinforce long-term sustainability along with financial growth.

Keywords: ESG Framework, BRSR, Sustainable Finance, Responsible Investing, SDGs

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CARING AND COMPLIANCES IN DOING RESPONSIBLE BUSINESS

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Indian companies also are part of the ESG compliances based on a set of indicators. The ability of an organization is dependent upon the policy frame and model designed. Many firms are empowered to access capital at a lower cost by building investors' confidence. Indian businesses are committed to ESG principles but their preparedness and action plan reveals a gap. Only 15% believe their suppliers are prepared to comply with organizations based on the principles of ESG. The idea of ESG and sustainability compliance is heatedly discussed in global meets and summits. The challenge here is aligning the policy, the obligation to 3 pillar parameters and commitment is what is looked for. So, who could guide companies at this incessant stage? Guidelines initiated by the Ministry of Corporate Affairs in harmonization with central and state ministries have drafted the National Action Plan on Business and Human Rights. Based on the discussion firstly, the research paper would overview the ESG scenario from a global perspective as well as Indian readiness for ESG compliances. Secondly, it would examine those organizations being part of world sustainable membership and if they have met the ESG requirements with adaptive model designs. Not all Indian firms have been ranked on the top, while a few companies are yet to board. In this context, selective firms from the Indian context are analysed. Lastly, the research paper would conclude those practices that would improve confidence.

Keywords: Model Framework, Indicators, Sustainability, Principles, Policy

Social and Sustainable Innovations in Commerce and Management



Editors

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Chapter 47
ENVIRONMENTAL, SOCIAL AND GOVERNANCE (ESG) REPORTING: BOARD HAS TO HAVE 'BROAD SHOULDERS'

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ABSTRACT

ESG represents a company's operational interest that emphasises on creating a sustainable impact on environment and society, alongside the financial returns. Progressive investors take the role of Impact Investors, demanding a greater emphasis on sustainability and for improved executive responsibility, that are expected to put more pressure on Boards to strengthen their ESG credentials. Although it is clear that Boards are in charge of sustainability and ESG compliance, how they carry out these duties varies greatly based on the business, the industry, and the organisational framework. Compared to social aspects, consensus on measurements and reporting systems has so far intensified more quickly for environmental issues. The data, metrics and reporting requirements that are most pertinent to governance may, however, become more convergent in the years to come. There may also be increased need to ensure that these metrics also evaluate effect rather than just inputs. This will further increase the significance of ESG to credit.

Keywords: ESG, Sustainability, Impact Investors, Board Roles and Responsibilities.

1. INTRODUCTION

Environmental, Social and Governance (ESG) is a topic for brainstorming discussion in any major Board Meetings. ESG is a phrase used to describe how a corporate operates while taking ethical and sustainable implications into consideration. Contribution of an organisation towards sustainability by considering Environmental, Social and Governance concerns is explored by stakeholders with the help of ESG framework. With an increasing emphasis on Sustainability and Greening in the global economy, ESG compliance is not any further limited to the Large-Cap companies, but for every organisation having a long-term vision for success. As a significant contribution to sustainable development, corporate sector has to incorporate into its' strategy, Environmental, Social and Governance elements, that are widely recognised for assessing effect and sustainability of investments.

Aligning the business practices with ESG principles helps in accelerating organisational goals while reinforcing brand value in addition to the bottom line. ESG standards have become a popular technique to gauge a company's social and environmental effect. Implementing, monitoring, reporting, and ensuring standards that precisely describe and quantify the ESG progress are essential as businesses quickly seek ESG initiatives to support their values and satisfy the stakeholders of the organisation. These ESG variables are taken into account as non-financial performance indicators of a company's efficiency and effectiveness.

2. STATEMENT OF THE PROBLEM

Despite the increasing focus on sustainability, many Indian Companies are still at an infant stage of framing ESG strategies. Board is considered to have broad-shoulders to take the responsibility of adhering to ESG and corporate governance framework. In reality, organisations run the danger of losing a critical chance to fully exploit the potential that comes with integrating concrete corporate governance

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Dear Readers,

Greetings from the Mapana Journal of Sciences,

On behalf of our editorial team, I am pleased to present you with the special issue of the Mapana Journal of Sciences for 2023. The mission of the Mapana Journal of Sciences (MJS) has always been to publish innovative research and review papers in the broad field of science. We're proud to continue this trend with our most recent release.

In this special issue, we delve into the dynamic landscape of innovative research ideas with a perfect blend of implementation and proven works. Moreover, we examine the reflective implications of various sustainable technologies on different applications and research avenues.

Paulin and co-investigators introduce how the conventional approach to defect detection in magnetic resonance brain images relies on manual human inspection, a method rendered impractical due to the sheer volume of data. The author outlines an approach to detecting and classifying brain tumours within patient MRI images. Additionally, the article reports a performance comparison of Convolutional Neural Network (CNN) models in this context.

Rajesh Kumar and co-investigators conducted a detailed study that comprehensively overviews lossless and lossy image coding techniques. The methods are divided into many groups, and a taxonomy of techniques is repeated. The different compression techniques are compared in this study. The compression algorithm performance evaluation parameters are presented. The main issues discovered during the current research are then reviewed, and potential directions for the future are discussed.

Nilesh Patil and co-investigators introduces MedicHub – Disease Detection using Deep Learning, where the integration of technology in healthcare is rapidly revolutionizing the sector and transforming through Machine Learning. This technique offers patients a very reliable and accessible alternative for immediate results and also minimizes the risk of errors. Another excellent utility of technology is in the discipline of medical image analysis. Convolutional Neural Networks (CNN) are neural networks which are capable of



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2D ENCODING CONVOLUTION NEURAL NETWORK ALGORITHM FOR BRAIN TUMOR PREDICTION

Dr. F. Paulin *, Dr. P. Lakshmi†

Abstract

In contemporary times, biomedical imaging plays a pivotal role in addressing various patient-related concerns. It serves as a vital tool for enhancing the diagnosis and treatment of a wide array of medical conditions. Within the realm of medical image analysis, the examination of brain images takes precedence. Brain imaging, particularly through techniques like MRI, offers valuable insights crucial for surgical procedures, radiotherapy, treatment planning, and stereotactic neurosurgery. To facilitate the accurate identification of cancerous cells within the brain using MRI, deep learning and image classification techniques have been deployed. These technologies have paved the way for the development of automated tumor detection methods, which not only save valuable time for radiologists but also consistently deliver proven

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NEURAL STYLE TRANSFER

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Abstract— The project titled *"NEURAL STYLE TRANSFER"* " describes a method for converting common photographs into works of art by using a style image to determine the style to be transferred and a content image to which the style is to be applied. In this project, using the Python-based Keras library and the *CNN* (Convolutional Neural Network) VGG-19 model. It intends to provide differentiation between style representations and content images for Deep Learning models. The content and style images are combined on the opposite side, giving the impression that the content image has been "Painted" in the manner of the style reference image. It is a computer vision application involving deep convolutional neural networks and image processing methods. The content loss is the mean squared error between the features of the content and the generated image. We use the VGG-19 model feature extractor to calculate the content loss and style loss using the features extracted from the content and style images. The style loss is the mean squared difference between the feature extraction from the style image and the generated image in the Gram matrices. By determining the correlation between the various feature maps, we employ Gram matrix is used to capture the style information of a picture on the other side.

Keywords—content image, pytorch, style image, content loss, style loss.

I. INTRODUCTION

Neural Style Transfer focuses on PyTorch implementation of neural style transfer. An application of deep learning called neural style transfer enables us to blend the style of one image with the content of another image. Understanding the neural style transfer process and how it might be applied to produce beautiful images is the aim of this.

The pre-trained VGG-19 network, a convolutional neural network that has been trained on millions of photos for object detection, is loaded first in this process. A pre-trained convolutional neural network is utilised in this method, which is based on the neural style transfer algorithm, to extract features from both the content image and the style image. The algorithm operates by minimising a total loss function, which is composed of the sum of two individual loss functions, namely, content loss and style loss. In order to achieve the required style transfer, the total loss is then minimised using an optimizer to update the target image. The Python programming language and PyTorch deep learning framework are used to carry out the project. To achieve neural style transfer, we make use of a number of PyTorch modules, including torch.nn, torch.optim, and torchvision.transforms. To demonstrate the effectiveness of the neural style transfer technique, a visualisation of the project's intermediate and final results is also provided.

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DEEP LEARNING WITH PYTORCH: SIAMESE NETWORK

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Abstract - *The project titled "DEEP LEARNING WITH PYTORCH: SIAMESE NETWORK" focuses on person re-identification (re-ID) as a challenging task in computer vision, which involves recognizing the same person across different camera views. Siamese Neural Networks (SNNs) are emerging as a popular approach for this task due to their ability to learn similarity rather than direct classification. In this approach, two parallel CNNs learn a reduced dimensional representation (embedding) of the input images and optimize a ranking loss function. The work provides an overview of the steps involved in person re-ID with SNNs, including data preparation, network architecture, training, testing, and deployment. The Triplet Ranking Loss function, a commonly used loss function for SNNs, is used. Siamese Neural Networks are a type of neural network architecture used for similarity-based learning tasks such as face recognition, image matching, and document similarity. The work provides a comprehensive guide on how to train a Siamese neural network for a similarity based task, specifically re-identifying photos from various cameras using the Siamese Neural Network (SNN).*

Keywords – re-identification, pytorch, feature learning, multi camera

I. INTRODUCTION

The project is a deep learning model used for person re-identification, which involves matching a person's identity across multiple non-overlapping camera views. In person re-identification, the Siamese network is used to train the model using pairs of images of the same person and pairs of images of different people. The network learns to map each image to a high-dimensional feature space in which similar images are closer together and dissimilar images are further apart. The images in the dataset are read and converted into PyTorch tensors. A custom dataset is created, which returns an anchor image, positive image, and negative image. These images are then passed through a custom data loader that returns batches of images. A custom model is defined, which uses an Efficient Net backbone to extract embedding from the input images. The model is then trained on the training set using a Triplet Margin Loss function, an Adam optimizer, and a learning rate of 0.001. The best model is saved during training, and the final model is evaluated on the validation.

This project was started with the goal of using stems from the need for accurate and reliable person re-identification in surveillance and security systems. Person re-identification is a challenging task due to the variations in appearance and lighting conditions, occlusion, and changes in posture and viewpoint. Deep learning-based methods, particularly those using Siamese networks, have shown promising results in addressing these challenges. The project aims to explore the use of a deep Siamese network with multi-layer similarity constraints for person re-identification using PyTorch. The motivation is to improve the accuracy and reliability of person re-identification in challenging

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OBJECT LOCALIZATION WITH TENSORFLOW

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Abstract

The TensorFlow framework will serve as the foundation for a deep learning model to create to locate and forecast pertinent emojis in textual data. In order to understand the contextual and semantic meaning of words and phrases in text, the suggested model makes use of convolutional neural networks (CNNs). For improved accuracy and performance, to use transfer learning techniques with pre-trained language models. The model is trained and tested on a large dataset of text-emoji pairings, and the results show that it is highly accurate and recallable when predicting emojis in context. The results of this study have important ramifications for applications that use emojis for communication in natural language processing, sentiment analysis, and social media monitoring

Keywords— convolutional neural networks (CNNs)

1. INTRODUCTION

1.1 COMPUTER VISION

Computer vision is a field of study that focuses on teaching computers to interpret and comprehend the visual world through the analysis of digital images and videos. It entails using algorithms and mathematical models to extract information from visual data and making decisions based on that information. Computer vision applications can be found in a variety of fields, including medical imaging, self-driving cars, security and surveillance, facial recognition, and entertainment. The use of computer vision has grown rapidly in recent years, thanks in part to the availability of large amounts of digital data, advances in machine learning, and the development of more powerful computing hardware.

1.1.1 OBJECT LOCALIZATION

The accuracy of object localization models is critical for many applications, as itdirectly affects their ability to correctly identify and track objects. These models are trained on large datasets with annotated bounding boxes, allowing them to learn to identify and localize objects in new images. To use emojis frequently in online communications. Nearly everyone on the planet can now recognize the tiny digital images. They can be found everywhere, including in emails, chat rooms, social media, and even print media, which is also regarded as a universal language. Emoji's primary function is to fill in the emotional cues that typed conversation lacks. Emoji can represent a wide range of things, including facial expressions, everyday objects, locations, weather patterns, and animals. Emoji are similar to emoticons in that they are images rather than approximate typographic representations. Although technically speaking, the term "emoji" refers to images that can be represented as encoded characters, it is also occasionally used to refer to messaging stickers.

A DEEP LEARNING APPROACH FOR HUMAN SEGMENTATION

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Abstract— *Human segmentation is a fundamental task in computer vision that aims to accurately identify and delineate human objects or regions within an image. This method is essential for many applications, including image editing, object recognition, and human-computer interaction. Deep learning technology has proven its ability in recent years great potential in solving segmentation challenges. One popular architecture for human segmentation is U-Net, a fully convolutional neural network (CNN) designed for semantic segmentation. U-Net's unique architecture, consisting of an encoder pathway for capturing contextual information and a decoder pathway for precise localization, allows it to effectively extract features and generate accurate segmentation masks. By leveraging U-Net's encoder-decoder structure, the model effectively captured contextual information and achieved precise localization. This allowed for accurate and reliable identification and delineation of human objects or regions within images. U-Net's ability to handle complex spatial relationships, occlusions, and variations in pose or appearance enabled robust human segmentation in diverse image scenarios. The integration of U-Net facilitated the automatic extraction of relevant features and the generation of accurate segmentation masks, contributing to the success of the human segmentation task.*

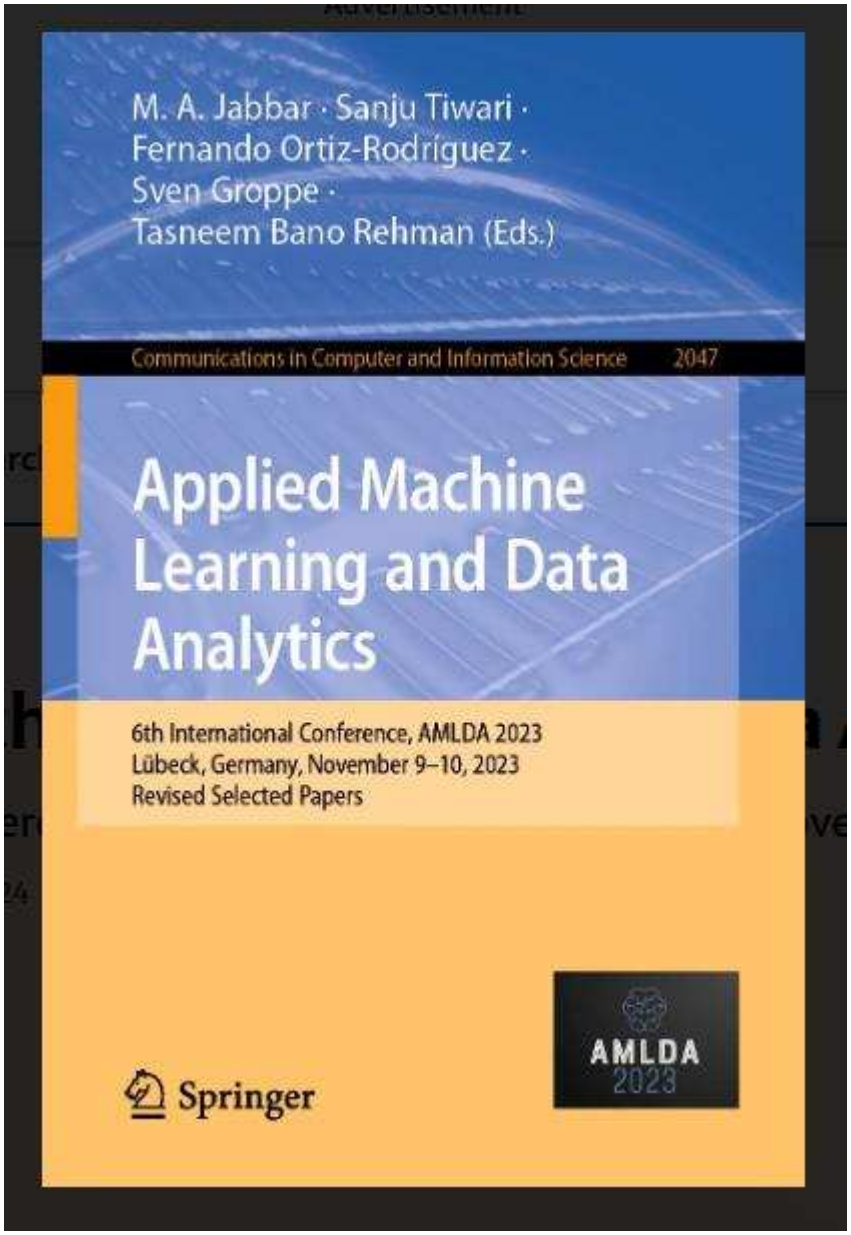
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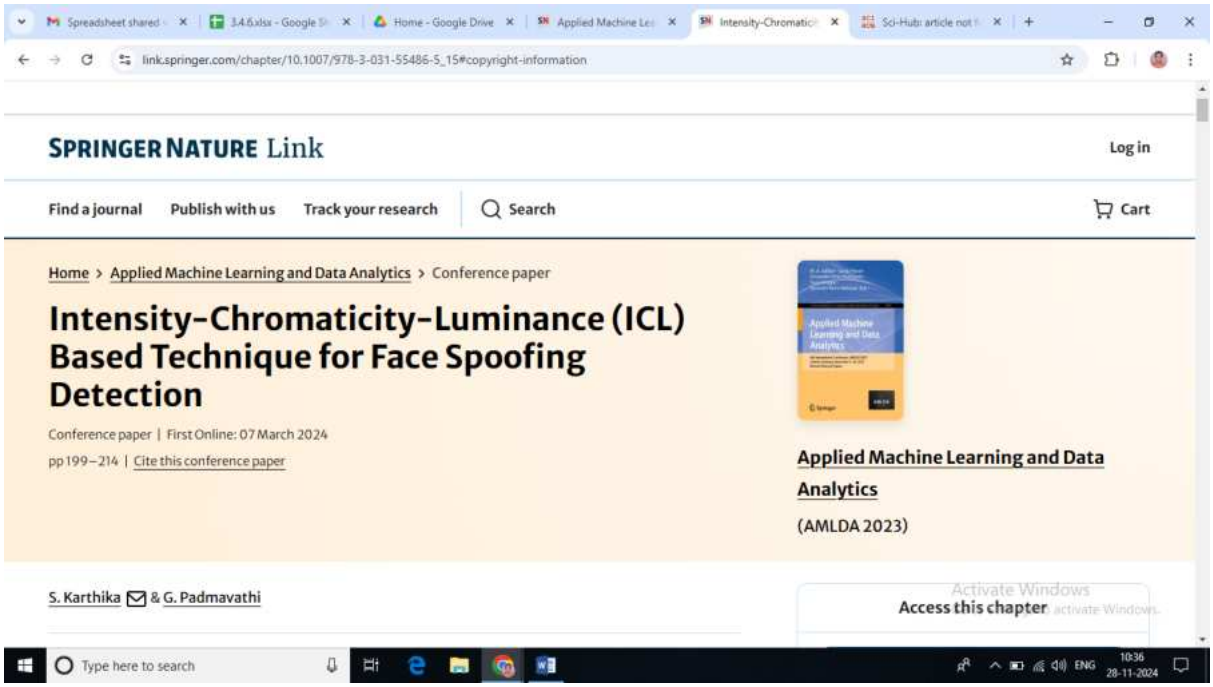
INTRODUCTION

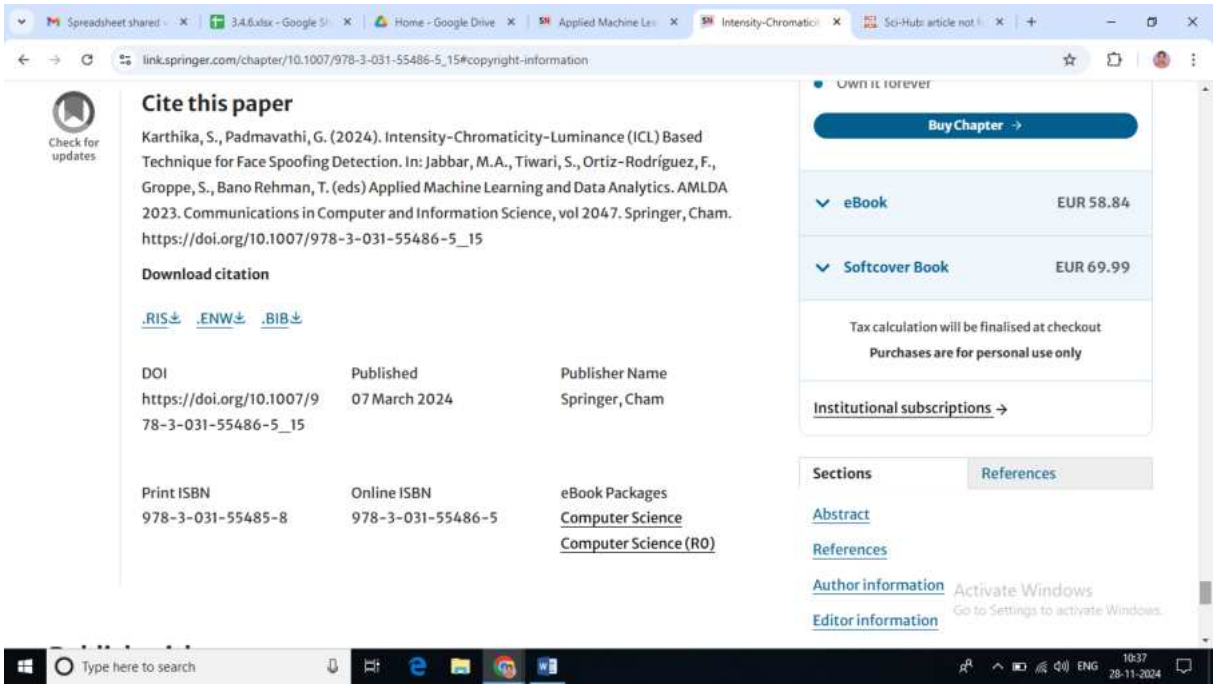
The technique of segmenting an image into several segments or areas is a crucial component of computer vision and image processing. It is a fundamental task for image analysis and understanding in a wide range of applications such as object recognition, medical imaging, and self-driving cars. Deep learning has revolutionized the field of image segmentation, and the use of convolutional neural networks (CNNs) has become the latest approach to semantic image segmentation. U-Net is a deep learning architecture that has shown good performance on semantic segmentation tasks, including human segmentation. Its design allows for the efficient processing of images while maintaining the spatial information necessary for accurate segmentation. Additionally, the U-Net is trained end-to-end, meaning that it learns to recognize relevant features and patterns in the data automatically, eliminating the need for complex algorithms and manual feature engineering. Therefore, the U-Net is a suitable solution for the limitations and disadvantages of the previously presented methods.The work of human segmentation is crucial to image processing, particularly in surveillance. Several methods have been suggested to enhance the efficacy and accuracy of human segmentation. Deep convolutional neural networks (CNNs) are one method that has demonstrated promise in automatically evaluating surveillance videos without the need for human interaction. Another technique is the use of interactive image segmentation methods such as Graph cut, Random walker, and Interactive image segmentation using geodesic star convexity, which employ algorithms such as Expectation Maximum algorithm and Gibbs random field to optimize the segmentation

Intensity-Chromaticity-Luminance (ICL) Based Technique for Face Spoofing Detection




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Fernando Ortiz-Rodríguez ·
Sven Groppe ·
Tasneem Bano Rehman (Eds.)
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Analysis of Machine Learning Approaches to Detect Pedestrian Under Different Scale Using Frame Level Difference Feature

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Abstract. Over the last 20 years, automotive technology has advanced to the point where automated systems can currently handle various aspects of vehicle control. Due to traffic congestion, pedestrians are particularly vulnerable and they collide with the vehicle's front end. In recent years, the legal standards and consumer protection assessments for pedestrian protection have gotten much stronger. Sensor technology that must reliably detect an impact between a vehicle and a person has substantial hurdles as a result. Computer vision-based technologies play an important role in the enhancement strategies of automation industries like the Advanced Driver Assistant System (ADAS) by identifying and tracking people on the road. During the process of pedestrian identification, human characteristics are a key factor in determining accuracy. The extraction of features to identify the pedestrians from the video images is a difficult task. In this paper, a per-frame evaluation methodology is taken in hand to make in depth and insightful comparisons among state of art detection techniques with FLD features. This investigates the detection rates at different scales. The experiments that are conducted with the help of Caltech pedestrian dataset. The recognition accuracy is compared and evaluated by avoiding a higher number of erroneous hits and a higher percentage of miss rates.

Keywords: ADAS · Pedestrian Detection · Feature Extraction · FLD Features · Scale variants

1 Introduction

Recent automobile accidents are primarily caused by human errors, which can be avoided by deploying advanced driver assistance systems (ADAS). This technique is used to identify pedestrians close to a vehicle. By giving the driver an early warning, this device aims to lower the amount of accidents involving pedestrians. Several sen sors, including cameras, radar, and lidar, can be used to execute this technology to identify pedestrians within proximity. This was used to provide more reliable and accurate detection. This

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A Survey on Spoofing and Selective Forwarding Attacks on Zigbee Based WSN

D. Shanmugapriya*, D Nethra Pingala Suthishni*,
V. Sasirekha†, G. Padmavathi‡ and M. Keerthika‡

Abstract

The main focus of WSN is to gather data from the physical world. It is often deployed for sensing, processing as well as disseminating information of the targeted physical environments. The main objective of the WSN is to collect data from the target environment using sensors as well as transmit those data to the desired place of choice. In order to achieve an efficient performance, WSN should have efficient as well as reliable networking protocols. The most popular technology behind WSN is Zigbee. In this paper a pilot study is done on important security issues on spoofing and selective forwarding attack on Zigbee based WSN. This paper identifies the security vulnerabilities of Zigbee network and gaps in the existing methodologies to address the security issues and will help the future researchers to narrow down their research in WSN.

Keywords: Zigbee, WSN, Protocol Stack, Spoofing and Selective Forwarding.

1. Introduction

Wireless Sensor Networks (WSN) can be defined as infrastructure-less and self-configured wireless network for observing environmental or physical conditions like pressure, motion, temperature, pollutants, sound or vibration as well as to directly

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NETWORK TRAFFIC ANALYSIS BASED ON WIRESHARK USING TIME SERIES ARIMA MODEL

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Abstract *- Due to the evolvement of computer networks, it is the need of the hour to capture and analyze the network traffic in order to identify the vulnerable threats. To capture the real-time network traffic, wireshark network packet analyzer is used to collect the data. Based on the received network traffic, the static network packet analysis is carried out by the means of graphical representations. The time series analysis of the real-time network traffic data is then used to create a proper time series model. Applying the techniques required to create an appropriate time series model for network traffic analysis furthers this study's work. Based on the significance of the data, to examine the network traffic patterns based on the suitable series, the ARIMA (Auto Regressive Integrated Moving Average) model is developed. The ARIMA model address the time series network traffic analysis based on the parameters such as time, protocol type, source and destination address.*

The model performance is the assessed using various metrics includes the Ljung-Box test, the Jarque-Bera test, and the root mean squared error (RMSE). Through this analysis, it demonstrates the effectiveness of the suggested approach in identifying underlying patterns and trends in network traffic data, which may be utilized to analyze and forecast network traffic patterns effectively. Hence the Developed ARIMA model supports to identify the network traffic patterns with the significant score of Ljung-Box test with 91.87, Jarque-Bera test with 10358350.40 and Root Mean Squared Error with 4413.019783241207 values.

Keywords: ARIMA, Network Traffic Analysis, Packets, Time Series, Wireshark

I. INTRODUCTION

1.1 DESCRIPTION

Understanding and improving network performance, ensuring network security, and spotting unusual behaviour all depend on network traffic analysis. In order to obtain knowledge about a variety of topics, including communication patterns, bandwidth usage, application performance, and potential security concerns, it entails looking at the data packets moving over a network.

Network traffic analysis is greatly assisted by Wireshark, a popular open-source network protocol analyzer. It enables real-time network traffic collection, inspection, and analysis for network managers and analysts. A wide variety of protocols are supported by Wireshark, which also offers detailed information about each packet to facilitate in-depth analysis and problem-solving. Using a variety of protocols and interfaces, Wireshark enables the monitoring and capture of network traffic. It is possible to compile a thorough dataset that illustrates the communication patterns and behaviour within the network by recording network traffic.

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Application of Bit Coin in Accounting through Block chain Technology

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Abstract

Block chain Technology has the potential to revolutionize the way of recording accounting transactions. One of the most prominent uses of block chain technology is in the form of Bit coin, a decentralized digital currency that allows for peer-to-peer transactions without the need for intermediaries. The main aim of this paper is to explore the potential application of Bit coin in accounting through block chain technology. Block chain technology is a distributed database system that enables secure and transparent financial transactions. Bit coin a decentralized digital currency, is one of the most well-known applications of block chain technology. The use of Bit coin for payroll, invoicing, and payment results in reducing fraud and enhancing transparency in accounting. Overall the study aims to provide a comprehensive understanding of the credible application of Bit coin in accounting through block chain technology, including its benefit, challenges, and limitations. However, the high energy consumption required for proof-of-work consensus and the limited scalability of the system remains significant challenges for the widespread adoption of block chain technology and crypto currency has captured the attention of entrepreneurs, investors, and policymakers around the world. The probable adoption of Bit coin in future periods will also be assessed in this study.

Keywords: Bit coin, Block chain Technology, Crypto currency

Introduction

Currently, e-commerce and online companies are expanding quickly, and the majority of online payments are handled by reputable third parties. The financial institution acting as a third party has some restrictions and defects, including price, time, and storage in addition to concerns for safety. The transaction's irreversibility is not prevented to deal with mediating disputes. If the deals take place in person and with cash, all of these problems can be prevented. Since that is quickly changing, a new system without a centralized authority is required for the payments to be effective and fraud-free. The pandemic has increased the demand for new, cutting-edge technology that is also safe. In 2008, a similar electronic payment method was suggested. A person, group, or anonymous person with the name Satoshi Nakamoto suggested it. The idea behind Satoshi's plan was to use cryptographic-proof methods to create an electronic system that would enable parties to conduct transactions without the need for third parties. A new technology known as Block chain technology was created as a result of the invention. This technology is more adaptable because of its widespread use, versatility, usefulness, and accessibility. This technology eliminates the issue of double spending and the middleman in the funding process. It acts as a protocol for trading digital assets like Bit coin. Bit coin was the first crypto currency to use for trade.

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6

Immobilized Enzymes

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Abstract

Enzyme is a highly efficient catalyst that is produced by active cells. When compared to chemical catalysts; enzymes have a number of benefits, including high specificity, high catalytic efficiency and flexible activity, all of which greatly help to promote their use in the pharmaceutical, chemical, and food sectors. The majority of enzymes such as protease, amylase, lipase and cellulose are relatively unstable and industrial uses are frequently restricted by a lack of long-term operational stability as well as the technically challenging recovery process and ruse of the enzyme. Enzyme immobilization provides an excellent base for increasing enzyme availability to the substrate with higher turnover over a long period of time. Enzyme immobilization are done by several methods and their performance are influenced by many factors. Physical and chemical based immobilization are the most commonly used methods. The matrix immobilizes the enzyme by holding it permanently or temporarily for a short stretch of time. The generally used matrixes for immobilizations includes natural, synthetic polymers and inorganic compounds.Currently, synergistic interactions of biotechnology and nanotechnology are useful for the development of immobilized enzymes. Enzyme immobilization is a commonly used technology in a variety of industries including food, pharmaceuticals, bioremediation, detergents, and textiles due to technical and economical advantages. This chapter focuses on most commonly used immobilized techniques in industry with many recent applications of immobilized enzymes.

Introduction

Enzymes are proteins that aid in the speeding up of a variety of biochemical and chemical reactions. They are natural catalysts and found in plants, animals, and microorganisms, where they accelerate essential biological processes (Homaei *et al*., 2013).

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A Hybrid Speckle Reduction Model for Effective Noise Removal in Ultrasound Images

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***Abstract*—A hybrid speckle reduction model aiming to enhance the quality of ultrasound images by synergistically combining Speckle Reduction Anisotropic Diffusion (SRAD) and Deep Neural Network (DNN) architectures. The model employs SRAD as a pre-processing step to locally smooth ultrasound images, preserving structural details while reducing speckle noise. Subsequently, a DNN refines the images by learning intricate patterns associated with both noise and anatomical structures. The effectiveness of the proposed model is evaluated on four diverse ultrasound images, representing various anatomical regions. Performance metrics, including Signal-to-Noise Ratio (SNR) and Structural Similarity Index (SSI), are used to quantify improvements in image quality compared to traditional methods. Experimental results demonstrate that the hybrid model consistently outperforms existing techniques, showcasing its ability to reduce noise and preserve diagnostic information. This novel approach holds promise for improving diagnostic accuracy in ultrasound-based clinical applications. The integration of SRAD and DNN leverages their complementary strengths, offering a robust solution for effective speckle noise removal in ultrasound images. The proposed model stands as a valuable contribution to advancing the quality of medical imaging and ultimately enhancing patient care.**

***Index Terms* — speckle reduction, SRAD, DNN, ultrasound images.**

I. INTRODUCTION

In medical imaging, Ultrasound (US) stands out as an extensively utilized procedure. Its noteworthy advantages include being radiation-free and non-invasive, making it a versatile tool for scanning a diverse range of body tissues. This imaging technique finds applications in cardiology, gynecology, obstetrics, vascular imaging, abdominal imaging, and various other medical fields [3]. Despite its widespread use, US images often suffer from a common artifact known as speckle noise, which manifests as granular interference and can compromise the quality and interpretability of the images. Commercially available US systems or scanners operate on the principle of echo imaging. Using a handheld transducer/probe as a transceiver, pulses of acoustic waves, ranging from 1 MHz to 20 MHz, are transmitted into target tissues. The interaction of these acoustic waves with the tissues results in the reflection of some transmitted energy, which is then detected by the US transducers. Notable advantages of US imaging systems, distinguishing them from other medical imaging methods, include their cost-effectiveness compared to computed tomography and magnetic resonance imaging, real-time functionality, noninvasive and radiation-free nature, as well as being compact and portable. However, these systems have limitations, such as

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limited tissue penetration and the necessity for skilled sonographers or physicians to extract meaningful insights from the examination [4].
Speckle noise arises due to the interference of US waves scattered by tissues with random microstructures, resulting in a grainy appearance that obscures important anatomical details. Speckle noise reduction is a critical pre-processing step in ultrasound image analysis to enhance diagnostic accuracy and improve the overall quality of medical imaging. Various filtering techniques have been developed to address this challenge, each with its own advantages and limitations. The paper is organized to discuss the methodology in Section II, present results in Section III, and conclude the study in Section IV.

II. Literature Survey

Numerous studies have been conducted to address the challenge of speckle noise in ultrasound images, employing a range of noise reduction filters from classical approaches like Lee and Frost filters to more recent advancements in deep learning techniques. Speckle Reduction Anisotropic Diffusion (SRAD) has emerged as a preferred method in recent years for its effectiveness [2, 3]. While recent research predominantly focuses on deep learning techniques, one notable approach involves a complex wavelet-diffusion algorithm designed for noise reduction and edge preservation in both 2D and 3D ultrasound images. This method utilizes the Rayleigh model for 2D images and a mixture of the Maxwell model for 3D images, optimizing filter parameters with genetic algorithms. The experiments, conducted with various image databases, demonstrate the algorithm's efficacy in suppressing speckle noise across different image types, including physical phantom images and clinical images [1].
Additionally, a Feedforward Convolutional Neural Network (CNN), specifically the DnCNN, is employed for denoising, comparing resultant noisy images with ground truth images [4]. Another innovative approach introduces a new hybrid model utilizing SRAD along with Discrete Wavelet Transform (DWT) for speckle noise reduction. This model not only effectively preserves edges but also outperforms conventional methods, as evidenced by evaluations based on PSNR, SSIM, and MSE values. The evaluation involves diverse images such as Ultrasound, Airplane, Lena, Boat, Cameraman, and Pepper [2]. Table 1 gives the summary of various pre-processing techniques used for speckle reduction in ultrasound images. The method was executed by integrating bacterial foraging optimization (BFO) with wavelet transform and Wiener filter within a homomorphic framework. To tackle noise in affected pixels, the application employed wavelet packet decomposition, while the Wiener filter played a crucial role in pre-processing. The BFO algorithm was subsequently deployed to minimize the error between the speckled image and the despeckled output image obtained from the homomorphic framework post-processing. Its primary objective was to uphold finer details, and the considered error percentage was set at 0.0001 [7].
This study had presented a novel denoising approach, employing a Weberized non-local total bounded variational model rooted in the Retinex theory and tailored to the noise distribution. This perceptually driven model aimed to effectively enhance image contrast, achieving notable restoration while preserving intricate details inherent in the data. To optimize practical application, the numerical implementation of the model had adopted the Bregman formulation, enhancing convergence rates and mitigating sensitivity to parameters [11]. A Cauchy prior and Gaussian Probability Density Function (PDF) had been utilized to characterize the wavelet coefficients of a logarithmically transformed noise-free ultrasound image and speckle noise, respectively. Initially, the study had derived the Cauchy Shrink GMAP, a closed-form shrinkage function. Additionally, it had estimated the noise variance and the parameter of the MAP estimator. Subsequently, the despeckling performance of the wavelet image denoising method employing Cauchy Shrink GMAP had been assessed in comparison to various despeckling methods, including median and Wiener filters, hard and soft thresholding, and Gauss Shrink GMAP, and MCMAP3N shrinkage functions [12].

TABLE I SUMMARY OF PRE-PROCESSING TECHNIQUES

Author	Dataset	Filters	Evaluation Metrics
Muhammad Shahin Uddin et al., 2016	• **US image of the heart containing dual-chamber pacemaker,** • **US image of abdominal aorta**	Non-linear multi-scale complex wavelet diffusion. GA-EM model	SSIM, EdgeMSE, CNR, FoM, UIQI
Chen et al., 2019	• Synthetic images • **Thyroid US** • **Breast US** • **Liver US**	Super-pixel segmentation of bilateral filtering and detailed compensation.	PSNR, SSIM

	• **Spleen US**		
Hyunho Choi and Jechang Jeong,2020	• Airplane, Cameraman, Peppers, Man, Lena • Malignant Breast Lesion US image • **US Phantom image**	SRAD, Discrete Wavelet Transform, Weighted Guided Image Filtering, Gradient Domain Guided Image Filtering	PSNR, SSIM, SMPI, Computational Cost in seconds.
Dass. R, 2018	• Different noise densities of **US image**	Bacterial Foraging optimization (BFO) with wavelet and DWT in homomorphic region.	PSNR, MAE

III. METHODOLOGY

The integration of SRAD and DNNs presents a powerful approach for speckle noise reduction in ultrasound images. SRAD, with its ability to locally smooth images while preserving structural details, serves as an effective initial step in mitigating speckle noise. It excels in adaptability to the image's spatial characteristics, reducing noise without compromising crucial anatomical information. The subsequent application of DNNs builds upon this foundation, leveraging their capacity for complex feature learning to further refine the images. DNN excels in capturing intricate patterns associated with both speckle noise and underlying anatomical structures, making them adept at discerning nuanced details within ultrasound images. The synergy between SRAD and DNNs creates a hybrid model that combines the spatial adaptability of traditional filtering techniques with the sophisticated learning capabilities of neural networks, resulting in a comprehensive and robust solution for effective speckle noise reduction in ultrasound images. This hybrid model not only enhances image quality but also holds promise for advancing diagnostic accuracy in ultrasound-based clinical applications. Fig 1 shows the block diagram of the proposed system.

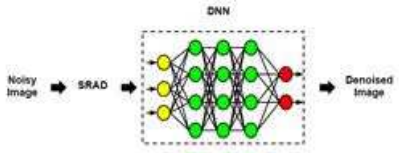


Fig 1 Proposed System

The hybrid model integrating SRAD and a DNN for speckle reduction in ultrasound images is designed to leverage the spatial adaptability of SRAD and the complex feature learning capabilities of DNNs. The hybrid model aims to enhance noise reduction while preserving important anatomical details.

A. SRAD

SRAD is employed as the initial processing step to locally smooth ultrasound images. The SRAD equation can be expressed as follows:

$$I_t = I_0 + \delta t \nabla . (\lambda(\nabla I_t) \nabla I_t \quad (1)$$

Here, I_t represents the image at time t, I_0 is the initial image, ∇ denotes the gradient, and λ is the edge-stopping function. The term δt represents the time step in the diffusion process.

B. DNN

The DNN is then applied to further refine the images obtained from the SRAD process. The architecture of the DNN involves multiple layers, including convolutional layers for feature extraction and fully connected layers for mapping extracted features to the output. The training of the DNN involves minimizing a loss function that captures the difference between the predicted and ground truth images. The DNN can be represented mathematically as:

$$Y = f(WX + b) \quad (2)$$

Here, X is the input image, W represents the weights, b is the bias, and f is the activation function.

C. HYBRID MODEL

The output of the SRAD process is denoted as I_{SRAD}, and the DNN output is denoted as I_{DNN}. The hybrid model combines these outputs to obtain the final denoised image I_{hybrid}:

$$I_{hybrid} = \alpha . I_{SRAD} + (1 - \alpha) . I_{DNN} \quad (3)$$

Here, α is a weighting parameter that controls the influence of each component in the final output. This allows for the adjustment of the balance between the spatial adaptability of SRAD and the learned features of the DNN in the denoising process.

The hybrid model is trained on a dataset of ultrasound images, with the goal of learning optimal parameters for both the SRAD and DNN components. The training involves minimizing a combined loss function that considers both the performance of SRAD in preserving structures and the ability of the DNN to learn complex features and denoise effectively. Once trained, the hybrid model can be applied to new ultrasound images for speckle reduction while preserving important diagnostic information. The learning parameters for SRAD and a DNN in the hybrid model for speckle reduction in ultrasound images are crucial components in optimizing the performance of both techniques. Below are the key learning parameters for each:

D. LEARNING PARAMETERS

1. SRAD

1. Time Step (δ): The time step controls the rate of diffusion in the SRAD process. It determines how quickly the speckle noise is smoothed over time. The choice of an appropriate time step is essential to balance noise reduction with the preservation of important structural details. The time step value is varied in the range of 0.1 to 0.5. However, the most optimal value is 0.28. When larger values are chosen, the noise reduction is efficient, but it lost some fine details in the image. Hence, an intermediate value is chosen for better accuracy and data preservation.

2. Edge-Stopping Function (λ): The edge-stopping function defines the strength of diffusion based on the local gradient magnitude. It plays a crucial role in preserving edges while reducing speckle noise. The choice of the edge-stopping function is vital for achieving an effective balance between noise reduction and edge preservation.

3. Number of Iterations: The number of iterations or diffusion steps determines how many times the SRAD process is applied to the image. It influences the overall effectiveness of speckle reduction but needs to be carefully chosen to avoid over-smoothing and loss of fine details.

2. DNN

1. Learning Rate: The learning rate controls the size of the steps taken during the optimization process while training the DNN. It is a crucial hyper-parameter that influences the convergence speed and stability of the training process. The learning rate is set to 0.0001.

2. Number of Layers and Neurons: The architecture of the DNN includes 3 layers and 10 neurons in each layer. Deeper networks with more neurons can capture complex features, but an optimal balance must be struck to prevent overfitting and computational inefficiency.

3. Activation Functions: The choice of activation functions in the DNN layers affects the non-linearity of the model and its ability to capture complex relationships in the data. The activation functions include ReLU (Rectified Linear Unit) and sigmoid functions.

4. Batch Size: The batch size determines the number of training samples used in each iteration of the training process. The selection of an appropriate batch size influences the training efficiency and generalization of the model. The batch size of the network is 128.

5. Optimizer: The optimizer algorithm, such as Stochastic Gradient Descent (SGD), dictates how the DNN adjusts its weights during training to minimize the loss function.

The optimal values for these parameters depend on the specific characteristics of the ultrasound images and the desired trade-off between noise reduction and preservation of diagnostic details. Experimentation and fine-tuning are typically performed to identify the most effective parameter values for a given dataset.

IV. Experimental Results

Some currently existing methods and the proposed approach are applied to US images to evaluate the performance.

a. Dysplasia US image (Test Image 1)

The dysplasia US image is obtained from [8]. The input images are taken from a publicly available database, which consists of 160 images with annotations. Seven classes of Graf type ultrasound images are available, and they are categorized based on alpha angle.

b. Thyroid US image (Test Image 2)

The TI-RADS dataset is made publicly available and refers to the thyroid lesion's risk. They are categorized into eight classes. Out of eight classes, six classes of images are available for the study [9].

c. Breast US image (Test Image 3)

The publicly accessible database is used to obtain the ultrasound dataset for this study [15]. There are 780 Breast Ultrasound images in the database, including Normal (133), Benign (487) and Malignant (487) categories (210). Out of the 160 photographs used in this study, 100 images are used for training (Benign - 40, Malignant- 30 and Normal-30). For testing, the remaining 60 pictures are used (Benign- 20, Malignant -20 and Normal-20) [10]

d. IVUS image (Test Image 4)

A publicly available IVUS segmentation dataset consisting of 99 annotated IVUS frames with a size of 384 × 384 pixels obtained from ten different patients is taken.

e. Synthetic Image (Test Image 5)

A publicly available synthetic image was acquired from [13].
The effectiveness of the proposed method is assessed through both qualitative evaluation via visual inspection of images and quantitative evaluation using standard metrics, including peak signal-to-noise ratio (PSNR) and structural similarity index (SSIM) values. The performance of our devised ultrasound (US) image enhancement model is then compared with three distinct filters: Perona-Malik [5], Double Degenerative Diffusion Model [6], and a wavelet filter [7]. Fig 2-4 shows the output images of various filtering techniques to that of the proposed methods for different US images.

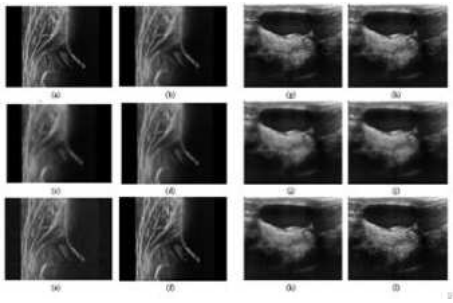


Fig. 2. Denoising results of various despeckling methods on Dysplasia Ultrasound image (Test Image 1) (a, g) Test Image 1 & 2 (b, h) Double Degenerative Diffusion filter (c, i) Deep Neural Network (d, j) Perona-Malik (e, k) Wavelet filter (f, l) Proposed Method

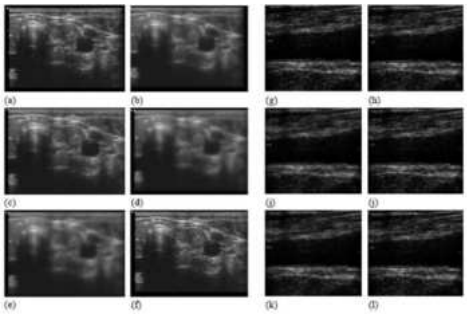


Fig. 3. Denoising results of various despeckling methods on Dysplasia Ultrasound image (Test Image 1) (a, g) Test Image 3 & 4 (b, h) Double Degenerative Diffusion filter (c, i) Deep Neural Network (d, j) Perona-Malik (e, k) Wavelet filter (f, l) Proposed Method

The provided table 2 displays the performance metrics, including Mean Squared Error (MSE), Signal-to-Noise Ratio (SNR) in decibels, Peak Signal-to-Noise Ratio (PSNR) in decibels, and Structural Similarity Index (SSIM), for different speckle reduction methods applied to five test images. The evaluation metrics offer insights into the effectiveness of each method in reducing speckle noise while preserving image quality. DDD filter: Performs reasonably well in terms of SNR and PSNR but has relatively higher MSE values. DNN Filter: Shows good performance in terms of SNR and PSNR, with competitive MSE values. PM filter: Generally, performs well across all metrics, with relatively low MSE values and high SNR and PSNR. Wavelet filter: Has varied performance, with good SSIM values but higher MSE compared to other methods. Proposed method: Demonstrates superior

performance across all images and metrics, especially in terms of MSE, SNR, and PSNR. It achieves the highest SSIM values and consistently outperforms other methods.

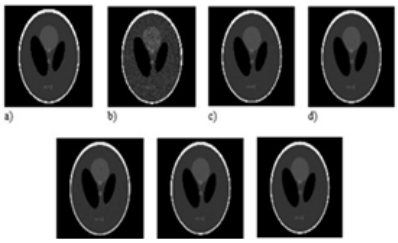


Fig 4. Denoising results of various despeckling methods on Synthetic Ultrasound image (Test Image 5) (a) Test Image 5 (b) Test image corrupted with speckle noise (c) Double Degenerative Diffusion filter (d) Deep Neural Network (e) Perona-Malik (f) Wavelet filter (g) Proposed Method

TABLE II PERFORMANCE EVALUATION METRICS FOR DIFFERENT ULTRASOUND IMAGES

Method	MSE	SNR (dB)	PSNR (dB)	SSIM
Test Image 1				
DDD filter	0.2992	15.2803	33.3028	0.9877
DNN Filter	0.3218	15.6185	32.9961	0.9177
PM filter	0.3016	15.9286	33.3076	0.9797
Wavelet filter	0.4012	14.2562	32.7062	0.8256
Proposed method	0.1187	16.5257	42.3981	0.9998
Test Image 2				
DDD filter	0.4386	15.2886	31.7097	0.9904
DNN Filter	0.4526	15.0164	31.5736	0.9715
PM filter	0.4382	15.0656	31.7132	0.9705
Wavelet filter	0.4016	15.1512	33.3076	0.9022
Proposed method	0.1721	16.2478	43.7727	0.9994
Test Image 3				
DDD filter	0.473	14.5651	31.3821	0.9983
DNN Filter	0.4819	14.4362	31.3006	0.9867
PM filter	0.4726	14.2255	31.3853	0.9989
Wavelet filter	0.4819	14.4394	31.301	0.9883
Proposed method	0.1848	15.1995	42.4638	0.9992
Test Image 4				
DDD filter	0.3206	18.009	33.0699	0.9977
DNN Filter	0.3393	17.5172	32.824	0.9858
PM filter	0.3207	17.9314	33.0685	0.9909
Wavelet filter	0.3399	17.5164	32.8171	0.9856
Proposed method	0.127	18.9416	41.0938	0.9995
Test Image 5 (Synthetic Image)				
DDD filter	0.2866	17.3146	33.5659	0.9224
DNN Filter	0.2641	16.4719	33.9116	0.9199
PM filter	0.2621	16.3338	33.9457	0.9266
Wavelet filter	0.1571	17.7277	36.1693	0.9845
Proposed method	0.1467	18.7269	38.1801	1.0000

V. DISCUSSION

The DDD filter demonstrates competitive performance across all metrics, with relatively low MSE values and high SNR and PSNR values. However, the SSIM values indicate slightly lower structural similarity compared to the proposed method. The DNN filter shows good performance, especially in terms of SNR. However, it exhibits higher MSE and lower PSNR values compared to the DDD filter and the proposed method. The SSIM values

suggest a moderate level of structural similarity. The PM filter performs consistently across the metrics, demonstrating effectiveness in speckle reduction. It achieves competitive results, particularly in SNR and PSNR. The SSIM values indicate high structural similarity. The Wavelet filter shows lower performance compared to other filters, with higher MSE and lower SNR, PSNR, and SSIM values. This suggests that, in this context, wavelet-based methods may be less effective in preserving image quality. The proposed method consistently outperforms other filters across all metrics. It achieves significantly lower MSE, higher SNR, and PSNR values, indicating superior speckle reduction and preservation of image quality. The near-perfect SSIM values suggest very high structural similarity with the ground truth.

In summary, the proposed method, which is a hybrid model combining SRAD and DNN, stands out as the most effective in speckle noise reduction for all test images. It not only achieves the lowest MSE but also demonstrates higher SNR, PSNR, and SSIM values, showcasing its potential for enhancing image quality in ultrasound applications. The results validate the efficacy of the hybrid model in striking a balance between noise reduction and preservation of important structural details.

VI. Conclusion

The hybrid speckle reduction model integrating SRAD and a DNN emerges as a robust and effective solution for enhancing the quality of ultrasound images. The collaborative synergy between SRAD's spatial adaptability and DNN's complex feature learning capabilities results in a method that consistently outperforms traditional filters and standalone deep learning approaches. The model demonstrates superior performance in terms of MSE, SNR, PSNR, and SSIM, showcasing its potential clinical significance in improving diagnostic accuracy. The successful reduction of speckle noise without compromising crucial anatomical details positions this hybrid model as a promising advancement in medical imaging, with implications for enhanced patient care and diagnosis. Further research and refinement of the model hold the potential to solidify its place as a valuable tool in the realm of ultrasound image analysis.

References

[1] Uddin, M. S., Tahtali, M., Lambert, A. J., Pickering, M. R., Marchese, M., & Stuart, I. (2016). Speckle-reduction algorithm for ultrasound images in complex wavelet domain using genetic algorithm-based mixture model. Applied Optics, 55(15), 4024.

[2] Hyunho Choi and Jechang Jeong, Despeckling Algorithm for Removing Speckle Noise from Ultrasound Images", Symmetry 2020, 12, 938.

[3] Moinuddin, M., Khan, S., Alsaggaf, A.U., Abdulaal, M.J., Al-Saggaf, U.M., & Ye, J.C. (2022). Medical ultrasound image speckle reduction and resolution enhancement using texture compensated multi-resolution convolution neural network. Frontiers in Physiology, 13.

[4] Loizou, C. P., and Pattichis, C. S. (2015). Despeckle filtering for ultrasoundimaging and video, volume I: Algorithms and software, second edition. SynthesisLect. Algorithms Softw. Eng. 7, 1–180. doi:10.2200/s00641ed1v01y201504ase014.

[5] Choi, H., & Jeong, J. (2019). Speckle noise reduction for ultrasound images by using speckle reducing anisotropic diffusion and Bayes threshold. Journal of X-ray science and technology.

[6] Zhou, Z., Guo, Z., Dong, G., Sun, J., Zhang, D., & Wu, B. (2015). A Doubly Degenerate Diffusion Model Based on the Gray Level Indicator for Multiplicative Noise Removal. IEEE Transactions on Image Processing, 24, 249-260.

[7] Dass, R. (2018). Speckle Noise Reduction of Ultrasound Images Using BFO Cascaded with Wiener Filter and Discrete Wavelet Transform in Homomorphic Region. Procedia Computer Science, 132, 1543-1551.

[8] Dysplasia Dataset: https://www.ultrasoundcases.info/cases/pediatrics/infant-hip-and-knee/

[9] Thyroid image Database: http://cimalab.intec.co/applications/thyroid/

[10] Al-Dhabyani, W.S., Gomaa, M.M., Khaled, H., & Fahmy, A.A. (2019). Dataset of breast ultrasound images. Data in Brief, 28.

[11] Febin, I.P., & Jidesh, P. (2021). Despeckling and enhancement of ultrasound images using non-local variational framework. The Visual Computer, 38, 1413 - 1426.

[12] Kim, K., Bahng, S., & Choe, R. (2020). Despeckling method of ultrasound images using closed-form shrinkage function based on cauchy distribution in wavelet domain. Int. J. Wavelets Multiresolution Inf. Process., 18, 2050026:1-2050026:25.

[13] Shepp, L.A., & Logan, B.F. (1974). The Fourier reconstruction of a head section. IEEE Transactions on Nuclear Science, 21, 21-43.

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Review on Smart Thermoware - A Development in Assistive Self-Health Care Manangement

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Abstract: ***Numerous applications and uses for thermal flasks are found by millions of people across the world. In this article, the developments of the vacuum flask's design and construction are covered. It now has technology to perform other tasks in addition to serving as a receptacle holding liquids, such as controlling temperature and serving as an alarm system. Consumers now anticipate that their vacuum vessel will preserve the freshness of the stored beverages. The vacuum flask should be able to sustain both hot and cold temperatures so that users can enjoy their beverages wherever they are and whenever they choose. People who have demanding and unpredictable work schedules are increasingly looking for reminders about how much fluid they should be consuming at all times to maintain a balanced diet.***
Keywords: Thermoware, vacuum flask, pH sensor, Temperature sensor, fluid intake monitoring, self-health care.

I. INTRODUCTION

Earlier glass containers were predominantly used for the preservation of beverages due to its resistance to permeability of microorganisms and other external contaminants thus maintaining the shelf life for a period of time. Later, due to its greater fragility and increased cost, steel or metal were used in the construction of the flask.

Recently, vacuum vessels are being used due to its greater efficiency in keeping up the quality and temperature. These vessels are sealed with vacuum so that heat cannot escape – this is largely because industry professionals agree that heat does not travel through vacuum[3]. In our everyday life, vacuum flasks are indelible among the numerous goods that improve the comfort and effectiveness of lifestyle. Applications of vacuum flasks include heaters, freezer boxes, warm milk containers, etc. [6]

Dehydration is a serious problem that can lead to a variety of complications, including confusion, falls, hospitalisation, and even death. It is critical for people with conditions that affect fluid regulation to have enough fluids on hand, so tracking their intake can help them determine if they are getting enough. There are numerous reports in the literature about attempts to develop systems or devices to track and manage fluid intake.[4]

Nowadays, paediatric and elderly patients are particularly susceptible to a condition known as acid reflux[11]. This is because modern lifestyles frequently involve different dietary changes, such as eating processed foods and beverages. Most vacuum flask versions feature an inner chamber and a plastic or metal casing that separates the glass. Some models are coated with reflective metals to increase durability. The stopper part is conventionally made from stainless steel screws that will secure it tightly.[13]

Thermoware are often used as thermal insulators due to their vacuum space, which is known as a thermal insulation. As the temperature inside the flask is required to remain consistent, this type of insulation is ideal. Thermally insulated containers are now an emerging trend as it is essential to maintain the freshness and quality of products with greater perishability factor especially beverages and milk. Thermal flask with vacuum mechanism is now greatly preferred by nurses in hospitals, lactating mothers due to its quality of keeping hot and cold liquid for longer period of time.[3]

II. DEVELOPEMENTS

A. History of Flask

The use of flasks dates to the 18th century, when they were typically constructed of pricey silver and glass. There were also less expensive versions made of pewter. These had a significant role in the storage of liquids like milk, wine, etc. [5]

Then, in 1892, Scottish scientist Sir James Dewar invented the vacuum flask. Through his work in the cryogenic field, he identified the need to maintain a chemical placed in a vial at a constant temperature. To do this, Dewar placed a glass bottle inside another larger glass bottle and sucked air between the two walls of the bottle. In doing so, Dewar created a partial vacuum to keep the internal temperature stable. Hiring a professional glassblower to create a more durable vase led to the commercial production of the "Dewar Vase" in 1898.[12]

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The insulation of the Dewar flask is done by vacuum. As a result, the freshness of the drink is retained for a certain period of time regardless of changes in the external environment.

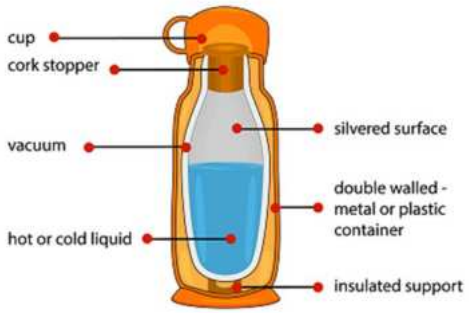


Figure 1. Dewar flask

B. Glass – Stainless Steel Insulation

The inside of the thermos uses glass material as a liner, and there is a vacuum around the glass. Glass maintains temperature longer than stainless steel because glass is very resistant to heat conduction to the environment. In addition, beverages contained in glass do not change their characteristic taste and do not react with glass materials. Meanwhile, steel or any other metal tends to react with the beverage and make it acidic and more susceptible to corrosion due to prolonged exposure to moisture. However, the glass envelope is fragile, so it is wrapped in a plastic or metal container. In many thermos, the glass cover can be removed and removed.

Later, stainless steel was used in the manufacture of thermos flasks due to its high strength and due to its non-corrosive properties during storage. Thermos flasks have an inner layer made of high-gloss stainless steel, making them virtually unbreakable. These thermos flasks are also coated with an insulating material to keep substances warm by reducing heat loss. [13].

For this, aerogel blankets are used as means of insulation instead of vacuum. [2]

In the modern world, the economy of a product is paramount, as is the quality. The cost of a product depends on many different factors such as the process, materials and time taken to manufacture the product. Current models of thermos flasks are analyzed for efficiency and cost.

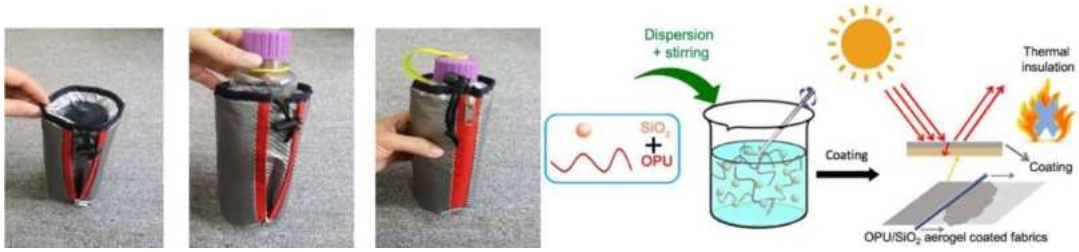


Figure 2. Aerogel Blanket

C. Modernization of Lifestyle

Due to the challenge of motivating users to regularly drink water or liquids to maintain a healthy and balanced diet, a smart water bottle can monitor water drinking behavior and notify users about this behavior. Through feedback around is currently consumer demand. Feedback from the bottle design from the point of view of the user and the designer must be analyzed. By analyzing different visualizations, the best indicator of representation fidelity, level of notice, aesthetic emphasis was selected. People love to receive personalized, accurate, playful, and prompt comments.

The potential implications of the results for the job as well as for ambient screen design to support user water consumption monitoring activities are discussed.

Drinking plenty of water is important to prevent dehydration and reduce recurrent kidney stones. In recent years, there has been a tendency to develop tools to track fluid usage using “smart” products such as smart bottles. Several commercial smart bottles are available, mainly targeted at health-conscious adults.

D. Current Advancements

Later, with the advancement of AI and IOT, smart water bottles are now widely used to display the temperature of the water contained in the tank. This can be achieved using a temperature sensor. The acidic nature of the water or any liquid contained in the bottle is required by the consumer to analyse the freshness of the product. Therefore, it is important for these people to know the pH level of common beverages before consuming them. This allows consumers to be informed about liquid consumption. This smart pitcher displays the pH for all types of mainly fruit drinks as well as milk. This can be achieved using a pH sensor. [1]

The smart water bottle becomes an aid that allows consumers to control their water intake and helps them monitor their hydration levels. Since the importance of consuming enough water has not yet reached everyone, technologies like IoT have been used to raise awareness and reach people easily. [13]

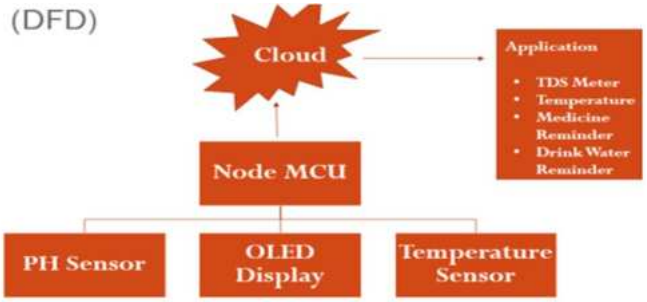


Figure 3. Design setup

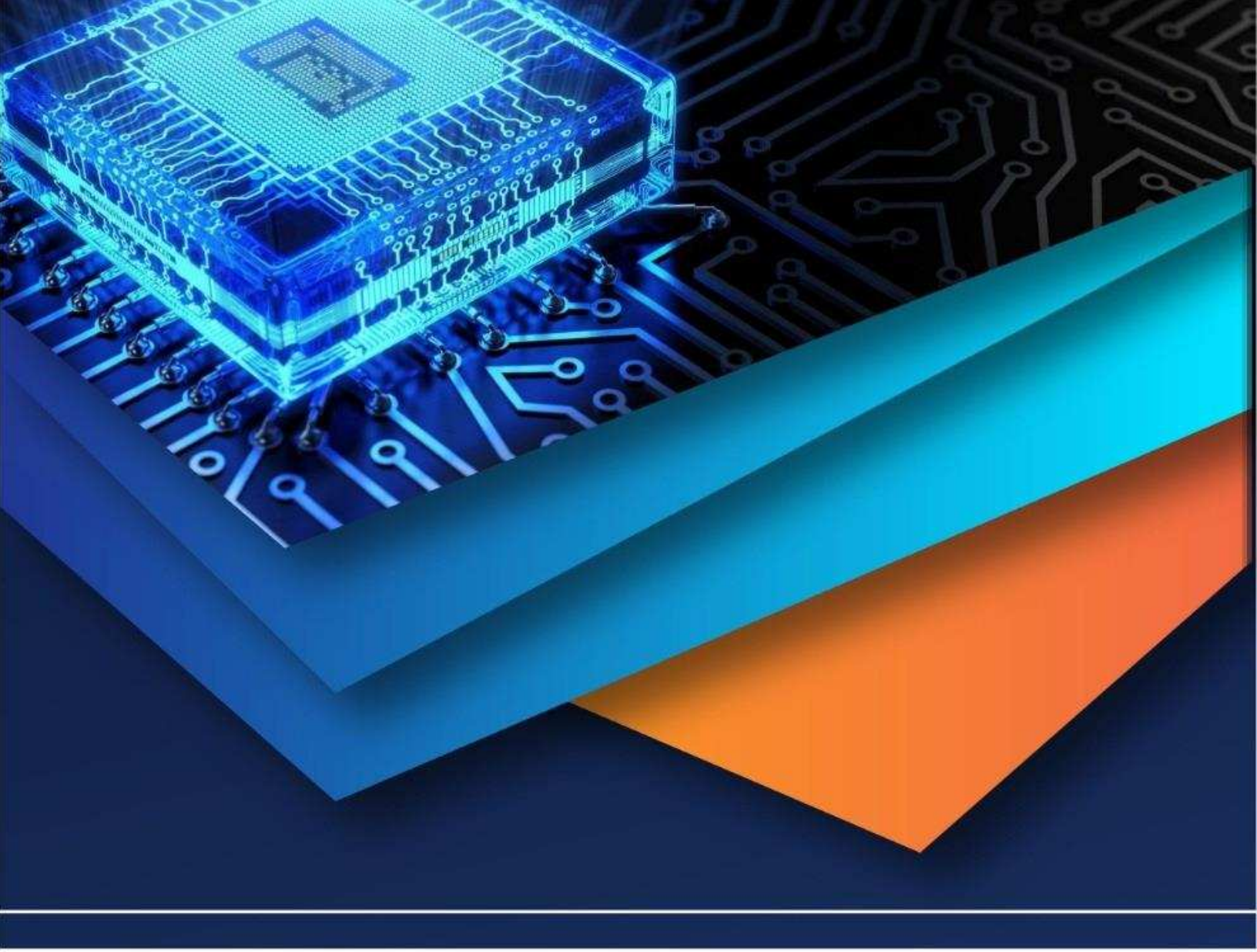
This technique is also implemented in various water monitoring systems in different industries to monitor pH, TDS and water flow where data is uploaded to the cloud and periodically monitor fluctuations. The acquired data is continuously fed into the cloud system describing the state in the form of a graphical representation. Any noted anomalies or fluctuations are the subject of immediate attention to remedy a major impact on consumption.

III. CONCLUSION

Commercially available smart flasks that can display the temperature and acidity level of the beverage they contain are currently in urgent need in the market. Smart thermos that remind consumers of their liquid levels with sounding alarms is more marketable. Furthermore, to inform consumers about the quality of the beverage contained inside the bottle, sensors that indicate the quality of the drink can be used. The development uses current technologies to help consumers lead a systematic lifestyle. This will encourage consumers to have the directed fluid intake. In this article, the evolution of the basic thermos model into a smart device due to the advancement of IoT and AI as well as its effective use as a support tool to help people take care Personal health was discussed.

REFERENCES

[1] A. Rozani, A. F. Z. Abidin, M. S. Karis, M. N. M. NIzam, A. H. Azahar, M. H. Harun, Z. M. Yusoff, K. K. Hassan and B. N. Shah, "E-OTHELLO: The Development Of An ElectronicHardware Version Of Traditional Othello Board Game," ARPN Journal of Engineering and Applied Sciences, vol. 14, no. 3, 2019.
[2] Ajmera JS, Karnawat SN. Advancements in Thermos Flask. Technology. 2015;6(9):120-5.
[3] Apok, Mario & James, Wilzy & Zainal Abidin, Amar Faiz & Hasim, Saipol & Omar, Nor & Ibrahim, Tengku. (2020). Improved of Smart Vacuum Flask with Beverage Identifier and Temperature Indicator. IOP Conference Series: Materials Science and Engineering. 846. 012030. 10.1088/1757-899X/846/1/012030.
[4] Cohen, R., Fernie, G. & Roshan Fekr, A. Monitoring fluid intake by commercially available smart water bottles. Sci Rep 12, 4402 (2022)
[5] Dungworth D. Three and a half centuries of bottle manufacture. Industrial Archaeology Review. 2012 May 1;34(1):37-50.
[6] F.P. Incropera, D.P. Dewitt, Fundamentals of heat and mass transfer, 7th edition, New York/USA: J. Wiley & Sons
[7] Frank Kreith, R.J. Manglik, Mark S. Bohn, Principles of Heat Transfer, 7th edition, Cengage Learning Inc.
[8] F. Hafizan, A. F. Z. Abidin, N. Z. N. Suhaimi, M. M. Mustam, F. Sukarman, K. A. Kadiran, S. A. Saleh and R. Rifin, "E-CONGKAK: The Development Of An Electronic Congkak Board Game To Promote Traditional Board Game To Younger Malaysian Generation," ARPN Journal of Engineering and Applied Sciences, vol. 13, no. 24, 2018.
[9] M. F. A. Halim, N. A. I. Idrus and A. F. Z. Abidin, "Development of an Electronic Educational Kit with Android Application that Test Student Knowledge in Series and Parallel Resistor for Electrical Circuit (Res-Circuit Quiz Board)," International Journal of Innovative Technology and Exploring, vol. 8, no. 9, pp. 1-5, 2019.
[10] Padha, Er Sahil, Mr Tushaar Anthal, Mr Rakesh Sharma, Mr Gulshan Singh, and Mr Manzoor Wani. "Enhancement in thermos flask a review." Global Res Dev J Eng (2017).
[11] Salvatore, Silvia, Federica Pagliarin, Koen Huysentruyt, Annalisa Bosco, Letizia Fumagalli, Kristel Van De Maele, Massimo Agosti, and Yvan Vandenplas. "Distress in infants and young children: don't blame acid reflux." Journal of Pediatric Gastroenterology and Nutrition 71, no. 4 (2020): 465-469.
[12] Soulen, Jr RJ. "James Dewar, his flask and other achievements." Physics Today 49, no. 3 (1996): 32-37.
[13] Warren M. Rohsenow, James P. Hartnett, Y.I. Cho, Handbook of heat transfer, 3rd edition, McGraw-Hill.



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Enhancement and Innovation in Millet Consumption

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Abstract: ***Millets is widely cultivated in many parts of India as a staple food for many people. Its production ranks him sixth in India after wheat, rice, maize, sorghum and vajra. Finger millet and pearl or cattail millet have, among other things, high nutritional, antidiabetic and antioxidant properties. Due to India's low socioeconomic status, large amounts of cereals are required to meet the nutritional needs of its growing population. is. These easy-to-grow, vigorous plants may be a good choice for farmers in semi-arid regions of India as they can contribute to a more stable and balanced food supply. If this millet were systematically cultivated, it would enable a significant portion of the malnourished population to eat an incredibly nutritious and inexpensive diet.***
Keyword: Pearl millet, Finger millet , Millet pellet , Health benefits

I. INTRODUCTION

A World Bank study published in 1986 sought to guarantee that everyone has access to enough food for an active, healthy, and well-balanced lifestyle. Millets, which are often found in the wild and in tropic and semi-arid parts of the planet, are a great option for ensuring a steady source of food [1]. The Food and Agriculture Organisation (FAO) temporarily focused on food protection in 2001. It defined this as a situation in which everyone, always, has the bodily, social, and economic right to use for adequate, covered, and healthful food that assembles their dietary requirements and food choices for an active, healthy, and balanced lifestyle. Due to its high quality bendiness in crowded habitats, particularly during dry times, millets are an excellent source of product in these areas [2]. According to Taylor et al. [3], Millets are one of the grain plants that can withstand drought the best, according to extensive testing. Millets are less impacted by numerous natural agricultural limitations because they are no longer merely subject to some abiotic factors like climate variability, which severely restricts their development requirements. They are also less affected by nutrient-depleted soils and limited and inconsistent precipitation [4, 5]. Sharma and others [6, especially in organising nations, stressed the need to instantly improve the plants that are acceptable for small-scale farmers and customers who are financially challenged. By putting in sincere effort during the growth of those plants that weren't excluded, this significant aim can be achieved. However, there could not be much resource rivalry because their production is focused in areas that aren't good for growing many other cereals. A decision [7] addressing the possible nutritional value of these plants was made in 1996 by the Food and Agriculture Organisation (FAO) and the International Crops Research Institute for the Semiarid Tropics (ICRISAT). Security and defence in several of the world's agro-ecological zones with food insecurity. This objective may be met in these agro-ecological areas by raising the output and productivity of these forgiving plants. Taylor [8] emphasised the potential of millets for the development of residential food safety and environmental protection due to their amazing adaptation to such situations and provided additional evidence for this viewpoint.

In semi-arid areas of India, millets have the potential to increase household food security and safeguard disadvantaged pastoral producers. One of the most underserved regions in the United States, the Medak Area of Andhra Pradesh (India), for instance, has been tasked with ensuring food security as well as demonstrating food self-sufficiency by cultivating sorghum and millet as the main component of their strategy [9]. These communities are underserved because they are predominantly made up of women and practise subsistence farming in the Deccan Plateau, one of the driest and most desolate parts of the world. However, they grow sorghum and millet, which are ecologically friendly and suited for semi-arid areas, to ensure residential food safety. They provided domestic food security and were therefore immune from receiving government benefits [10]. A study was carried out in Japan's Kenya's semi-arid areas. Unexpectedly, it was found that dwellings with more adaptive plant cultivation, such as sorghum and millet, had superior domestic food protectionOn the other side, farmers who cultivated less ecosystem-adaptable crops like beans and maize saw an increase in food unpredictability as a result of unexpected precipitation.

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At this point, it is sufficient to describe the importance of these adaptable plants to food protection in areas of the arena where there is a sprinkler deficit [11]. Because of their high degrees of adaptability to African concerns and their significance as cereals for food safety, Taylor [8] concentrated on these millets in the context of Africa. Using FAO's [12] assertion that these grains are the solution to intermittent food shortages affecting pastoral populations in semi-arid regions, particularly the sub-Saharan region, the genuine concept is maintained. Millets are a great source of healthy protein for Africans, accounting for approximately 50% of the total grain production in the continent. Alumira and Rusike [11] conducted the actual equal tracking, and they discovered that specific millet and sorghum stages can reduce the likelihood of zero yields. Because of this, those plants could play a significant role in residential food protection during dry spells [11]. When compared to a number of typical cereal plants, millets, according to Taylor, still need more investigation. He came to the conclusion that millets' higher bendability, as compared to maize, is a requirement for considerably healthier long-term food protection [8]. Rohrbach [13] made similar considerations when he emphasised that many developing semi-arid cultures use millet and sorghum as main staple foods. The argument that tiny grain plants can perform much better than maize in terms of drought resilience, particularly in semi-arid environments, is well supported by literary worksDuring dry seasons, maize is prone to spoiling, but tiny grain cereals that can withstand drought, like millet, may be able to supply some food for survival [14]. As a result, tiny grains (millet) have the ability to perform much better than maize under a green, beneficial treatment in specific regions of the field [14].

Although maize uses harmful organophosphate protectants, which can only be stored for a maximum of eight months, Van Oosterhout [15] noted a few benefits that small grains have over maize for farmers: Compared to maize, a smaller amount of flour is needed to prepare the most popular dish; Little grains provided covered strength and guaranteed starvation for a mile longer; Compared to maize, which cannot be stored for more than eight months, the garage treatment of small grains is much higher. There is no need to purchase specific cereals' seeds because their developmental phases are sufficient. These seeds may be swapped with members of your own family, friends, and neighbourhood, so they don't need to be purchased. A multi-cropped system with much fewer grains will primarily produce a few harvests in years with quick precipitation.

II. MILLET PEARL OR BAJRA

Pennisetum glaucum is known by various names around the world, including Bajra, Bajri, Cumbu and Sajje in India. In English, it is also called candle mild millet, pearl millet, bull rush, and bull rush. Bazira pearl millet (Pennisetum glaucum (L.) R. Br.) is a plant that usually grows in dry soil. It usually grows in semi-arid and arid regions with low rainfall, fertile sandy soils and high air, where many other hardy crops like sorghum and maize cannot provide accurate yields. This strain is diploid (2n=14) and is mainly cultivated for its grain. However, the sediments or slabs of this plant are an important food source, especially in areas with lower precipitation. It was calculated that this particular plant could provide between forty and fifty percent of the entirely dry problem feeding feed for cattle during the arid season. In the semi-arid and desert sections of the arena, the pearl millet persona functions as both food and fodder protection. Pearl millet grains offer a greater net concentration of nutritious protein (10.6%), many stabilised amino acids, and other minerals. They provide around one-third of one's daily needs for iron and zinc. On nutritional security and protection, these nutritional elements have a big influence. A tiny amount of grain is also used in bird feed. The grains of this millet are also gaining importance as a low-cost source of starch for premium brewers [20, 21]. The largest producer of this plant in terms of land is India (9). The findings of 856 kg ha-1 were average on three million acres) and produced 97 facts tonne). 3,9 percent of the general meals grain produced in India and 7,8 percent of it are produced by this factory. About 50% of the land and 42% of the world's pearl millet are grown in India's Rajasthan area. Uttar Pradesh, Gujarat (production, 8% and 7%), Maharashtra (13 percent manufacturing, five percent and 16 percent manufacturing). Maize may be a complete failure when produced in a system with other crops. Due to their promise of high yields, the production of wheat, rice, and maize continues to outpace that of millet and other minor grains in India's semi-arid areas. Low millet yields constitute a difficulty for conventional farmers and a number of substantial hurdles, claim Sukume et al. [16]. Macgarry [17] mentioned a few of the frequent problems farmers have to cope with when growing millet. The drawback is that the food is of lesser quality, which is largely the result of farmers' negligence when it comes to ecological testing [18]. The quelea bird's preference for sorghum and millet over wheat, rice, and maize is one of the bigger problems that farmers must deal with. The setback of harvesting and successfully refining harvested grains, as well as the growing number of team members with within the production of millets have overemphasised many cultivators, exhausting land preparation work, the removal of unwanted weeds, bird protection, and the setback of harvesting are all factors that contribute to limited production [7]. Currently, all of these components—wheat, rice, and maize—are affordable. This is only one of the primary causes for why wheat rose to such prominence in India during the indigo transition [11]. According to Sukume et al. [16], the absence of refining advancements is essentially the sole factor preventing the expansion of millet's premium professional markets.

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Traditional refinery methods take a much longer to process millet than they do maize, especially during harvest [16]. These reasons eliminate the need for the most hideous of the ugly conventional dwellings. Alumira and Rusike [11] go into further depth regarding the problems, pointing out that even in semi-arid settings, it might be very difficult for tiny grains to compete with maize. This is a result of millet's low production of plant debris, which is a crucial quality for regular farmers in terms of dog food and plant manure. Animals need plant deposits to survive the winter, usually from maize fires, according to Mapfumo [19]. According to the FAO [7], when consumers' earnings increase, they are more inclined to spend money on wheat, rice, and maize as opposed to typical standard grains. A further important factor that has constrained millet output is changing dietary preferences. Standard farmers are therefore likely to consider millet farming to provide below-average profits in compared to a number of other unstable plants. In comparison to cash plants, prices for millets and safe-to-eat legumes dramatically dropped once the career liberalisation programme was put into place. Additionally, this poses the possibility of impeding American farmers' ability to produce millet. The purpose of this study was to highlight the production power of millet using all pertinent data that were at hand.

III. MILLET FINGER (THE RAGI)

Coracana Eleusine (L.) Gaertner Although Eleusine coracana is referred to by several names around the world, ragi is the name by which it is most frequently used in India. In English, it is known as finger millet. Eleusine Coracana lives in a pattern resembling tufts. The development has a diameter of 45–125 centimetres and is growing annually. Maturation typically takes between five and six months.

Fallen leaves from this cultivar generally resemble tightly packed grass. The development has a lot of tillers and branches. On the skull, a series of dignifiedly arranged spikes are visible.

It has a chromosomal count of x = 9. One species in this genus is E. coracana subs. The uncultivated diploid subspecies africana, which is tetraploid in nature, is whence coracana originates [16]. Rarely does Eleusine coracana, often known as finger millet, become extinct. Undoubtedly, this is only one of a handful of unique varieties that now contain the local food supply. This common plant in India offers nourishment for countless numbers of people. The majority of the world's producers, or around 2 million of the 4 million loads generated annually worldwide, are in Africa. In India, a total of 1587.15 thousand hectares were anticipated to be under cultivation.

Thus, irrigation was used to irrigate over 13.30 percent of the crop. As an irrigated plant, it grew increasingly prevalent in places like Gujarat and Tamil Nadu. Ragi grains are thought to weigh an average of 2282.84 million tonnes, with irrigated Ragi accounting for 20.58 percent of that weight. However, when including high-producing types, the total production was anticipated to reach 1614.53 million tonnes, or 70.73 percent. This ballpark figure highlights the necessity to persuade HYV to work with the adversarial global marketing organisation [17]. The development is successful and effective in a range of ecological contexts. In India, finger millet is cultivated in rows with the proper management practises, much like many other grains. However, in most African countries, it is handled differently [10].

In India, the last harvest is often done by hand. Personal growth goings, which normally have several centimetres of stem, are cut out using a blade. Following that, they are stretched out in rows for a few days, resulting in fermentation, heat production, and hydrolysis, which makes the grains simpler to thresh. Weevils can't enter the small seeds of finger millet because of their size. In fact, because they are so efficient at keeping pests away from garages, their unthreshed goings can be kept there for up to 10 years without risk from insects [18].

Despite the many advantages, the smaller size of the grains is a serious drawback. Due of the plant's tiny size, it is quite challenging to manage it during the full flora's life cycle. In order to convert finger millet grains into flour using standard techniques, high-quality cap potential and primary duties are required. Additionally, existing hammer generators have a few problems to solve in order to do it.

Generators must be configured with great shows in order for them to run at broadband. Design innovations that made it easier to produce flour led to the creation of a remarkable mill for millet. However, the practise of dispersing seeds is still fraught with problems. Bird attacks are possible, which lowers the quality of the final output. The flora is often resistant to pollution and many bugs, but a severe fungal illness known as "blast" that may wipe out entire regions is still difficult to treat [19–21]. The majority of nations no longer produce finger millet, yet almost 30 years ago it was thought to be one of the largest plants. Yes, if prompt action is given, the barriers that caused the rejection may be eliminated. For the long-term food security and safety here, duties are really being developed.

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IV. NUTRITIONAL INFORMATION

PEARL MILLET

Nutrients	Per 100g
Protein(g)	12
Carbohydrate(g)	68
Fat(g)	4
Minerals(g)	1.9
Fibre(g)	2.5
Calcium(mg)	43
Phosphorus(mg)	238
Iron(mg)	11.5
Energy (Kcal)	365
Thaimine(mg)	0.37
Niacin(mg)	2.5

FINGER MILLET

Nutrients	Per 100g
Protein(g)	7.6
Fat(g)	1.5
Carbohydrate(g)	88
Calcium(g)	370
Vitamin (A)	0.48
Thiamine(B1)	0.33
Riboflavin(B2)	0.11
Niacin(B3)	1.2
Fibre	3
Minerals(g)	2.5
Phosphorous(mg)	280
Iron (mg)	4
Energy	338

V. MODERNIZATION OF LIFESTYLE

Millets are frequently referred to as "smart food," meaning that they are "good for the individual" (nutritious and healthy), "good for the planet" (sustainable in the environment), and "good for the farmer" (resilient). Millets are known for their toughness, ability to survive in degraded soils and high temperatures, and low need for fertilizers, pesticides, and water. Their farming practices have a smaller impact on the environment than those of the major staples that are grown with more fertilizers and pesticides.[34] Millets are used in place of legumes that are commonly used in India, like chickpeas and pigeon peas. Their amino acid content makes them a complete protein that is easier to digest when cooked . Aside from protein, contingent upon the assortment and species millets are likewise plentiful in minerals, like iron, zinc, and calcium, which convey medical advantages to all progress in years gatherings and sexual orientations.

Millets outperform other foods with comparable nutritional value in terms of their high nutritional content; It is particularly high when compared to polished rice, maize, and refined wheat flour, which were the primary staples of the post-green revolution. Urban areas typically have access to cutting-edge millet processing technologies that offer safe, simple-to-handle, ready-to-cook, and ready-to-eat meals on a commercial scale, where refined wheat flour and rice are the most common ingredients and are significantly less expensive.

The utilization of refined grains, to be specific, refined white rice, is demonstrated to be related with non-transferable infections, for example, type II diabetes mellitus and weight. Whole grain consumption has become increasingly popular worldwide as a result, highlighting the significance of mainstreaming and promoting nutritious smart food crops as a staple. [34]According to Singh and Raghuvanshi (2012), this is one of the Smart Food initiative's primary goals. Traditional whole grain and multigrain alternatives to refined carbohydrates that are more nutritious and healthier can be an important part of therapeutic dietary diversity and modification.Expanding urbanization and per capita livelihoods are changing shopper tastes and inclinations.Inconvenience, low social status, and a lack of traditional knowledge in the preparation of millets Shorter shelf life of milled grainsThe PDS includes wheat and rice on a larger scale.Millets haven't been consistently remembered for the PDS.

Among the supply-side factors are:

Farmers are discouraged from cultivating millets because there is no industrial demand for millet products with added value.Profitability is low.

The Green Transformation has leaned toward the development of rice and wheat, including yield value motivations and info endowmentsAbsence of admittance to quality seeds inadequate infrastructure to address the entire value chain, including cutting-edge processing technologies and milling machinery.[35]

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VI. CURRENT USAGE OF MILLETS

The only primary method of learning about millets was by word-of-mouth; either family members, friends, or neighbours shared the information. There were hardly any further awareness sources.[11] Millets were thought to be “good for health,” “easy to digest,” “good for people who have deficiencies in them,” and “good for weight loss,” but very little was known about them. Not only was there a lack of diversity, but there was also a lack of “availability” and “knowledge of what to do with the millet.” Some of the primary health advantages highlighted included “good for health,” “easy to digest,” “gives needed nutrition,” “makes bones/body strong,” “reduces body weight,” “keeps you warm in winter,” and “good for diabetics.” The main obstacle to eating is its "availability" first, then "very little knowledge on how to cook" or "what to cook," which are the next two biggest obstacles. Last but not least, "children / family members do not like the taste" limits its use as a grain for cooking to infrequently.

VII. MILLET CONSUMPTION TRENDS

Nearly all the households mostly ingested rice and wheat.The two most important considerations for considering eating millets were "Easy/light to digest" and "Healthy to eat" across all the cities where interviews were performed.For "once a week" consumption, only pearl and finger millet were taken into consideration. It was "less often than once a month" for the other Millets kinds.[17]
The justifications for beginning millet intake at home The main justifications for beginning millet consumption were "Good for health," "body become Strong," and "reduces body weight."[17]

Good for health	14%
Body becomes strong	12%
Reduces body weight	10%
Has vitamins/ gives nutrients	6%
Makes bone stronge	5%
Has a good taste	5%
Easy to digest	3%
Reduces cholesterol	3%

VIII. ADVANCEMENTS IN MILLETS

Since the outbreak of the Russia-Ukraine conflict, the demand for different varieties of millets, particularly finger millet and barnyard millet, has increased dramatically across the globe. This is because Russia and Ukraine have outlawed the export of millets and their byproducts. Therefore, now is the perfect time for India to address the problems with the millet value chain in order to increase millets’ production, consumption, and exports, as well as their by-products.
Economically speaking, millets’ demand in India until relatively recently was primarily in low-income areas, with sporadic occurrences in the middle-to-high income segment. Most millet crops continue to sell for modest costs, keeping them affordable for the poor.[17] Millets may be grown in a variety of climates, including those with scarce water resources, mountainous terrain with rocky and gravelly soil, sandy soils, etc., making it a source of income and food security for many who cultivate and eat it. A premium market for the crop has been established by the growing demand for millet among higher income people in India, Europe, and the US due to its health benefits. The income level of farming communities that live in difficult terrain in different regions of the country is anticipated to change as a result of this market demand.[29],

IX. CONCLUSION

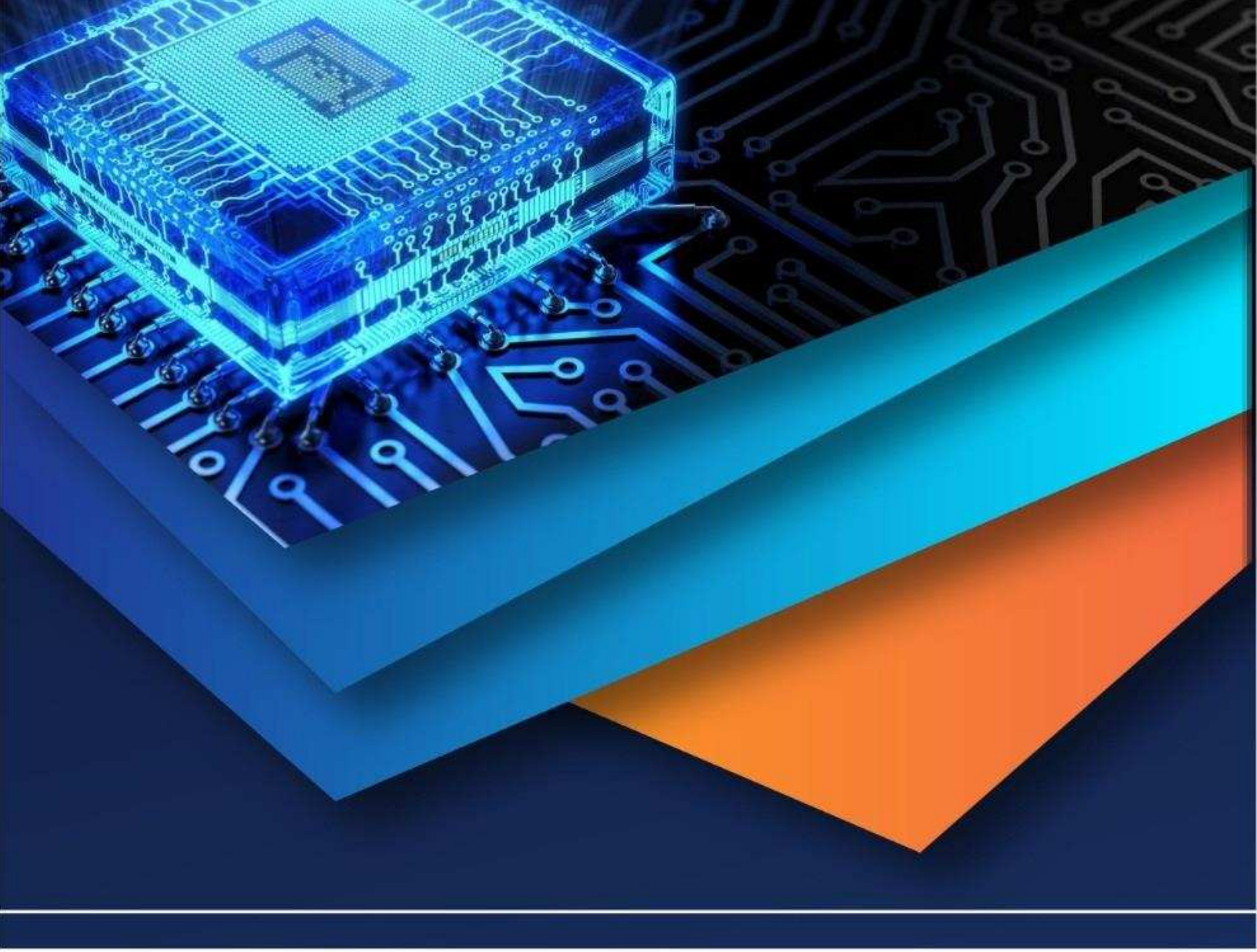
It is challenging to comprehend why millet is being rejected given the high-quality qualities described above. There have been very few attempts to research these beneficial but understudied plants in compared to the countless studies that have been done on wheat, rice, and maize. This essential herb continues to be misunderstood by the general populace of little nations as well as a few major nations, causing it to be referred to as a "awful person's plant" globally. a "meals for famine" or, even worse, officially labelled as a "fowl seed" [12].Despite the component's simplicity, many ignore it since they are drawn to sorghum and maize. In actual honesty, cultivating is taxing, which contributes to the plants' lower produce. The reality is that millets have a great chance of supplying the world's growing population with the wholesome nourishment they need. The cultivation of such plant for a substantially longer period of time and at a significantly greater price demand commitment and the right techniques. Millets may also be made into quick items in the age of instant meals, such as instant millet pellets, millet drink, and millet snacks.

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REFERENCES

[1] The authors are grateful to Prof. Aditya Shastri, Vice Chancellor, Banas thali University, Rajasthan (India) for providing necessary support. REFERENCES [1] Food and Agriculture Organization (FAO). 2001. FAO 's State of Food Insecurity 2001. Rome, Italy.
[2] Dicko, H., Gruppen, H., Traore, A, Voragen, J. and Berker, J. 2005. Sorghum grain as human food in Africa. Relevance of content of starch and amylase activities. African Journal of Biotechnology, 5 (5): 384-395.
[3] Taylor, J.R, Schober, T.J and Bean, S. 2006. Novel and non-food use for sorghum and millets. Journal of Cereal Science, 44: 252-271.
[4] Sharma, K.K. and Ortiz, R. 2000. Program for the application of genetic transformation for crop improvement in the semi-arid tropics. In vitro Cell Developmental Biology—Plant 36: 83-92.
[5] Maqbool, S.B., Devi, P. and Stickle, M. 2001. Biotechnology: genetic improvement of sorghum (Sorghum bicolor). In vitro Cell Developmental Biology-Plant 37: 504-515.
[6] Sharma, K.K., Crouch, J. H, Seetharama, N., and Hash, C. T. 2002. Applications of biotechnology for crop improvement: Prospects and Constraints. In vitro Cell Developmental Biology—Plant 163: 381-395.
[7] Food and Agriculture Organization (FAO). 1996. Rome Declaration on World Food Security and World Food Summit Plan of Action. World Food Summit 13-17 November 1996, Rome, Italy.
[8] Taylor, J. R. N. 2003. Overview importance of sorghum in Africa [Online]. Available from: http://www.sciencedirect.com/science.
[9] Mukarumbwa P. and Mushunje A. 2010. Potential of sorghum and Finger millet to enhance Household food security in Zimbabwe 's semi-arid regions: A review contributed
[10] Food and Agriculture Organization (FAO) & International Crops Research Institute for The Semi-Arid Tropics (ICRISAT). 1996. The World Sorghum Economies: Facts, Trends and Outlook. FAO, Rome, Italy and ICRISAT, Andhra Pradesh, India.
[11] Almira, J. and Rusike, J. 2005. The Green Revolution in Zimbabwe. Journal of Agricultural and Development Economics, 2 (1):50-66.
[12] Food and Agriculture Organization (FAO) & Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS), 2008.
[13] Rohrbach, D. 1991. The impact of new sorghum and millet technologies in the evolving grain market of Southern Africa, pp:51-60. Proceedings of the International Sorghum and Millet Conference, 8-12 July 1991.Corpus Christi, Texas, USA.
[14] Rukuni, M.,Tawonezvi, P., Eicher, C.,Munyuki-Hungwe, M. and Matondi, P. 2006. Zimbabwe 's Agricultural Revolution Revisited, University of Zimbabwe Publications. Harare, Zimbabwe. 22.
[15] Van Oosterhout, S. A.M. 1995. Excerpts from Zimbabwe's communal areas: International Development Research Centre [Online]. Available from: www.idrc.ca/en/ev- 85113-201-1-DO_TOPIC.html - 2008-07-29 [Accessed 4 Nov 2013].
[16] Sukume, C., Makudze, E., Mabeza –Chimedza, R. and Zitsanza, N. 2000. Comparative Economic Advantange of Crop Production in Zimbabwe. Technical Paper No.99 Department of Agricultural Economics and Extension. University of Zimbabwe, Harare.
[17] McGarry, B., 1990. What Are We Promoting? A case study of the Introduction of a New Milling Technology in a Rural Area in Zimbabwe. Journal of Social Development in Africa, 5(1): 73-81
[18] Food and Agriculture Organization (FAO), 1995. Sorghum and Millets in Human Nutrition. Rome, Italy.
[19] Mapfumo, P., Mtambanengwe, F., Giller, K. E., and Mpepereki, S. 2005. Tapping indigenous herbaceous legumes for soil fertility management by resource-poor farmers in Zimbabwe. Journal of Agriculture Ecosystems & Environment 109: 221-233 [Online]. Available from: http//www.sciencedirect.com [Accessed 9 April 2009].
[20] Khairwal, I.S. 2003. Coordinator 's review. All India Coordinated Pearl Millet Improvement Project. Agricultural Research Station, Mandor, Jodhpur.
[21] Khairwal, I.S., Rai, K.N., Rajpurohit B.S. and Nirwan, B. 2006. Pearl millet cultivars for drought prone environments. All India Coordinated Pearl millet Improvement Project, Indian Council of Agricultural Research, Mandor, Jodhpur, India.
[22] Manga, V.K. and Kumar, A. 2011. Cultivar options for increasing pearl millet productivity in arid regions. Indian Journal of Fundamental and Applied Life Sciences, 1 (2): 200-208.
[23] Arya, H.C. and Kumar, A. 1976. Diseases of bajra- A serious problem of Rajasthan desert economy. Transactions of Indian Society of Desert Technology & University Center of Desert Studies 1:177-182.
[24] Singh, S.D. 1995. Downy mildew of pearl millet. Plant Disease. 79: 545-550.
[25] Singh, S. D. 1994. Recycling of pearl millet cultivars for the control of downy mildew. Indian Journal of Plant Protection. 22: 164-169.
[26] Rao, P.K., Nambiar, A.K. and Madhav Menon, P. 1951. Maximization of production by the cultivation of hybrids strains with special reference to cumbu (pearl millet). Madras Agriculture Journal. 38: 95-100.
[27] Chavan, V.M., Patil, J.A. and Chowdhury, B.B. 1955. Hybrid bajri in Bombay State. Poona Agriculture College Magazine. 46: 148-150.
[28] Burton, G.W. 1958. Cytoplasmic male sterility in pearl millet (Pennisetum glaucum (L.) R. Br.). Agronomy Journal. 50: 230.
[29] Burton, G.W. 1965. Pearl millet Tift 23A1 released. Crops and Soils 17:19.
[30] Athwal, D. S. 1965. Hybrid bajra makes a new era. Indian Farming 15: 6-7.
[31] Athwal, D.S. 1966. Current plant breeding research with special reference to Pennisetum. Indian Journal of Genetics and Plant Breeding. 26A: 73-85.
[32] Govila, O.P., Ray, K.N., Chopra, K.R, Andrews, D.J. and Stegmeier, W.D. 1996. Breeding pearl millet hybrids for developing countries; Indian experience. International Conference on Genetic Improvement of Sorghum and Pearl Millet. September 22-27, 1996, Holiday Inn Plaza, Lubbock, Texas. pp:97-118.
[33] Rai, K.N., Anand Kumar, K., Andrews, D.J., Gupta, S.C. and Quendeba, B. 1996. Breeding pearl millet for grain yield and stability. International Conference on Genetic Improvement of Sorghum and Pearl Millet. September 22-27, 1996, Holiday Inn Plaza, Lubbock, Texas.
[34] Anitha, S., Kane-Potaka, J., Botha, R., Givens, D. I., Binti Sulaiman, N. L., Upadhyay, S., et al. (2021c). Millets can have a major impact on improving iron status, haemoglobin level and in reducing iron deficiency anaemia - a systematic review and meta-analysis. Front. Nutr. Submitted.
[35] Anitha, S., Kane-Potaka, J., Tsusaka, T. W., Botha, R., Rajendran, A., Givens, D. I., et al. (2021a). A systematic review and meta-analysis of the potential of millets and sorghum for managing and preventing diabetes mellitus. Front. Nutr. doi: 10.3389/fnut.2021.687428

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Review on Effect of IoT in Inventory Management System

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Abstract: ***Inventory management plays a crucial role in every business organization that works on production. Appropriate control mechanism of inventory is essential to ensure stock levels of all the raw materials that are required for production of good. With the application of emerging technologies like IoT and sensors, the management of the stock levels has become more efficient in both industrial and domestic level. This has not only reduced the man power that is required for supervision of inventory, but also made the lifestyle of people more comfortable and easier.***
Keywords: Inventory management, IoT, Sensors, Microcontroller, User interface.

I. INTRODUCTION

Supply chain acts as a very important methodology in business management by playing an important role in business processes. This largely deals with turning all of the raw resources into completed goods and services, as well as distributing them to the eventual customer. Thus it acts as a vital link between producers and the consumer market. One of the key dimensions of supply chain management is Logistics management. Logistics is about the processes of planning, executing the forward flow and warehousing of the raw materials and finished goods with relevant information and records between the point of origin and landing point. This therefore involves Inventory management. [39] Inventory Management is the management of stock levels of particular good at particular point of time and at particular place. It plays a crucial role in running and maintaining a business organization that mainly functions in the production line.

A. Purpose

The primary goal of this article is to research and provide in the form of a review how inventory management is crucial in organizations, how it has evolved over a period of time at both industrial and domestic level and how the invention and expansion of IoT can impact the management of inventory.

B. Significance of Inventory Management

In any business organization that works as a production unit, there is a space where the raw materials go in and get stored. Similarly, the finished products are also taken back this stock area at times, before distribution. Inventory management makes extensive use of data to keep track of the batch numbers, price, and quantity of the items as well as the information collected during the process. In general, inventory management receives 60% of the budget. It holds a very significant place as it co-ordinates and schedules operation flow. [40]

Models for inventory management are used in almost all businesses. The literature's scope encompasses a variety of subject areas, including engineering, engineering technology, agriculture, energy, environmental science, and medical according to Science Direct's search for publications on Inventory management.

When considering both open access publications and journals to which only subscribers have access, it was found that the most commonly discussed topics in inventory management are engineering, energy, and environmental science. Due to the expanding consequences of climate change, environmental science has made re-engineering necessary, which has increased the need for stock management. [3]

C. Timeline of Inventory management

Inventory management concepts have existed since the dawn of time. With the development of new tools and technology over the past century, inventory practice has become more contemporary and has undergone evolution. For instance, traders in the past counted and totaled the goods sold each day.

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Prior to the development of more precise inventory record management and accounting systems by the Egyptians and Greeks, handwritten notes and hunches were used in an inefficient and imprecise manner. Inventory management practices have improved over the years. These advancements have resulted in further cost savings and increased customer satisfaction.
One of the major advancement seen in Inventory management is the intervention of IoT. It has enabled to manage stock levels by providing real time data at all point of time along with giving accessibility to the data related to inventory from anywhere.

II. IOT EVOLUTION

In this modern era, nourishing the standard of innovation in daily life act as a catalyst that changes the way we live our lives. Innovation starts with an idea or invention followed by bringing them under general usage. For example: If Fryer is an invention, development of smart sensors that can maintain pre-defined oil temperature and notifying the users helps in optimizing the process which is ultimately known as innovation. These operations are sustainable with the execution of IoT (Internet of Things) in a far-reaching manner. IoT is an adjunct of internet that unites the physical world with sensors and other communication networks.

A. Pre Internet

There was a time when there is no internet and had only human to human interaction. This period is known as Pre-Internet era which follows a hierarchical and standardized structure in various industrial activities. The rational strategy followed in Pre-Internet economy was an energy intensive period that made communication difficult between customers and suppliers. The challenges faced during the pre-internet era lead to the enrichment of communication and business by virtue of internet.

B. Internet of Content

The emergence of Internet dates back to 1950's. The first phase of Internet (1989) concentrates on connecting information with hardly any interaction between server and user. It started with the evolution of www (World Wide Web) that enables people and machine communicate easily. Dornberger et al (2018) had given a model on how the development of enumerative technology leads to changes in human to computer interaction. Greater number of users of Web 1.0 is consumers of content, focusing on reading. [52]

C. Internet of Services

Web 1.0 technology allows only one way communication between creator and user with no interaction from users on other side. This marked the escalation of Social web (Web 2.0) that enables users to create, read and write on web. Aggregate of Web 1.0 and Web 2.0 forms the Smart IT platforms and services. Web 2.0 technology is widely applied in Supply chain management (e-business) that relies on internet for front end and back end process involving inventory management, financial tasks etc. In their study of web technologies in supply chain management, Cagliano et al. (2003) divided them into three main categories: e-commerce, e-procurement, and e-operations. [53]Supply chain management is an essential process in industries that has an ultimate aim to establish a synergy among the various supply chain partners and also the employees.

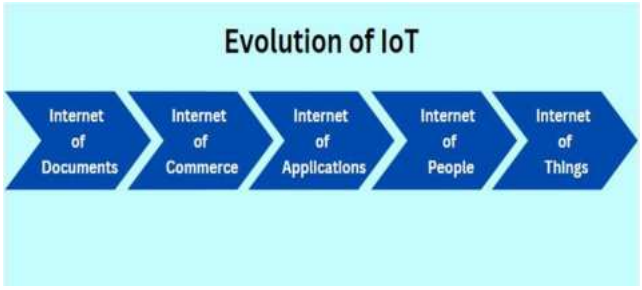


Fig. 1 Evolution of IoT

D. Internet of People

The third stage of evolution of internet is the decentralized version of web2.0 (Web 3.0) that focuses on detailed insights and data analysis that helps in development of semantic web, artificial intelligence etc. The web technologies are been improved to generate, connect and share the content through findings and analysis. This revolutionary step is made through development of Block chain technology that helps to access information from any electronic device. The key features of web3.0 like Block chain, Crypto currency, NFT, Decentralized apps captures the web and become closer to the users like us.

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Web 3.0 technologies enables digital identity for various supply chain partners like farmers, growers with data privacy and also helps in real time payments using smart contracts, which lowers the transaction costs. Tools of web 3.0 like NFT creates unique tokens or digital asset attached to field, orchard or particular crops for efficient traceability.

E. Internet of Things

Development of intelligence in machines and devices marks a radical growth among industries and domestic areas. This collective network of devices with embedded sensors and built-in software impacts our lives in various ways. Inventory management plays a keen role in food industry that allows business to thrive, if properly maintained. This was made easier by virtue of IOT that minimizes overstocking and shortages and creates streamlined supply chain. Smart containers embedded with ultrasonic sensor and other modules communicate the inventory status of products to the user through web application. [21] This overcomes the tedious process of manual inspection. Deployment of wireless sensor networks, IoT and cloud computing enables real time tracking and monitoring of products and parameters like shelf life, sales, responses from customers. [27] The system is set up to make an order as soon as the grocery level drops below the essential threshold thanks to the use of cameras that scan the data stored within the cabinet. [54]

III. IOT IN INVENTORY MANAGEMENT

The process of making orders for, keeping, using, and reselling a company's inventory is known as goods management. This encompasses raw material, component, and completed goods management, as well as storage and processing. In a variety of businesses, including manufacturing and the pharmaceutical industry, inventory management is crucial. Similar to that, it plays a significant role in our daily activities, particularly in the kitchen. Kitchen inventory control is crucial for maintaining control over the supplies of food and goods in our kitchen.

Initially, managing the kitchen inventory was done manually, which takes up a lot of our time. People today are extremely busy and look for alternatives to such time-consuming chores to improve and simplify their lives. The use of IoT to manage the inventory is the most widespread and effective invention that has made human lives easier and better. IoT is a vision that enables people and objects to interact in an ideal world via any channel or service.[42] The Internet has evolved into the world's fastest and biggest data exchange network, connecting billions of devices. The notion of the Internet of Things arose as a result of network evolution and the pervasive presence of the internet. Fundamentally, the objects referred to by the phrase Internet of Things are self-contained sensors capable of gathering and sending real-time data via the Internet, making them smarter. [43] IoT in kitchen inventory management typically includes the use of sensors, microcontrollers, and development of a website or application to display the real times values of the groceries. This aids in the proper management of kitchen inventory by keeping track of groceries, generating notification alerts for replenishment expiry, and alerting for recipe recommendations contained in the database.[45], [46] Some advances have been achieved utilizing IoT, including not just measuring the quantity of goods and alerting users, but also automatically placing orders.[3] This is particularly relevant at big scale levels, such as warehouses, where finding any product can be quite challenging because a user must manually do a thorough search in every stockroom present.

Inventory management is an important aspect of customer service and cost reduction in any production setting. Inventory becomes a concern when firms become worldwide, with thousands of components and hundreds of warehouses, and a lot of effort is spent managing inventory and assuring proper distribution. [9] As a result, the warehouse inventory management system is very helpful in preventing this problem since it maintains track of the details of the individual products and informs us of the stockroom in which the product is stored. [42] There are different methods to track the inventory such as the use of load sensor to detect the weight of the products using a load cell [3], [44], [45] or using RFID technology i.e., RFID tags to locate a particular product. [9], [42], [46], [47] Among the Internet of Things (IoT) technologies that concentrate on identifying and tracking are RFID (Radio Frequency Identifying), bar codes, and smart sensors. Because of its identifying and tracking abilities, RFID in particular is often used. Additionally, RFID provides the benefit of optimizing corporate processes, reducing labor costs, improving the precision of inventory movement and placement, and consistently raising business productivity. [43] RFID is the wireless communication technology that is most appropriate for warehouse inventory control systems. The transmitter component transmits the tag data to the open source hardware through a wireless link that may access the internet. The Internet of Things architecture is used in the design of the warehouse inventory management system to track the products connected to the tags with product information and time stamps for additional verification. [42]

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Quick access to current value of goods via a website or application is one of the most important advantages of integrating IoT in inventory management. Because most individuals now have smart phones that can connect to the internet, real-time values are collected from the product or container and sent to a website or application via a wifi module. This allows the user to view the inventory at any time and from any location. Both the values recorded by the sensors and the signals produced by the RFID tags are transferred via a wifi module and saved in the cloud, where they may be accessed through a website or application created specifically for the purpose.[9]

Table I given is constructed after studying several papers that talk in detail about warehouse maintenance using sensors and integrating IoT. Inventory can be managed in different methods. These methods are based on the types of sensors used for measuring the levels of stocks, types of microcontrollers used, the user interface that is in action and the integrated circuit that is handled in each case.

A. RIFD system

For many years, supply chain management, the food business, the retail sector, and the livestock management sector have all employed RFID technology. It has lately emerged as a brand-new and fascinating field of study and is getting much of attention. The big push began when the large retailer Wal-Mart declared in 2005 that all of its vendors had to provide shipments with RFID capabilities. Real-time product replenishment is made possible by RFID technology in the retail sector without the assistance of a person or line of sight. [47] Radio-frequency identification, also known as RFID, collects and stores data from a tag that is attached to an object using radio waves. If the tag isn't in the reader's immediate line of sight, it can be read from many feet away. [9] A microprocessor included within the RFID tag itself allows the reader to read data from it as well as write data to it to perform in-place real-time updating. Every tag is encased in plastic or paper for safety, and it may be affixed to a variety of places for tracking. A great deal of RFID tags used for tracking inventory is passive, meaning they are energised by the reader's radio waves rather than a battery. Active tags are used for distant tracking of vehicles like trucks and railway wagons; they are powered, more costly, and more sophisticated. Containers with RFID tags assist increase internal control, improve event management, such as the replacement of cold storage areas, and minimise the preparation of items for expiration. [46]

B. Sensors

IOT's primary building blocks include sensors, user interfaces, networking, and data processing systems. The benefits associated with wireless sensor and actuator networks (WSAN) and information-centric sensor networks (ICSN) are incorporated into the Internet of Things (IoT). When smart sensors were used with the IOT, it became smarter and more intelligent. One of the technology standards for IOT established by researchers is the use of sensors. So sensors play an important role in an IOT based device. Management of supply chains, retail, irrigation, aeroplanes, and autos are just a few industries where sensors are used. Wireless sensor networks (WSN) and single sensor technologies enable intelligent parking, illumination, traffic control, smart irrigation and farming, structural wellness, the armed forces, smart structures, and transit systems, among other things.[48]

Sensors also known as detectors are devices that are used to detect a physical or chemical change as a signal from the surrounding environment and sends the data to other electronic device which converts it into an understandable form to the electronic device from which the data can be analysed. The input signal can be either heat, light, gas, moisture, pressure and other environmental phenomenon. Sensors are used in various applications starting from a simple water detection system to more advanced applications like in aerospace. They play a significant part in our everyday life and make it easier and better because they are utilised everywhere. The electrical properties of sensors often change in response to changing physical conditions. As a result, most artificial sensors collect, analyse, and send environmental data using electronic devices. The capacity to manage the movement of electrical power is crucial since these electronic devices work on the same concepts as electrical circuits. A sensor, in the simplest terms, transforms environmental inputs such as light, sound, heat, and mobility into electrical impulses. Before being sent to the computer for processing, these signals are routed via a device that converts them to a binary code.

Different sorts of sensors may be used to track inventory, such as detecting the weight of the container or measuring the quantity of product in a container using ultrasonic waves. In general, a load cell is used to assess whether the goods are adequate by measuring the weight of the container. In this type of inventory system, each change in the item weight is precisely calculated by computer software, and logical inferences are drawn as to if the inventory needs more stock or not. In this method, "Load Cells," which are merely metallic spring parts composed up of "Strain gauges," are employed. It should be noted that when a load or weight is put to a "Strain gauge," the resistance changes. The Wheatstone bridge technique, which determines the null voltage difference across two potential dividers connected in parallel, can be used to identify this resistance shift. [49]

The load cell provides us with analogue data. Digital load cell output is produced using a load cell connected to the HX711 load cell amplifier with a 24-bit ADC. Anywhere in the world may access the internet and view the weight of a retail container as measured by the load cell via a computer, tablet, or smart phone. A notification is sent to the phone or laptop when the load cell weighs the shopping container and determines if the weight is below the threshold value. [45] The load cell must be installed between two flat surfaces using the two threaded holes on each side to provide the required strain for estimating the container's weight. Once fixed, the flat surface may be used as a scale to weigh a storage container on our mobile app and track food consumption. [46]

Another type of sensor used in inventory management is the ultrasonic sensor. Ultrasonic sensors measure distance using ultrasonic pulses. It sends out an ultrasonic pulse and receives the reflected wave from the target. This technology-based inventory system is especially well-suited for products held in liquid form. Using this technique, it is possible to estimate the liquid content of storage containers with accuracy. Every change in the volume of fluid in its container of storage may be precisely calculated and recorded by computer software within fraction of a second. The main advantage of using an ultrasonic detector in such an inventory system is the fact that the liquid being kept is not physically harmed by it. Only ultrasonic sound waves are used by the sensor to communicate with the liquid. It should be underlined that the sensing parts of this inventory system become modular since the sensor does not physically come into touch with the liquid. [49] These can be used to manage both liquid and solid stocks without any modifications. The transducer calculates the amount of time it takes for a pulse to go from the container's top to its whole surface and back. The space between the highest point of the box and the surface of the inventory is calculated using this time. By using two assumptions: maximum and thresholds, the maximum is the distance from the lowest permissible inventory and threshold is the distance from the maximum acceptable inventory. It's obvious that a maximum threshold exists since the separation increases when stock prices fall. A threshold amount should be chosen so that the market can function up until the arrival of the new products. Similarly a LDR (light detecting resistor) can be used to manage the inventory. LDR is a high resistance semiconductor that serves as a photo resistor. An LDR, or light-detecting resister, loses resistance as the amount of light striking its surface increases. LDR operates on the basis of photo conductivity; when light strikes its surface, the electrons in the semiconductor's valence band are stimulated to the conduction band and can conduct electricity as a result. This idea may be applied to create an intelligent inventory system in conjunction with output analysis computer software. [3], [49]

Different sensors may be employed to preserve the security of the items in the warehouse or in a kitchen in addition to calculating the amount of the goods. These sensors include moisture and gas sensors. Gas sensors are used to find gas leaks in warehouses, while moisture sensors are used to monitor a product's moisture content and alert the user by linking to a website or mobile application over wifi. We may learn more about the condition of the product within the container by collecting the moisture content readings. Gas sensors are also highly helpful in securing a warehouse since they can detect gas leaks. [47], [51]

C. Microcontrollers

With the advancement of modern technology, standalone systems are now able to do all required operations without the help of extra hardware like microcontrollers. These feature a large number of integrated circuits on board, allowing them to carry out a variety of tasks independently. They are used in a variety of settings, from sturdy industrial equipment to simple home gadgets. [55] In IoT base systems, many microcontrollers are employed.

1) *Arduino Uno:* It is known as an open-source programming board because you can upload programmes onto it and utilize them to communicate with real-world objects. Based on the Atmega328 microprocessor, it is a microcontroller board. It can communicate with electromagnets, sensors, and motors.
2) *Raspberry Pi:* It is a collection of small single-board computers that is maybe the most inventive computer of the market today. Python, C, C++, BASIC, Perl, and Ruby are just a few of the programming languages that the Raspberry Pi can run. [56] By integrating relays, sensors, and lights with smart phones or computers, home automation systems can readily host some of the applications for home automation. The system may be remotely controlled with ease by the operator.
3) *Beagle Bones:* Beagle Bones Texas Instruments has developed a family of single-board Linux computers (SBCs) called Beagle Bones. Beagle Bone Black is an inexpensive, society-supported development platform for developers. This small single board computer would be ideal for a complex robot project.
4) *ESP8266:* Espressif Systems produced the WiFi SOC (system on a chip) in question. It is a closely integrated semiconductor designed to provide full internet connectivity in a small package. By connecting the ESP8266 to any microcontroller through the serial UART and running the conventional AT Command set Firmware, the ESP8266 may be utilized as an exterior Wi-Fi module. Alternatively, it can operate directly as a microcontroller that supports Wi-Fi by building updated firmware with the available SDK.

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D. Wireless Communication Protocol

IoT Communication Protocol is anticipated to revolutionize the way information is transmitted from people to people, people to things, and things to things. Connected, information-transferring, and decision-making capabilities exist in smart devices. [57] Now that there are millions of IoT devices linked to the internet, we can use the suite of protocols known as TCP/IP to interact over networks. [58] The productivity of many smart domains (smart homes, smart cities, etc.) is increased through wireless sensor network connections, however some hazards are also added. For a better understanding of how protocols are implemented in smart environments, it is imperative to first grasp the relationship between the traditional OSI or TCP/IP model and the IoT protocol stack. [59]

IoT protocols for communication are typically described as LPWAN and network short.

1) *Low Power Wide Area Network (LPWAN):* A reduced-power wide-area network, often called a low-power network or LPWAN, is a type of wireless broad-area networking used for wireless communications that permits long-distance communication at a low bit rate among devices like sensors which are powered by batteries.
2) *Short Range Network:* Although short-range wireless communication is not specifically categorized, it generally refers to communication distances on par with WPAN and WLAN. Wide-area wireless networks using multi-hop technologies, such FAN (Field Area Network), have gained popularity recently.

- *6LoWPAN:* The first and most popular IoT connectivity standard, 6loWPAN is an IP-based protocol for Internetworking. It can be directly connected to another IP network gateway or proxy without using any intermediary entities for translation.
- *ZigBee:* Based on IEEE802.15.4 low power wireless networks, the ZigBee Alliance was created. ZigBee is a standard for high-level suites of inexpensive protocols for the creation of personal areas, low power digital radios, and small-sized networks for data transmission over greater distances.
- *Bluetooth Low Energy (BLE):* BLE is also known as a smart Bluetooth Essential IoT programme protocol. It is intended to be enhanced for fast, low bandwidth, and low latency IoT applications.
- *Near-Field-Communication (NFC):* NFC is a wireless contact technology that transmits data between devices over a very short distance.
- *Message Queue Telemetry Transport (MQTT):* The MQTT protocol is the actual norm for IoT communications. The MQTT publish/subscribe protocol, which is an OASIS and ISO standard, provides a scalable and reliable way to link devices over the Internet.
- *Wi-Fi:* Wi-Fi is a wireless internet technology that transfers networks via electromagnetic waves. Wi-Fi integration and interoperability will enable IoT solutions to securely interact with one another and with billions of user-centric devices in order to extract the most value from IoT applications and settings.

E. User Interface

User interaction is vital in a wide spectrum of software and systems. This is also applicable to Internet of Things (IoT) technologies. However, IoT has grown well beyond the installation of commercial plants: IoT is already (and will stay) an aspect of everyday life for customers. As a result, interfaces for users in the Internet of Things (IoT) system are going to have an increasingly essential role in consumer acceptance, much as they do in other domains like the internet, mobile, and wearables. [60]

1) *Mobile Application:* The creation of internet-of-things apps for mobile apps allows for the administration of smart devices such as smart watches, detectors, medical equipment, and other gadgets. With less hazards and expenses for the workforce, to offer a simple and comfortable user experience, a single application combines device-specific programmes on a single dashboard.
2) *Websites:* Websites are the most often utilized user interfaces for IoT based solutions. It is an easy-to-use online software solution that simplifies Stock, Client Data, Sales Leads, Customer Orders, and other inventory management systems.

F. Cloud platform

The "cloud platform" relates to a server's operating system and hardware in a cloud data centre. It enables the coexistence of distant and widespread hardware and software products. Using this paradigm, a cloud computing service which you are able to use via the public web or a specialized personal connection allows you to store data over the internet. The provider secures and maintains its storage servers, facilities and network to ensure that information of any size may be accessed. Wi-Fi modules are used in IoT systems to save data in the cloud. The data may then be obtained and examined via HTTP protocol.

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TABLE I

Ref.	Sensors	IC	Communication Protocol	User Interface	Key features
[1]	Load cell1 for countable and load cell 2 for uncountable groceries	Raspberry Pi Microcontroller	NodeMCUESP8266 (Wireless WiFi module) (MQTT protocol)	Website	A complete, inexpensive, strong, and easy-to-use continuous tracking and kitchen control via remote system.
[2]	Load cell	Raspberry Pi	MQTT protocol	Mobile application	Keeping track of the availability of food in the kitchen. Automatic grocery ordering based on inventory levels.
[3]	Load cell	Arduino Mega	Node MCU ESP8266(TCP and 12 C)	Website	Maintain inventory control. Grocery shopping is done automatically. It is environmentally friendly since it consumes very little electricity and has reusable rechargeable batteries.
[4]	Ultrasonic sensor	Arduino Uno microcontroller	Wi-Fi module(ESP8266)	Mobile application	Places orders once the groceries level found to below.
[6]	DHT-11 Sensor Ch4 Sensor Light Sensor	Arduino Mega	Wi-Fi module(ESP8266)	Mobile application	Temperature and humidity are measured within the containers. When an emergency happens, the user is notified via messages, along with the location of the cargo.
[7]	HC-SR04 Ultrasonic sensor	Raspberry Pi	Wi-Fi module with Realtek 8188 EU chipset	Website	Order placement is automated. Self-sustaining, with no delays caused by insufficient inventory.
[8]	Ultrasound sensor Color sensor Infrared sensor	Raspberry Pi and Arduino module	Wi-Fi/Bluetooth	Mobile application	Automatic inventory management system for remote inventory management and inventory status monitoring. Can be utilized in a small business without the need for a separate terminal.
[9]	Load cell	Arduino Microcontroller	Wi-Fi module MQTT broker	Desktop application Android application	A food stock tracking system built on the Internet of Things guarantees real-time inventory monitoring in the kitchen.

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[10]	Load cell	Arduino Mega	Node MCU(ESP8266) Wi-Fi module	Website and App	Manage the inventory's average use of commodities and items.
[11]	HC-SR04™ ultra-sonic sensor	TARANGTMP-20MODULE	Wi-Fi module	Website	Measures the container fill state and sends the notification to the user to update the entire process.
[14]	Load cell with HX711IC Driver LM35IC Temperature sensor	Raspberry Pi 3B+and Arduino module	Wi-Fi module	Mobile application	Reduce the need of human labor, enhancing speed and delivery accuracy, and providing merchants with unprecedented visibility into inventory and supply networks.
[15]	Fork lift UWBIMU Scale RFID tag	Arduino microcontroller	LoRa module WCDMA module Wi-Fi module RFID	Web server	Automated warehouse management
[16]	RFID tag	RaspberryPi3	Node MCU (ESP8266-12e) Wi-Fi module RFID	Web server	Warehouse inventory management system. Very low-cost system and works dynamically.
[17]	RFID tag	Controller	WiFi module RFID	Mobile application	Real-time visibility into the whole logistics process improves inventory operation efficiency by conserving human resources and lowering operational costs.
[18]	Temperature sensor Humidity sensor Illumination sensor	Raspberry Pi 3B+	Wi-Fi module(ESP8266)	Mobile application/ Web application	System for warehouse monitoring and control. Possess more control over commodities, lowering the risk of harm and improving the quality of the warehousing operation.
[19]	MQ2 gas sensor MQ135 sensor LM35 Temperature sensor	Arduino Uno	Node MCU ESP8266	Web server	Simple gas leak detector is its simplicity and its ability to warn its stakeholders about the leakage of the Gas.
[20]	Load cell with HX711 ADC MQ2 smoke sensor MQ5 gas sensor	Microcontroller	SMTP (Simple Mail Transfer Protocol)	Web application	The user is wary about LPG leaks and even of gas. LPG detector tells the user when there is a leak and also when the gas cylinder is nearly empty.

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[21]	Load cell Gas sensor Temperature And Humidity sensor	ATMega35 Microcontroller	Wi-Fi module/Bluetooth	Web server	Alerts the user of gas leakage. Prevent accidents and hazards. Cost effective and time consuming.
[23]	DHT22 sensor QM-135 gas sensor PIR sensor	Node MCU ESP8266- 12eboard	Wi-Fi module	Web server	Existence of gas leakage, uncontrolled fire, extreme temperature, and in hospitable environment is identified and addressed as soon as possible.
[25]	RFID tag	Arduino Uno with AT Mega328p microcontroller	ESP 8266 Node MCU RFID	Web server	Assist the building industry with inventory management of necessary form work shuttering goods.
[26]	Piezoelectric Loadcell1 Loadcell2	Arduino UNO and Mediatek Linkit ONE.	Wi-Fi module/HM- 10BLEmodule	Mobile application	Allow for automated, real-time updates on inventory availability. Notify the user if food is about to expire. Use past inventory consumption data to improve forecast and planning.
[27]	MQ4 smoke sensor MQ135 gas sensor Load cell	Arduino Uno Microcontroller	Wi-Fi module	Web portal	The daily record of food waste in the computer system contributes to lowering the quantity of food waste at homes and restaurants alike.
[29]	Load cell RFID tag	Arduino Uno	ESP8266 Wi-Fi module RFID	Mobile application	Customers may use the mobile app to look up the availability and details of a product. Retailers may keep track of each product's sales and restock as necessary to prevent situations when the store sells out of a particular item.
[30]	MQ2 gas sensor DHT11 sensor Load cell	Arduino Uno	Node MCU ESP8266	Web application	Notifies the user about the leakage of a gas cylinder and leakage of a gas. Prevent hazards and accidents. Cost efficient and time consuming solution.
[33]	MQ5 gas sensor LM-35sensor	ATMEGA32 Microcontroller	Bluetooth	Mobile application	Detect leakage of the gas. Monitor weight of the gas. Automatically books gas based on availability.

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[34]	HC-SR04 Ultrasonic sensor	Raspberry Pi 3+	E-mail	Mobile application	Automatically alert the consumer when a certain commodity is necessary. Places an order for the same with a minimum of human assistance.
[35]	MQ135 gas sensor DHT11sensor Ultrasonic sensor	Microcontroller	ESP32 Module	Web application	Able to control home appliances. Has a scientifically significant effect on electricity usage and cost.
[37]	Load cell	Microcontroller	Node MCU Wi-Fi module	Web server	Identify and teach usage of grocery. Low cost, effective design and easy.
[38]	IR sensor (Fire sensor) MQ2 gas sensor Pressure sensor	Raspberry Pi	GSM module Wi-Fi module	Web server	GSM–extensive coverage of all parameters. Provides a decision making device concept for adaptation to several kitchen scenarios.

The information in the aforementioned table can be summarized as follows. Measuring the quantity of raw materials is the main prerequisite for inventory management. The load cell performs the essential function in this area with the greatest benefits. The implantation of an ultrasonic sensor is another approach to achieve the same result. Utilizing ultrasonic sound waves, it calculates the product's level and distance from the top end of the container. Its main drawback is that it only provides approximations of distances and does not provide measurements in readable units. The type of product in the container affects how the sensor measures and functions (solid or liquid). At an industrial level, gas sensors are used to find gas leaks in warehouses.ESP8266 Wi-Fi Module is the most used communication protocol in line with all the sensors mentioned above. Although the Raspberry Pi is thought to operate more efficiently, the Arduino microcontroller is more practical, more affordable, and used in majority of inventory management devices.

IV.SUMMARY

This paper reviewed the literature on the implementation of various technologies that focus on six main areas: food inventory optimization, minimal human intervention, reducing food waste and pilferage, identifying bottlenecks in operations, inventory tracking automation, and constant visibility to inventory quantity, location, and movements. Based on the aforementioned conclusions on inventory management and others, it is clear that the advancement of IOT revolutionised the digital transformation of data and inventory management with less manpower, hence enhancing overall performance efficiency. It was identified that some of the aforementioned papers outlining suggested ideas for inventory management are lacking in some key functionality and are challenging for users who are unaccustomed to using sophisticated technology. In some cases, the user interface might be difficult for users to understand effectively due to its complexity. More study is needed to determine the extent to which these technologies improve efficiency of use.

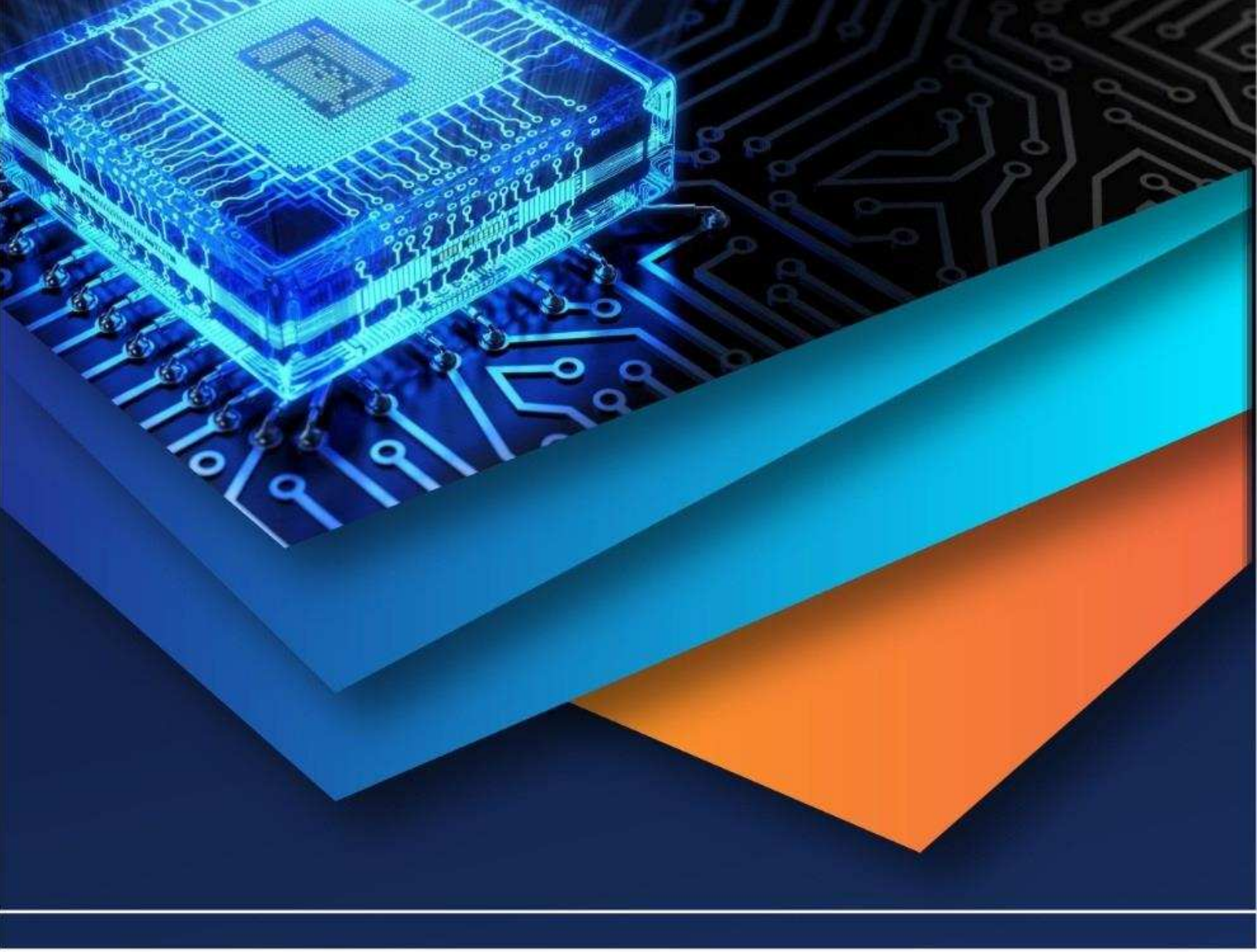
REFERENCES

[1] Omkar Mulay, Manas Bhalerao, SayaliBhamare, Vinod Gaikwad, Dr. Kamini Nalavade, “IoT based food inventory tracking system for domestic and commercial kitchen using weight sensors, LDR, LED, Arduino Mega and Node MCU(ESP8266), Wi-Fi module with website and App, IJSDR,” Volume 4, October 2019.
[2] Akshay Pendbhaje, S. Rajesh, “IoT in home grocery management,” 2017.
[3] Sifat Rezwan, Wasit Ahmed, Mahrin Alam Mahia and Mohammad Rezaul Islam, “IoT based Smart Inventory Management System for Kitchen,” 2018.

[4] K. Sakthisudhan, S. Maharaj, T. V. P. Sundarajan, "A Smart Kitchen Automation and Grocery Management system using IoT," Volume 18, May 2018.
[5] Anup Aravind Lakkanagavil, Amulya. H N, Apoorva. N, Bhargav, Aryan Singh, Naveen N C, "Smart Kitchen Containers as a part of Smart home appliances using IoT and Android," Volume 4, 2019.
[6] Shubham More, Dhar Shelar, Vaibhav Randhave, Prof. Ashwini Badge, "IoT Based Smart Kitchen System," June 2021.
[7] SravyaMandadi, Yashaswini. C, Suraksha. M,"IoT Based Smart Kitchen," April 2019.
[8] Jyotir Moy Chatterjee, Raghvendra Kumar, Manju Khari, Dao Thi Hung, "Internet of Things based system for Smart Kitchen," July 2018.
[9] Souvik Paul, Atrayee Chatterjee, Digbijay Guha, "Study of Smart Inventory Management System based on IoT," 2012.
[10] Shivaranjini Shivayogi Mogali, "IoT and its role in Smart Kitchen,' September 2015.
[11] Bandhan Nagaria, Parv Shroff, Rajat Mehrotra, "IoT based Inventory System for Stock Management," July 2016.
[12] Shazmina Gull, Imran Sarwar Bajwa, Waheed Anwar, Rubina Rashid, "Smart e-Nose Food Waste Management System," July 2021.
[13] Shyam Purkayastha, "IoT application that monitors your food pantry," March 2016.
[14] Shyam Purkayastha, "Model IoT Application for Tracking Kitchen Inventory by using Pub Nub," July 2017.
[15] Rajesh Bose, Haraprasad Mondal, Indranil Sarkara, Sandip Roy, "Design of smart inventory management system for construction sector based on IoT and cloud computing," Volume 2, March 2022.
[16] Alsan Parajuli, "ESP8266 Based Smart Kitchen Automation & Monitoring System," January 10, 2022.
[17] Professor Rajesh Kumar Kaushal, Harini. T, Pavithra Lency.D, Sandhya.T, Soniya.P, "IoT based smart food monitoring system," Volume 6, 2019.
[18] Eun-Soo Choi, Min-Soo Kang, Yong Gyu Jung, Jean Kyung Paik, "Implementation of IoT-based Automatic Inventory Management System," Volume 5, 2017.
[19] S.P. Lakshmi Narayanan, E. Kavinkartik, E. Prabhu, "IoT Based Food Inventory Tracking System," January 2019.
[20] Satare Devika Jitendra, Salva Karan Pankaj, Khan Aman Islam, Mrs. Pranali Wagh, "FreshBox – IOT based Pantry System with Store Management," Volume 4, April 2021.
[21] Neha.M.R, Mr. Madan. G, Dr. K. R. Prakash, Mr. Shivraj. CS, "Design and Development of Smart Containers using Smart Sensors to Maintain Inventory," Volume 6, June 2016.
[22] Maha Riad, Amal Elgammal, DoaaElzanfaly, "Efficient Management of Perishable Inventory by Utilizing IoT," 2018.
[23] Chelinka Rafiesta Sahara, "Real-time data integration of an Internet-of-things-based smartWarehouse: a case study," January 2021.
[24] WalaaHamdy, Noha Mostafa, Hesham Elawady, "Towards a Smart Warehouse Management System," September 2018.
[25] K. Umamaheshwari, M. Susneha, B. Sheeba Kala, "IoT based Smart Cold Storage System for Efficient Stock Management," 2020.
[26] C.K.M. Lee, Yaqiong Lv, K.K.H. Ng, William Ho & K.L. Choy, "Design and application of Internet of things-based warehouse management system for smart Logistics," October 2017.
[27] Abhirupkhanna, Ravi Tomar, "IoT based Interactive Shopping Ecosystem," 14-16 October 2016.
[28] Alam Colakovic, Samir Causevic, Amel Kosovac, Ermin Muharemovi, "A Review of Enabling Technologies and Solutions for IoT Based Smart Warehouse Monitoring System," 2020.
[29] Vadivukkarasi K, Ritherton C, Vignesh M, Vishrut S and Aravindan K, "Inventory Management for Retail Applications Using IoT Systems," Volume 8, June 2019.
[30] B. Sneha Reddy, R. Ramya Veera, B. Ram Mohan Reddy, Mr. G.P.V. Kishore, "IoT Based Smart Kitchen Automation and monitoring System," Volume 4, June 2022.
[31] Hanbin Wang, Xiaoxia Chen, "IoT Technology – Based Manufacturing Inventory Management," 2013.
[32] Pratik Maheshwari, Sachin Kamble, Ashok Pundir, Amine Belhadi, Nelson Oly Ndubisi, Sunil Tiwari, "Internet of things for perishable inventory management Systems: an application and managerial insights for micro, Small and medium enterprises," September 2021.
[33] Gaurav V Tawale-Patil, Miss. Kalyani H Kulkarni, Miss. Pooja U Kuwad, Miss.Pooja R Pawar, "Smart Kitchen Using IoT," March 2016.
[34] Ch Anwar Ul Hassan, Jawaid Iqbal, Muhammad Sufyan Khan, Saddam Hussain, Adnan Akhunzada, Mudabbir Ali,Abdullah Gani, Mueen Uddin and Syed Sajid Ulla, "Design and Implementation of Real-Time Kitchen Monitoring And Automation System Based on Internet of Things," September 2022.
[35] J. Damodhar, S. Swathi, "Internet Based Monitoring System for Smart Kitchen using Embedded Web Server Architecture," Volume 4, June – July 2016.
[36] S. Yerpude, T. K. Singhal, "Smart Warehouse with IoT supported Inventory Management System," 2018.
[37] X Jing, P. Tang, "Research and design of the Intelligent Inventory management system based on IoT and RFID Technology," 2013.
[38] I. Affia and A. Aamer, "An IoT based smart warehouse Infrastructure: Design and Application," 2021.
[39] Shilpa Parkhi Sourabh Joshi Shubham Gupta Mridu Sharma, "A Study of Evolution and Future of Supply Chain Management", Volume 9, no. 2, pp. 95-106, May 2015.
[40] Punam Khobragade, Roshni Selokar, Rina Maraskolhe, Prof. Manjusha Talmale, "Research paper on Inventory management system, "Volume: 05, Issue: 04 | Apr-2018.
[41] J.B. Munyaka& V.S.S. Yadavalli, "Inventory management concepts and Implementations: a systematic review," Volume 33(2), pp 15-36, July 2022.
[42] B. Sai Subrahmanya Tejesh , S. Neeraja, "Warehouse inventory management system using IoT and open source framework,"Received 29 April 2017; revised 4 February 2018; accepted 19 February 2018.
[43] Samir Yerpude, "Smart Warehouse with Internet of Things supported Inventory Management System,"Volume 118 No. 24 2018.
[44] Ashwini S. Shelake, "IoT Based Food Inventory Tracking System for Domestic and Commercial Kitchens (Result Based)," Volume 3 - Issue 3, May - June 2020.
[45] Bandhan Nagaria, Parv Shroff, Rajat Mehrotra, "IoT Based Inventory System for Stock Management,"Vol. 8, Issue 1, 2020.
[46] Shital Dilip Chopade, Mininath K. Nighot, "Smart Kitchen Management Using IOT Technology,"Volume 8, Issue 7, July 2019.
[47] Sizakele Mathaba, "On the use of the Internet of Things and Web 2.0 in inventory management,".
[48] Anukriti Sharma, "A Review of Sensors and Their Application in Internet of Things (IOT),"Volume 174 – No. 24, March 2021.
[49] Kunal Singh, "Smart Inventory Management Using Electronic Sensor Based Computational Intelligence,"2019.
[50] Jayanth Suresh, "Inventory Management System Using IOT,"January 2017.

[51] CH.N.S.Kameswari,"A smart warehouse inventory management and monitoring system using internet of things and open source technology, "Volume 8, Issue 12 December 2020.
[52] Rolf Dornberger, Terry Ingelese, Sadak Korkut, Vivienne Jia Zhong, "Digitalization: Yesaterday, Today, Tomorrow," May 2018.
[53] Raffaella Cagliano, Federico Caniato, Gianluca Spina, "E-Business Strategy – How companies are shaping their supply chain through the internet," Jan 2003.
[54] Muhammad Asad Khan, Muhammad Hayyan Bin Shahid, Hassan Mansoor, Uzair Shafique, "IoT based grocery management system," Dec 2019.
[55] Kurnal A Moharkar, Ankita A Tiwari, Pratik N Bhuyar, Pradip K Bedre, Prof. Sudesh A Bachwani, "Review on Different Microcontroller Boards used in IoT," 2013.
[56] Hirak Dipak Ghael, Dr. L Solanki, Gaurav Sahu, "A Review on Raspberry Pi and its Application," Volume 2, Issue 12, Jan 2021.
[57] Anu Sharma, "Review on Communication Protocols Internet of Things (IoT)," Volume 6, Issue 5, May 2019.
[58] Navneet Verma, Sukhdip Singh, Devendra Prasad, "A Review on existing IoT Architecture and systems via domain-specific components and patterns," 2017.
[59] Communication Protocols used in Healthcare Monitoring System," Feb 2021.
[60] Deepti Rani, Nasib Singh Gill, "Review on Various IoT Standards and Communication Protocols," Volume 12, Number 5(2019).
[61] Marco Brambilla, Eric Umuhoza, Roberto Acerbis, "Model-driven development of user interfaces for IoT systems via domain-specific components and patterns", 2017.

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A Review on Quality Scanner Device for Radish and Carrot using Image Processing Technique

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Abstract: ***Agriculture is the backbone of the Indian economy and productivity. The market value obtained from them is immense and effect both the export and quality valuation . Although grading and quality can be analysed by humans it is still inaccurate, time intensive, unreliable, subjective, and also hard which can be easily influenced by surrounding. Hence, there is an ultimate need for intelligent classification for vegetables. This paper focuses on Developing an analysis device for Radish (Raphanus raphanistrum) and Carrot (Daucus carota subsp. sativus) which is an edible root vegetable grown in most parts of India. Radish and carrots are good sources of natural nitrates, minerals, calcium, and potassium. Thus, vegetables must be used as soon as possible to get a superior fresh character from them. External parameters such as size, shape, and quality factors of radish are important for finding out the total quality that is acceptable to the people. Various methods and algorithms are been put forwarded for the quality evaluation for the external defects present in it. Convolutional Neural Networks is the method used in image processing as this is more advantageous since it can learn special characteristics from images and by establish CNN for image classification where analyst have to gather the dataset. The requirement for doing this project is to have a computer and a python program for use the driver code. Image processing method is used for estimating quality of the particular food product efficiently in these days. This review paper examines current developments in methods for assessing food quality through image processing. The use of CNN (Convolutional Neural Networks) to identify characteristics of vegetables and its diseases through several built-in python libraries.***

Keywords: Quality Analysis, Image Processing, Grading, Non-Destructive, Agriculture.

I. INTRODUCTION

An approximate figure given by food and agricultural ministry states that roughly 40 percent of foods which are cultivated in India are fittrad away yearly due to disrupted food and ineffective supply chains management system. Around 1% of GDP is depleted in form of food waste which is given by Ministry of Agriculture [3]. Lack of untrained manpower and lack of acceptance of automation is the main reason for this back fall. Furthermore, inferior quality and misused supply chain transport is also one of the reasons. Conventional quality evaluation involves both the chemical and microbial evaluation [15]. The chemical evaluation implies finding the chemical constitution of food product which exist in it as natural or which is substitute to foods for increasing their nutritional composition. The goal of the microbiological study is to identify microorganisms that may be harmful to humans which is present in food products. It is frequently used as a key quality control technique [16]. The sensory evaluation is the most commonly used quality analysing method. The quality factors of food product are analysed which require testing of the food product manually by a specialist. it is a difficult task, when there is a bulk amount of food products to be analysed at a time. Low level of precision and repeatability of food evaluation are caused by a variety of variables, including the attitudes and perceptions of the experts [17]. Vegetables will continue to respire after harvest, so they will look fresh for a little while. Vegetable will eventually lose their freshness as the days go by. In addition to this, inadequate facilities for storage and delivery result in vegetable spoilage . Additionally, there is a potential that the secretions from one rotten fruit and vegetable could spread to the nearby fruits and vegetable and destroy the entire batch. Currently, computer vision has a wide range of uses in industries including food and agricultural, automotive, education, healthcare, etc. Applications for computer vision in agriculture [5].

II. LITERATURE REVIEW

Nowadays the fruit and vegetable industry has sustained due to the introduction of image processing methods and such methods has been successful in the non-destructive assessment of various food products.

Han S. EL-Mesery [9] states that there is an increasing concern on quality and safety of food in worldwide business. Non- invasive methods or non-destructive methods creates an esteemed value , especially in fruit and vegetable industries.

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Non-destructive procedures are a component of high-quality controls and they complement the majority of existing approaches. In addition, consumers have a tendency to want more information about the items they buy nowadays as a result of their enhanced awareness.

The popularity of microprocessors, signal analysis techniques, and sensors has permitted new businesses to use these approaches. It took a lot of work to establish this strategy because there is a profitable demand in finding food and Agri product which are more uniform in grade and customer favourites [2].

Fruits and vegetables are evaluated for quality using both destructive and non-destructive methods. Destructive method of analysis determines how a procedure react under pressure till it fails. It's not suitable in fruit and vegetable industry, as it ruptures the fruit and vegetable tissue and is difficult to evaluate the whole lot at a time. Destructive testing is more expensive and generate waste. This testing is less efficient because Destructive testing is direct approach and does not provide accurate result.

If the testing is done by destructive method in large food manufacturing industry in order to analyse the hidden characteristics of the product, an analyst must destroy the various aspects of the product. Destructive method of analysis provides reliable result due to its manual process and material degradation procedure cost the manufacturer. Non-destructive analysis is similar to destructive analysis but it will not permanently damage any produce. This is based on physiological property which connects with certain quality factor of fruits and vegetables. Both internal and exterior characteristics of vegetables are very much important and internal attributes plays a major role in consumer selection of a particular food product.

Non-destructive analysis is non-invasive, rapid and suitable for instantaneous analysis so this non-invasive analysis is emerging as highly efficient means of analysing the quality of the material [6]. In today's post-harvest and processing of agricultural products, assessing the quantity and quality of agricultural products without causing any harm and reducing food waste has a significant place. For fresh fruit and vegetables, non-destructive procedures with a focus on quality value have become increasingly important and prevalent in recent years [9].

NDM was established with the goal of concentrating on developing the best systems required to assess the quality of food and agricultural products, which have improved the standards needed to categorise the grade of food quality in a particular product that can be sold according to the grade in the market. The aim of non-destructive evaluation approaches is "on the structure, mechanical, physical, and chemical properties of food". The best method for food processing processes is the use of non-invasive measurement [20]. Common non-invasive (non- destructive) evaluation techniques that include "machine vision, near-infrared spectroscopy, hyperspectral imaging, electronic noses, ultrasonic measurement, and acoustic emission tests". According to scientists, food primarily consists of water, carbs, fats, and proteins. The methods of processing frequently change as the chemical structure of the agricultural product changes [8].

"Colour, size, form, texture, and quantity of flaws" are the three primary components of a fresh inspection. Carrot and radish defects or damage typically result from rotting, bruising, scabs, fungal development, injury, disease, etc. After these vegetables are harvested, proper care should be given [22].

A. Radish (Raphanus statives')

The Radish, Raphanus sativus L., comes from Central and Western China and India and is a member of the Brassicaceae or Cruciferae family [23]. It is both diuretic and revitalising. Radish is used to treat persistent diarrhoea, insomnia, and neurological headache. Radish is also beneficial for bladder and piles problems. For the purpose of making culinary and lighting products as well as for the industrial extraction high amount of protein from radish leaves, radish seeds may be a good source of non-drying fatty oil [25].

Because of its specialised structure (hypocotyls), which can store starch and other substances, its similar resemblance to actual roots, and its home in the ground, the radish is classified as a root [19]. While the majority of European and Asian crops have white flesh, the surface colour of radish can range from white in Asia to red in Europe, to purple green, and even black [18]. A plenty of indigenous recipes are made out of radish which gives great health benefits. They taste best when eaten fresh, can be prepared in salads and sandwiches in slices, or can be consumed whole and dipped in houmous as a nutritious snack [12]. They are frequently used in cooking to give meals the greatest peppery as well as for pungent flavour. Mooli Subzi, Radish Dry Vegetable. White Radish is used in South Indian "Radish Sambhar, Mooli ka Salad, Radish, Cucumber, and Curd Dip, Indian Theplas, Parathas, Mooli Thepla, Radish Nachni Roti, Mullangi Sambar, and Bhatia Kadhi". Radish comes in a wide range of varieties such as black radish, daikon radish, horse radish, and watermelon radish. Radishes can be prepared in different ways, including pickling, roasting, and can be used in sandwiches also. Radish have a very large amount of nutritional value and it provide wide range of elements that can have a significant impact on human health.

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B. Radish Diseases

Radish *(Raphanus sativus L.)* have a significant issue with storage decay, which makes it difficult to keep this produce fresh and increase its postharvest shelf life at both low and high temperatures. Radishes are susceptible to postharvest and storage degradation caused by a number of fungi, however Alternaria and Fusarium species are the most frequent infections when the vegetable is individually wrapped in food packaging film for storage. High moisture content and low temperatures can control the softening and weight loss, which are mostly caused by the loss of water. Bruises are caused by collisions during post harvesting and transportation; when produce is harvested by hand, the chance of this damage is typically lower. Additionally, spongy look is a change that might happen during harvesting and persist during post-harvesting. Chilling damage and cavities are the physiological changes that happen most often. Temperatures of -0.7℃ cause freezing. In severe conditions, the roots gets weak, dry out, and become brittle. The cavities, which might appear before or after the harvesting and become more frequent during storage, are signs of senescence. Low temperatures lessen its occurrence.

Radishes are susceptible to parasite infections after harvest. The two most prevalent illnesses are bacterial black spot and powdery mildew, which are both brought on by the fungus Peronospora (caused by *Xanthomonas vesicatoria*)

C. Carrot (Daucus carota)

In the Apiaceae family of herbaceous plants, the carrot (*Daucus carota*) is an edible taproot. It is often a biennial plant. Common forms of roots come in a variety of morphologies, from spherical to lengthy, with blunt to pointy bottom ends. White, yellow, and purple flesh variants are also known in addition to those with orange-coloured roots. It is a cool climate crop which is grown in subtropic as well as temperate climate zone. Carrot is mostly used as an edible produce for millions of people all over the world. Carrot are good source of calcium, potassium, mineral and natural nitrates. Carrots are also good source of carotenoids, vitamins, dietary fibres and antioxidants. Carrots are very much popular for its abundant nutrient. Quality analysis of carrot based on the product quality is most basic and important operation. In tradition method quality evaluation of carrot is done manually and its expensive and is time consuming with low performance. Carrot is mostly used in salads and halwa, sambar. Vegetable biriyani , roasted carrot, carrot curry, glazed carrot, carrot smash, carrot juice, carrot supe and carrot poriyal.

Now a days, fruits and vegetables industry has sustained due to the introduction of image processing method and such method had been successful in non-destructive assessment of variety of the particular food item. Fruits and vegetables are graded according to their quality Deep learning is established by complete convolutional network, deep learning in food safety and quality assessment, deep learning in food process monitoring and packaging, deep learning in foreign object detecting etc. after harvest. So, in order to gain the best fresh quality, carrot must be utilised as soon as possible. To increase the effectiveness of grading and sorting as well as for automatic detection [10].

D. Carrot Diseases

During the cultivation of carrot large variety of diseases are been detected which results in the reduction of yield and market value. The majority of carrot diseases are brought on by organisms like mycoplasma, which cause “stunting, yellowing, bronzing of the leaves, sterility, and yellowing of the leaves that look like aster petals, common scab, dark root rot, cavity spot, rubbery brown rot, heat canker”[13]. Carrots are damaged by various microorganism. Due to nature of the carrot, the spoilage is brought about by different microbes and microorganisms which is a significant element that restricts the carrot production. To provide best quality of carrot to the market, fruits and vegetable industry update the innovations like image processing of carrot.

E. Need For Intelligent Quality analysing system

Automation in food processing without a concern significantly increases efficiency, quality and productive development of the country using computer vision, image processing is utilized to automatically detect and identify plant disease such as colour, texture and shape. Food quality can be further developed by quality examination using computer vision [11].

F. Convolutional Neural Network

Image recognition has lately used deep learning. The term "deep learning" refers to algorithms that tackle complicated problems using a deep architecture. The most distinctive aspect is that training allows superior visual features for recognition to spontaneously separate. The convolutional neural network and one technique that fully satisfies the requirements of the deep learning methodology is CNN.

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CNN is made up of a number of layers, including convolutional, nonlinear, pooling (down-sampling), completely connected, and the final result. For picture identification tasks like the Large-Scale Visual Recognition Challenge, CNN is currently the best method available [1].

Numerous important developments in imaging technology have been sparked by the rapid growth of both hardware and software frameworks. Researchers have developed a number of non-contact techniques recently for the evaluation or inspection of food and beverage goods, mostly addressing the drawbacks of conventional procedures like human inspection. [24]. This made a shallow interest towards change to computerized image handling by which machines are prepared to classify predefined dataset of food classes within a particular food dataset.

G. Computer Vision

Machine vision is an engineering technology which consolidates mechanics, optical instrumentation, electromagnetic detecting, digital video and image processing technology. The recent progression of computer technology, machine vision system has been applied in different industrial applications principally the food handling industry. The capability of computer vision is to mimic the video and graphic information which is typically caught by human eyes and to screen and handle existing data image information, which can work with technician to rapidly capture sensitive indicators during the process of data entry, data incorporation, data analysis and labelling [4]. Many researchers conducted studies on utilization of deep learning in food handling, quality assessment. The recognition steps of conventional deep learning are to gather huge number of datasets and there after this information are used to train a network model, and next the training model is used for detection and recognition of food images.

At the ongoing stage, the quality has been evaluated generally by hand, analysing the products individually or testing huge batches which is actually tedious and conflicting. The assessment is performed by a labour force trained to detect defects, colours, sizes or peculiar highlights, and characterize the product in its relevant category. The massive variability that can introduce this kind of products with regards to colours, textures or various sorts of imperfections, hinders their classification, being machine vision, a valid volition to automize this task. In particular, food processing sectors a machine vision framework can gather a series of parameters such as size, weight, shape, texture and colour of the food and numerous details that cannot be observed by the human eye, fully intent on checking and controlling food handling methods. By this way we can defeat human blunders brought about by repetitive works which can be avoided [7].

H. Image Processing

Image Processing produces new pictures in based on existing pictures, by this the objective of bringing out and enhancing the characters from the district of interest. Image Processing contains low level processing, mid/Moderate-level processing and high-level processing which is also undeniable level handling [5].

Low level handling is utilized to pre-process image [21] While imaging the items, both image detecting gadgets can be at the same time used to educe images of test sample and convert them into advanced digital forms, which can be obtained by the system. The image which is obtained might be defective due to lot of cause including inappropriate lighting, imperceptible distance or low resolution of the imaging gadget, unsteady and variable viewfinder, and other different characteristics.

Moderate/Mid-level handling have three cycle image division or segmentation, image portrayal, and image depiction (Shih, 2010). Image segmentation is perhaps of the most fundamental and pivotal move toward Image handling and processing, since it generally decides if the Image investigation centres around the Main objective (Food). The primary capability of Image segmenting is to isolate the objective from other undesirable image information, in this manner helping in decreasing the computational expense and work force in resulting Image analysis, while also improves the accuracy.

High Level Processing basically incorporates two stages: Image recognition and Image interpretation that is understanding. Here, Statistics/profound deep learning techniques are usually embraced to characterize the objective, which is based on application of interest. Neural networks and the most profitable fuzzy logic strategies have been evolving all over the planet and to a great extent applied to the food producing industry. Professor Kashyapa (2016) [14] proposed a best machine vision-based framework which assists with eliminating the calyx from strawberries with greater ease of access.

III. PROPOSED METHODOLOGY

A Device setup arrangement is built by ESP32 cam and a Gas sensor. ESP32-CAM is a complete featured and advanced microcontroller with a coordinated camcorder/Integrated Camera and micro-SD card attachment slot.

It's cheap and Open effectively, and is ideally suited for IoT gadgets requiring a camera with cutting edge capabilities like Image Tracking and recognition. Gas sensors which are otherwise called gas detectors are electronic gadgets which distinguish and recognize various kinds of gasses. They are normally used to distinguish poisonous/ toxic or explosive gasses and furthermore used to measure gas concentration. Agricultural gas sensors are broadly used to screen and identify poisonous gasses tracked down food production and food quality control. Food and beverage makers and processors produce perilous or harmful gasses in many stages, including the processing of food, waste, and by-products and the preservation of food until it is opened.



Fig. 1 Gas Sensor



Fig. 2 ESP-32 Cam

A. Components

1) Node MCU
2) ESP32CAM
3) MQ-135
4) OLED Display
5) TP4056battery charging circuit
6) Lithium-ion battery(3.7V)
7) Boost converter
8) Toggle Switch
9) Push button

Their images and values are collected by the microcontroller and the sensor values sent to the system to perform convolution neural network which analyse the image of carrot or radish and the final result is sent to the mobile application through IoT cloud and more over the sensor collects the gas value and the data further viewed by the same application and the device has an inbuilt lithium-ion battery with protection board which has a capability to cut off once the battery charged full. The sensor reading are captured and displayed using inbuilt OLED display.

B. Procedure for Image Processing

Image Acquisition is the initial step of image handling or processing in which camera is utilized for capturing pictures of radish in computerized structure / digital form and stored in any advanced digital media. Image Pre-processing is a part eliminates noise, smoothen the image additionally perform resizing of radish images. RGB images are changed over completely to grey pictures likewise the contrast of image is expanded to an ideal level

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Image Segmentation is utilized for partitioning and isolating an image into different parts which are desirable. Feature Extraction is for Acquiring features like colour tone, surface texture and shape which helps in diminishing resources to portray large dataset information before classification of image.

Image Characterization is the part examines mathematical property of image features including organizing its data into categories. It utilizes neural network which performs training and classification of vegetables and fruit diseases

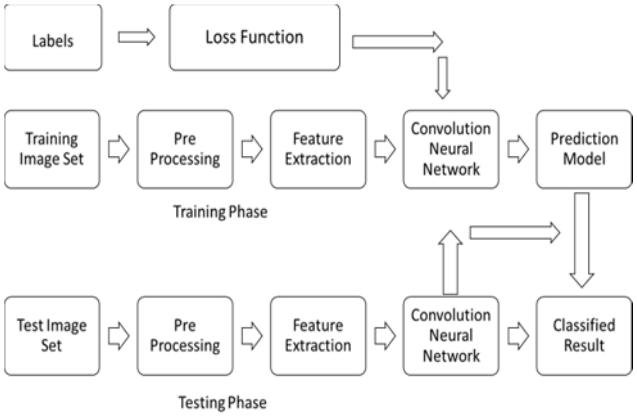


Fig. 3 Block Diagram

IV. CONCLUSIONS

This review paper highlights the use of developing a system for Quality analysis of Carrot and Radish. This is a Novel and non-invasive method done by image processing and computer vision innovation in the field of food industry, horticulture agriculture. The most important quality characteristics of agricultural products are size, variety, shape, surface and imperfection and these data could be collected by Scanning Technology through image processing. To change manual investigation of food products computer vision method is used efficiently which provide authentic characteristic approach, equitable and non-destructive rating. This device is more feasible to operate and can also applied in Industrial Conveyors. The computer vision-based quality review contains four essential and significant stages, which acquisition, segmentation, division, extraction lastly classification. Monitoring is easy as it has both device (OLED) and a computer display. Therefore, this enables in achieving real-time data through cloud reducing time and increasing efficiency. classification will be more robust if more characters and features are added including circumference, form and shape recognition.

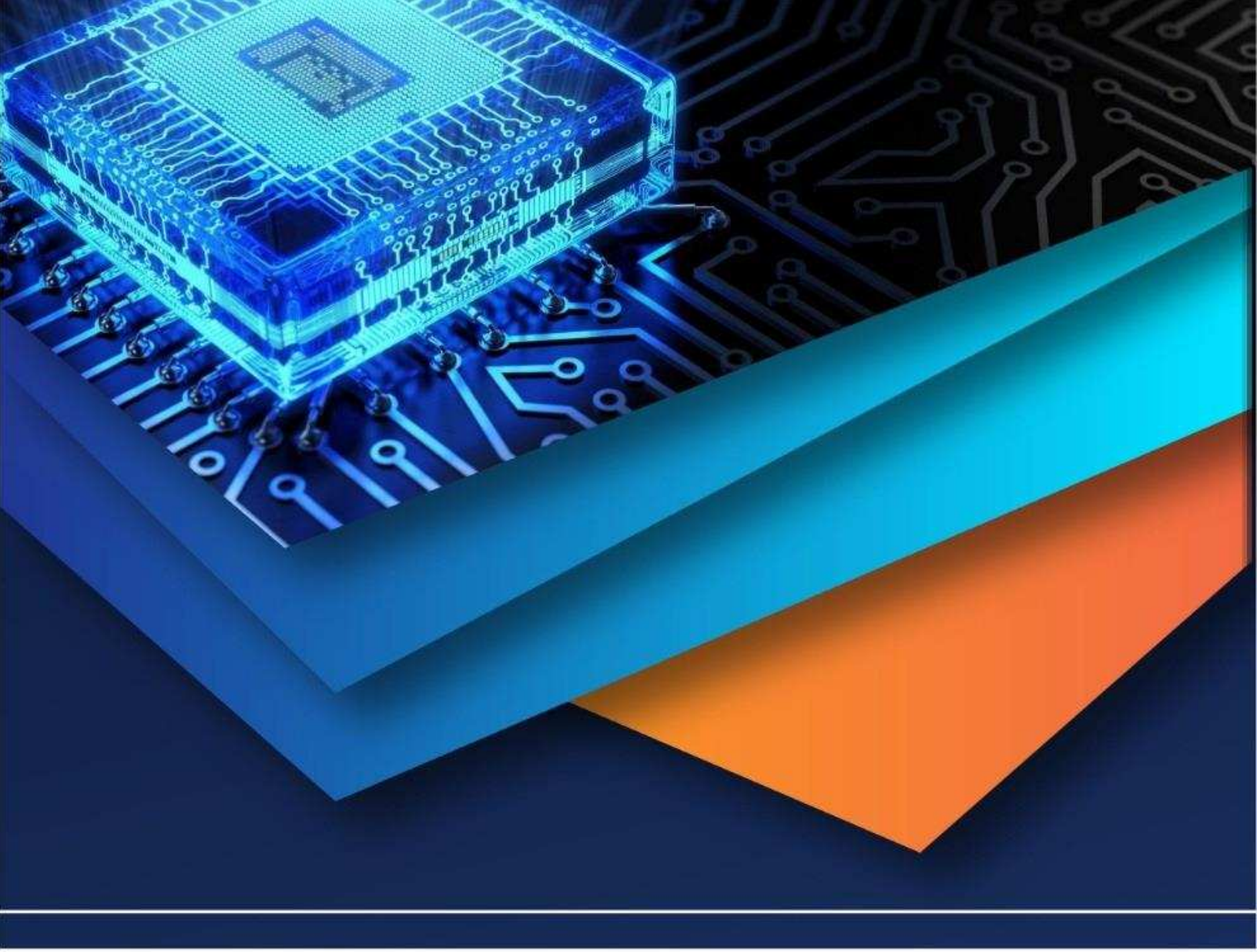
REFERENCES

[1] Krizhevsky, I. Sutskever, and G. Hinton. ImageNet classification with deep convolutional neural networks. In NIPS, pages 1106–1114, 2012.
[2] Aboonajmi, M and Faridi, H. 2016. Non-destructive quality assessment of Agro-food products, Proceedings of the 3rd Iranian International NDT Conference Feb 21-22, Olympic Hotel, Tehran, Iran.
[3] Agarwal, Monika & Agarwal, Sushant & Ahmad, Subia & Singh, Ruchika & Jayahari, K.M.. (2021). Food Loss and Waste in India: The Knowns and The Unknowns. World Resources Institute. 10.46830/wriwp.20.00106.
[4] Bi X. Machine vision. In: X Bi editor. Environmental Perception Technology for Unmanned Systems. Singapore: Springer Singapore (2021). p. 105–41.
[5] Brosnan, T. and Sun, D.-W. (2004). Improving quality inspection of food products by computer vision—a review. Journal of Food Engineering, 61(1):3 – 16. Applications of computer vision in the food industry.
[6] Chauhan, Om & Lakshmi, S. & Pandey, Arun & Ravi, N. & Gopalan, Natarajan & Sharma, Rakesh. (2017). Non-destructive Quality Monitoring of Fresh Fruits and Vegetables. Defence Life Science Journal. 2. 103. 10.14429/dlsj.2.11379.
[7] Cubero, S., Aleixos, N., Moltó, E., Gómez-Sanchis, J., and Blasco, J. (2011). Advances in machine vision applications for automatic inspection and quality evaluation of fruits and vegetables. Food and bioprocess technology, 4(4):487–504
[8] Damez, J.-L.; Clerjon, S. Quantifying and predicting meat and meat products quality attributes using electromagnetic waves: An overview. Meat Sci. 2013, 95, 879–896.
[9] Elmesiry, Hany & Mao, Hanping & Abomohra, Abdelfatah. (2019). Applications of Non-destructive Technologies for Agricultural and Food Products Quality Inspection. Sensors. 19. 846. 10.3390/s19040846.
[10] Feng, Que & Hou, Xi-Lin & Wang, Guang-Long & Xu, Zhi-Sheng & Guo-Fei, Tan & Li, Tong & Wang, Ya-Hui & Khadr, Ahmed & Xiong, Ai-Sheng. (2019). Advances in research on the carrot, an important root vegetable in the Apiaceae family. Horticulture Research. 6. 69. 10.1038/s41438-019-0150-6.
[11] H. Zheng, H. Lu, "A least-squares support vector machine (LS-SVM)based on fractal analysis and CIELab parameters for the detection of browning degree on mango (Mangiferaindica L.)," in Computers and Electronics in Agriculture, vol. 83, pp. 47-51, January 2012.
[12] Hadley, P., & Fordham, R. (2003). Vegetables of temperate climate | Swede, turnip, and radish. In B. Caballero (Ed.), Encyclopedia of food sciences and nutrition (2nd ed., pp. 5946–5948). Academic Press.

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[13] Hongfei Zhu, Lianhe Yang, Yuxin Sun, Zhongzhi Han, Identifying carrot appearance quality by an improved dense CapNet, Journal of Food Process Engineering, 10.1111/jfpe.13586, 44, 1, (2020).
[14] Kashyapa, R. (2016). Machine vision guide for automotive process automation. Auto Tech Review, 5:14–
[15] Maninder Meenu, Baojun Xu, Application of vibrational spectroscopy for classification, authentication and quality analysis of mushroom: A concise review, Food Chemistry, Volume 289, 2019, Pages 545-557, ISSN 0308-8146,
[16] Maninder Meenu, Qianxi Cai, Baojun Xu, A critical review on analytical techniques to detect adulteration of extra virgin olive oil, Trends in Food Science & Technology, Volume 91, 2019, Pages 391-408, ISSN 0924-2244,
[17] Maninder Meenu, Chinmay Kurade, Bala Chakravarthy Neelapu, Sahil Kalra, Hosahalli S. Ramaswamy, Yong Yu. "A concise review on food quality assessment using digital image processing" , Trends in Food Science & Technology, 2021
[18] Nishio, T. (2017). Economic and academic importance of radish. In H. K. Takeshi Nishio (Ed.), The radish genome (pp. 1–10). Springer.
[19] Radovich, T. J. K. (2018). Biology and classification of vegetables. In M. S. a. M. A. Uebersax (Ed.), Handbook of vegetables and vegetable processing (2nd ed., Vol. I, pp. 1–23). John Wiley & Sons Ltd.
[20] Saldaña, E.; Siche, R.; Luján, M.; Quevedo, R. Review: Computer vision applied to the inspection and quality control of fruits and vegetables. Braz. J. Food Technol. 2013, 16, 254–272.
[21] Senni, L., Ricci, M., Palazzi, A., Burrascano, P., Pennisi, P., and Ghirelli, F. (2014). On-line automatic detection of foreign bodies in biscuits by infrared thermography and image processing. Journal of Food Engineering, 128:146 – 156.
[22] Siddhika Arunachalam, Harsh H. Kshatriya, Mamta Meena.: Identification of Defects in Fruits Using Digital Image Processing. International Journal of Computer Sciences and Engineering 6(10), 637-640 (2018)
[23] Thamburaj, S. and Singh N. 2005. Vegetables, Tuber Crops and Spices. New Delhi: Indian council of Agriculture Research. pp 40.
[24] Valous, Nek & Sun, Da-Wen. (2012). Image processing techniques for computer vision in the food and beverage industries. 10.1533/9780857095770.1.97.
[25] Yadav, Naveen & Petluru, Syam Sundar Reddy & Syed, Sadarunnisa & Srinivasarao, G. & Kiran, Y. & Kadiri, Lalitha. (2018). Influence of Organic and Inorganic Sources of Nitrogen on Growth and Yield of Radish (Raphanus sativus L.). International Journal of Current Microbiology and Applied Sciences. 7. 4499-4507. 10.20546/ijcmas.2018.708

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A Review On Intelligent Irrigation for Millets with GSM Application

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***Abstract*—**Agriculture is called the backbone of the Indian economy because majority of the population is dependent on agriculture. The agriculture sector contributes about 14% of the total GDP in India. Several irrigation techniques are used in agriculture like irrigation sprinklers, surface irrigation, drip irrigation, manual irrigation, etc. Some of these techniques are effective in the management of water resources but still, they do not measure the moisture or the required amount of water. So, to further improve the mode of irrigation, smart irrigation techniques are used to improve the effective usage of water resources. The challenges faced by the existing irrigation system are water wastage, manual labour, and poor performance, so sensors like moisture, temperature, and pH are used in monitoring and irrigating the field. From the sensed value of the temperature and moisture sensor, the field would be irrigated if the sensed value is low. If the moisture and temperature value for the particular crop is reached the irrigation system would turn off automatically. So this technological improvement would be helpful in meeting the demand for irrigation, as there may be a scarcity of water in the future.

Keywords- Agriculture, Sensors, Intelligent irrigation, IoT

I. INTRODUCTION

Smart irrigation would play an important role in the world where the world is moving towards smart technologies. As the needs of people keep on expanding with the increase in population, this smart farming technology would be useful in meeting the demands of people. Some farmers have introduced smart farming to monitor and irrigate their fields.

Water is an important element in the agricultural sector. By using these smart farming technologies, the usage of water can be significantly reduced. The irrigation is done according to the requirement of the plant to grow healthier. The quality of the crop is increased if it is not over or under-watered. Using smart irrigation technology would be beneficial for both the environment and the farmer as the amount of water consumed is reduced and the yield quality is increased.

Smart farming uses sensors like temperature, moisture, and other sensors to monitor and irrigate the field. Factors like climate, soil, temperature, season, crop type, and moisture are important factors in agriculture. These factors can be determined in smart farming. Soil moisture is an important parameter in determining the crop's requirement for irrigation. The smart irrigation system irrigates the land based on soil moisture, temperature, and humidity. The moisture sensor and the temperature sensor monitor the soil moisture and environment temperature respectively and irrigate the crop based on the readings. Water can also be irrigated by calculating the water loss that may happen in the field due to climatic conditions.

II. REVIEW OF LITERATURE

To improve the effectiveness of water usage during irrigation, soil moisture sensors have been used along with temperature sensor LM35 was connected to the relay through Arduino UNO microcontroller board and irrigates the field when the moisture level was below the threshold value. A mobile application has also been provided. Arduino IDE 1.8.9 software has been used for coding and uploading to the Arduino board [1].

Based on the tank monitoring system, the Arduino UNO (ATMEGA328P) is a microcontroller board, which would run at 5 V, 16 MHz clock speed, 14 digital input/out pins, 6 analog input (A0–A5) pins, 6 PWM outputs, 1 universal asynchronous receiver transmitter (UART), and programming interface (USB) via ATMega16U2 [2].

A notification would be sent to the user if the moisture level of the farm was low. A low-cost moisture sensor, temperature sensor and humidity sensor were used. The water level of the water source was also monitored and if there was a fall in the water level it would also be indicated.[3]

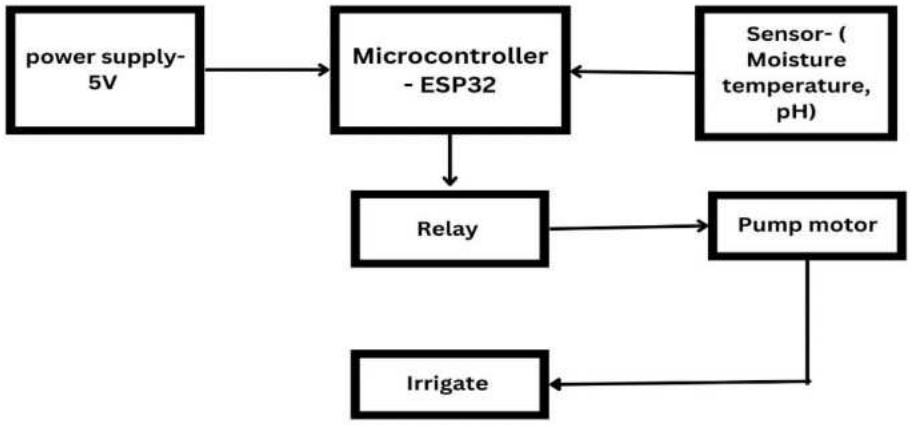


Fig.1: System architecture diagram

ESP 8266 Wi-Fi module, YL-38 soil moisture sensor have been used. This IoT device used architecture based on three-level architecture. Based on the surrounding temperature and the moisture content of the soil threshold value was given. Data were collected and analysed based on the threshold value, the threshold value was analysed and if the value was low the pump would be on automatically. The sensor data were represented with a graphical representation in the application.[4]

An IoT-based smart farming system was used to increase the quality and quantity of the yield using IoT-based technology to monitor the temperature and soil moisture with the help of Arduino UNO. Cloud computing was used to access the current data of the farm through mobile and website for current data access, the results produced were 98% accurate. The system was operated by both battery and a power supply.[5]

Automated and manual irrigation was provided with NODE MCU programmed with Arduino IDE built with DHTTL. The soil moisture and temperature sensor contributed data to the microcontroller to irrigate the field when needed. The farmer can also ON/OFF the motor by the switch provided. The major drawback was that NODE MCU have to be kept within the range of Wi-Fi to rescue the signal.[6]

By monitoring the weather conditions and soil moisture level proper irrigation could be provided by the IoTbased smart irrigation system. The soil moisture sensor detects the moisture and a mobile application was designed to analyze the data and monitor the moisture, humidity, and temperature of the soil.[7]

Modern agricultural methods were used to provide the farmer about the field's current status through the mobile application. The data like moisture, and temperature of the crops and field was displayed on the mobile screen. The pH of the soil was also identified by the pH sensor to notify about the crops which are best suited for the soil. The manual operations of irrigation of the field could be done through the application provided.[8]

The smart irrigation system used drip irrigation and indoor precision agriculture. The system used only soil moisture sensors to irrigate. The soil moisture level was checked and according to the threshold value, the field was irrigated. A drawback of the system was that it does not comprise of a temperature sensor to monitor the climatic condition.[9]

The smart irrigation system with Bluetooth and Arduino was automatic and regulates the usage of water in the field. The system used only soil moisture sensors to monitor and irrigate the field. If the moisture level was below the required moisture, then the system would be on automatically until the desired level of moisture was reached. The addition of a temperature sensor would make the system more efficient as the climatic temperature could also be monitored.[10]

The rate of evaporation was calculated based on feed forward NN (FFNN), a machine-learning technique. The research was conducted for nearly 4 years every hour to evaluate the evaporation rate. Each record consists of six different fields, relative humidity of the air, air temperature, wind direction, Net radiation, wind speed, and evaporation field. In addition, a soil moisture sensor was used to calculate the moisture present in the soil for every 30 minutes. Multi-crop data with the information on irrigation of those crops were saved and used for further irrigation. As the rate of evaporation was calculated, this IoT-based multi-cropping irrigation technique would be more effective in the conservation of water.[11]

The system used soil moisture sensor, temperature sensor, and electrical conductivity. The value of the moisture threshold was set to 800 units and the threshold temperature value was 24 degrees Celsius for the crop. The electrical conductivity value ranged from 5.5 to 6.5 units. The electrical conductivity was used to detect the pH of the soil, further based on the pH value the nutrient level of the soil could be determined. The moisture value was checked by the controller first. If the moisture went above 800, then the temperature was checked. The plant could sustain for one or two days without water in case the threshold temperature value was low. But if the threshold value went above the plant was irrigated.[12]

An IoT-based drip irrigation system used a moisture sensor to determine the moisture level of the soil and to monitor the water level in the tank ultrasonic sensor was used. ATMEGA 382 microcontroller was used to control the smart irrigation systems activities. The feedback pump recycles excess water from the farm back to the reservoir. Temperature sensors could be added to this system to make it more effective.[13]

Multi-farming techniques have been introduced so that each part of the land could be cultivated without waste of any land resources. By smart farming, other resources like water and energy could also be conserved. To monitor the field temperature and humidity sensor was used. An advantage of this system was the age of the crop could also be viewed.[14]

The crops were monitored with the help of a wireless sensor network. A basic level temperature and humidity sensor called DHT 11 sensor have been used due to its low cost. Based on the resistance of the soil, the moisture level was determined by a soil moisture sensor. The decision to irrigate the field was done with or without user interference. The Bluetooth technology could be replaced with a Wi-Fi module if required.[15]

The system used a soil moisture and humidity sensors to irrigate the field. The moisture level of the soil was sensed by the sensor and the value was stored and sent to the android phone through the GSM port and irrigated based on the value sent. The temperature sensor could have been added to this system to be more effective.[16]

III. MATERIALS AND METHODOLOGY

Materials:

- Micro Controller
- Relay
- Temperature Sensor
- Moisture Sensor
- Soil pH Sensor

Microcontroller:
Microcontroller is one of the essential components as they provide necessary processing power and control to automate the irrigation process. It gathers information from the moisture, temperature and pH and use the information to make decision on irrigating the field. It also helps to connect the irrigation process to the mobile phone **Relay:**
Relay plays an important role in the flow of water. Relay is connected to the water pump, it turns on/off based on the signals received from the microcontroller. Microcontroller sends signal to the relay to turn on the flow of water if the soil moisture is low and then when the soil moisture is high it turn off the water flow.
Temperature sensor:
By using temperature sensor, the irrigation system can be set up to water more frequently if the temperature is above 30º C and to avoid over irrigation during the cold weather where the soil is moist. **Moisture sensor:** Moisture sensor is used to monitor the soil moisture to irrigate when the moisture level is below 60% and when above 60% there is no need of irrigation. It helps to optimize the irrigation according to the plants needs preventing over or under irrigation. **pH sensor:**
pH sensor helps to monitor the acidity level of the soil, different plants have different pH requirements by monitoring the soil's pH we can adjust the pH of the soil for it to remain healthy by adding manures and fertilizers.

Methodology:
The microcontroller acts as the brain of the system. Every sensor, relay, and pump motor were connected to the microcontroller. If the moisture level is low the field was irrigated and if the desired moisture level was reached the pump motor was switched off. The temperature sensor checks the surrounding temperature and, if the temperature was high the irrigation was carried out. The pH of the soil was checked manually. The mobile application was designed to display the values of the moisture and temperature of the fields. The manual switching on/off of the pump motor was also enabled in the application.

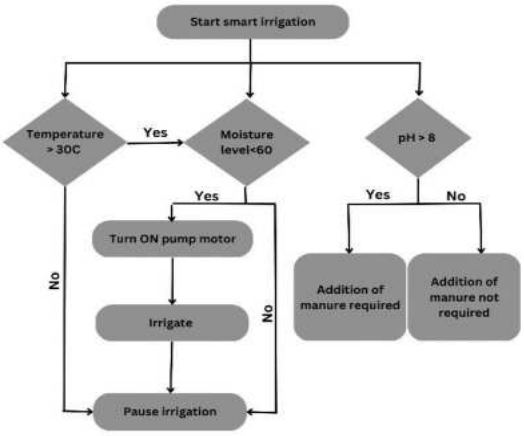


Fig.2: Working of smart irrigation

IV. CONCLUSION

Traditional agriculture practices can be improved by intelligent irrigation system incorporated with moisture sensor to monitor the water content of the soil, temperature sensor to monitor the surrounding temperature of the field and pH sensor to monitor the acidity level of the soil. The intelligent irrigation system can adjust the watering schedule according to the plants requirement of water preventing over or under irrigation which leads to the spoilage of crops. The pH sensor incorporated in the intelligent smart irrigation system alert the farmer to maintain the optimum pH of the soil. Mobile or GSM application provides remote access and complete database of the soil based on the entire agriculture fields data on surrounding temperature, moisture of the soil and pH of the soil

REFERENCES

[1] Bobby Singla, Satish Mishra, Abhishek Singh, Shashank Yadav., 2019. A Study on Smart Irrigation System using IoT. International Journal of Advance Research, Ideas and Innovation in Technology (IJARIIT), 5 (2).

[2] Tayo Dorcas Obasanya, Ilesanmi Banjo Oluwafemi, Olawale Bello, Taiwo Abdulazeez Lawal., 2022. An Internet of Things- based Irrigation & Tank Monitoring System. International Journal Of Informatics & Communication Technology (IJ-ICT), 11 (1).

[3] Gomathy C K, Vamsikumar A, Karthik B, Purushothamreddy A., 2021. The Smart Irrigation System using IoT. International Research Journal of Engineering & Technology (IRJET), 8 (10).

[4] Madhurima Bhattacharya, Alak Roy, Jayanta Pal., 2020. Smart Irrigation System using Internet of Things. Research gate.

[5] Yasir Fahim., 2019. IoT based Smart Farming System. Research gate.

[6] Amolkawade., 2022. Smart Irrigation System with Mobile Controller. International Research Journal of Engineering & Technology (IRJET), 8 (12).

[7] Velmurugan S, Balaji V, Manoj Bharathi T, Saravanan K., 2022. An IoT based Smart Irrigation System using Soil Moisture & Weather Prediction. International Journal of Engineering Research & Technology (IJERT),8 (7).

[8] Prashant B Wakhare, Neduncheliyan S, Gaurav S Sonawane., 2020. Automatic Irrigation System based on Internet of Things for Crop Yield Prediction, Research gate.

[9] Shilpa S, Rajegowda C S, Rashmi P, Sachin A Gowli, Prof. Kiran Kumar P S., 2020. Mobile Application for Smart Irrigation System. International Research Journal of Modernization in Engineering Technology & Science(IRJETS), 2 (7).

[10] Aparajitha S, Swathija R, Haritha K, Subashka Ramesh S S., 2018. Smart Irrigation System using Bluetooth Module & Arduino. International Journal of Advance Research and Innovative Ideas in Education(IJARIIE), 2 (7).

[11] Venus Wazeer Samawi., 2021. An IoT based Secure Multi- Crop Irrigation System for Smart Farming. International Journal of Innovation Computing, Information & Control, 17 (4).

[12] Priyadharsinee K, Dr S Rathi., 2017. An IoT based Smart Irrigation System. International Journal of Scientific & Engineering Research, 8 (5).

[13] Olugbenga Kayode Ogidan, Abiodun Emmamnuel Onile, Oluwabukola Grace Adegboro., 2019. Smart Irrigation System: A Water Management Procedure. Scientific Research Publishing.

[14] Krishna Singh, Samyak Jain, Varun Andra, Shilpi Sharma., 2019. IoT based Approach for Smart Irrigation System Suited to Multi Crop Cultivation. International Journal of Engineering Research & Technology, 12 (3).

[15] Ashwini B V., 2018. A Study on Smart irrigation System using IoT for Surveillance of Crop- field. International Journal of Engineering & Technology, 7 (10).

[16] Abhinayalalitha K, Ramadoss P., 2017. Arduino based Agricultural, Monitoring System in Mobile Application. International Research Journal of Engineering & Technology, 4 (5).

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Intelligent Irrigation for Millets with GSM Application

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Abstract: Due to the dependence of a significant portion of the population on agriculture, agriculture is referred to as the foundation of the Indian economy. About 14% of India's GDP is contributed by the agricultural sector. In agriculture, a variety of irrigation methods are employed, including sprinkler irrigation, surface irrigation, drip irrigation, manual irrigation, etc. Even though some of these strategies are successful at managing water resources but do measure the amount of water required for the plants. Therefore, intelligent irrigation techniques are employed to increase the efficient use of water resources and further improve the irrigation mode. Due to the problems with the current irrigation system, which include water waste, labor-intensive maintenance, and poor performance, sensors like moisture, temperature, and pH are employed to monitor and irrigate the area. Based on temperature and humidity sensor readings, fields are irrigated when readings are low. The irrigation system automatically shuts off when the humidity and temperature values suitable for the specific crop are reached. Therefore, this technological improvement will help meet irrigation needs as water shortages may occur in the future.

Keywords- Agriculture, Sensors, Intelligent irrigation, millets

I. INTRODUCTION

Smart irrigation will play an important role in a world where the world is moving towards smart technology. As the population grows and people's needs increase, this smart farming technology will help meet their needs. Some farmers are adopting smart farming to monitor and irrigate their fields.

Water is an important factor in agriculture. By leveraging these smart farming technologies, water consumption can be significantly reduced. Watering is done as needed for the plants to grow healthier. Crop quality improves when irrigation is not over- or under-irrigated. The use of intelligent irrigation techniques reduces water consumption and improves crop quality, benefiting both the environment and farmers.

Smart agriculture uses temperature, humidity and other sensors to monitor and irrigate fields. Factors such as climate, soil, temperature, season, crop type and humidity are important in agriculture. These factors can be determined with smart agriculture. Soil moisture is an important parameter that determines the irrigation needs of crops. An intelligent irrigation system irrigates the land based on soil moisture, temperature and humidity. Moisture and temperature sensors monitor soil moisture and ambient temperature, respectively, and water crops based on the readings. You can also irrigate the water by calculating the possible water loss caused by the climatic conditions of the field.

II. MATERIALS AND METHODOLOGY

Materials:

- **Micro Controller**
- **Relay**
- **Temperature Sensor**
- **Moisture Sensor**
- **Soil pH Sensor**

Microcontroller:

Microc ontroller is one of the essential components as they provide necessary processing power and control to automate the irrigation process. It gathers information from the moisture, temperature and pH and use the information to make decisions on irrigating the field. It also helps to connect the irrigation process to the mobile phone.

Relay:

Relay plays an important role in the flow of water. Relay is connected to the water pump, it turns on/off based on the signals received from the microcontroller. Microcontroller sends signal to the relay to turn on the flow of water if the soil moisture is low and then when the soil moisture is high it turn off the water flow.

Temperature sensor:

By using temperature sensor, the irrigation system can be set up to water more frequently if the temperature is above 30º C and to avoid over irrigation during the cold weather where the soil is moist.

Moisture Sensor:

Moisture sensor: Moisture sensor is used to monitor the soil moisture to irrigate when the moisture level is below 60% and when above 60% there is no need of irrigation. It helps to optimize the irrigation according to the plants needs, preventing the over or under irrigation.

pH sensor:

pH sensor helps to monitor the acidity level of the soil, different plants have different pH requirements. By monitoring the soil's pH we can adjust the pH of the soil for it to remain healthy by adding manures and fertilizers.

Methodology

The GSM-enabled smart irrigation system for millets operates by employing soil moisture, temperature, and pH sensors to gather data concerning soil moisture, ambient temperature, and soil pH. These sensors are strategically positioned within the irrigation system to continuously collect information on soil moisture levels, surrounding temperature, and pH. The collected sensor data is then transmitted to a central control unit or microcontroller.

When the soil moisture level drops below a certain threshold, a signal is sent to the microcontroller, prompting it to activate the pump motor. Once the desired moisture level is reached, the pump motor is switched off. The collected sensor data undergoes processing and analysis using algorithms that take into account factors such as the type of millet, soil moisture level, and ambient temperature. These algorithms determine the water requirements of the soil and optimize the irrigation schedule accordingly. Based on the soil moisture level, the system makes decisions regarding when and how much water should be irrigated, controlling the pumps to deliver the necessary amount of water to the soil.

Additionally, a mobile application has been developed and connected to the system. This application provides a user-friendly interface through which users can interact with the system. Users can monitor real-time sensor data, adjust settings, and remotely control the irrigation system. The mobile application can be accessed from smartphones, allowing users to view the current status of the irrigation system and make necessary adjustments to the irrigation settings. By providing the right amount of water at the appropriate time, the system optimizes water usage, conserves water resources, and reduces water waste.

The intelligent automatic irrigation system integrates soil moisture sensors, temperature sensors, pH sensors, data analysis algorithms, and a mobile application. This integration enables the system to continuously monitor sensor data, irrigation performance, and ambient temperature. By doing so, the system optimizes water usage, improves irrigation efficiency, and provides users with real-time control and monitoring capabilities to meet their irrigation needs.

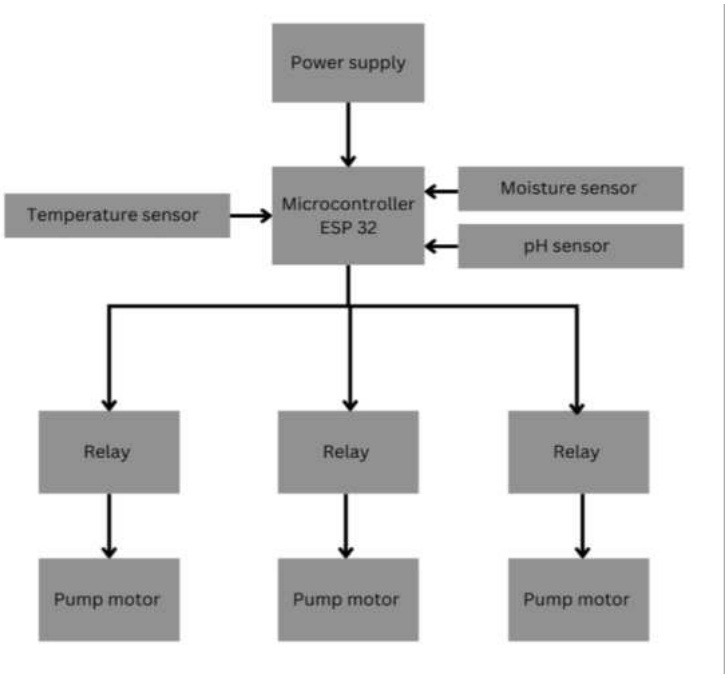


Fig 1: Block Diagram Of Intelligent Irrigation System

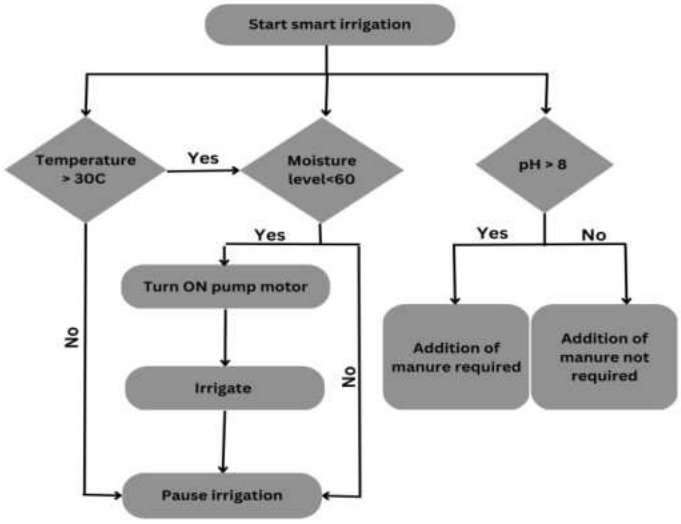


Fig 2: Working Of Intelligent Irrigation System

III. RESULT AND DISCUSSION :

Ragi or finger millet (Eleusine coracana) and kambu or pearl millet (Pennisetum glacum) are grown. The soil moisture level was checked using soil moisture sensor and the surrounding temperature was monitored using temperature sensor and the pH of the soil was also monitored with pH sensor and the readings were taken. Based on the value the field was irrigated.

Crop : Finger Millet

Day	Moisture	Temperature °C	pH
1	22	28	7
2	18	30	7.5
3	24	29	7.9
4	19	32	8.1
5	23	30	8.6
6	17	27	8.9
7	24	29	9.5
8	19	32	10.3
9	23	34	10.6
10	18	28	11

Table 1: Observations of Finger Millet Sensors Reading

Crop: Pearl Millet

Day	Moisture	Temperature °C	pH
1	18	28	8.7
2	23	30	9.2
3	17	29	9.6

4	22	32	10.1
5	19	30	10.6
6	24	27	11
7	16	29	11.5
8	22	32	12.2
9	19	34	12.7
10	23	28	12

Table 2: Observations of Pearl Millet Sensors Reading

Consumption Of Water By The Millet Crops

The water consumption of the millet crops is noted by monitoring the amount of water consumed for the area of land 330 cm^2.

Crop: Finger millet

Day	Amount of water used in ml
1	450
2	0
3	425
4	0
5	465
6	0
7	450
8	0
9	475
10	0

Table 3: Observation Of Water Consumption By Finger Millet

Crop: Pearl Millet

Day	Amount of water used in ml
1	0
2	445
3	0
4	430
5	0
6	465
7	0
8	450
9	0

10	475

Table 4: Observation Of Water Consumption By Pearl Millet

Comparison Of Irrigation Methods

This intelligent irrigation system is compared with the traditional methods, where intelligent irrigation methods are more water-efficient as they accurately measure and respond to the plants water requirement, minimizes runoff, optimal water distribution and avoids over or under irrigation.

Area considered for experimental setup = l*b

= 22*15

= 330 cm²

Method of irrigation	Amount of water consumed in ml (approx.)
Traditional method	500
Intelligent irrigation method	450

Table 5: Comparison Of Irrigation Methods

In the above comparison 50 ml of water was saved for 330 cm² land. While proceeding with a real time field 1 acre of land the amount of water consumed would be higher.

1 acre= 100 cents

=4,04,68,564 square centimeters

Real Time Value:

Quantity of water utilized for 1 acre = 61,316 liters per day

= 16,197.974 gallon per day

Experimental Value:

Quantity of water utilized in experimental setup 330cm² = 450 ml

So, Quantity of water utilized for 1 acre will be

= (450/ 330)*4,04,68,564cm²

= 55,184 liters per day

= 12,578.071 gallon per day

Total amount of water conserved = Real Time Value - Experimental Setup Value

= 61,316 - 55,184

= 6132 liters per day

= 1619.903 gallon per day

So, approximately 6000 liters of water can be saved for an acre of land per day and 90,000 liters of water for a month can be saved while using this technology, in real time for a larger area more water would also be saved. The saved water can be used for further irrigation purposes. At the same time the amount of power consumed is also saved.

The amount of power used by 5hp motor = 5000 watts per day

Cost of 1 kilowatts power = 4.5 rupee

Cost of 5 kilowatts power = 22.5 rupee

Cost of power for a month = 337.5 rupee

By using this intelligent irrigation system,

The amount of power used by 5hp motor = 3750 watts

Cost of 3750 watts power = 16.8 rupee

Cost of power for a month = 252 rupee

Total amount of power saved = Amount of power used by motor for traditional agriculture method - Intelligent irrigation system

= 5000-3750

= 1250 watts

Total cost saved = Cost of power consumed for a month by traditional agriculture method - intelligent irrigation system

= 337.5-252

= 85.5 rupee

So, for a month 1250 watts power, 85 rupee and 1,04,850 liters of water can be saved for an acre for 1 month by implementing this system for a larger area more water and power could be saved.

IV. CONCLUSION

The integration of an intelligent irrigation system with a GSM application revolutionizes agriculture by combining sensor technology and a user-friendly mobile app. The system collects real-time data on soil moisture, temperature, and pH, providing farmers with convenient access to analyze their fields. The main goal is to optimize water usage and ensure efficient irrigation. By customizing

irrigation based on precise data, water wastage is minimized and crop spoilage risks are mitigated. The mobile app enables remote monitoring and control, allowing farmers to make adjustments anytime, anywhere, and respond effectively to changing conditions.

REFERENCES

1) Shilpa S, Rajegowda C S, Rashmi P, Sachin A Gowli, Prof. Kiran Kumar P S., 2020. Mobile Application for Smart Irrigation System. International Research Journal of Modernization in Engineering Technology & Science(IRJETS), 2 (7).
2) Aparajitha S, Swathija R, Haritha K, Subashka Ramesh S S., 2018. Smart Irrigation System using Bluetooth Module & Arduino. International Journal of Advance Research and Innovative Ideas in Education(IJARIIE), 2 (7).
3) Venus Wazeer Samawi., 2021. An IoT based Secure Multi- Crop Irrigation System for Smart Farming. International Journal of Innovation Computing, Information & Control, 17 (4).
4) Priyadharsinee K, Dr S Rathi., 2017. An IoT based Smart Irrigation System. International Journal of Scientific & Engineering Research, 8 (5).
5) Olugbenga Kayode Ogidan, Abiodun Emmamnuel Onile, Oluwabukola Grace Adegboro., 2019. Smart Irrigation System: A Water Management Procedure. Scientific Research Publishing.
6) Krishna Singh, Samyak Jain, Varun Andra, Shilpi Sharma., 2019. IoT based Approach for Smart Irrigation System Suited to Multi Crop Cultivation. International Journal of Engineering Research & Technology, 12 (3).
7) Ashwini B V., 2018. A Study on Smart irrigation System using IoT for Surveillance of Crop- field. International Journal of Engineering & Technology, 7 (10).
8) Abhinayalalitha K, Ramadoss P., 2017. Arduino based Agricultural, Monitoring System in Mobile Application. International Research Journal of Engineering & Technology, 4 (5).
9) Bobby Singla, Satish Mishra, Abhishek Singh, Shashank Yadav., 2019. A Study on Smart Irrigation System using IoT. International Journal of Advance Research, Ideas and Innovation in Technology (IJARIIT), 5 (2).
10) Tayo Dorcas Obasanya, Ilesanmi Banjo Oluwafemi, Olawale Bello, Taiwo Abdulazeez Lawal., 2022. An Internet of Things-based Irrigation & Tank Monitoring System. International Journal Of Informatics & Communication Technology (IJ-ICT), 11 (1).
11) Gomathy C K, Vamsikumar A, Karthik B, Purushothamreddy A., 2021. The Smart Irrigation System using IoT. International Research Journal of Engineering & Technology (IRJET), 8 (10).
12) Madhurima Bhattacharya, Alak Roy, Jayanta Pal., 2020. Smart Irrigation System using Internet of Things. Research gate.
13) Yasir Fahim., 2019. IoT based Smart Farming System. Research gate.
14) Amolkawade., 2022. Smart Irrigation System with Mobile Controller. International Research Journal of Engineering & Technology (IRJET), 8 (12).
15) Velmurugan S, Balaji V, Manoj Bharathi T, Saravanan K., 2022. An IoT based Smart Irrigation System using Soil Moisture & Weather Prediction. International Journal of Engineering Research & Technology (IJERT),8 (7).
16) Prashant B Wakhare, Neduncheliyan S, Gaurav S Sonawane., 2020. Automatic Irrigation System based on Internet of Things for Crop Yield Prediction, Research gate.

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Development of IOT Based Assistive Self-Health Care Smart Vacuum Flask with Consumer Alert System for Beverages

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Abstract : Thermal flasks have several applications and benefit millions of people worldwide. The design and manufacturing of the vacuum flask have advanced significantly. It is no longer just a vessel for transporting liquids; it now has the technology to function as anything from a liquid carrier to a temperature controller and an alarm system. Users have recently started to expect their vacuum vessel to keep stored beverages fresh. The vacuum flask is meant to keep both hot and cold temperatures stable, allowing users to drink at any time or in any location. People with hectic and changeable work schedules are now looking forward to a reminder for fluid intake at all times to maintain a balanced healthy diet. This project aims at developing a smart thermal flask that displays the pH and temperature value and gives voice alert system. Standardized pH and temperature is to be studied for various beverages. Aim to develop a thermal flask that stores beverages and maintains its temperature for both hot and cold. This project is aimed to meet the consumer expectation so as to provide an assistive health care system.

Keywords—— Thermoware, vacuum flask, pH sensor, Temperature sensor, fluid intake monitoring, self-health care.

I. INTRODUCTION

Drinking enough liquids is important for our overall health, and dehydration is a serious problem that can lead to a variety of health complications. It is critical for people with conditions that affect fluid regulation to have enough fluids on hand, and tracking their intake can help them determine if they are getting enough. The quality of beverages is critical to guaranteeing customers overall health. Acid reflux has been increasingly common in paediatric and geriatric individuals in recent years.[5] This is due to the fact that modern lives usually need tough dietary modifications, such as the use of processed foods and beverages. As a result, it is critical to assure beverage quality by evaluating important parameters and identifying any spoiling.

People are becoming more health-conscious, and they are seeking for items that may help them monitor and manage their health. Furthermore, as the digital era advances, people are searching for items with sophisticated capabilities that are also user-friendly. A smart thermal vacuum flask with pH and temperature display, voice indicator for fluctuation, and a timed configuration option meets these customer expectations and market trends.

A smart thermal vacuum flask with enhanced functions gives a quick and effective means of monitoring their water consumption. [1] The device's potential benefits, including as boosting hydration levels, keeping a balanced pH level, and assuring safe drinking water, make it a relevant product in today's health-conscious society.

To meet current market trends and customer expectations, the construction of a smart thermal vacuum flask with these advanced characteristics is required.

OBJECTIVES OF THE WORK

- To fabricate a smart thermal flask for storing beverages.
- To indicate pH and temperature of the beverage stored in the smart thermal flask.
- To develop an app to connect with the flask.
- To evaluate the suitable storage time for different beverages stored in the smart thermal flask.
- To perform the cost evaluation for the fabricated smart thermoware.

II. . MATERIALS AND METHODS

This chapter gives the detailed explanation of the various materials and methods used in the development and evaluation of the fabricated smart thermal flask for the storage of beverages.

- **BATTERY:**

The battery utilized is a compact and lightweight lithium-ion unit that incorporates advanced technology, offering a remarkable energy density. Each individual cell can generate a maximum of 3.7 volts with a current of 400 milliamps. It features a standard 2-pin connector and is specifically intended for utilization with specialized charging equipment only. The battery provided with the device is designed to safeguard users from potential harm caused by overvoltage, undercurrent, and insufficient voltage. Recommended alternative batteries for clothing projects are coin cells.



Figure.1. Battery

- **ARDUINO NANO V3.0 MICROCONTROLLER** :

The Arduino Nano V3.0 microcontroller is a compact and fully functional device that utilizes the ATmega328 MCU, which is also found on the Arduino Duemilanove board. While it shares most features with the popular Arduino model, it is slightly smaller in size and does not have a DC power jack. Instead, users need to connect it to external devices using Mini USB (Mini-B) cables.[8] This version of the Nano is compatible with Arduino programs and the Arduino IDE. It can be powered through an external power source with an uncontrolled voltage range of 6 to 20 volts, a regulated voltage range of 5 volts, or a Mini-B USB connection.



Figure.2. Arduino Nano V3.0 microcontroller

- **DS18B20 TEMPERATURE SENSOR :**

The DS18B20 Temperature sensor, manufactured by Maximum Integrated, is a programmable sensor that operates on a 1-wire interface. It is commonly used in challenging environments such as chemical solutions, mines, or soil to measure temperature. The sensor is easy to install due to its sturdy casing, which can also be made waterproof. The DS18B20 sensor can measure temperatures ranging from -55°C to +125°C with a reasonable accuracy of 5°C.[13] It offers a convenient solution for taking multiple temperature measurements without occupying a large number of digital pins on the microcontroller. Each sensor has a unique address and only requires a single connection to the microcontroller for data transmission.



Figure. 3. DS18B20 Temperature sensor

- **pH SENSOR:**

The pH sensor is used to measure the hydrogen-ion activity in water-based solutions, primarily for determining the pH level of liquids. It is widely used in various fields such as chemistry, pharmaceuticals, dyes, and scientific research, where testing for acidity and alkalinity is necessary. This sensor supports both 3.3V and 5V systems through its drive board in the kit. The pH electrodes utilized in this sensor are made of glass and typically consist of a glass tube with a small glass bubble at the end. The inside of the electrode is filled with a buffered solution of chlorides, and there is a silver wire covered with silver chloride immersed in it.

The pH of the internal solution can vary, for example, it can be 1.0 (0.1M HCl) or 7.0 (different buffers used by different manufacturers). The active part of the electrode is the thin glass bubble, while the tube has strong and thick walls. The surface of the glass bubble becomes protonated by both the internal and external solutions until equilibrium is reached. The charge resulting from the adsorbed protons on both sides of the glass bubble is responsible for the potential difference. This potential is described by the Nernst equation and is directly proportional to the difference in pH between the solutions on both sides of the glass. Most commercially available pH electrodes are combination electrodes that incorporate both a glass H+ ion-sensitive electrode and an additional reference electrode in a single housing.[12]

The construction of combination electrodes is largely determined by the processes involved in measuring pH and the need to measure the potential difference between the two sides of the glass electrode. To achieve this, a closed circuit is required, which is completed through the solutions (internal and external) and the pH meter. However, in order to obtain accurate and stable measurement results, the reference electrode must be isolated from the solution to prevent cross-contamination. Connecting and isolating two solutions simultaneously is not an easy task. The connection is established through a small hole in the electrode body, which is blocked by a porous membrane or ceramic wick. The internal solution flows very slowly through the junction, which is why these electrodes are referred to as flowing electrodes. In gel electrodes, the internal solution is gelled to minimize leakage.[7]



Figure.4. Ph Sensor

- **BLUETOOTH MODULE :**

The Bluetooth module serves as a convenient alternative to wired serial connections. It allows for easy establishment of connections between various devices such as microcontrollers and GPS systems, PCs, and embedded projects or robots. This module effectively replaces the need for a serial port and can be configured to operate at baud rates ranging from 1200 to 115200 bps. (Karim et al., 2018).

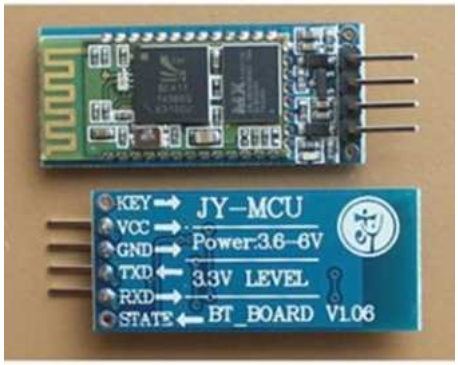


Figure.5. Bluetooth module

- **SOFTWARE APPLICATION SPECIFICATION**
- The app is been named “Quality Analyser”



- It requires Bluetooth connection to access the app

- After connecting it with the Bluetooth, the IP address need to be given



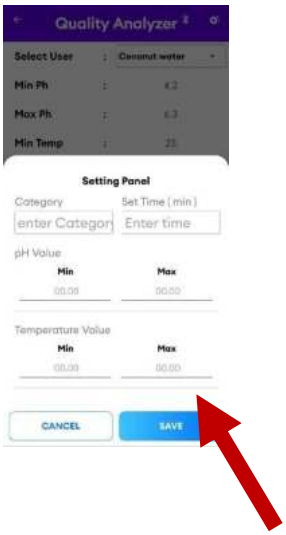
- Once inside the app, the users can view and select the beverage that is to be stored and tested from the list.



- The users can give inputs like pH and temperature for beverages other than the given list manually



- The users can also set timer to remind them on their consumption



III. RESULTS AND DISCUSSION

In this chapter the fabricated smart thermal vacuum flask working and stability were discussed in detail. These were calculated based on the values observed during the test trials performed in laboratory. The details of significant changes in the pH and temperature for each beverage after several hours is tabulated and represented graphically in the table below.

Sample	TIME	Milk	Grape Juice	Watermelon Juice	Pomogranate Juice	Mango Juice	Lemon Juice	Apple Juice	Orange Juice	Pineapple Juice	Papaya Juice
pH	**Initial**	6.79	2.67	5.45	3.32	4.77	2.79	3.67	2.87	3.7	5.12
	1st hr	6.77	2.62	5.42	3.28	4.72	2.72	3.64	2.83	3.67	4.97
	2nd hr	6.73	2.56	5.36	3.26	4.69	2.67	3.61	2.74	3.63	4.91
	3rd hr	6.71	2.41	5.31	3.24	4.65	2.61	3.59	2.69	3.57	4.86
	4th hr	6.69	2.35	5.27	3.22	4.58	2.55	3.57	2.56	3.54	4.82
	5th hr	6.65	2.24	5.23	3.18	4.52	2.44	3.56	2.51	3.45	4.75
	6th hr	6.62	2.19	5.2	-	4.48	2.32	3.52	2.46	3.37	4.71
	7th hr	6.59	S	5.18	-	-	2.28	3.49	-	3.32	4.67
	8th hr	-	-	-	-	-	1.99	3.47	-	2.86	4.51
	9th hr	-	-	-	-	-	-	-	-	2.69	4.43
	10th hr	-	-	-	-	-	-	-	-	2.5	3.57
	11th hr	-	-	-	-	-	-	-	-	-	2.95
	12th hr	-	-	-	-	-	-	-	-	-	2.89
Temperature (°C)											
	Initial	41.38	28.01	25.31	26.19	25.32	26.77	25.04	27.33	26.13	27.36
	1st hr	41.37	27.85	25.21	26.01	25.24	26.65	24.99	27.01	26.13	27.35
	2nd hr	41.35	27.33	25.1	25.98	25.16	26.53	24.87	26.89	25.62	27.21
	3rd hr	41.3	27.3	24.99	25.92	24.88	26.48	24.78	26.78	25.44	27.01
	4th hr	41.28	27.28	24.87	25.89	24.76	26.36	24.64	26.66	25.31	26.87
	5th hr	41.25	27.1	24.77	25.81	24.64	26.77	24.58	25.53	25.24	26.66
	6th hr	41.01	26.98	24.65	-	24.57	26.65	24.45	24.43	25.01	26.35

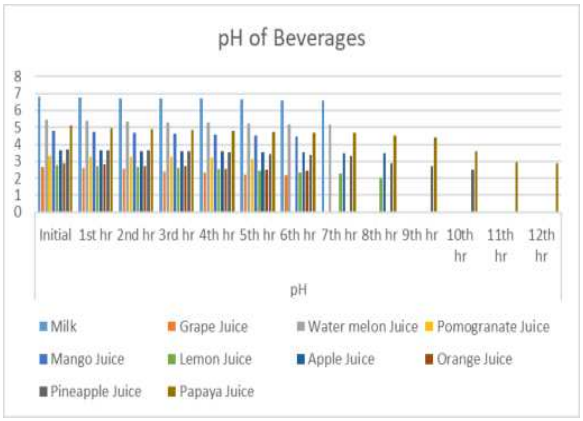
	7th hr	40.85	-	24.46	-	-	26.53	24.22	-	25.98	26.13
	8th hr	-	-	-	-	-	26.48	24.1	-	25.01	25.98
	9th hr	-	-	-	-	-	-	-	-	24.98	25.97
	10th hr	-	-	-	-	-	-	-	-	24.96	25.95
	11th hr	-	-	-	-	-	-	-	-	-	25.87
	12th hr	-	-	-	-	-	-	-	-	-	25.83

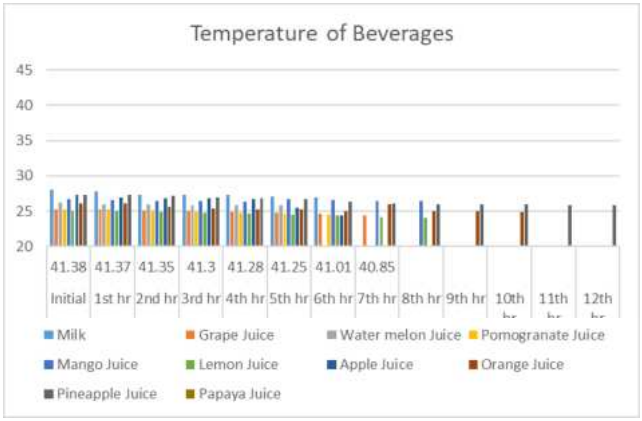
Table 1: pH and Temperature of Beverages for 12 hrs

The given table provides information about the pH levels and temperature of various juices over a period of 12 hours. The table includes different types of juices such as Milk, Grape Juice, Watermelon Juice, Pomegranate Juice, Mango Juice, Lemon Juice, Apple Juice, Orange Juice, Pineapple Juice, and Papaya Juice.

The pH values of each juice are recorded at different time intervals, starting from the initial measurement and continuing up to the 12th hour. The pH level indicates the acidity or alkalinity of a substance, with values below 7 being acidic and values above 7 being alkaline. In this case, the pH values range from approximately 2.4 to 6.8, indicating varying levels of acidity among the juices.

Overall, the table provides the pH levels and temperature of different juices change over time, which can be useful for monitoring and analyzing the quality and stability of the juices. The samples are tested and observed for any fluctuations for several hours before it develops characteristic changes that makes it unfit for consumption. This determines the keeping efficiency of the fabricated thermal flask. The results obtained from these testing shows the actual period of time the fabricated vessel can maintain the freshness of the stored beverage.



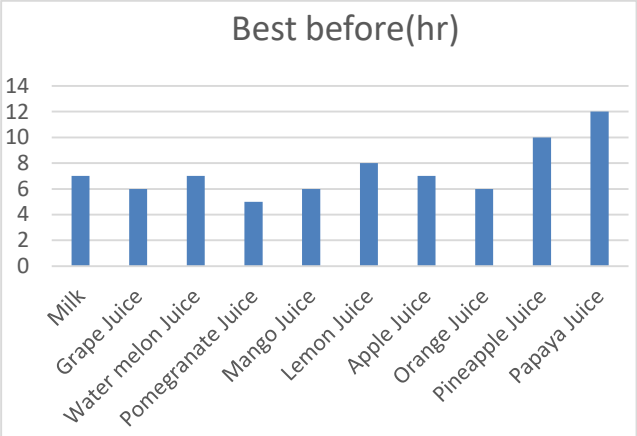


- **STORAGE TIME STUDIES FOR BEVERAGES:**

  The provided information presents the best before (shelf life) in hours for various beverages. Milk, watermelon juice, lemon juice and orange juice have a relatively longer shelf life, with a best before range of 12 hours. Grape juice, pomegranate juice, mango juice, apple juice, pineapple juice have a moderate shelf life, ranging from 5 to 12 hours. These recommendations suggest the recommended time for consuming the beverages while they are expected to maintain their quality and freshness.

Sample	Best before(hr)
Milk	7
Grape Juice	6
Water melon Juice	7
Pomegranate Juice	5
Mango Juice	6
Lemon Juice	8
Apple Juice	7
Orange Juice	6
Pineapple Juice	10
Papaya Juice	12

Table 2: Storage Time for Beverages



IV.CONCLUSION AND FUTURE WORK

The development of smart thermal flask has become a growing research field, and the integration of sensors and microcontrollers has enabled the tracking and monitoring of fluid intake and maintaining optimal hydration levels. The studies reviewed in this survey provide valuable insights into the design, materials, and technologies used for developing smart thermos and the potential benefits they offer. In conclusion, this thesis aims to design and develop a smart thermal flask that incorporates vacuum insulation and sensors for temperature and pH, a timer setting option, and a voice indication system. The proposed smart thermal flask will offer enhanced functionality and convenience, making it a valuable addition to the market of thermal flasks for the storage of beverages.

Future Scope

- Incorporation of additional sensors for detecting and monitoring other parameters such as dissolved oxygen levels and contaminants.
- Integration with smart home systems for seamless control and automation of beverage storage and dispensing.
- Exploration of sustainable and eco-friendly materials for flask construction to align with environmentally conscious consumer trends.
- Collaboration with beverage companies to create customized smart bottles that cater to specific beverage types, such as wine, beer, or coffee, with optimized storage conditions and real-time quality monitoring.

REFERENCES

[[1]Ahmad, A., Abdullah, W. A. T., Kausar, A., & Jamaludin, F. (2021). Development of a smart flask with pH monitoring for drinking water. Journal of Physics: Conference Series, 1792(1), 012070.
[2] Ajmera JS, Karnawat SN. Advancements in Thermos Flask. Technology. 2015;6(9):120-5.
[3] Apok, Mario & James, Wilzy & Zainal Abidin, Amar Faiz & Hasim, Saipol & Omar, Nor & Ibrahim, Tengku. (2020). Improved of Smart Vacuum Flask with Beverage Identifier and Temperature Indicator. IOP Conference Series: Materials Science and Engineering. 846. 012030. 10.1088/1757-899X/846/1/012030.
[4] Brouwer, C. P., Vleeschouwers, J., De Baets, P., & Vervaet, C. (2020). Design and evaluation of a smart water bottle for optimal hydration. Sensors, 20(19), 5447.
[5] Choi, S., Kim, K., & Kim, D. (2018). Development of a smart water bottle for the elderly. International Journal of Precision Engineering and Manufacturing, 19(8), 1145-1152.
[6] J. Li, Q. Li, Y. Zhang, and H. Li, "Research on the intelligent vacuum flask based on IOT," in 2019 3rd International Conference on Education and Multimedia Technology (ICEMT), Jul. 2019, pp. 52-56, doi: 10.1145/3345995.3346040.
[7] J. Qian, G. Chen, Y. Zhang, S. Li, and H. Liu, "Development of a smart bottle for real-time quality assessment of stored beverages," Sensors and Actuators B: Chemical, vol. 307, 127648, Jan. 2020.

[8] K. Devi, S. Swathi, and N. Karthik, "Internet of things based smart vacuum flask for temperature regulation," in 2017 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), Mar. 2017, pp. 1-6, doi: 10.1109/ICIIECS.2017.8272914.

[9] Kim, J., Kwon, H., & Cho, J. (2021). Development of a smart thermal flask for monitoring and controlling the temperature and pH of beverages. Sensors and Actuators A: Physical, 324, 112698.

[10]Kuo, C. H., Lee, C. Y., Hsieh, T. H., & Liu, C. H. (2019). Development of a smart vacuum flask with IoT functions for water quality monitoring. IEEE Access, 7, 67428-67435.

[11]Salvatore, Silvia, Federica Pagliarin, Koen Huysentruyt, Annalisa Bosco, Letizia Fumagalli, Kristel Van De Maele, Massimo Agosti, and Yvan Vandenplas. "Distress in infants and young children: don't blame acid reflux." Journal of Pediatric Gastroenterology and Nutrition 71, no. 4 (2020): 465-469.

[12]Zhang, X., & Ma, X. (2020). Intelligent insulation flask based on temperature and humidity monitoring and control. IOP Conference Series: Materials Science and Engineering, 769(3), 032040.

[13]Zhou, Y., Li, W., Chen, M., Li, Y., & Wang, L. (2019). A Smart Thermos Flask with Temperature Control and Remote Monitoring. 2019 IEEE International Conference on Applied System Innovation (ICASI), 1-4.

Development and Optimization of Millet Pellet

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Abstract - Inning accordance with our searching for, the millet pellets can be made from powder developed from pearl millet and finger millet. For extra flavor and color, the cocoa powders were included, to ensure that it provides enjoyable preference and scent. Dates and jaggery were utilized as the sweetening representative and included various other components to include worth to the millet pellet. The last pellets had the increase in healthy protein, carb and energy, vitamin D, fat content, water absorption and solubility, moisture and ash content after being liquified in the hot water or milk. it also can be consumed as such. One of the most palatable pellets in the ready examination were used 25 g pearl millet ,25 g finger millet ,5 g oats ,5 g chia seeds ,5 g flax seeds, 3 g almond, 3 g dates,5 g jaggery ,10 g cocoa powder,9 g gellan gum and 2 g salt benzoate. Therefore, this millet pellet is more cost-effective, lasting and efficient technique to conquer poor nutrition.

Keywords – Millet pellets, Pearl millet, Finger millet, Health benefits

I. INTRODUCTION

Millet pellets which have 377.43% of energy content,77.24% of carbohydrate, 2.46% of fat and 25grams of Pearl millet and finger millet powder each and 10g of cocoa powder, 3g of walnuts,5g of Oats,3g of almond, 5g of Chia seeds, 5g of Jaggery, 3g of dates, 5g of flaxseeds and it also includes 9g of gellan gum, 2g of sodium benzoate, before serving it is diluted. Millet pellets is developed as a food supplement for grownups, kids. Millet pellets is a total mineral, vitamin and fiber abundant supplement that can correctly stabilize the mineral and vitamin degrees of ordinary grains or can be utilized to offer additional degrees of minerals, fibers and vitamins to a currently stabilized a 100% for age diet plan. It includes natural minerals and distinct vitamin resources that offer a mineral and vitamin stabilize assisting to assistance typical blood structure, immune work and general efficiency. Ragi (*Eleusine coracana*), typically called finger millet, is commonly cultivated millet on the planet. It's the sixth expanded grain in India and utilized as staple food throughout the nation together with main and eastern Africa. In current years, ragi was in concentrate because of its dietary stamina and high quantity of nutritional fiber. Bajra flour is an outstanding resource of iron, protein; folic acid and fiber that maintains complicated conditions like anemia. To bring out the best nature of millets, both the millets were subjected for germination process. After milling all ingredients to fine powder, they are further taken to the process of pellatization to bind it to a definite shape. Millet pellets are high in nutrients, gluten-free, and have a reduced glycogenic index. They can assistance support blood glucose degrees for diabetic person clients and advertise insulin level of sensitivity. Additionally, millets are a great resource of nutritional fiber, healthy proteins, important amino acids, vitamins, and minerals. Millet pellets are identifiable and can be distinguished from each other. Consisting of millets in routine diet plan can assist with weight reduction, inning accordance with research researches. Enhanced mass thickness reducing mass quantity. Enhancement of the uniformity of the web content. Pellets allow much far better circulation, dissolution and absorption.

Keywords: Pearl millet, Finger millet, Germination, Pellatization, Millet pellet.

OBJECTIVES OF THE WORK

- Comprehending the use of millet integrated pellet.
- Suitable components for manufacturing of Millet pellets health and wellness consume.
- To check out the idea of different millets nourishment.

II. LITERATURE SURVEY

A literary works evaluate works as a device to offer a history to the work by summarizing the formerly released work. A comprehensive examine on progressed advancement of health and wellness consume utilizing millet pellets.

PEARL MILLET

Health and wellness and nourishment viewpoint Significance of expanding iron strengthened bajra ranges and their advantages were discussed in a variety of research researches, a research study released in Journal of Nourishment exposed that iron deficient Indian kids under the age of 3 that use up typically pre- pared porridges, and level bread made from iron abundant bajra flour take in more iron sufficient to satisfy their physical demands as this iron abundant bajra included zinc which was taken in in adequate quantities of zinc .Colin et alia. (2013) in their examine on iron absorption by girls from iron-bio-fortified pearl millet compound dishes is dual

that from routine millet dishes however much less compared to that from message gather iron strengthened dish. Their experiment on and so on So biography stronghold for that reason describes advancement of mini nutrition improved staple plant ranges by conventional reproducing methods or by utilizing contemporary biography innovation. For that reason, Iron biography stronghold of bajra is guaranteeing method to fight iron shortage in the millet taking in nations i.e., Oriental and Below Saharan African nations. It some medical residential or commercial homes when bread is consumed with honey in the early morning. It's quickly digestible and has the most affordable possibility of triggering allergies. Bajra, being gluten free, is an excellent food option for those struggling with celiac illness that can't endure gluten. Being abundant in fiber sugar degrees typical. It's useful in preserving cardio health and wellness and in acidity issues. Bajra assists in decreasing weight. It manages blood glucose degrees and thus great for diabetic person.[1]

FINGER MILLET

One of the oldest millets in India dates back to 2300 BC, and this evaluation of finger millet or ragi focuses on its historical context, culinary applications, nutritional makeup, processing, and health and wellness benefits. Finger millet contains the highest levels of calcium (344 mg%) and potassium (408 mg%) of all the grains and millets. Compared to white rice, the current major staple in India, it has more nutritional fibre, minerals, sulphur, and amino acids. Despite the plentiful nutritional value of finger millet, recent study suggests that Indians living in urban areas should consume fewer millets overall. Yet, these effects on health and wellness are not being affected by appropriate treatment or randomised clinical trials. Glycemicindex (GI) research studies on finger millet preparations indicate low to high values, but the majority of the studies used an antiquated methodology. Millets are tiny grains of the Poaceae family, which includes the turf (Malathi & Nirmalakumari, 2007). According to research, consumption of whole grains and grain fibre is inversely related to BMI, waist circumference, total cholesterol, metabolic disease, cardiovascular disease death, and insulin resistance. [2]

JAGGERY

Granular jaggery manufacture follows a similar process to that of focus. To promote grain growth, the concentrating slurry is scraped with a wood scraper. For good quality granular jaggery, smaller than 3 mm sized crystals are found to be considerably preferable. High quality granular jaggery with a high sucrose content of 88.6%, reduced wetness of 1.65%, and excellent colour, friability, and crystallinity was found to be produced by increasing the pH of walking stick juice with lime, as much, and striking factor temperature of 120°C. Jaggery is ground into granules (about 3 mm sieved), dried out in the sun, and its moisture content is reduced to less than 2% before being packed in polyethylene polyester bags. Jaggery powder can range in colour from gold to a dark brownish gold that resembles dark, decadent chocolate. Compared to sugar, it is softer and more amorphous. Jaggery consumption is therefore advised in cases of anemia due to a lack of iron. Power is therefore provided for a much longer periods of time and is not harmful to the body. [3]

ALMOND

The nutrition structure of almond differs from one type to other types due to genotype, ecological problems, expanding problems, cultivation techniques and so on. Almond was acknowledged as a resource of nutrients in lots of conventional diet plans. Research study likewise suggests advantageous impact of almond on cardiovascular disease danger and kind 2 diabetic issues. Lots of research study outcomes recommend that almond likewise have biography energetic substances which assistance the diabetic person client to manage glycemic index. Because of high power thickness of almonds, it was thought that usage might enhance weight acquire, nevertheless there's no weight acquire reported up until now since it assists in managing of satiety and advertise enhance in high quality final thought of diet plan. So, in purchase to know the varied function of almonds in illness avoidance, more long-term medical treatments are required.[4]

WALNUT

The most widely consumed readily expanded tree nut on the earth is the walnut. The use of these has been linked to a number of health benefits, including a reduced risk of heart disease, coronary heart disease, type II diabetes treatment, prevention and treatment of particular cancer cells, and a reduction in the symptoms of aging-related and other neurological diseases. Walnuts' fatty acid profile, which is rich in polyunsaturated fat and has the highest 3:6 ratio of any tree nut, is associated with the health benefits of its consumption. Walnuts are a promising candidate for research into the prevention of free radical-induced nucleic acid damage due to their high amount of polyphenols and other phytochemicals, which have been known to have claimed cytotoxic properties. Research on the consumption of walnuts by humans and animals using a variety of information gathering and analytical methodologies suggests that walnuts may be considered a potentially safe nutraceutical or medicinal component.[5]

OATS

Oats are a practical food that have real physical benefits including a hypoglycemic effect, a hypocholesterolemia effect, a reduction in cancer cells, and a reduction in hypertension. Oats include nutritious protein, fats, vitamins, anti-oxidants, phenolic compounds, minerals, and other nutrients in relatively high concentrations. From this analysis, it can be concluded that glucan is the main active ingredient responsible for these entire physical beneficial effects of oats. The altitude of thickness and the altitude in thickness schedules to soluble fibre, i.e. glucan, account for the majority of the physical effects. Research is required to determine how the active ingredient in oats, beta-glucan, might be used in the development of products that are regularly used in daily life. It is also necessary to examine the effects of various refining advancement on beta-glucan as well as how it interacts with other components of food products. [6]

CHIA SEEDS

The dietary properties of chia seeds, including their high level of polyunsaturated fat, vegetable healthy protein, nutritional fibre, vitamins, minerals, and bioactive substances, have sparked a variety of studies on these seeds to demonstrate its healing properties. Chia seeds are recognized with providing hypotensive, antineoplastic, laxative, and analgesic residential or commercial properties. A randomized, single-blind study on 20 adults with type 2 diabetes found significant reductions in systolic blood pressure and C-reactive protein concentration in blood plasma. Additionally, after consuming 37g of chia seeds added to bread daily for 12 weeks, a dual increase of -linolenic acid and eicosapentaenoic acid in plasma was noted in comparison to the control group. Increased levels of unsaturated fatty acids in plasma blood were also seen in the study of postmenopausal healthy women who had been taking 25 g of ground chia seeds daily for 7 weeks.[7]

FLAXSEEDS

Flaxseed (Linseed) encompasses the prospective health and wellness suiting dietary account in it. Nevertheless, lots of people are still uninformed of the prospective health and wellness advantages of flaxseed and food applications. ALA (omega-3 fatty acid), nutritional fiber and Lignan (particularly SDG) web content draws in food technologists to check out its capabilities at max degree in industrial food refining industry. Flaxseed includes essential amounts of substances with practical and bioactive residential or commercial homes, such as alpha- linolenic acid, lignans, soluble fiber and healthy protein, whose impacts on the avoidance of specific nontransmissible persistent illness have been evaluated. As a matter of fact, the web content of substances such as polyunsaturated fat, important amino acids, vitamin E, lignans and nutritional fibers makes flaxseed a resource to please fundamental requirements in the human diet plan and health and wellness upkeep. Refining developments in more-recent years have improved flaxseeds utilize as a component, production it offered in lots of types with particular dietary advantages for today's health-conscious customers.[8]

DATES

Phoenix dactylifera, sometimes referred to as dates or date win, is a flowering plant species in the Arecaceae (win) family that is grown for its edible, sweet dates. The species is widely grown in southern Asia, the middle east, and northern Africa, and it has also become naturalized in many tropical and tropical areas around the world. The type species of the rubric phoenix, which includes 12–19 species of wild date triumphs, is p.dactylifera. Date trees can grow up to 30 meters tall and form bunches of many stems from a single root system. (100 feet). With the right care, they can live for more than a century and grow slowly. The type species of the rubric phoenix, which includes 12–19 species of wild date triumphs, is p.dactylifera. Date trees can grow up to 30 meters tall and form bunches of many stems from a single root system. (100 feet). With the right care, they can live for more than a century and grow slowly.[9]

COCOA POWDER

The process of separation fat - free cocoa solids from fatty Cocoa solids yields cocoa powder, which is then marketed as natural cocoa powder (Coco butter). Dutch -processed or natural cocoa powder are both available and have a strong choclate flavour. Natural cocoa powder has a strong, distinct chocolate flavour and has a light brown colour. It is better to use natural cocoa powder in recipes that call for baking soda because it is slightly acidic. Moreover, it is used to produce no bake biscuits and hot chocolate. Darker ih hue, less acidic and testing more like chocolate is alkalized cocoa powder. For baking powder - required recipes, alkalized cocoa powder is advised.[10]

GERMINATION

On the physico-chemical characteristics, practical associates, and mineral web content, germination time had a significant impact. As germination time increased, sugars and crude fiber increased but starch, good proteins, fat, and mineral web content decreased. While the overall phenols and tannins components decreased with germination, an increase of these components was seen during prolonged germination (over 48 h). Ascorbic acid content, antioxidant activity, and useful properties like WSI, WAI, OAI, foaming capability, and foam security were also improved by germination. With germination, calcium concentration increased but other minerals such phosphorus, potassium, magnesium, sulfur, salt, manganese, iron, zinc, and copper decreased. According to the investigated parameters, a germination time of more than 48 hours is advised for the preparation of malted beverages, which often require higher sugar and sprinkle solubility levels. High malting loss and an increase in anti-nutrients resulted from a prolonged germination period of 72 hours. [11]

PELLETIZATION

Pellets are the little free streaming, round or semi-spherical bits and meant generally for dental administration by utilizing the agglomerates of great powders or granules of mass medications and excipients utilizing suitable refining devices. Pellets provide high level of versatility throughout develop and advancement of dental dose types. They can be split into various dosage staminas without any type of alter in the procedure. Pellets can be developed over a lengthy time period as an instant launch shipment develop or in constant medication launch or can likewise be covered to provide a medication to a specific intestinal system website of activity. These can be divided into various dose staminas without elements or procedure modifications and can likewise be integrated to offer incompatible bioactive marketing experts with different launch accounts on the exact same website or at various websites within the intestinal system.[12]

I. MATERIALS AND METHODS

SAMPLE COLLECTION

The ingredients used to develop the millet pellets were purchased from a local market in Coimbatore, Tamil nadu.

PROCESSING OF MILLETS

All the basic materials were cleaned up to eliminate dirt and dust and cleaned. Bajra, Ragi was soaked for 12hrs. After that they were enabled sprouting overnight. After that the sprouts were taken color dried out and rosted in frying pan, the roasted mix were powdered utilizing pulvarizer and sieved.

Millets

↓

Cleaning

↓

Soaking (12hrs)

↓

Germination (16hrs)

↓

Drying (sun drying)

↓

Roasted in pan (50-60ºc)

↓

Grinding

↓

Sieving

↓

Flour is ready

FLOWCHART OF GERMINATION PROCEDURE

S.NO	*INGREDIENTS (g)*	*QUANTITIES(g)*
1	Finger Millet	25
2	Pearl Millet	25
3	Oats	5
4	Flax seeds	5
5	Chia seeds	5
6	Walnut	3
7	Almond	3
8	Dates	3
9	Jaggery	5
10	Cocoa powder	10
11	Gellan Gum	9
12	Sodium benzoate	2

Table- 1: Formulated Ingredients of Millet pellet

REFINING OF VARIOUS OTHER COMPONENTS:

Oats were sunlight dried out for 1hour and grined. Chia seeds, flax seeds, almond, walnut were roasted separately and grined to powder and seived. Dates were sunlight dried out for 3 days and grined. Jaggery were grined and dried out in sunlight for 2 days.

REFINING OF HEALTH AND WELLNESS BLEND

All the refined components were blended and gellan periodontal is included properly. It's after that pushed in mould tablet computer push to obtain the Pellet develop.

Selection of raw materials

↓

Cleaning

↓

Grading

↓

Germination/ Drying

↓

Milling/ Roasting

↓

Mixing

↓

Addition of preservative

↓

Addition of binding agent

↓

Mixing

↓

Pelletization

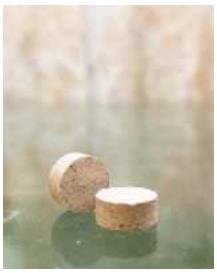
↓

Blister Packaging

↓

Storage

Flowchart on preparation of Millet pellets



MILLET PELLETS

SENSORY EVALUATION OF MILLET PELLET

The sensory evaluation of millet pellet was carried by various people in our surrounding using 5 points Hedonic scale score.

POINT HEDONIC SCALE

S.NO	ATTRIBUTES
5	Excellent
4	Good
3	Regular
2	Bad
1	Very bad

PROXIMATE ANALYSIS OF THE PRODUCT

This chapter focuses on the result and discussion of processing and preparation of millet pellet. Proximate analysis of the product was analyzed for ash content, protein content, fat content, carbohydrate and energy, vitamin D, bulk density, water absorption and water solubility.

III. RESULTS AND DISCUSSION

S.NO	PARAMETERS	WEIGHT PER 100ML (IN %)
1	Moisture content	7.24
2	Ash content	<5
3	Protein content	11.54
4	Fat content	2.46
5	Carbohydrate	2.46
6	Energy	377.23
7	Vitamin D	<0.1
8	Water absorption	1:1.7
9	Water solubility	5g in 100ml

TABLE- 4.1: PROXIMITY ANALYSIS REPORT

The Millet pellet was developed using Pearl millet and Finger millet. The result of the product was tabulated and discussed. The physio-chemical characteristics of millet pellet were found ash content (<5 %), moisture content (7.24 %), protein content (11.54 %), fat content (2.46 %), carbohydrate (2.46 %), energy (377.23 %), vitamin D (<0.1 %), water absorption (1: 1.7) and water solubility (5g in 100ml)

IV. CONCLUSION AND FUTURE WORK

According to our findings, the millet pellets can be made from powdered form of pearl millet and finger millet. For additional flavour and colour the cocoa powders were added, so that it gives pleasant taste and aroma. Dates and jaggery were used as the sweetening agent and added other ingredients to add value to the millet pellet. The final pellets had the rise in ash, protein, moisture, carbohydrate and energy, vitamin D, fat content, water absorption and solubility after being dissolved in the warm water or milk. The most palatable pellets in the prepared test were made using 25 g pearl millet ,25 g finger millet ,5 g oats ,5 g chia seeds ,5 g flax seeds, 3 g almond ,3 g almond ,3 g dates,5 g jaggery ,10 g cocoa powder,9 g gellan gum and 2 g sodium benzoate. Thus, this millet pellet is more economical, sustainable and effective strategy to overcome malnutrition.

V. REFERENCES

[1] Shakuntala Devi I, Suhasini K and Rao Dayakar. Is pearl millet (bajra) cultivation a boon or bane without value addition. In December 2013 DOI:10.13140/RG.2.1.2965.9682

[2] S.Shobana, K. Krishnaswamy, V. Sudha, N.G. Malleshi,R.M. Anjana, L. Palaniappan, V. Mohan .Finger Millet (Ragi, Eleusine coracana L.). A Review of Its Nutritional Properties, Processing, and Plausible Health Benefits.March 2013Advances in Food and Nutrition Research 69:1-39. DOI:10.1016/B978-0-12-410540-9.00001-6

[3] Amanat Ali,Mostafa I Waly , Mohamed Essa Musthafa ,Sankar Devarajan. Nutritional and Medicinal Value of Date Fruit., January 2012

[4] Tabasum Fatima, Nazia Nissar, Bazila Naseer and Syed Zameer Hussain. Health benefits of almond. ISSN (E): 2320-3862.ISSN (P): 2394-0530.JMPS 2018; 6(2): 228-231.Received: 01-01-2018, Accepted: 05-02-2018
[5] David Hayes et al. Crit Rev.Walnuts (Juglans regia) Chemical Composition and Research in Human Health Food Sci Nutr. In 2016.
[6] Wani Sajad Ahmad, Shah Tajamul Rouf, bazaria Bindu, Nayik Gulzar Ahmad, Gull Amir, Muzaffar Khalid, Kumar Pradyuman Oats as a functional food: A review.February 2014
[7] Mr. Shaikh Akbar1, Mr. Mirza Nazish Baig, Miss. Desahmane Amruta Assistant Professor, G.M.C College of Pharmacy, Aurangabad (M.S.)
Lecturer, R.B.T College of D. Pharmacy, Aurangabad (M.S.) Flaxseeds: A Review.,August 2021| IJIRT | Volume 8 Issue 3 | ISSN: 2349-6002,IJIRT 15245
[8] Katarzyna Marcinek, Zbigniew KrejpcioPoznan. CHIA SEEDS (SALVIA HISPANICA): HEALTH PROMOTING PROPERTIES AND THERAPEUTIC APPLICATIONS – A REVIEW in January 2017
[9] Ali, Mostafa I Waly, Mohamed Essa Musthafa, Sankar Devarajan. Nutritional and Medicinal Value of Date Fruit., January 2012
[10] L. Katz, Kim Doughty, and Ather Ali (2011) Cocoa and Chocolate in Human Health and Disease doi: 10.1089/ars.2010.3697
[11] Ashwani Kumar, Amarjeet Kaur, Kritika Gupta, Yogesh Gat and Vikas Kumar.Assessment of germination time of finger millet for value addition in functional foods.,Received 10 January 2020; accepted 5 November 2020.doi: 10.18520/cs/v120 i2/406-413
[12] M R J Joysa Ruby Acharya and BM Reddy. A REVIEW ON PELLETIZATION TECHNIQUES.In June 2020 DOI:10.7897/2277-4343.110376

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Development of Smart Bin for Inventory Management in Small Scale Industries

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Abstract - Inventory management plays a crucial role to maintain essential products in business organization. Inventory control is one of the challenging tasks as it directly affects the production processes of a business organization. To overcome these challenges, novel and emerging technologies like IoT and sensors are adopted in inventory control system. These control systems are used to stabilize the entire process flow from raw material acquisition to finished goods dispatch. This has not only reduced the man power but also made the supervision of the entire flow of inventory and refilling the storage bins easier. This project gives an efficient way to make inventory management more efficient by implementing IoT to make smart bin that helps to monitor the quantity and quality aspects of a product by embedding sensors in the system. Smart bin has a capacity of 2.7 kg. A load cell is fixed on the base of bin to measure the weight of the commodity that will be placed inside the bin. A moisture sensor is fixed inside the base of the bin to detect moisture changes of the commodity. A DHT11 (Digital Humidity and Temperature sensor) is used for measuring the temperature and humidity conditions inside the bin.

Key Words: IoT, Sensors, Inventory management , Smart Bin, Technology, Microcontroller

1.Introduction

Technology will keep advancing. New discoveries are created daily that improve and simplify human existence. Every industry or company organization places a strong emphasis on research and development to make sure that their operations are in line with technology. [1] The development, expansion, and market survival of the firm may be secured by incorporating rising trends into the sector of business. The Internet of Things is one of the rapidly expanding and largely embraced phenomena. It allows for remote measurement and monitoring of the system's physical infrastructure and components. The precision and real-time data update it offers, in addition to permitting remote operation of the system, increases its relevance. The food sector is one of the industries with considerable potential for introducing this idea of inventory management. Food processing companies employ a variety of raw materials that must be kept in stock for an extended length of time in order to ensure seamless output. Inventory must be checked on a regular basis, not only to ensure that there is enough stock, but also because the raw materials utilized in this business are perishable. Having a system that can handle both quantity and quality characteristics can help the sector in terms of both economics

and sustainability. The creation of smart bins is one approach to meeting the aforementioned demand. These containers include IoT capabilities to enable remote monitoring. With sensors built in, it is possible to track the stock's amount and quality in real time. For a number of reasons, smart bins may be quite helpful for inventory control in the business

world.

1. Real-time inventory tracking: It is possible thanks to sensors that are built into smart bins. This makes it possible for businesses to more accurately monitor their stock levels and choose when to place fresh orders for products. [2]

2. Automatic replenishment: Organizations might set up automatic replenishment systems using smart bins. The system may automatically purchase new supplies when the amount of goods in a bin drops beyond a certain threshold, lowering the possibility of shortages and

downtime.

3. Savings: Smart bins can help firms reduce their inventory expenditures by more precisely monitoring inventory levels and lowering the chance of stockouts. By maximizing inventory levels and reducing overstocking, they can also assist firms in reducing waste.

4. Efficiency gain: By eliminating the need for manual inventory monitoring and freeing up staff time for higher-value duties, smart bins can help inventory management procedures run more smoothly. By automating some operations, they can also assist organizations in lowering the

time and expense related to inventory management. [3]

Overall, smart bins may assist organizations in improving inventory accuracy, lowering expenses, and increasing efficiency, making them an appealing solution for inventory control in industry. These bins are a sort of inventory control system that monitors and tracks inventory levels using technology. They are generally outfitted with devices that identify when stocks are low or bins get overcrowded. This data is then sent to a one central database or structure, where it may be utilized to optimise inventory levels and supply chain management. One of the key advantages of smart bins is their ability to track inventory in real time. This entails that employees won't have to waste time scouring bins or shelves in order to get the products they want swiftly and efficiently. Both productivity and labour costs may increase as a result. By decreasing trash and avoiding overstocking, smart bins could assist businesses save money. Smart bins may assist companies prevent overstocking, which can result in extra inventory and

excessive costs, by monitoring inventory levels in real-time. Smart bins can also assist in lowering the price of human inventory tracking and data entry, that can be labor-intensive and prone to mistake. Predictive analytics are another feature that smart bins can offer in in addition to real-time tracking.

Smart bins can assist organisations in forecasting demand by gathering information on inventory levels and consumption trends. This can assist firms in making inventory plans and preventing stockouts. Additionally, smart bins might improve workplace safety. Smart bins can lessen the risk of accidents and injuries caused by falling goods by monitoring inventory levels and bin capacity. Overall, smart bins are an effective tool for inventory management in the industrial setting, giving firms real-

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time tracking, predictive analysis, and improved safety, as well as aiding in cost-savings and inventory level optimisation.

There are mainly three processes involved:

1.1 Measurement of Weight of the Commodity

By using a load cell to measure the weight and level of the product is continually checked. Both the web application and the prototypes LCD display the value continually.

1.2 Displaying of Real Time Values of the Commodity

Continuous measurements are made of the commodity and quality indicators, including the moisture content and container humidity. As a result, the web application status will be changed to High Moisture Level Detected if these values surpass the pre-set value. This works best for hygroscopic products like sugar.

1.3 Web Application

All the information about the object in the container is contained in a web application that is developed. Through a wireless module and cloud, the smart bin is linked to the online application. With the use of sensors, the physical characteristics of the commodity, such as its weight and moisture content, humidity, and temperature levels, are continually monitored and saved in the cloud. This information is sent and accessible via the online application. [4] .Thus, our main idea is to provide a simple, affordable and a safe solution to make any normal bin into a smart one, with only a bin and a smartphone as a requirement, so that it can be used by the small scale industries.

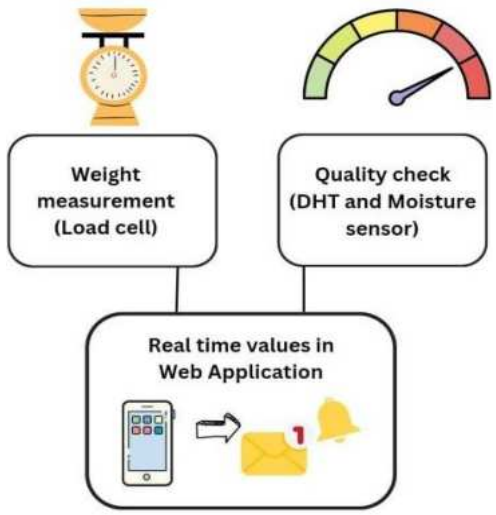


Fig – 1 : Three main process involved

2. Objectives

The following are the objectives of the proposed work:

1. To develop a prototype of a smart bin for smart inventory management
2. To connect and monitor the inventory via internet (database)
3. To create a hassle free inventory management
4. To provide real time data access to the moisture, weight and humidity of the products stored in industries for running business.

3. Review of Literature

The paper [7] proposes a conceptual framework for the implementation of Internet of Things (IoT) in domestic environments. The system aims to enhance the management of groceries by incorporating technological advancements for efficient tracking, monitoring, and organizing of goods. The application of a load cell was leveraged for the purpose of quantifying the weight of groceries, facilitated by the utilization of a Raspberry Pi microcontroller. This study explores alternative electronic commerce platforms in order to identify more cost-effective options for purchasing goods. The paper [1] uses a smart cabinet based on the thought that the basic supply things can moreover be kept outside the fridge. The framework gives a plenty of benefits and employments. In spite of the fact that, the framework itself is very bulky and requires quite a part of space. The interface may well be precarious and lumbering for clients to get it and utilize proficiently. The paper [10] presents an analysis of the development of an Internet of Things (IoT) based model designed to monitor inventory levels of groceries in stores and commercial markets. Additionally, the model has the potential to be employed in domestic kitchens to oversee basic pantry inventory management as well.

4. Materials and Methodology

This chapter deals with the materials and parts used in the fabrication of the smart Container.

4.1 Materials

The system consists of the following components and modules:

- Arduino Microcontroller (Node MCU)
- Load cell
- DHT11 (Digital Humidity and Temperature sensor)
- Moisture sensor
- 16×2 LCD i2c
- HX711 Load cell amplifier
- Battery (Power source)
- Cloud
- Wi-Fi Module
- Web Application

4.1.1 *Arduino Nano*

It is a 2008 ATmega328P-based board that is compact, comprehensive, and breadboard-friendly. In a more compact design, it provides the same connections and specifications as the Arduino Uno board. The Arduino Nano has 30 male I/O headers

organized in a DIP- 30 type format and is capable of being programmed via the Arduino Software Integrated Development Environment (IDE), which is available online and offline and is shared by all Arduino boards. The board is powered by a type-B mini-USB connection or a 9 V battery.

This board, like the Arduino Duemilanove, offers numerous functionality and features. This Nano drive, on the other hand, stands out from the crowd. It doesn't have a DC plug, so the power supply comes from a small USB socket, which is otherwise connected directly to the contacts Such as VCC and GND. This board can be powered from 6 to 20 volts through a mini-USB connector Board of Directors.

4.1.2 Microcontroller

Microcontrollers are "special purpose computers". The microcontroller is an integrated circuit that houses a microprocessor, memory, and associated circuitry. It is used to control some or all of the operations of electronic devices including household appliances and systems. Microcontrollers are embedded in some other device (often a consumer product) So that they can check the features or functions of the product. It has a separate feeder and often (but not always) the output is a small LED or LCD screen. This is used to obtain useful information from the sensor and thus helps to detect the level of the goods in the container. The Wi-Fi module is also linked to the microcontroller. Through the microcontroller and the Wi-Fi module the collected data will reach the cloud.

4.1.3 Node MCU/ESP8266 Wi-Fi Module

Node MCU is an open source IoT platform that includes ESP8266 Wi-Fi So C and ESP-12 based devices from Espress if systems . It is used by many open source projects such as Lua-cjson and spiffs. The ESP8266 is an affordable Wi-Fi module that has a full TCP/IP stack [6]. This little gadget connects a microcontroller to a Wi-Fi connection and performs basic TCP/IP communications using Hayes instructions. It has 1MB of flash memory integrated in, allowing single-chip devices to connect through Wi-Fi. The ESP8266 contains one processor: the L106, which is a 32-bit RISC microprocessor. ESP8266 has an external flash 16 MB of memory.

4.1.4 Load Cell

A load cell is a sensor that converts force or pressure into electrical energy. The magnitude of this electrical output is directly proportional to the applied force. Load cells have a strain sensor that changes shape when pressure is applied to it. And then the Strain the meter provides an electrical stress signal when its effective resistance changes to change A load cell typically consists of four Wheatstone bridge strain gauges configuration Load cells are available in different ranges like 5 kg, 10 kg, 100 kg and more used a load cell that can weigh up to 40 kg. Now the electrical signals generated by the load cell are in the range of a few millivolts, so Still needs to be amplified with an amplifier, so the HX711 weight sensor is needed To the picture. The HX711 load cell module has an HX711 chip with a height of 24 Precision A/D converter (analog to digital converter). The HX711 has two analog input channels and by programming these channels we get a gain of up to 128.Thus, the HX711 module validates the load cell's low electrical power before feeding the Arduino with an amplified and digitally converted signal to determine the weight.

4.1.5 Moisture Sensor

A moisture sensor or moisture analyser measures the moisture content of any food products for evaluating the quality of raw food ingredients. Moisture sensor can help monitor food moisture, improves food quality and safety, and provides the following benefits:

Real-time analytics and data, non-destructive testing capabilities and improved information flow effective storage and control of ingredients. We use it in our warehouse management system .Moisture sensors are built Into the containers to monitor and measure moisture content of ingredients stored in the smart container. Hence this helps finding out if the ingredients have absorbed moisture during its usage.

4.1.6 DHT11 (Digital Humidity and Temperature Sensor)

DHT11 is a simple and very affordable digital temperature and humidity sensor. There is no need for analogue input buttons because it uses a thermistor and capacitive humidity sensor to detect the surrounding air and spit out an electrical signal on the data port.It is easy to use, but requires careful time to collect data. We are receiving new data from it once every second. Comes with a 4.7K or 10K resistor that can be used as a pull-up Transferring data to VCC. This sensor can be easily interfaced with any microcontroller e.g. such as Arduino, Raspberry Pi etc. to measure humidity and temperature instantly. The temperature range of the DHT11 is 0 to 50 degrees Celsius with an accuracy of 2 degrees. Humidity range of this sensor is 20-80% with a precision of 5°. The sampling rate of this sensor is 1 Hz, i.e. it gives one reading every second. DHT11 has a small operating voltage of 3-5 volts. The maximum current used for measurement is 2.5 mA. Hence this sensor in our system, is used to measure the humidity and temperature of the surrounding of the ingredients inside the container to help track the condition of the ingredients which has remarkably low humidity.

4.1.7 16X2 LCD

It is a 16x2 LCD screen with I2C interface. It is capable of displaying 16x2 Two lines of characters, white letters on a blue background. This is usually an Arduino LCD It's easy for a project to run out of pin resources, especially when using an Arduino Uno. That's a lot Complicated wire welding and connection. The Arduino I2C 16x2 LCD is Use the I2C communication interface. This means that the LCD needs only 4 pins: VCC (Voltage Common Collector) GND (Ground), SDA (Serial Data), SCL (Serial Clock). It will have a capacity of at least 4 digital/analog Pins on the Arduino. All connectors are standard XH2.54 (board type). You can contact Directly with the rider. Avoid conflicts between I2C (inter-integrated circuit) Handle other I2C devices such as ultrasonic sensors, IMU accelerometers and gyroscopes, The I2C address of the module can be set as 0x20-0x27. It could be their contrast Set manually. Another alternative option is the Arduino I2C 20x4 LCD Display Module, if it is More characters are required.

4.1.8 Cloud Platform

A cloud platform is the operating system and hardware of an internet server based information center. It enables the harmonious coexistence of software and hardware on a vast scale, allowing users to securely store their data and files on the Internet using the services of a cloud service provider. The user can access

their data either through a public Internet connection or via a dedicated private network connection. In our system , the information on grocery level, moisture content, humidity and temperature level and its shelf life are stored in the cloud with the Wi-Fi module. The recorded sensor data can then be analysed and can be found via the HTTP protocol.

4.1.9 Interfacing Software

Software used in the interfacing of smart inventory system with Arduino is Arduino IDE. The Arduino Software (IDE) - also known as the Integrated Development Environment - comprises a script editor for scripting, a communication area, a script console, a set of general function buttons on a toolbar, and a range of menus. It interfaces with Arduino hardware to load scripts and engage with them.

4.1.10 User Interface

A web application was created for our intelligent warehouse management system that track the inventory anywhere, anytime. Users can also monitor inventory, grocery level, moisture content, Humidity and Temperature level inside the bin. Also when the moisture content , humidity and temperature of groceries and bin rises above the pre-set value for certain articles, the user will be notified and updated continuously. In addition to this, the user is warned about the expiration date and month of the groceries stored in the bin .

4.2 Methodology

The system provides intelligent inventory management through an Internet of Things (IoT) service. The Smart Inventory Device is controlled by the Node MCU microcontroller with built-in Wi-Fi module. The sensors namely load cell , moisture sensor and DHT sensor are connected to a microcontroller device. Those sensors that are connected to the smart container is used to collect data on the level of food and its physical parameters. This data is stored in the cloud platform through Wireless protocol (built-in Wi-Fi module).The information includes the stock level of f all products, moisture content, humidity and temperature levels using load cells, moisture sensor and DHT sensor. This information can be viewed through the web application and on LCD screen. This process happens every day. The fig.1 shows the architecture of overall system.

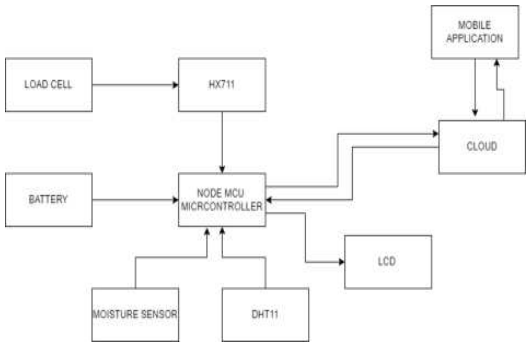


Fig – 2 : Smart Inventory Management System

5. Cost Estimation

Cost estimation was calculated for individual component for the fabricated Smart Bin shown in table 5.1

S.NO	MATERIALS	AMOUNT(Rs.)
1.	Raw material for Body Fabrication	1000
2.	Battery	1000
3.	Node MCU	400
4.	Load Cell	200
5.	Moisture Sensor	100
6.	DHT11	100
7.	HX711 Amplifier	300
8.	LCD Display	300
9.	Webpage Development	850
10.	Fabrication charge	600
11.	Miscellaneous expenses	500
TOTAL COST		5,350

Table – 1 : Cost Estimation of Smart Bin

6. Results and Discussions

In Smart Bin for Inventory Management System, we have used Load cell to measure the stock level in it. We have also used Moisture sensor and Digital Humidity and Temperature sensor to measure the moisture of the stock and humidity and temperature of the bin respectively. These sensors are connected to the Node MCU Board. The collected grocery information is stored in the cloud platform where analysis takes place and finally viewed by Web Application. The information collected as values are displayed on the LCD attached to the Smart Bin.
For testing purposes, hygroscopic food materials such as Chilli powder, coriander powder and rice flour were used. The images of various level measurements of chilli powder are given below.

S. No	Mode	Weight(in grams)	Temperature(in °C)	Relative Humidity(in ٪)	Moisture(in ٪)	Status
1	Spices	100.47	32.00	50.00	0.00	Normal
2		104.12	33.00	52.00	91.208	High Moisture level detected

Table – 2: Tabulation for various parameters of Chilli powder

Table – 3: Tabulation for various parameters of Rice Flour

S .No	Mode	Weigh t (in grams)	Temper ature (in ˚C)	Relativ e Humidi ty (in %)	Moist ure (in %)	Status
1.	Flour	104.1 0	33.00	56.00	13.18	Norma l
2.		114.5 5	32.00	56.00	34.06	High Moistu re level detecte d

S . N o	Mod e	Weight (in grams)	Temperat ure (in ˚C)	Relative Humidit y (in %)	Moist ure (in %)	Status
1 .	Spic es	100.67	31.00	55.00	0.00	Normal
2 .		101.27	31.00	55.00	1.32	
3 .		106.58	31.00	56.00	25.06	High Moistur e level detected
4 .		111.14	31.00	56.00	60.88	

Table – 4: Tabulation for various parameters of Coriander Powder

S. No	Mode	Weig ht (in grams)	Temper ature (in ˚C)	Relativ e Humidi ty (in %)	Mois ture (in %)	Status
1.	Cereals and Pulses	415.6 6	29.00	59.00	0.00	Produ ct Expir ed

Table – 4: Tabulation for indicating the expiration of Urad Dal



Fig – 3 : Smart Bin

7. Conclusion

The purpose of the project is to develop a bin embedded with sensors for a Smart Inventory Management in Small scale Industries. This system takes care of both quality and quantity parameters. Trials were performed using commonly available and most frequently used grocery items like Rice, Sugar and Urad dal. The system monitored the products placed in the bin continuously by providing real time data updates on weight of the product, Temperature and humidity conditions and the moisture content of the product. The weight of the product is measured using a load cell that is fixed at the base of the bin. The moisture level is measured by the moisture sensor. The temperature and Humidity conditions are measured by DHT11 sensor. The efficiency of the system is found to be 81.8%. This system makes the management of stock in the small scale industries easier and does not require highly skilled labour for maintenance.

8. References

[1] Sifat Rezwan, Wasit Ahmed, Mahrin Alam Mahia and Mohammad Rezaul Islam, “IoT based Smart Inventory Management System for Kitchen,” 2018.
[2] Alsan Parajuli, “ESP8266 Based Smart Kitchen Automation & Monitoring System,” January 10, 2022.
[3] Aniqa Bano, Ikram Ud Din, Asma A Al-Huqail, “ A IoT-Based Smart Bin for Real-Time Monitoring and Management of Solid Waste”, December 2020.
[4] Anup Aravind Lakkanagavil, Amulya. H N, Apoorva. N, Bhargav, Aryan Singh, Naveen N C, “Smart Kitchen Containers as a part of Smart home appliances using IoT and Android,” Volume 4, 2019.
[5] Alam Colakovic, Samir Causevic, Amel Kosovac, Ermin Muharemovi, “A Review of Enabling Technologies and Solutions for IoT Based Smart Warehouse Monitoring System,” 2020.
[6]Omkar Mulay, Manas Bhalerao, Sayali Bhamare, Vinod Gaikwad, Dr.Kamini Nalavade, “IoT based food inventory tracking system for domestic and commercial kitchen using weight sensors, LDR, LED, Arduino Mega and Node MCU(ESP8266), Wi-Fi module with website and App, IJSDR,” Volume 4, October 2019.
[7] Akshay Pendbhaje, S. Rajesh, “IoT in home grocery management,” 2017.
[8] Professor Rajesh Kumar Kaushal, Harini. T, PavithraLency.D, Sandhya.T, Soniya.P, “IoT based smart food monitoring system,” Volume 6, 2019.
[9] Chetal. S. Patil1, Kanaksing. N. Pawar, “Smart grocery management system using internet of things”, Volume: 05 Issue: 07, Jul-2016.
[10] Satare Devika Jitendra, Salva Karan Pankaj, Khan Aman Islam, Mrs. PranaliWagh, “FreshBox – IOT based Pantry System with Store Management,” Volume 4, April 2021.

Development of Quality Assessment Device for Fruits and Vegetables

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Abstract - Quality measurement of fruits and vegetables is at the centre of attention by the food industry The export market and quality evaluation are affected by assorting of fruits and vegetables. Fruits and vegetables are very important agricultural products in daily life. Evaluating the quality attributes of fresh fruits and vegetables by non-destructive sensing techniques has been an accepted technique today. Quality is a human construct comprising many properties or characteristics. Instrumental measurements are ruling over the world as they are accurate, fast and reduces labour. Non-destructive analysis refers to the surface testing of fruits and vegetables without any intrusive technique affecting the food aspect and quality. Since non-destructive testing makes it possible to examine the condition or quality of food without damaging it, the use of non-destructive analytical techniques is quickly gaining momentum in the food industry. Quality assessment of Fruits and Vegetables becomes challenging in both small- and large-scale areas such as market hubs, cold storages and supermarkets. Dedicated care and handling procedures are required to protect fruits and vegetables from spoilage. Smart equipment works with Non-destructive analysis is required for quality assessment of such areas Automation aids in raising the quality, productivity, and economic growth of the nation's agriculture produce. Manual inspection and grading are still possible, but they are imprecise, time-consuming, unreliable, subjective, difficult, expensive, and easily influenced by the environment. This project suggests an efficient non-destructive method of vegetable quality assessment using a scanner device. This Scanner is fast, accurate, less time consuming, Compact and handy with great ease of access. This equipment can also be fixed in conveyors and programmed with sorting instrument for automatic detection and sorting of fruits and Vegetables. The machine is of 86.6% efficiency. This can be used in smart hubs, cold storage, transport vehicles and market quality inspection.

Index Terms – Convolutional Neural Network (CNN), Quality Assessment (QA), Non-Destructive Analysis (NDA), Machine Vision (MV), Image Scanning(IS)

I. INTRODUCTION

Food Safety and Quality Assurance in fresh produce should be continual procedures that include actions ranging from soil selection and preparation in agricultural operations through final food preparation and consumption. Both Food Safety and Quality Assurance (QA) should emphasize problem prevention, because if safety or quality is compromised, it is difficult or impossible to restore. Furthermore, implementing QA procedures should assist ensure that problems encountered in the past do not have the same impact on future products. Damage to fruits vegetables during transportation or storage is common and difficult to detect, resulting in losses for fruit and vegetable distributors and poorer consumer satisfaction. One of the primary goals of the fruit,vegetable business is to offer unique, inventive commodities of the greatest quality, safety, and nutritional value in order to efficiently meet expanding consumer expectations. Using cutting-edge, unconventional technologies (such as microwave drying, pulsed electric field drying, pulsed light drying, and ultrasound drying) fruits and vegetables can be processed to increase their stability while preserving their thermolabile nutrients, flavor, texture, and overall quality. Some of these techniques can also be used to value waste and by products. The employment of rapid, non-intrusive solutions for process control is critical in the fruit and vegetable industry [24].The challenge for the fruit and vegetable industry is to produce such commodities while also addressing consumer acceptance, quality, and safety. Emerging, novel processing of fruits and vegetables is increasingly being researched in order to develop items rich in bioactive components, while also paying attention to waste and by-product valorization [4].

(1). Quality Evaluation Methods Of Fruit And Vegetables

Fruit and vegetable quality can be objectively verified by testing the physical and/or chemical components associated with the trait. Texture/firmness, taste, flavor and smell, and nutritional quality can all be judged destructively, whereas others can be calculated non-destructively. Some non-destructive approaches, such as optical, vibrational, electrical, nuclear magnetic resonant, and gas analysis techniques, have commercial promise. The chemical composition, physical qualities, or a combination of these two elements determine the quality of fresh fruits and vegetables. Consumers are interested in visual appearance, texture/firmness, sensory, nutritional, and food safety attributes. Some can be estimated using destructive procedures, while others can be calculated using non-destructive approaches. [26].

During the preharvest and postharvest periods, it is estimated that more than 30% of fruit and vegetables are wasted. These losses, however, can be avoided by appropriately assessing ripeness, harvesting period, and quality features throughout the shelf life. Recent projects have focused on using non-destructive technology to analyses the quality standards of fruits and vegetables. These methods are classified into three types: vision-based, spectroscopic, and mechanical. These techniques include hyperspectral and multispectral imaging, vis/NIR and NIR spectroscopy, nuclear magnetic resonance and magnetic resonance imaging (NMR, MRI) spectroscopy, X-ray computed or microcomputed tomography, chlorophyll fluorescence, and terahertz radiation.[13]

(2). Image Scanning

Increased demands for objectivity, consistency and efficiency have necessitated the introduction of computer-based image processing techniques. Recently, computer vision employing image processing techniques has been developed rapidly, which can quantitatively characterize complex size, shape, color and texture properties of foods. Image processing systems play a more and more important role in the food quality evaluation by maintaining accuracy and consistency while eliminating the subjectivity of manual inspections. They offer flexibility in application and can be reasonable substitutes for the human visual decision-making process. Image processing analysis generally consists of the following five step which are
(1) Image acquisition operations to convert images into digital form;
(2) Pre-processing operations to obtain an improved image with the same dimensions as the original image;
(3) Image segmentation operations to partition a digital image into disjoint and non-overlapping regions;
(4) Object measurement operations to measure the characteristics of objects, such as size, shape, color and texture; and
(5) Classification operations to identify objects by classifying them into different groups.
Recent advances in signal processing technology and computational power have increased the attention towards computer vision-based techniques in diverse applications such as agriculture, food processing, biomedical, and military. Especially in agricultural and food processing, computer vision can replace most of the manual methods for screening of seed, grain and food quality.

(3). Image Scanning Trends

An increasing digitization and automation capability is paving the way for new technology, spawning a slew of initiatives, startups, technology firms, and advice services. In recent years, image processing techniques have been extensively used to assess food quality. This paper discusses recent advances in image processing techniques for food quality evaluation, such as charge coupled device cameras, ultrasound, magnetic resonance imaging, computed tomography, and electrical tomography for image acquisition; pixel and local pre-processing approaches for image pre-processing; thresholding-based, gradient-based, region-based, and classification-based methods for image segmentation; size, shape, color, and texture features for object recognition; and The promise of image processing techniques for food quality evaluation is illustrated, as well as certain challenges that need to be overcome or researched further in order to accelerate the deployment of image processing technology for food quality evaluation. In the food industry, some quality evaluation is still performed manually by trained inspectors, which is tedious, laborious, costly and inherently unreliable due to its subjective nature.

(4). Need For Image Sorting

Traditionally, manual quality checking techniques for vegetables were used, but they were inaccurate, time consuming, boring, and somewhat expensive. Manual grading and sorting of vegetables is inefficient and may result in some human mistake. Another issue is manpower demanding, and to address these issues, agricultural companies have implemented numerous automated grading and sorting systems. Sorting tonnes of quality veggies to manufacture food products made from vegetables is another issue that most agriculture and food enterprises encounter due to expense and inaccuracy. In recent years, automated machine vision-based technology has grown in potential and importance in a variety of fields, including agriculture and the food processing industry. One of the most significant processes is vegetable sorting and grading, however as previously said, this is generally done manually. An autonomous vegetable quality checking system accelerates the process, improves accuracy and efficiency, and saves time. The use of a machine vision-based system was intended to replace manual grading and sorting techniques for fruits and vegetables. The manual labor had difficulties in maintaining consistency in grading and regularity in sorting.

A computer vision-based automatic grading and sorting system is required to speed up the process while maintaining consistency, homogeneity, and accuracy. In general, gradation indices include shape, size, color, maturity, defection, and so on. Gradation techniques based on computer vision have evolved as computer image vision technology has advanced. The computer vision gradation technique is real-time, objective, and non-destructive, and it can identify multiple indices at the same time, including size, defect, color, shape, and maturity. The new generation of intelligent grading and sorting algorithms is significantly more powerful than classic visual analysis algorithms; they have automated learning capabilities, ensuring detection performance far above the speed and accuracy of any trained operator.

Automatic vegetable sorting can increase product quality, eliminate uneven manual inspection, and reduce reliance on available labor. Quality is determined by a variety of factors, including flavor (sweetness, acidity), appearance (color, size, shape, flaws, glossiness), and texture (firmness, mouthfeel). Edan stated that multi-sensor quality classification can be used in real-time sorting to improve overall categorization. The use of vision and an impact sensor to classify tomato quality was successful. To sort according to the surface defects requires an analysis as complete as possible of the entire vegetable surface.

Size, shape, and color are the most important factors to consider while sorting vegetables for quality. Size measurement is critical for measuring the surface area of produce. The form of fruits and vegetables is an essential visual quality measure. Human sorters are now used to sort fruits depending on shape. Because radish and carrot get deformed as a result of excess nitrogen, climate, and other variables, these malformed ones are sorted in image processing to improve export quality. Color is another essential quality component that has received a lot of attention. The wavelength of light reflected from an object's surface determines its hue. The wavelength of light varies greatly in biological materials. These spectral changes offer a one-of-a-kind key to machine vision and image processing. Radishes are typically red, white, or purple, whereas carrots are orange. These three basic factors can also be used to evaluate its quality.

(5) Rise Of Raw Food Vegan Diet

The raw food diet is a dietary approach that involves consuming at least 75% of the food in its raw or uncooked form. This mainly consists of raw fruits, vegetables, nuts, seeds, and sprouted grains. Supporters of the raw food diet contend that cooking can deteriorate vital enzymes and nutrients in food, and consuming raw foods can promote better health and a longer lifespan.

Consuming a salad-based diet can provide numerous health benefits that can enhance one's overall well-being. A significant advantage of this type of diet is an increased intake of nutrients. As fresh vegetables are packed with essential nutrients like vitamins, minerals, and fibre, they can promote optimal health. Furthermore, the low calorie and high fibre content of most salad ingredients make them an ideal choice for weight management. This can also help in maintaining regular bowel movements, leading to improved digestion. Studies have shown that consuming a diet that is high in fresh vegetables is associated with a lower risk of chronic diseases, including heart disease, diabetes, and specific types of cancer.

(6) Fruits And Vegetables

Fruit and vegetables should be an important part of your daily diet. Indian fruits and vegetables are now more frequently produced and exported. It ranks second in fruits and vegetable production in the world, after China. As per National Horticulture Database published by National Horticulture Board, during 2020-21, India produced 102.48 million metric tonnes of fruits and 200.45 million metric tonnes of vegetables. They are nutritious by nature and include vitamins and minerals that can support our overall wellbeing. They can aid in illness prevention as well. Fruits and vegetables are low in fat, salt and sugar. They are a fantastic source of dietary fibre, which helps keep you satisfied for longer and help you avoid overeating. A high consumption of fruit and vegetables, along with a balanced, healthy diet and an active lifestyle, can enable you to, lower your cholesterol, combat obesity, keep a healthy weight and reduction in blood pressure.

Defects in these fruits and vegetables generally appear due to insect damage, scarring, product decay, and so on. The numerous fruits and vegetable diseases affect the yield's quality, quantity, and stability. These diseases not only lower yield but also destroy the variety and force its eradication from cultivation. Fruit and vegetable illnesses manifest as spots on their surface and can result in significant losses if not addressed right once. An important factor in groundwater contamination has been linked to the overuse of pesticides to treat fruit and vegetable diseases, which raises the levels of hazardous residues on agricultural products. Pesticides are among the most expensive production costs, and using them comes with serious health hazards for both consumers and ecosystems. Therefore, it is necessary to limit their application.

Using scanner devices to identify these defects of fruits and vegetables can bring reduction in time consumption and act as an effective way to immediately identify spoilage as soon as it detoriates. As a single potential spoilage in any one of the fruit or vegetable can spoil the whole bulk quantity which affects exports and imports.



Fig 1 Fruits and Vegetable Market

(7) Radish (Raphanus Sativus L.)

Radish *(Raphanus sativus L.)* belongs to genus Raphanus, family Brassicaceae or Cruciferae originated from the Central and Western China and India [22]. It has diuretic and reviving qualities. Additionally, it is used to treat persistent diarrhea, insomnia, and neurological headache. Additionally helpful for piles and bladder issues are the roots. The seeds of radish are a possible source of non-drying fatty oil appropriate for the production of edible and lighting products as well as for the commercial extraction of protein from radish leaves.

Because of its specialized structure (hypocotyls), which can store starch and other substances, its similar resemblance to actual roots, and its home in the ground, the radish is classified as a root. The surface color of radish can vary from white in Asia to red in Europe through purple green and black [17], while its flesh is white in most European and Asian crops [12]. A plenty of indigenous recipes are radish which gives great health benefits. They are best when eaten raw, can be made sliced for salads and sandwiches or enjoyed whole and dipped into houmous for healthy snack.



Fig 2 Radish *(Raphanus sativus L.)*

They are often used in culinary world which adds a best pungent, peppery element to dishes. Mooli Subzi, Radish dry vegetable. White Radish is used in South Indian Radish Sambhar, Mooli ka Salad, Radish, Cucumber, and Curd Dip, Indian Theplas, Parathas, Mooli Thepla, Radish Nachni Roti, Mullangi Sambar, and Bhatia Kadhi. There are many different types of radish black radish, daikon radish, horse radish, water melon radish. Radishes are prepared in many different ways, they can be pickled, used in sandwiches, roasted. Nutritional profile of radishes is very diverse and offers a scope of nutrients that can has a profound effect on health.

(8) Radish Diseases



Fig 3 Radish *(Raphanus sativus L.)* in a crate

Radishes *(Raphanus sativus L.)* have a significant issue with storage decay, which makes it difficult to keep this produce fresh and increase its postharvest shelf life at both low and high temperatures. Radishes are susceptible to postharvest and storage degradation caused by a number of fungus, however Alternaria and Fusarium species are the most frequent infections when the vegetable is individually wrapped in food packaging film for storage.

The softening and loss of weight are mainly due to the loss of water and they are controlled with high relative moisture along with low temperatures Bruises are due to impacts during the mechanical harvesting and during transportation, when the produce is hand harvested the incidence of this damage is usually smaller. Furthermore, spongy appearance is an alteration that may arise during the harvesting and continues its development during post-harvesting. The most frequent physiological alterations are chilling injuries and cavities. Freezing takes place at temperatures of -0,7ºC.In extreme situations, the roots become brittle, lose moisture, and weaken. The cavities, which might appear before or after the harvesting and become more frequent during storage, are signs of senescence. Low temperatures lessen its occurrence.

(9) Carrot (Daucus carota)



Fig 4 Carrot, *(Daucus carota)*

Carrot, *(Daucus carota)* is an herbaceous, generally biennial plant of the Apiaceae family which produces an edible taproot. Among common varieties root shapes range from globular to long, with lower ends blunt to pointed. Besides the orange-colored roots, white-, yellow-, and purple-fleshed varieties are known. Carrot is a cool climate crop which is grown in subtropic as well as temperate climate zone. Carrot is mostly used as an edible produce for millions of people all over the world. Carrot is good source of calcium, potassium, mineral and natural nitrates. Carrots are also good source of carotenoids, vitamins, dietary fibers and antioxidants. Carrots are very much popular for its abundant nutrient. Quality analysis of carrot based on the product quality is most basic and important operation. In tradition method quality evaluation of carrot is done manually and its expensive and is time consuming with low performance. Carrot is mostly used in salads and halwa, sambar. Vegetable biriyani , roasted carrot, carrot curry, glazed carrot, carrot smash, carrot juice, carrot supe and carrot poriyal.

Now a days, fruits and vegetables industry has sustained due to the introduction of image processing method and such method had been successful in non-destructive assessment various food products. Grading of fruits and vegetable based on the quality of produce after harvesting. So, carrot must be used as soon as possible in order to get superior fresh characteristics. In order to improve the efficiency of grading and sorting and for automatic detection purpose.[11]

(10) Carrot Diseases

During the cultivation of carrot large variety of diseases are been detected which results in the reduction of yield and market value. Most of the carrot diseases is caused by organisms like mycoplasma, which results in stunting, yellowing, leaf bronzing, sterility and leaf like petals and aster yellow, black rot, bacterial soft rot, nematodes, common scab, black root rot, cavity spot, rubbery brown rot, heat canker. Carrots are attacked by a large number of pathogens. Due to the nature of the carrot, the damage is caused by various pathogens and microorganisms which is an important factor that limits the carrot production. To give best quality of carrot to the consumer, fruits and vegetable industry update the technologies like image processing of carrot.

II. LITERATURE SURVEY

Nowadays fruit and vegetable industry has sustained due to the introduction of image processing methods and such methods has been successful in the non-destructive assessment of various food products. Increasing concern on quality and safety of food in worldwide business. Non- invasive methods or non-destructive methods creates an esteemed value, especially in fruit and vegetable industries. Non-destructive procedures are a component of high-quality controls and they complement the majority of existing approaches. In addition, consumers have a tendency to want more information about the items they buy nowadays as a result of their enhanced awareness. [10]

The trend of microprocessors methods of signal analysis and sensors has opened up new establishments to employ techniques for this purpose. It took a lot of work to establish this strategy because there is a profitable demand and interest in finding food and agricultural products that are more uniform in quality and consumer favourites. [1]

Quality evaluation of fruits and vegetables is done by both destructive and non-destructive methods. Destructive method of analysis determines how a procedure react under pressure till it fails. It's not suitable in fruit and vegetable industry, as it ruptures the fruit and vegetable tissue and is difficult to evaluate the whole lot at a time. Destructive testing is more expensive and generate waste. This testing is less efficient because Destructive testing is direct approach and does not provide accurate result. [6]

If the testing is done by destructive method in large food manufacturing industry in order to analyses the hidden characteristics of the product, an analyst must destroy the various aspects of the product. Destructive method of analysis provides reliable result due to its manual process and material degradation procedure cost the manufacturer. Non-destructive analysis is similar to destructive analysis but it will not permanently damage any produce. This is based on physiological property which connects with certain quality factor of fruits and vegetables. Both the internal and the external attributes of fruits and vegetables are very much important and internal attributes plays an important role in influencing a consumer selection of the particular product. Non-destructive analysis is non-invasive, rapid and suitable for real time analysis so non-destructive analysis are emerging as highly efficient means of analyzing the quality of the material. [7]

(1) Quality Of Agricultural Products

In today's post-harvest and processing of agricultural products, assessing the quantity and quality of agricultural products without causing any harm and reducing food waste has a significant place. Non-destructive methods attributed quality valuation methods have increased dominant factor and considerable attempts for fresh fruit and vegetable these years.

NDM is created to focus on creating best needed systems to evaluate the agricultural product quality which has been improved the standardization which is required to classify the marks of food quality in an item, required for selling the material. The non-destructive evaluation techniques concentrate on aspects of food such structure, mechanical, physical, and chemical qualities. The application of non-invasive measurement is the great approach for food processing techniques. [19]

The main aspects of fresh inspection are color, size shape texture and number of defects. Defect or damage usually occurs in radish and carrot due to rotting, bruising, scab, fungal growth, injury disease etc. Proper care should be taken following post-harvest of these vegetables. [20]

(2) Computer Vision Techniques

Machine vision, near-infrared spectroscopy, hyperspectral imaging, electronic noses, ultrasonic measurement, and acoustic emission measures are examples of common non-destructive evaluation methods. Scientists have concluded that the main components of food are water, carbohydrates, fats, and proteins. Changes in the agricultural product's chemical structure frequently have an impact on the processing techniques. [9]

Computer vision techniques for classifying fruits and vegetables may also be used to automatically sort fruits from a set of various fruits. At supermarkets, selecting various fruits and vegetables is a common duty. To establish the price of a particular fruit or vegetable, the cashier must be able to recognize both the species (such as banana, apple, or pear) and the variety (such as Golden Delicious, Jonagold, or Fuji). Although product packaging has attempted to solve this issue, most customers still prefer to choose their own purchases, which cannot be boxed and must instead be weighed. [25]
This issue is frequently solved by assigning codes to each type of fruit and vegetable, but this technique has drawbacks, such as the need to remember a lot of codes, which might lead to price issues if not done correctly. At many supermarkets, a tiny book with images and codes is given to the cashier as assistance, although this method has the drawback that it takes time to go through the booklet. It has taken a lot of effort to automate the visual evaluation of fruits for size and color. Yet, due to the wide variances in types of flaws and the natural changes in skin color across various types of fruits, the identification of defects on fruits using photographs is rife with issues. [2]

Companies must teach staff to inspect produce as it moves along a conveyor belt in order to maintain the quality standards needed for fruit and vegetable production lines. Fruits and vegetables are divided into certain groups by these experts based on their visual qualities. However, this strategy is not competitive and occasionally inaccurate for quick and accurate quality standards. Assumedly, it follows that a smart-methods-based automated framework is essential. There have been reported on a number of techniques focused on the capture of more precise pictures. [15]

The use of a machine vision-based system was intended to replace manual grading and sorting of fruits and vegetables. The manual labor had difficulties in maintaining consistency in grading and regularity in sorting. Aside from that, the fruit processing contains numerous procedures that can be broadly described as grading, sorting, packaging, shipping, and storing. Grading is regarded as one of the most critical steps in achieving a high standard of quality.

The computer vision-based quality assessment contains four fundamental stages, to be specific, securing, division, highlight extraction and order. By utilizing computer vision framework, numerous attributes like surface, shape, variety, size and deformities can be evaluated and reviewed naturally. Hyperspectral computer vision framework joins both spectroscopic and imaging methods which give otherworldly data to every pixel of the spatial picture.

For vegetable classification and recognition, developments in deep learning and convolutional neural networks are extremely effective. The features of an image are learned through deep learning, which also extracts contextual details and global features that will reduce error. The computer vision system offers an automated, low-cost, and non-destructive method. At the moment, multispectral and hyperspectral computer vision systems are widely used to evaluate the quality of fruits and vegetables.[27]

(3) Artificial Intelligence And Imaging Techniques

The goal is to examine how artificial intelligence and imaging techniques which can be used to analyses external faults in fruits and vegetables using soft computing. Many business processes, including washing and packing, are highly automated, the world's most crucial monitoring measures are still done by hand (e.g., quality inspection and grading). In order to achieve this, we propose the introduction of an efficient classifier based on an analysis of the geometric (sizes, shapes), color, and skin texture of vegetables and fruits. The RGB image of the fruits and vegetables is perceived. The pre-processing strategy has been used to improve image quality.
The targeted fruit and vegetable portion is the focus of the segmentation process. According to the data collection, features are extracted using the Segmentation-based Fractal Texture Analysis (SFTA) method. [23]

Automation improves the nation's quality, production, and economic growth in agriculture science. The selection of fruits and vegetables has an impact on the export market and quality assessment. The most important sensory quality of fruits and vegetables is appearance, which influences their market value and the preferences and choices of consumers. Although though humans are capable of sorting and grading, their work is inconsistent, time-consuming, variable, subjective, burdensome, expensive, and easily impacted by their surroundings. Thus, a clever technique of fruit grading is required. Researchers have used computer vision in recent years to create a variety of algorithms for grading and sorting. This paper presents a detailed overview of various methods i.e. pre-processing, segmentation, feature extraction, classification which addressed fruits and vegetables quality based on color, texture, size, shape and defects.

The difficulty for picking robots to correctly identify target fruits and vegetables is greatly increased by issues with fruit images that are collected by picking robots in natural environments, such as uneven lighting, complicated backgrounds, occlusion of branches and leaves, and overlapping fruits and vegetables. In contrast, the backgrounds of most fruits and vegetables are a similar color. [28]

Fruits and vegetables with similar-colored backgrounds are more difficult to identify than those with backgrounds of different colors because their hues resemble those of their leaves and the nearby weeds. Therefore, accurate fruit and vegetable identification in backgrounds with similar colors is essential to achieving dynamic fruit and vegetable growth monitoring and intelligent picking, which has significant value and applicant The close-color background and various processing techniques in the identification process were used to summaries the distinctive qualities of fruits and vegetables.[21]

The following techniques have been outlined, including fruit and vegetable detection in the process, image capture, image pre-processing, feature extraction, and image segmentation. Several techniques have also been contrasted. The current research was finally addressed, and a solution for the various processing phases of fruit and vegetable detection in backdrops with comparable colors was suggested. To recognize fruits and vegetables with a close-color background, deep learning techniques were integrated with some classical techniques, providing references for subsequent research in other areas. Ion potential for improving plantation management. [14] Farmers and distributors sort and grade agricultural and food items using traditional quality inspection and handpicking, which is time-consuming, difficult, and inefficient. Manual sorting and grading are based on traditional visual quality inspection performed by human operators, which is time-consuming, inefficient, and inconsistent. Traditionally, harvesting is done through manual sensory observations. Color, look, texture, and odor are common quality criteria used to determine harvest maturity. Sorting and grading collected product is the first and most critical stage in the post-harvest process.

Rapid Color Grading for Fruit Quality Assessment Color mapping was done for several fruits using Direct Color Mapping process and depending on the color of the gradation process. The strawberry can be graded utilizing an automation method based on its form, size, and color. The detection of apple fruit illness was produced using means clustering segmentation.
Although the quality of fresh fruits and vegetables can be defined differently depending on consumer preference and final utility, a standardization to identify the degree of quality in commodities is required for marketing fresh and safe products. The tree is obtained from real time and simulation using MATLAB in real time utilizing digital camera under different lighting conditions with application software for intelligent segmentation and automatic yield computation of fruits and vegetables. The captured images are filtered to eliminate background noise before the fruit region is separated from its background.

Fruit and vegetable image processing has been extensively used to find defects in size, shape, and color. Image categorization can be demonstrated in the classification of vegetables and the detection of fruit diseases. An image is segmented to extract the region of interest, and the characteristics from that segmented region are then calculated and used in training and classification. Experts divided vegetables into seven groups, after which they divided them further into groups based on characteristics including color and the shape of outward flaws.

Non-destructive methods are effective than traditional conventional methods as non-destructive methods are mainly based on physical properties which correlate well with certain quality factors of fruits a Size, shape, color, gloss, firmness, texture and freedom from external defects such as visible blemishes, dullness, etc., are various external quality factors of importance. non-destructive methods are mainly based on physical properties which correlate well with certain quality factors of fruits and vegetables. It is rapid, precise, reduces the processing time, reduces cost, save energy, improve the shelf life.

Sensory characteristic of fruits and vegetables like appearance impacts their market value. Digital image processing technology helps to process images and attempt an extension for their analysis. Computer vision technology corresponds the effect of the human vision in inspecting quality of fruits and vegetables by electronically perceiving an image, interpret and recognize the characters and an information is provided for the quality grading and sorting machine.

III. MATERIALS AND METHODS

Carrots, Radish, Mangoes were the sample used for trails to deduct the Quality and calculate the spoilage of the raw material
Many trials are conducted in the selection of materials. Also, the materials should have their own properties with high strength.
The materials used for fabrication of this machine are:

- Node MCU
- ESP32CAM
- MQ-135
- OLED Display
- Thonny (Application Software)
- TP4056 battery charging circuit
- Lithium-ion battery(3.7V)
- Boost converter
- Toggle Switch

(1)Design and Fabrication

The proposed methodology involves detecting the quality of carrots and radishes using an ESP32CAM module. The module is connected to a laptop, and a Python code with a convolutional neural network (CNN) and OpenCV with contour is used to detect the affected percentage. The detected data is sent to Thing Speak cloud and displayed using a webpage.

(2) Python Code with CNN and OpenCV

The Python code will be used to process the images captured by the ESP32CAM and detect the quality of the carrots and radishes. It will use a CNN to classify the images as healthy or unhealthy, and OpenCV will be used to detect the affected percentage using contour detection.

(3)Thingspeak

Thing Speak is an Internet of Things (IoT) platform that allows you to collect, analyze, and visualize data from sensors or other devices. In this methodology, we will be using Thing Speak to store and display the detected data.

(4)Image Scanning Steps

- Image Acquisition: Capturing pictures of radish and carrot in computerized structure/digital form and stored in an advanced digital media.
- Image Pre-processing: Perform resizing of radish and Carrot images.
- Segmentation: Segmentation is utilized for partitioning and isolating an image into different parts which are desirable.
- Feature Extraction: Acquiring features like color tone, surface texture and shape
- Image Characterization: This part examines property of image features including organizing its data into categories

Thresholding is a type of image segmentation, where we change the pixels of an image to make the image easier to analyze. In thresholding, we convert an image from color or grayscale into a binary image, i.e., one that is simply black and white.

(5)Procedure For Fabrication:

- Connect the ESP32CAM module to your laptop via the USB cable.
- Install the necessary software, including the Arduino IDE, Python 3.x, OpenCV library, TensorFlow, Kera's, and Thing Speak account.
- Program the ESP32CAM module using the Arduino IDE and upload the code to the module. The code should capture images of vegetable and stream them to the laptop.
- Write a Python code with a CNN and OpenCV to process the images captured by the ESP32CAM and detect the quality of the carrots and radishes. The CNN should classify the images as healthy or unhealthy, and OpenCV should be used to detect the affected percentage using contour detection.
- Use Thing Speak to store and display the detected data. The data can be sent to Thing Speak using the Thing Speak API. The data can be displayed on a webpage using the Thing Speak channel widgets.
- Run the Python code and capture images of the carrots and radishes using the ESP32CAM module. The detected data will be sent to Thing Speak and displayed on the webpage.

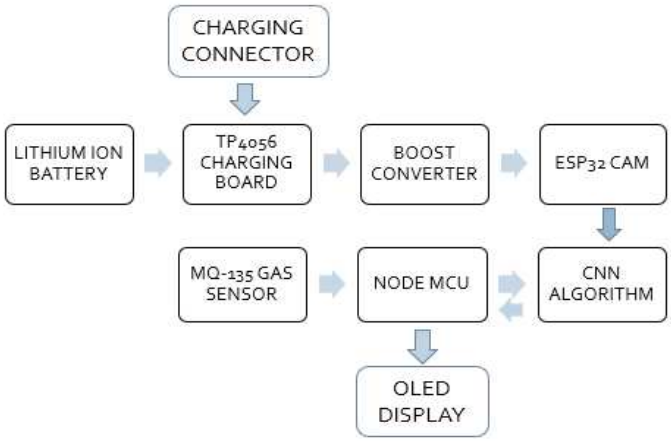


Fig 5 Block Diagram for Fabrication

IV. RESULTS

(1) Working of Quality Scanner

- The lithium-ion battery is used to drive the device and the battery is connect to ESP32 Cam which is a microcontroller used to assess the program.
- ESP 32 Cam is linked to NODE MCU device is programmed with phyton code in assistant of Thonny software and OpenCV library is used.
- For the voice assistance, we use Thing Speak.api which gives command for the result and observation through voice
- When the device is turned on using toggle switch and esp32 cam is connected with Thonny application software using WIFI module.
- Once the device is connected with Thonny application , we should position the camera towards the sample and camera captures the image of the sample by pressing the key "q". Further, the image is get processed by comparing with OpenCV library and the results can be processed.
- And the results will be depicted in app(html). This results can be acquired in PC and mobile applicationss

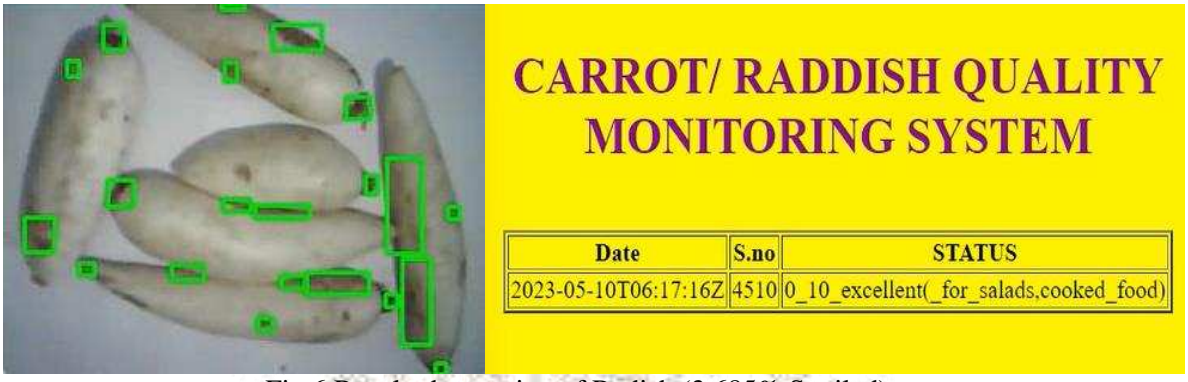


Fig 6 Result observation of Radish (3.685% Spoiled)



Fig 7 Result observation for Mangoes (30.1652% Spoiled)

(2) Determination Of Quality Scanner Efficiency

The efficiency of the Quality Scanner refers to the number of successfully examined vegetables per total number of vegetable present. The efficiency of the detector was calculated based upon the formula given in Equation

$$\text{Efficiency}(\eta) = \frac{number\ of\ successfully\ identified\ vegetable}{total\ number\ of\ vegetable\ present} \times 100 \qquad \text{(Equation 1)}$$

Efficiency(η) =(26)/30x100

Efficiency(η)= **86.66%**

(3) Determination Of Precision Of Result

Determination of Precision is done for checking the error percentage of the quality scanner which is done by placing the sample in the tray and positioning the camera in particular height and set of trails and the highest value of difference is taken for error determination were taken and consistency is determined

S.no	Sample	Distance (cm)	Trail	Percentage of spoilage	Difference
1	Radish	30 cm	1	6.9535	-
2			2	6.5195	+0.434
3			3	7.3935	-0.874
4			4	7.6535	-0.26
5			5	7.675	-0.0215

Table 1 Determination of Precision of Result

Hence from the analysis of difference given in the above-mentioned table the Accuracy is depicted it is concluded to be ±0.874 or ±0.9.

(4) Determination Of Correct Height Range for Detection (Cm)

Determination of Correct Range for detection refers to the Height between the ground (where the materials were placed for detection) to the Camera Lens which gives correct spoilage value. The samples were placed in trays and the camera is positioned in different Heights and the testing trails where taken, The Height which gives nearest correct Percentage without deviation (%) is taken

S.No	Sample	Height (cm)	Trials	Percentage of Spoilage	Difference
1	Carrot	15 cm	1	3.09	0.43
			2	3.523	
2		30 cm	1	4.3395	0.11
			2	4.448	
3		45 cm	1	4.635	0.12
			2	4.513	
4		60 cm	1	3.512	0.34
			2	3.854	
5		75 cm	1	2.364	0.56
			2	2.925	

Table 2 Determination of Correct height range for Detection

At the Positioned height from which the difference between trails is least, is observed to be the correct height for Detection. As the least distance was observed at 30 cm and 45 cm for detection of spoilage where the difference value is found to be 0.11 at 30cm and 0.12 at 45cm. Thus, it is recommended to have a distance range at these positions.

(5) Determination Of Infected Vegetable (%) (Theoretical)

Determination of infected vegetable (%) refers to the number of infected-vegetable successfully identified by the scanner after sensing. The bad ones are identified by the scanner. (Theoretical) The percentage of infected vegetables is calculated based upon the formula given in Equation

$$\text{Infected Vegetable (\%)} = \frac{number\ of\ successfully\ Identified\ infected\ Vegetable}{total\ number\ of\ vegetable\ present} \text{ x100} \qquad \text{(Equation 2)}$$

$$\text{Infected Vegetable (\%)} = \frac{5}{16} \text{ x100} \qquad \text{Infected Vegetable (\%)} = \mathbf{31.25\%}$$

(6) Determination Of Good Vegetable (%) (Theoretical)

Determination of good vegetable (%) refers to the number of good vegetables successfully identified by the detector after sensing via ESP32cam. The percentage good vegetables are calculated based upon the formula given in Equation

Good Vegetable (%) = 100 – Percentage of Infected Vegetables (Equation 3)

Good Vegetable (%) = **68.75%**

(7) Comparitive Analysis of Quality Scanner with Other Image Processing Techniques

We have compared the performance of different approaches for addressing vegetable classification and spoilage detection [8] used dataset with 2 – Normal and anthracnose- affected fruit types Pre-Processing with K-means Features with Texture features and the color space training was done with RGB BPNN classifier with a Accuracy of 84.65% and [18] used dataset 15 with cropping and with various co-occurrence features such as contrast ,energy, local homogeneity, cluster shade and cluster prominence is done with HSV and the training was done with minimum distance classifier with an accuracy of 86%. An average classification error of 1% and 3% was reported for fruit and vegetable classification and fruit disease classification, respectively. In Apple, Orange, Tomato the color and texture features was extracted using Gray-level Co-occurrence Matrix and support Vector Machine and their accuracy was about 84%. The review made by [5] analyzes the use of computer vision and image processing techniques in the agri-food industry. They define that the most relevant quality properties of agricultural products are color, size, texture, shape, and defects. Hence, the authors present an overview of different methods for preprocessing, segmentation, feature extraction, and classification using these features. They study

several approaches for classification in food quality evaluation, including KNN, SVM, ANN, and CNN. According to them, DL-based approaches such as convolutional neural networks are very efficient for fruit classification and recognition, reducing the error remarkably in classification. [16] applied CNNs with data expansion techniques to select a total of 5822 color images in ten-class food items from the ImageNet comparing its method against bag-of-feature (BoF)and support vector machine (SVM) models. BoF with SVM showed accuracy results of 56% while the CNN model performed an accuracy of 74% and 90% without and with data augmentation techniques, respectively. [3] developed a machine vision system for sorting apples according to surface defects, including bruises. Their system could detect surface defects using a combination of a routine based on artificial neural networks and principal components, and three different threshold segmentation routines. When they evaluated using eight apple varieties, the routines were able to detect 77%–91% of the individual defects and were able to measure 78%–92.7% of the total defective area. Comparing with these methods this project working with CNN method has an efficiency of 86.6% at single threshold level. But if the threshold is adjusted the efficiency ranges from 84-90% with least error rate of ±0.9%.

V. CONCLUSIONS

Assessing the quality of fruit and vegetables is crucial to ensure that consumer receive fresh, nutritious and safe produce. Quality Assessment of fruits and vegetables is essential for maintaining consumer satisfaction, promoting health and ensuring food safety. The analysis of fruits and vegetables for several aspect criterions is a continual task; machine vision systems are best befitted for conventional analysis and quality assurance. So, the purpose of the project is to design and develop a low-cost efficient, non-destructive scanner for Quality Detection of vegetables mainly to prevent the post-harvest losses. In order to alter manual inspection of vegetables, computer vision is used efficiently which provide authentic characteristics approach, equitable and non invasive rating. Identification, quality and testing the analysis of infected vegetables is determined using quality scanner. Monitoring using this quality scanner is easy as it has both devices (OLED and Computer display). Therefore, this enables in achieving real-time data through cloud and reducing time and increase efficiency. This detector does not require any high skilled technicians or gadgets. The device is compact, user friendly, portable and quiet cheap when compared to other devices. As a result it can be used in Smart Hubs, Cold Storage, Transport Vehicle and Market Quality Inspection. This device is more feasible to operate and can also be applied in Industrial Conveyors and Sorters. On the test and trial in super market and grocery shop, the percentage of spoiled vegetables is found to be 31.25% and we observed that the quality detector was more efficient due to high accuracy. The speed and accuracy of the system expedite production and improve both safety and quality control. The efficiency of the device is 86.6%, but manual examining takes about 3-4hrs for the same because of strain and discomfort faced by the laborers.

VI. REFERENCES

[1] Aboonajmi, M and Faridi, H. 2016. Non-destructive quality assessment of Agro-food products, Proceedings of the 3rd Iranian International NDT Conference Feb 21-22, Olympic Hotel, Tehran, Iran.

[2] Anuja Bhargava , 2021 Fruits and vegetables quality evaluation using computer vision: A review, Journal of King Saud University - Computer and Information Sciences, ISSN: 1319-1578, Vol: 33, Issue: 3, Page: 243-257

[3] B. S. Bennedsen and D. L. Peterson, Performance of a system for apple surface defect identification in near-infrared images, Biosyst. Eng.90 (2005), 419–431.

[4] Barba, Francisco & Parniakov, Oleksii & Pereira, Sofia & Wiktor, Artur & Grimi, Nabil & Boussetta, Nadia & Saraiva, Jorge & Raso, Javier & Martin-Belloso, Olga & Witrowa-Rajchert, Dorota & Lebovka, Nikolai & Vorobiev, Eugene. (2015). Current applications and new opportunities for the use of pulsed electric fields in food science and industry. Food Research International. 77. 10.1016/j.foodres.2015.09.015.

[5] Bhargava, A.; Bansal, A. Fruits and vegetables quality evaluation using computer vision: A review. J. King Saud Unive. Comput. Inf. Sci. 2018, in press. Available online: https://doi.org/10.1016/j.jksuci.2018.06.002

[6] Brown, Matthew & Wright, D. & M'Saoubi, R. & McGourly, J. & Wallis, M. & Mantle, A. & Crawforth, Dr & Ghadbeigi, Hassan. (2018). Destructive and non-destructive testing methods for characterization and detection of machining induced white layer: A review paper. CIRP Journal of Manufacturing Science and Technology. 23. 10.1016/j.cirpj.2018.10.001.

[7] Chauhan, Om & Lakshmi, S. & Pandey, Arun & Ravi, N. & Gopalan, Natarajan & Sharma, Rakesh. (2017). Non-destructive Quality Monitoring of Fresh Fruits and Vegetables. Defence Life Science Journal. 2. 103. 10.14429/dlsj.2.11379

[8] D. Pujari, R. Yakkundimath and A. S. Byadgi, Grading and classification of anthracnose fungal disease of fruits based on statistical texture features, Int. J. Advanced Sci. Tech.52 (2013), 121–132.

[9] Damez, J.-L.; Clerjon, S. Quantifying and predicting meat and meat products quality attributes using electromagnetic waves: An overview. Meat Sci. 2013, 95, 879–896

[10] Elmesiry, Hany & Mao, Hanping & Abomohra, Abdelfatah. (2019). Applications of Non-destructive Technologies for Agricultural and Food Products Quality Inspection. Sensors. 19. 846. 10.3390/s19040846.

[11] Feng, Que & Hou, Xi-Lin & Wang, Guang-Long & Xu, Zhi-Sheng & Guo-Fei, Tan & Li, Tong & Wang, Ya-Hui & Khadr, Ahmed & Xiong, Ai-Sheng. (2019). Advances in research on the carrot, an important root vegetable in the Apiaceae family. Horticulture Research. 6. 69. 10.1038/s41438-019-0150-6.

[12] Hadley, P., & Fordham, R. (2003). Vegetables of temperate climate | Swede, turnip, and radish. In B. Caballero (Ed.), Encyclopedia of food sciences and nutrition (2nd ed., pp. 5946–5948). Academic Press

[13] Hulya Cakmak, 10 - Assessment of fresh fruit and vegetable quality with non-destructive methods, Editor(s): Charis M. Galanakis, Food Quality and Shelf Life, Academic Press, 2019, Pages 303-331, ISBN 9780128171905,

[14] Khoshroo, Alireza & Arefi, Arman & Khodaei, Jalal. (2014). Detection of Red Tomato on Plants using Image Processing Techniques. Agricultural Communications. 2. 9-15.

[15] Londhe, D. & Nalawade, Sachin & Pawar, G. & Atkari, V. & Wandkar, Sachin. (2013). Grader: A review of different methods of grading for fruits and vegetables. Agricultural Engineering International: CIGR Journal. 15. 217-230.

[16] Lu, Yuzhen. "Food image recognition by using convolutional neural networks (cnns)." arXiv preprint arXiv:1612.00983 (2016).

[17] Nishio, T. (2017). Economic and academic importance of radish. In H. K. Takeshi Nishio (Ed.), The radish genome (pp. 1–10). Springer.

[18] S. Arivazhagan, R. N. Shebiah, S. S. Nidhyanandhan and L. Ganesan, Fruit recognition using color and texture features, J. Emerg. Trends Comput. Inform. Sci.1 (2010), 90–94.
[19] Saldaña, E.; Siche, R.; Luján, M.; Quevedo, R. Review: Computer vision applied to the inspection and quality control of fruits and vegetables. Braz. J. Food Technol. 2013, 16, 254–272.
[20] Siddhika Arunachalam, Harsh H. Kshatriya, Mamta Meena.: Identification of Defects in Fruits Using Digital Image Processing. International Journal of Computer Sciences and Engineering 6(10), 637-640 (2018)
[21] Soltani Firouz, Mahmoud & Sardari, Hamed. (2022). Defect Detection in Fruit and Vegetables by Using Machine Vision Systems and Image Processing. Food Engineering Reviews. 14. 10.1007/s12393-022-09307-1.
[22] Thamburaj, S. and Singh N. 2005. Vegetables, Tuber Crops and Spices. New Delhi: Indian council of Agriculture Research. pp 40.
[23] Tippannavar, Sandhya & Soma, Shridevi. (2017). A Machine Learning System For Recognition Of Vegetable Plant And Classification Of Abnormality Using Leaf Texture Analysis. International Journal of Scientific & Engineering Research. 8. 1558-1563. 10.14299/ijser.2017.06.008.
[24] Tylewicz, Urszula & Tappi, Silvia & Nowacka, Małgorzata & Wiktor, Artur. (2019). Safety, Quality, and Processing of Fruits and Vegetables. Foods. 8. 569. 10.3390/foods8110569.
[25] V G, Narendra & Pinto, Ancilla. (2021). Defects Detection in Fruits and Vegetables Using Image Processing and Soft Computing Techniques. 10.1007/978-981-15-8603-3_29.
[26] Watada, A.E. (1995). METHODS FOR DETERMINING QUALITY OF FRUITS AND VEGETABLES. Acta Hortic. 379, 559-568 DOI: 10.17660/ActaHortic.1995.379.70
[27] Zhenbo Li, Fei Li , Ling Zhu, Jun Yue, International Journal of Computational Intelligence Systems Vol. 13(1), 2020, pp. 5 Vegetable Recognition and Classification Based on Improved VGG Deep Learning Network Model.
[28] Zhou, Hongyu & Wang, Xing & Au, Wesley & Kang, Hanwen & Chen, Chao. (2022). Intelligent robots for fruit harvesting: recent developments and future challenges. Precision Agriculture. 23. 1-52. 10.1007/s11119-022-09913-3

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A Review on Non-Invasive Quality Evaluation of Eggs using Sensor

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ABSTRACT: The concern for food quality and safety is shared by all sectors of the food industry, government regulatory agencies, and consumers. Eggs play an important part of our daily diet. New technologies and new methods of egg processing are followed in the egg industry to improve nutrition, safety, shelf life, and taste of egg products. One of the biggest challenges for the poultry industry is providing consistent-quality egg products to the consumer. The quality detection of eggs by using sensors helps to assure the safety and quality of the eggs. The paper discusses the factors influencing the quality of eggs. A relatively short period of time may pass before eggs become unusable if they are not handled and stored properly. One of the earliest signs of deterioration is the expansion of the air cell as a result of water evaporating from the white through the pores of the shell. The ageing impact of eggs can be measured using either destructive or non-destructive methods. The aim of this work is to develop a real-time model to check the quality of eggs by using the sensors. The quality of the egg can be sensed by using the Pressure sensor, a Pic Microcontroller embedded with an analog to digital converter that analyses the weight of the egg, and the result will be displayed on both LCD and LED.

Keywords: Egg, Nutrition, Quality parameter, Non-invasive, Sensors, Shelf-life, Quality detection.

INTRODUCTION

Quality is becoming increasingly important at all stages, including packaging, Preservation, and processing. Microbiological quality is crucial and must be strictly controlled. The storage time, the possibility of contamination and their ability to influence nutrition, and the overall sensory quality of the products all play an important role in the quality control of individual raw materials (Ledvinka, 2016).

The food industry has both a legal and moral obligation to provide consumers with foods that meet all conventional quality and safety requirements. Customers who purchase raw materials, ingredients, and food contact packaging materials for the production of consumer foods must ensure that these materials are safe and suitable for use throughout the food supply chain (Alli, 2003).

Prior to processing, each egg quality parameter must be checked. Eggs can quickly reach a point where they are no longer edible if they are not handled and kept in good conditions. Evaporation of water from the white through the shell's pores and subsequent expansion of the air cell are early signs of deterioration. The yolk's flattening and the white's thinning is two additional measurable signs. Specific criteria based on morphological, chemical, physical, organoleptic (sensual), and microbiological factors determine the quality of eggs. An egg is a biological substance with numerous closely related structures. A nutritional complex made up of egg proteins, fats, sugar, vitamins, and minerals helps the chicken grow and develop. The value of eggs is primarily influenced by parameters such as the hen's weight, genetic influences, age, laying cycle stage, and other factors, which are internal and external in nature. Egg weight is measured in grams, which can vary significantly. When comparing hens laying eggs with white or brown shells, which are related to the hens' genetic origins, the influence of the genotype on the egg weight is more evident (Juliet, 2004).

In 2020, more than 86.67 million metric tonnes of eggs will be produced globally, up from 74.14 million metric tonnes in 2016. The volume of eggs produced globally has increased by more than 100% since 1990.

Since global egg production is likely to continue growing at a rate of more than 2% per year, output in 2015 could reach 71.5 million tons, with Asia contributing more than 42 million tons, or roughly 59%. It is important to note that the figures provided by the Food and Agriculture Organisation (FAO) include estimates of backyard output, hatching egg production, and commercial production (Terry and Linden 2014). Weight and regularity of shape are the two most important parameters in industries that process eggs because they determine the rate of loss during

automated processing. The proportion of the egg's longer to shorter axis determines the shape. In practise, the weight ratio of the egg yolk and albumen to the total egg weight is a significant indicator of internal egg quality. It is expressed by an egg-shape index. Haugh units, which measure the amount of albumen and egg weight, are the primary measurement of albumen quality (Ledvinka, 2016).

Quality of Egg: The egg white (albumen), albumen's relative viscosity, the shape and firmness of the yolk, its strength, and the size of the air cell are all examples of the egg's internal quality. Fresh egg yolk is round and hard. The quality of the egg yolk decreases as it absorbs water and grows in size as it ages. Thin albumin surrounding the yolk absorbs water, whereas thick albumin becomes transparent and watery as CO_2 escapes through the egg shell. The egg grades determined by both internal and external factors by the US Department of Agriculture (USDA) are depicted in Fig. 1. The majority of eggs are vulnerable to both internal and external damage by pathogenic microorganisms. Despite the fact that the majority of eggs were discovered to be sterile when they were laid, it is always possible for them to become contaminated with bacteria and fungi, which increases the chance of food-borne disease and product deterioration. The amount of nutrients available, the temperature, how the egg is stored, and how it is handled all have an impact on how quickly eggs deteriorate (Bhaskar and Sudheer 2017). Since the cuticle hardens right after the ovi-position, the pores on the egg's surface could be entry points for bacteria; these are insignificant in comparison to the potential structural flaws. A structural flaw makes it much more likely that bacteria will enter the contents of the egg. Black, red, and green rot are typically the outcomes of bacterial and fungal contamination of eggs. When it comes out of its shell, the egg looks and smells bad. Good management practises, such as regularly replacing nesting materials or maintaining cages in an appropriate manner, can prevent the contamination and deterioration of eggs caused by bacterial and fungal contaminants. After collection, eggs should be handled and stored correctly to reduce the likelihood of bacterial or fungal contamination. However, the likelihood of bacterial or fungal contamination will rise as a result of improper washing practises, high storage temperatures, and humidity. The feed source should be carefully considered because *Salmonella spp.* can be distributed via the feed (Beyer, 2005).



1. Grade AA- Indicates the good quality of egg; 2. Grade A- Slightly less quality than grade AA; 3. Grade B- Indicates that quality of egg is low.

Fig. 1. Grading system of Eggs (US Department of Agriculture Washington, DC (2000))

The external egg quality indicators are: egg weight, shell thickness, shell weight, maximum length, maximum width, and Shape index. Haugh unit, Albumen index, Yolk index, Yolk weight, Yolk diameter, Yolk height, Diameter of albumen, and Height of albumen are the internal egg quality criteria measured (Muhammad *et al.,* 2020).

Egg weight, shell quality (strength, colour, and cleanliness), and internal Quality (freshness indicators) are some of the physicochemical properties that need to be taken into consideration when grading eggs. The egg's quality and freshness are mostly affected by the temperature at which it is stored and the conditions in which it is kept. Egg grading equipment currently grades eggs at a rate of up to 180.000 eggs per hour, making it impossible for a trained human eye to control each egg individually. As a result, in order to estimate one or more quality aspects of the graded eggs, the egg grading equipment is outfitted with specially developed sensor devices. The need for rapid and non-destructive installation devices is obvious. Infected eggs must never come into contact with uninfected eggs in order to prevent infection. These new gadgets were developed in comparison to conventional quality inspection, which is often harmful and time-consuming (Bamelis *et al*., 2003).

Fresh eggs can be easily stored for three to five weeks, depending on the conditions, in these devices. The rebound from a small impact on the egg shell is used to measure the local integrity of the egg shell. If the storage room's environment is not adequate, prolonged storage can affect the internal egg quality (Ali *et al.,* 2019).

The Haugh Units (HU) will decrease by 70 HU after one week at 25°C, reaching the acceptable level of freshness; however, after one week at 8°C, the eggs will still be very fresh (85 to 90 HU). As a result, an ideal cooling method for egg storage and transportation should be established. This is uncommon in Europe, where storage rooms are frequently maintained at 18°C throughout the year. During the hot summer months, small farms without a fully controlled storage room may struggle to maintain good egg quality.

Quality detection methods for eggs: The physical qualities of the shell, such as its strength and integrity, have been evaluated using a variety of mechanical methods. When evaluating the development of quick

and non-invasive techniques, these methods are frequently used as a reference. A device for detecting hair cracks in commercial egg grading machines is based on a mechanical technique for the non-invasive evaluation of egg shell strength and integrity (Bamelis *et al.,* 2003).

1. Near Infra-Red (NIR): While the Near Infra-Red (NIR) range has wavelengths between 700 and 2500 nm, the Visible Infrared (VIS) range has wavelengths between 300 and 750 nm. Generally speaking, light is composed of a variety of electromagnetic waves of various wavelengths. Due to chemical and physical interactions, its spectrum changes as it passes through materials. After comparing the altered spectrum to the original spectrum, features of the material's chemical and physical qualities can be connected to the optical information of the object through which the light travelled. Several investigations have conclusively related this optical data to the calibre of eggs ingested. A benefit of optical measurements is that they are rapid and non-destructive. Furthermore, it is possible to create without coming into contact with the egg, removing the chance of cross contamination. White-shelled eggs have a large internal variation in their optical transmission spectra under visible light (Bamelis *et al.,* 2003).

2. Computer Vision Techniques: Computer vision techniques are utilised in two primary applications for egg grading.

a) A computer vision system for identifying open and hairy cracks in eggs is being developed. A two-dimensional Fast Fourier Transformation was used in place of neural network analysis to extract relevant information from the images, but their detection rate was only 88%.

b) Computer vision was also used to find blood spots. 92.8% of the blood spots in eggs could be identified using a neural network detection method and colour image analysis (Bamelis *et al.,* 2003).

3. Candling method: The candling area is where defective eggs are removed from the eggs. Candling is a method that lets you see the inside and outside of eggs without breaking them. When eggs were held up to a candle while being rapidly rotated, their contents could be seen, and candling was once used to check incoming eggs for freshness by viewing their internal contents under candlelight (Vickie *et al.,* 2008).

Eggs that are dirty, cracked, or have blood stains are electronically marked during candling using a wand-like pointer. Today, trays of commercial eggs can be illuminated by powerful lights and mass scanned. Thanks to recent technological advancements, these eggs can be retrieved automatically and with minimal human involvement. Modern egg washers come equipped with automatic loading, washing, drying, oiling, candling, weighing, and packaging. Eggs are carried to the proper packing line after being candled, weighed, and separated into weight classes (Jianping, 2014).

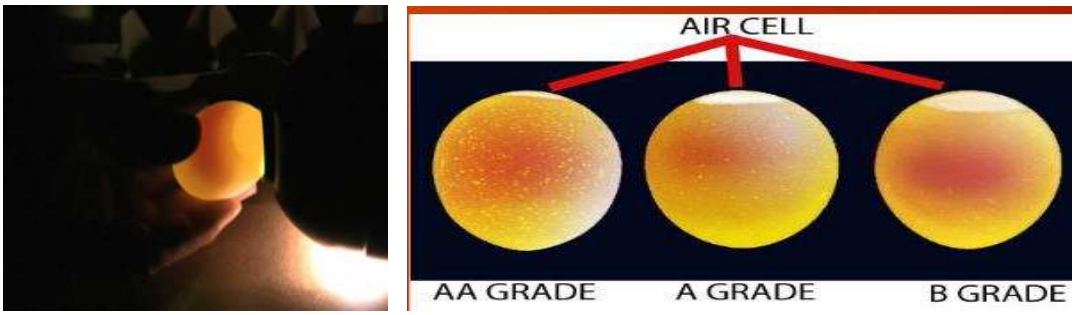


Fig. 2. Grading of Eggs by candling method.

4. Electronic Nose (EN) The state of freshness of eggs has been evaluated using a system based on the Electronic Nose (EN) that makes use of a collection of four low-cost commercial tin-oxide odour sensors. Over a period of 20 to 40 days, measurements were taken from the headspace of four egg sets. The sensor system consists of a sensor chamber that houses four identical tin-oxide odour sensors. The sensors were selected based on their sensitivity to various gases; the selected sensors are made to respond to gases like ammonia, hydrogen sulphide, alcohol, toluene, xylene, and cooking vapours, among others. When reducing or oxidising gases are present, the sensors' electrical conductance varies. As the Electronic Nose systems appear to have a lot of potential for non-invasive determining egg freshness for a number of reasons, it was discovered that the sensor conductance generally increased. The inexpensive, non-specific solid-state sensors that are sensitive to the gases released by eggs serve as the foundation for the EN systems. Additionally, an EN that has been "trained" can potentially produce results in as little as a few tens of seconds and does not require a skilled operator. A pattern recognition engine in the EN system makes it possible for the system to carry out intricate aroma analysis on the sensor signals (Dutta and Hines 2005).

The quality of the egg will be analyzed without breaking it, so this method will be termed a non-destructive method. The eggs can be spoiled in different ways due to improper storage conditions. The egg shell has void space, and through that space, air will be moved into the egg during storage, so that air will be turned into hydrogen sulphide gas, which will give a rotten smell to the egg when it is broken. The fresh egg will weigh approximately 60 to 70g; when it is spoiled, the weight will be reduced due to the presence of gas inside the egg. The quality of the eggs will be determined using the pressure sensor. The pressure sensor will be placed at the bottom of the egg trays. The pressure sensor will be connected to the PIC

microcontroller, which is embedded with Analog to Digital Converter (ADC). This is to analyse the weight of the eggs placed on the tray. The AD converter will help convert the analog values into digital values. The LCD and LED help to display the result of the egg quality, where the LCD will display the weight of the eggs and also the quality of the egg, whether it is good or bad. Green and red LED is also represent the quality of the egg. The Green light indicates that the quality of the egg is good, and the red light indicates that the egg is unfit for consumption.

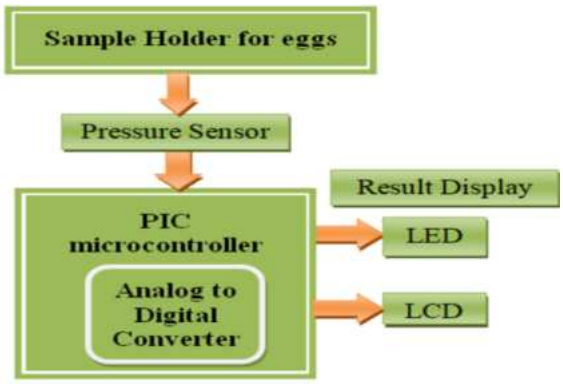


Fig. 3. Processing Flow Chart for Quality Determination of Eggs using Pressure sensor.

CONCLUSION

The producer's or vendor's intention should mainly depend on the egg reaching the consumer with as much of its original quality as possible. The quality of the egg cannot be improved after it is laid. The quality will be lowered very quickly by many factors of management and by being exposed to high temperatures and low humidity. The quality detector for eggs will be compact in size and weight, so it can be carried anywhere and in any place. Pressure sensors, which help to analyse the weight of the eggs based on the weight of the eggs, the weight of the eggs will be sensed by the sensor. In the end, the system accurately and simply informs customers about the condition of the egg. Low-cost components can be effectively used to construct the design. The design of the kit is low-cost, feasible, compact, and cost-effective. The display system clearly shows the egg freshness level, giving customers a clear understanding of its construction, which makes it accessible to all socioeconomic groups. The design is simple, effective, compact, and cost-effective.

FUTURE SCOPE

The present study is about the development of a real time model for quality checking eggs, which provides a direct and convenient means to monitor the quality of eggs and also addresses food safety. A future study on the development of quality detection of eggs with multiple sensors for large-scale industries in a continuous manner

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REFERENCE

Ali, R., Ibrahim, Abdelbasit B. Habib and Salim Gibril (2019). Evaluation of Egg Quality Conditions in Omdurman Locality. *Journal of Applied Veterinary Sciences*, *4*(2), 1-5.

Alli, Inteaz (2003). Overview of food quality and food safety. *Food quality assurance: principles and practices*, CRC press Chapter 2, 27-39.

Bamelis, F., De Ketelaere, Bart, Kemps, B., Mertens, K., Decuypere, Eddy., De Baerdemaeker, and Josse. (2006). Non-invasive methods for egg quality evaluation. *Research gate*, 1-7.

Beyer, R. Scott (2005). Factors Affecting Egg Quality. *Kansas State University Agricultural Experiment Station and Cooperative Extension Service, EP 127,* 1-4.

Bhaskar, K. and Sudheer, K. (2017). Levels of hygiene and microbial quality indicators among the eggs collected from different sources in gannavaram, Andhra Pradesh. *The Pharma Innovation Journal, 6*(12), 446-450.

Dutta, R., Hines, E. L., gardner, J. W., Udrea, D. D. and Boilot, P. (2003). Non-destructive egg freshness determination: an electronic nose based approach. *Measurement Science and Technology, 14*, 190–198.

Jianping, Wu (2014). Eggs and Egg Products Processing. *Food Processing: Principles and Applications, Second Edition*. Published by John Wiley & Sons, Ltd., *2*, 443-446.

Juliet, R. Roberts, (2004). Factors affecting egg internal quality and egg shell quality in laying hens. *Journal of Poultry Science*, *41*, 161-177.

Ledvinka, Z. (2016). Egg shell quality in some white egged and brown-egged cross combinations of dominant hens. *Journal of animal science, 45*(6), 285-288.

Muhammad HashSim Khan, Tayyaba Shan, Fozia, Najeeb Ullah Mandokhail, Saghir Imdad Hassan, Yasir Ihtesham, Irum Binyamin, Waqas Ahmad and Saira Naz. (2020), Effect of different Storage time on External and Internal Characteristics of Eggs of Hen (*Gallus domesticus*). *International Journal on Emerging Technologies, 11*(5), 642-646.

Terry, Evans and Jackie, Linden (2014). Account for 20 Per Cent of Global Egg Output. Global Poultry Trends The poultry site, 1-7.

Vickie A., Vaclavik, Elizabeth W., Christian & Elizabeth Yasir Ihtesham, Irum Binyamin, Waqas Ahmad and Saira Naz W. Christian (2008). *Essentials of Food science, 3*, 210-213.

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Automation In Coconut Water Extraction and Breaking Machine – A Review

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Abstract—

Mature Coconut water is rich in carbohydrates and electrolytes such as potassium, sodium, and magnesium, but lot of coconut processing industries are wasting tons of coconut water because they did not have proper way of water collection system. And also, lots of copra industries are using manpower to break the coconut it is unhygienic and time-consuming process. To overcome such problems facing in copra industries we developing a coconut cutting cum water collection machine with cooling system. The main aim of this machine is to minimize the coconut water wastage , hygienic way of water collection, and cooling system maintains the coconut water in certain temperature to avoid fermentation. By collecting coconut water, we can produce lots of byproducts like ready to drink coconut water, coconut water vinegar etc... Which is completely natural product containing lot of micro and macro nutrients.

Keywords— *Mature Coconut Water, Coconut Water, Existing Machines, Coconut Water Collector, Cooling System, Waste Utilization.*

1. INTRODUCTION

Cocos nucifera (L.) is a critical family member Aceraceae (palm family) popularly referred as coconut. The plant is originally from Southeast Asia (Malaysia, Indonesia and the Philippines) and the island between the Indian and Pacific Oceans. The coconut are the fruits of the cocos tree, which is part

of family of palm trees. The term “coconut” may refer to the entire coconut palm, its seed or its fruit, which is botanically a drupe rather than a nut.

The aqueous portion of coconut endocarp is known as coconut water (CW). Coconut water is used as a tropical beverage, an environment for growth for microbes, a medication and a ceremonial gift. About 25% of the overall weight of the nut is made up of coconut water. Its contents are translucent and colorless, with a flavor that is pleasantly sweet and tart. In its natural state, the liquid endosperm is sterile and housed in a hermetic container.

There are two primary types of coconut water: Mature Coconut Water (MCW) and Tender Coconut Water (TCW), each having unique flavors, appearance and nutritional profile. TCW is the liquid that can be found inside a young, green coconut. It has a translucent appearance, taste sweeter and is transparent. Mature Coconut water, on the other hand, is the liquid that may be found inside a fully matured, brown coconut. It has moderately nutty flavor and hazy, opaque appearance.

It is naturally isotonic beverage made primarily of components that are similar to those present in blood plasma and is considered nutritional and healthful when derived from palm trees. Coconut water is packed with nutrients, vitamins, minerals, ammino acids, antioxidant, growth hormones and enzyme.

Coconut water is seen as a natural functional drink because of its distinct qualities. It’s a great refreshing and rehydrating beverage to have after physical activity because of its sugar content and mineral composition.

Total phenolic and sugar content is greater in TCW compared to MCW. serine, cysteine, arginine, and alanine are among the ammino acids that are more abundant in TCW. Rich in arginine, coconut water supports the body’s stress-response mechanisms.

Most of the soluble solids in coconut water are composed of sugars. Sucrose, Fructose, glucose and sorbitol are main sugars in MCW. The smaller sugar galactose, mannose and xylose come next. The predominant sugars present in coconut water are glucose, fructose and sucrose which also comprise the majority of the soluble solids.

Mature coconut water has historically been seen as waste products, particularly in plants that process coconuts (such as the ones that produce coconut milk and desiccated coconuts).

A desiccated coconut plant that breaks down roughly 300,000 coconuts a day produces 50 m^3 of effluent per day, consisting of 44m^3 of wash water and about 5.3 m^3 of pure coconut water. The biological oxygen demand (BOD) of wash water and pure coconut water combined is approximately 3000 and 29000 mgL^{-1} respectively. As a result, the factory’s overall liquid waste contains 5800 mgL^{-1} of BOD, which needs to be lowered to the recommended amount of 50 mgL^{-1} .

Due to technological issues in gathering coconut water and separating the oil from the coconut water, the initial attempts to use the liquid waste by food industry were unsuccessful. Therefore, we are building a machine that will mechanically breaking the coconut and collect the water by filtering through the filters.

2. REVIEW OF LITERATURE

A. . Nutritional Characteristics of Coconut water

Coconut water is a nutritious clear liquid inside coconut fruit, which is rich in vitamins and minerals. The soft coconut water, technically liquid endosperm is the most nutritious health drink than nature provided the inhabitants of the tropics with fighting strains heat with a calorific value of 17.4 per 100$gm^{3.}$

Coconut water contains plant hormones namely auxins, cytokinin’s, gibberellins and abscises acid (ABA), which act as plant growth regulators addition, it is rich in minerals such as potassium, calcium, magnesium, iron, sodium, phosphorus, zinc, manganese, copper, Sulphur, aluminum, boron, selenium and chlorine. Among these minerals, potassium is dominant, followed by sodium as the next visible element. Coconut water contains several B vitamins, especially thiamine(B1), riboflavin(B2), niacin(B3), pantothenic acid (B5), pyridoxine (B6), biotin (B7) and folate(B9).

Coconut is known as a functional food which gives health benefits other than basic nutrients. Lauric acid is a main ingredient of coconut product; about 50% The fatty acids in coconut oil are lauric acid. (Percent arginine, alanine, cystine and Sestos sensitivity protein coconut water is higher. The green dwarf variety contains the highest in total phenols and vitamin C24. Amino acid important not only as a building material for the body, but it is another important characteristic, as an energy source (the body transforms amino acids to glucose), helps produce lymphocytes that there are cells in the human lymph nodes and bloodstream that are vital immune system It can help regulate blood sugar; help reduce symptoms of prostate enlargement in men, helps the adrenal gland function.

a. Nutritional Chart

- Calories: 22 Kcal
- Carbs: 3.7 grams
- Protein: 0.7 grams
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- Fiber: 1.1 grams
- Iron: 1% of the Reference DailyIntake (RDI)
- Calcium: 2% of RDI
- Magnesium: 6% of RDI
- Vitamin C: 4% of RDI

B. Composition of Coconut Water

The majority of the soluble solids in coconut water are sugars. The main sugar in mature coconut water includes glucose, fructose, sucrose and sorbitol. Lesser sugar like mannose, galactose and xylose comes next. The primary sugars in coconut water are glucose, fructose and sucrose which also makes up majority of the soluble solids. But as a plant reaches maturity, its non-reducing sugar content increases while its reducing sugar content increases while its reducing sugar content decreases with fructose and glucose. The synthesis of sucrose at the expense of the glucose-fructose bond is responsible for these changes. Among the components of coconut water, minerals come in second terms of quantity.

Based on available data, their composition ranges from 0.4 % to 1% of the constituents in coconut water, which is adequate to provide isotonicity. The six main minerals that were discovered were magnesium, potassium, sodium, calcium, zinc and iron. In coconut water, potassium is followed in abundance by sodium, calcium, magnesium and calcium. Zinc and iron, however, are only present in extremely minute levels.

Table 1 : Mineral Composition of Coconut Water

Vitamins	Tender Coconut Water	Mature Coconut Water
Calcium	0.47	0.57
Magnesium	0.11	0.11
Potassium	3.50	4.64
Sodium	0.03	0.29
Phosphorous	0.08	0.23
Sulphur	0.01	0.07
Manganese	20.3	14.4
Iron	4.06	2.94
Zinc	11.3	3.51
Copper	0.96	5.32
Boron	12.8	14.3

A single cup of coconut water contains 600-700 mg of potassium, 60mg of magnesium, 40 mg of calcium. When added to a balanced diet, coconut water can be great method to increases mineral composition and improve overall health and wellbeing

C. Physiochemical Properties

a) Volume of Coconut Water

A tender coconut typically has 200 to 300 ml of water; however, a mature coconut may only have 100 to 200ml. The reason for the decreases in water content is that as the coconut ages, more of the water is absorbed by the developing coconut meat. The water content might vary depending on its growing environment. The chemical composition of coconut water from several Indian states, including Kerela, Tamilnadu, Andhra Pradesh and Goa were reviewed. It was found that the quantity of coconut water varied significantly by location. Coconuts from Kerala had the highest average water content, at 271.3 mL per coconuts. The lowest water content was found in Tamilnadu coconuts, which had an average of 159.7mL per coconut. The average amount of water in the coconut from Andhra Pradesh and Goa was 201.6 mL and 220.2 mL respectively.

b) Total Soluble Sugar (TSS)

MCW was shown to have more total soluble solids than TCW which is a measure of sweetness. As the kernel develops, it takes up the soluble substances found in the coconut water. As a result, the TSS value of coconut decreased with age. From the review article by using the freeze concentrations method, the initial TSS values of the mature coconut and tender coconut could be enhanced by two-fold from 3.9 to 7.9^{o} Brix and from 6.0 to 12.1 ^{o} brix respectively.

c) Titrable Acidity (TA)

Due to its impact on food flavor and aroma, acidity is an important parameter that is used as a sensory indicator. Tender coconut water coming in second and third.

d) Preservation and Processing of Coconut Water

CW is safe and sterile as long as it remains inside the inner chamber of the coconut. After being extracted from the internal chamber of the nuts, it must first go through a complex and time-consuming procedure in order to preserve its quality before being taken from the nut for additional processing. After the coconut water is removed from the nuts, it is exposed to the external air. As a result of faster biochemical and enzymatic activities, CW changes in colour, turbidity, appearance, and numerous biological components.

In this field, several non-thermal, thermal, and Hurdle technologies with additional additives are employed. Among these techniques are infrared heating, ultrasonication, pulsed electric fields, plasma processing, microwaves, and dense phase carbon dioxide processing.

D. Value Added Products

Zero waste ideas provide the foundation of the mass production of value-added coconut goods. In the coconut plantation, the husk that is collected during dehusking is used for burial. Cashew nut processing uses the coconut shells that are removed during deshelling as a fuel source. The Testa extracted in order to produce virgin coconut water is dried, combined with cow feed and fed to farm's diary animals. The defatted, desiccated coconut is marketed after being added value to other goods. As previously mentioned, coconut water collected during processing is used enhance the value of a variety of variety of goods. Nursery plants and vegetable are grown using the concentrated, nutrient-enriched coconut water and leftover kernel wash water, which have undergone microbiological processing. It is therefore kept as zero polluting unit.

a) Coconut water vinegar

A naturally occurring product made from coconut water and sugar, which is fermented by adding yeast or Acetobacter and the allowed to oxidize and become acidic and they are filtered out as vinegar.

The drawbacks of synthetic vinegar made from industrial acetic acid, which is bad for your health are absent from natural vinegar.

b) Coconut water syrup

Delicious beverage created by persevering the freshness of the mature nuts used to make the coconut water while making virgin coconut oil. Coconut water, ginger, sugar, natural coloring and citric acid as a preservative are combined in equal measure to produce it. After diluting four to five times with water, it can ingest.

c) Xanthum Gum

Xanthum gum forms a flocculent complex with coconut protein under acidic condition. Soy polysaccharides specifically binds to coconut protein. Under acidic conditions, this complex is stabilized through the steric hindrance of soy polysaccharides. Due to gelatine coconut protein interaction, the isoelectric point of this complex changes.

d) Nata-de-Coco

The cellulose white to creamy yellow substance known as “nata-de-coco” is produced on the surface of sugar enriched coconut water, coconut milk, plant extract and other sugar-rich waste product by acetobacter aceti subspecies Xylinium. It is frequently served as dessert. Additionally, it’s a component of food items like fruit cocktails, ice cream and more. The Spanish term “Nata” comes from Latin word “nature” which means to “to float”. Because there is increasing interest in producing in nata from coconut water, a plentiful byproduct of coconut processing facilities, Nata making from coconut water, a plentiful byproduct of coconut processing facilities, Nata making is critical to the growth of our coconut sector.

e) Coconut Squash

It is hydrating and revitalizing healthy soft drink concentrate made by combining the sugar, coconut water and organic preservatives like ginger and lemon.it has few calories and is high in vitamins and minerals. Three months is product’s shelf life in normal conditions.

f) Frozen Coconut Water

The spray evaporation method can be used to create coconut water concentrate. Fresh coconut water is used to create frozen coconut water. Fresh coconut water collected in a hygienic manner from recently opened shell. Prior to concentration, the suspended particles and oils were eliminated by centrifugation and the minerals were extracted from the coconut water by passing it through an ionic resin -packed column to give it as sweet flavor. the flavor. The concentrated ‘s shelf life ranged six to twenty-four months, depending on how concentrated it was. Approximately 800g of concentrate might be produced from ten liters of coconut water. After diluting the concentrate to the appropriate concentration, it can



Figure 1 : Coconut Vinegar

be refrigerated or kept in cans and used as a base to make both carbonated and non-carbonated coconut drinks.

E. Existing Machines

a) Conventional method for coconut breaking

Since past few years, a sharp knife has been used to cut the dry coconut completely in manual method. The tools are unsteady, risky and need training and experience. In addition to the significant danger of damage and there will be risk of injury.



Figure 2 : Manual Breaking of Coconut

b) Coconut Water Extraction System

Coconut Water is derived from dry coconut can be used to produce high quality ready to drink coconut water. Coconut Water can be extracted by drilling the hole close to one of the three eyes on the coconut, where the meat and shell are thinnest. Its purpose is to reduce contamination and simplify handling.

c) Coconut Water Collection System

Breaking half of a fresh coconut and collecting the coconut water in a tank is one method of collecting coconut water. Coconut elevator, Equipment for holding and cutting coconuts and a tank for collecting coconut water make up system. The fresh coconut is transported by elevator to a coconut holding and cutting apparatus that has sharp blades fitted. The apparatus identifies the coconut and cut them in half, collecting the coconut water that remains after the coconut are cracked and chopped. Although there is less labour intensity with this procedure than the first, the hygiene condition is still lower.



Figure 3 : Existing Machine for Coconut Cutting

d) Hydraulic Coconut Splitter

A Hydraulic coconut splitter is a specialized machine designed to crack open coconuts efficiently. The working mechanism of a hydraulic splitter typically involves a hydraulic cylinder or press. When a coconut is placed in the splitter, hydraulic pressure is applied to the shell. The force exerted by the hydraulic system causes the coconut shell to crack open revealing inner contents. When compared to

traditional hand cracking, hydraulic splitters perform favorably, with an average cracking efficiency of 94.17%.

e) Coconut Water Pre-Pasteurization

The coconut water must be quickly chilled or pasteurized after filtering. The processing capacity determines whether the coconut water needs to be pasteurized or chilled. In the event that the coconut water has a modest capacity and can be sterilized and packaged in 5-8 hours, it can be stored in batch tanks after being chilled to 4°C. Either the jacketed tank feeding chill water or the plate cooler can be used to rapidly cool the water and coconut water in the tanks. Pre-Pasteurization is the preferable method if the coconut water must be kept in tanks for more than 12 hours or a day in order to be processed and packed later. The major goal of this process is to render the enzymes in the coconut water inactive and prevent oxidation. The purpose of the plate pasteurizer is to heat treat coconut water. Following pasteurization, the water is cooled to 4–10°C and stored in insulated tanks.

f) Coconut Water Cooling System

The coconut water must be quickly chilled or pasteurized after filtering. Depending on the processing capacity, the coconut water may need to be pasteurized or chilled. In the event that the coconut water has a modest capacity and can be sterilized and packaged in 5-8 hours, it can be stored in batch tanks after chilled 4^{o} C. The coconut water in the tanks can be rapidly cooled using the jacketed tank providing chill water or by using the plate cooler. Pre-pasteurization is the preferable method if coconut water must be kept in tanks for longer than 12 hours or a day in order to be processed and packed later. The main goal is to render the enzyme in the water inactive and prevent oxidation. After the coconut water is pasteurized, it is chilled to 4 - 10^{o} C and stored in insulated tanks.

F. Benefits of Machine

- In order to effiency to cut the coconut in half and collects its fluids, a machine for cutting coconuts is designed.
- It helps to save time, labor and resources when compared to cutting a coconut by hand, however the physical handling and process of slicing a coconut causes several risks and inefficient.
- Sanitary hazards can exist since the seller may not have provided enough hygiene materials, which could lead to microbial growth.
- Freshly extracted coconut water is unstable they start to ferment within a hour, so our machine helps to stabilize the coconut water by cooling the water where stability can be extended to four hours.

3. DESIGN METHODOLOGY

A. Design Of Machine

From a machine design perspective, the mature coconut's proportion are very important. In order to understand the range of dimension involved in the mature coconut, several farms and location were visited. When compared to region of India like Tamil Nadu and Kerala where coconuts are abundant, certain coconuts from Andaman and Nicobar Islands are quite large.

This study 's primary goal is to develop a coconut cutting machine that incorporates with rotatory motion of cutting. This design will serve as the foundation for prototype creation and a source for commercial manufacture. The research will specifically look into following:

- Outline the disadvantages faced by the farmers while collecting coconut water and splitting of coconuts.
- List the data elements that call for the automation of the cutting of coconuts.
- Using the principles of rotatory motion as basics, create a three-dimensional design for an automated coconut cutting machine.
- Using machine shop technique, create a prototype for the machine design.
- Compare the data collected from manual operation with motorized coconut cutting machine's effectiveness.

4. CONCLUSION

The current paper summarises the substantial research efforts and findings on the usage of mature coconut water and collection machines in order to make the material useful. Future scholars as well as those who build alternative machines will find value in the information gained in this work. We can comprehend the market opportunities such as coconut squash, frozen coconut water, nata de coco, coconut water syrup, coconut water vinegar, Xanthum gum, and also other existing machines. A greater percentage of the mature, healthy coconut's water content is wasted. According to the assessment, there is an opportunity to gather coconut water in a hygienic way for the creation of different items. By considering contemporary technologies like automation, data analytics, and sensors, smart machines provide higher productivity, consistency, and efficiency than manual techniques. In addition to enhancing the output and quality of coconut water and associated goods, automation's continuous monitoring and control features also save labour costs and increase worker safety. The use of automated systems in the coconut sector is positioned to play a vital role in satisfying market needs while fostering innovation and sustainability in production processes, particularly as the demand for healthy beverages like coconut water continues to rise internationally.

5. REFERENCE

[1] S. Lopez, "A concise review on tender and mature coconut water," *The Pharma Innovation Journal,* vol. 12, no. 8, pp. 835-848, 2023.

[2] A. B. a. V. S. Aishwarya Singh Gangawara, "Fermentation of Tender Coconut Water by Probiotic Bacteria," International Journal of Food Studies, vol.7, pp.100-110, 2018.

[3] M. D. N. D. J. -P. P. Alexia Prades, "Coconut Water Preservation and Processing:a review," Fruits,vol.67, pp.157-171, 2012.

[4] S. B. a. V. S. Satheeshan K.N, "A successful innovation model for promoting value addition with emphasis on coconut," Indian Coconut Journal, pp.10-16,July 2020.

[5] V. M. John, "Design & Fabrication of coconut breaker extractor grater machine, "International Journal for innovative Research in Science and Technology, vol.2, no.11, 2016.

[6] P. K. P. K. G. K. K. A. Sunil L. Prakruthi Appiah, "Coconut Water Nature 's Miracle Health Drink," Indian Coconut Journal, November 2020.

[7] 1. E. -L. J. a. M. J.W. D. Thorburn Burns, " Authenticity and Potability of coconut water – a review," Journal of AOAC International, vol.2020, no.3, November 2020.

[8] *. L.A. A. S. A. H. N. N. S. Olawumni Ajibola, "Probiotic Fermentation of coconut water," University of Malaysia Sarawak, 2018.

[9] N. S. 1. Z. K. 1. R. N. S. 1. -S. N. S. a. 3. 1K. F. Aziz, "Development of mature coconut (Cocos nucifera L.) probiotic beverage, "International Food Research journal, vol. 30, no.1, pp.119-129,2023.

[10] Roshni T., Jippu J., Ratheesh C.S., Sachin J., Sreevisakh K.L. ―Development of a Household Coconut Punch-cum-Splitter‖. Agricultural Engineering International: the CIGR Ejournal. Manuscript 1188. Vol. XI. May, 2009.

[11] Mr. Ketan K.Tonpe 1, Mr. Vinod P. Sakhare 2, Dr. C. N. Sakhale3 ―Design & Performances of Coconut De-Shelling Machiner‖. Int. Journal of Engineering Research and Applications

[12] Mownesh.R, Dr. Ashok Mehatha. ―Design and Fabrication of Punch Cum Splitter For Tender Coconut‖ International Journal of Engineering Research and General Science Volume 3, Issue 4, July-August, 2015 ISSN 2091-2730

[13] Augustine S.P., Wine produced using tender coconut and product, Patent US2007/017897 A1, inde, 2007.

[14] Yong JW, Ge L, Ng YF, Tan SN. The chemical composition and biological properties of coconut (Cocos nucifera L.) water. Molecules 2009;

[15] Mohd Lazim MI, Badruzaman NA, Koh SP, Long K. Quantification of cytokinins in coconut water from different maturation stages of malaysias coconut (*Cocos nucifera L.*) varieties. J Food Process Eng 2015;

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AUTOMATIC MATURE COCONUTS BREAKING CUM COCONUT WATER EXTRACTION MACHINE

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ABSTRACT
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Keywords
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1. INTRODUCTION

Cocos nucifera (L.) is a critical family member Aceraceae (palm family) popularly referred as coconut. The plant is originally from Southeast Asia (Malaysia, Indonesia and the Philippines) and the island between the Indian and Pacific Oceans. The coconut are the fruits of the cocos tree, which is part of family of palm trees. The term "coconut" may refer to the entire coconut palm, its seed or its fruit, which is botanically a drupe rather than a nut.

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Calcium	0.47	0.57
Magnesium	0.11	0.11
Potassium	3.50	4.64
Sodium	0.03	0.29
Phosphorous	0.08	0.23
Sulphur	0.01	0.07
Manganese	20.3	14.4
Iron	4.06	2.94
Zinc	11.3	3.51
Copper	0.96	5.32
Boron	12.8	14.3

A single cup of coconut water contains 600-700 mg of potassium, 60mg of magnesium, 40 mg of calcium. When added to a balanced diet, coconut water can be great method to increases mineral composition and improve overall health and wellbeing

C. Physiochemical Properties

a) Volume of Coconut Water

A tender coconut typically has 200 to 300 ml of water; however, a mature coconut may only have 100 to 200ml. The reason for the decreases in water content is that as the coconut ages, more of the water is absorbed by the developing coconut meat. The water content might vary depending on its growing environment. The chemical composition of coconut water from several Indian states, including Kerela, Tamilnadu, Andhra Pradesh and Goa were reviewed. It was found that the quantity of coconut water varied significantly by location. Coconuts from Kerala had the highest average water content, at 271.3 mL per coconuts. The lowest water content was found in Tamilnadu coconuts, which had an average of 159.7mL per coconut. The average amount of water in the coconut from Andhra Pradesh and Goa was 201.6 mL and 220.2 mL respectively.

b) Total Soluble Sugar (TSS)

MCW was shown to have more total soluble solids than TCW which is a measure of sweetness. As the kernel develops, it takes up the soluble substances found in the coconut water. As a result, the TSS value of coconut decreased with age. From the review article by using the freeze concentrations method, the initial TSS values of the mature coconut and tender coconut could be enhanced by two-fold from 3.9 to 7.9° Brix and from 6.0 to 12.1 ° brix respectively.

c) Titrable Acidity (TA)

Due to its impact on food flavor and aroma, acidity is an important parameter that is used as a sensory indicator. Tender coconut water coming in second and third.

d) Preservation and Processing of Coconut Water

CW is safe and sterile as long as it remains inside the inner chamber of the coconut. After being extracted from the internal chamber of the nuts, it must first go through a complex and time-consuming procedure in order to preserve its quality before being taken from the nut for additional processing. After the coconut water is removed from the nuts, it is exposed to the external air. As a result of faster biochemical and enzymatic activities, CW changes in colour, turbidity, appearance, and numerous biological components.

In this field, several non-thermal, thermal, and Hurdle technologies with additional additives are employed. Among these techniques are infrared heating, ultrasonication, pulsed electric fields, plasma processing, microwaves, and dense phase carbon dioxide processing.

D. Value Added Products

Zero waste ideas provide the foundation of the mass production of value-added coconut goods. In the coconut plantation, the husk that is collected during dehusking is used for burial. Cashew nut processing uses the coconut shells that are removed during deshelling as a fuel source. The Testa extracted in order to produce virgin coconut

water is dried, combined with cow feed and fed to farm's diary animals. The defatted, desiccated coconut is marketed after being added value to other goods. As previously mentioned, coconut water collected during processing is used enhance the value of a variety of variety of goods. Nursery plants and vegetable are grown using the concentrated, nutrient-enriched coconut water and leftover kernel wash water, which have undergone microbiological processing. It is therefore kept as zero polluting unit.

a) Coconut water vinegar

A naturally occurring product made from coconut water and sugar, which is fermented by adding yeast or Acetobacter and the allowed to oxidize and become acidic and they are filtered out as vinegar. The drawbacks of synthetic vinegar made from industrial acetic acid, which is bad for your health are absent from natural vinegar.



Figure 1 : Coconut Vinegar

b) Coconut water syrup

Delicious beverage created by persevering the freshness of the mature nuts used to make the coconut water while making virgin coconut oil. Coconut water, ginger, sugar, natural coloring and citric acid as a preservative are combined in equal measure to produce it. After diluting four to five times with water, it can ingest.

c) Xanthum Gum

Xanthum gum forms a flocculent complex with coconut protein under acidic condition. Soy polysaccharides specifically binds to coconut protein. Under acidic conditions, this complex is stabilized through the steric hindrance of soy polysaccharides. Due to gelatine coconut protein interaction, the isoelectric point of this complex changes.

d) Nata-de-Coco

The cellulose white to creamy yellow substance known as "nata-de-coco" is produced on the surface of sugar enriched coconut water, coconut milk, plant extract and other sugar-rich waste product by acetobacter aceti subspecies Xylinium. It is frequently served as dessert. Additionally, it's a component of food items like fruit cocktails, ice cream and more. The Spanish term "Nata" comes from Latin word "nature" which means to "to float". Because there is increasing interest in producing in nata from coconut water, a plentiful byproduct of coconut processing facilities, Nata making from coconut water, a plentiful byproduct of coconut processing facilities, Nata making is critical to the growth of our coconut sector.

e) Coconut Squash

It is hydrating and revitalizing healthy soft drink concentrate made by combining the sugar, coconut water and organic preservatives like ginger and lemon.it has few calories and is high in vitamins and minerals. Three months is product's shelf life in normal conditions.

f) Frozen Coconut Water

The spray evaporation method can be used to create coconut water concentrate. Fresh coconut water is used to create frozen coconut water. Fresh coconut water collected in a hygienic manner from recently opened shell. Prior to concentration, the suspended particles and oils were eliminated by centrifugation and the minerals were extracted from the coconut water by passing it through an ionic resin -packed column to give it as sweet flavor. the flavor.

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The concentrated ‘s shelf life ranged six to twenty-four months, depending on how concentrated it was. Approximately 800g of concentrate might be produced from ten liters of coconut water. After diluting the concentrate to the appropriate concentration, it can be refrigerated or kept in cans and used as a base to make both carbonated and non-carbonated coconut drinks.

3. DESIGN METHODOLOGY

A. Design Of Machine

From a machine design perspective, the mature coconut’s proportion are very important. In order to understand the range of dimension involved in the mature coconut, several farms and location were visited. When compared to region of India like Tamil Nadu and Kerala where coconuts are abundant, certain coconuts from Andaman and Nicobar Islands are quite large.

This study ‘s primary goal is to develop a coconut cutting machine that incorporates with rotatory motion of cutting. This design will serve as the foundation for prototype creation and a source for commercial manufacture. The research will specifically look into following:

- Outline the disadvantages faced by the farmers while collecting coconut water and splitting of coconuts.
- List the data elements that call for the automation of the cutting of coconuts.
- Using the principles of rotatory motion as basics, create a three-dimensional design for an automated coconut cutting machine.
- Using machine shop technique, create a prototype for the machine design.
- Compare the data collected from manual operation with motorized coconut cutting machine’s effectiveness.

B. Benefits of Machine

- In order to effiency to cut the coconut in half and collects its fluids, a machine for cutting coconuts is designed.
- It helps to save time, labor and resources when compared to cutting a coconut by hand, however the physical handling and process of slicing a coconut causes several risks and inefficient.
- Sanitary hazards can exist since the seller may not have provided enough hygiene materials, which could lead to microbial growth.
- Freshly extracted coconut water is unstable they start to ferment within a hour, so our machine helps to stabilize the coconut water by cooling the water where stability can be extended to four hours.





4. MATERIALS AND METHODS

A. Compents of machine

The materials required for fabricating coconut water collection machine are of

3.3.1 Motor
3.3.2 Gear box
3.3.3 C Channel
3.3.4 Pully
3.3.5 Round Plate
3.3.6 Heavy Plate Knife
3.3.7 Belt

3.3.8 Peltier Coil
3.3.9 Instant Cooler
3.3.10 Collector
3.3.11 Filter Sheet

Motor

A 1 HP motor refers to an electric motor with a power output of approximately 1 horsepower. Horsepower is a unit of power commonly used to measure the rate at which work is done. In the case of motors, it indicates the amount of mechanical power they can produce. For practical purposes, a 1 HP motor can typically provide enough power to perform tasks such as driving small machinery, pumps, fans, and various other applications in both industrial and domestic settings. Motor characteristics such as torque, speed, voltage and current determine the efficiency and power output of a motor. Higher torque and speed result in greater power output, while higher efficiency is achieved with optimal voltage and current to minimise energy losses within the motor.

Gearbox

A gearbox with a ratio of 20:1 means that the input shaft (usually connected to a motor or engine) must rotate 20 times to achieve one complete rotation of the output shaft. This ratio indicates the relationship between the rotational speeds of the input and output shafts. Gearboxes with different ratios are used in various applications to control speed, torque, and direction of rotation. In the case of a 20:1 gearbox, it would typically reduce speed while increasing torque.

C Channel

C Channel, also known as a C-beam or C-section, is a structural steel profile characterized by its cross-sectional shape resembling the letter "C". It features a vertical back, flanges extending outward from each side, and a flat base connecting the flanges. Typically made from materials like steel, aluminum, or stainless steel, C channels are produced through hot rolling or cold rolling processes to achieve desired dimensions and strength characteristics. They come in various standard sizes, catering to a wide range of applications in construction, manufacturing, and engineering. Common uses include providing structural support in buildings, framing systems for walls and roofs, support structures for equipment and machinery, and applications in the automotive industry. With their strength, versatility, and efficient load-bearing capabilities, C channels play a crucial role in numerous industrial and structural projects worldwide.

Pully

In a cutting machine, a pulley plays a crucial role in the movement and control of the cutting mechanism. By using a system of pulleys, the machine can efficiently transfer power from a motor or other power source to the cutting blade. The pulley helps to regulate the speed and torque of the blade, ensuring precise cuts and smooth operation. Additionally, pulleys allow for adjustments in the tension of the cutting mechanism, enabling the machine to accommodate different materials and cutting requirements.

Round Plate

A round plate typically refers to a circular flat object with a uniform thickness. It can be made from various materials such as metal, plastic, ceramic, or glass. Round plates are commonly used in culinary settings as serving dishes or dinnerware for meals. They come in various sizes and designs to accommodate different serving needs and aesthetic preferences. In industrial and engineering contexts, round plates may serve as components in machinery, equipment, or structures, providing support, reinforcement, or a mounting surface.

Heavy Plate Knife

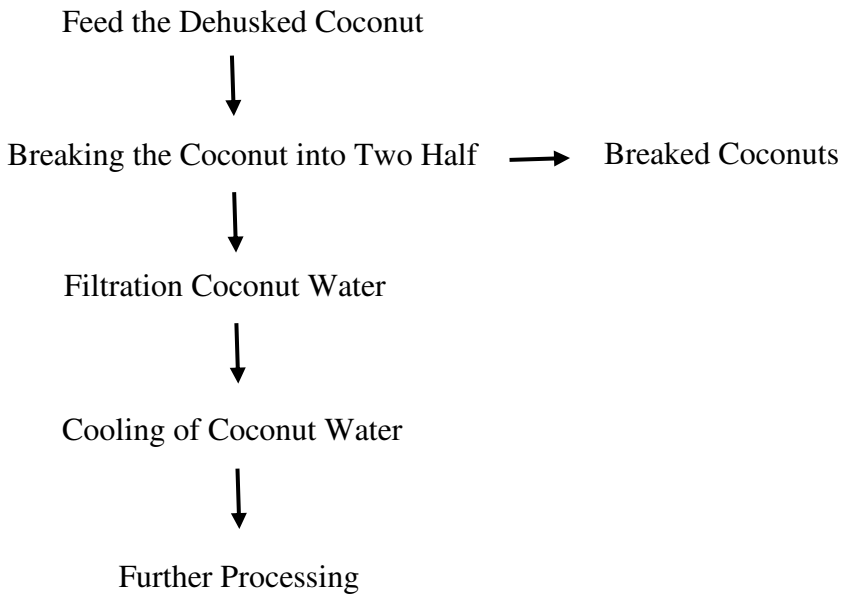
A heavy plate knife is a type of kitchen knife designed specifically for cutting through thick and dense food items, such as meats, poultry, and large vegetables. Plate 6 : Heavy plate Knife It typically features a thick and sturdy blade with a broad surface area, allowing for greater force to be applied when slicing through tough ingredients. The heavy plate knife is ideal for tasks that require significant cutting power and precision, making it a valuable tool for professional chefs and home cooks alike. Its robust construction and sharp edge enable efficient and effortless cutting, even through the toughest of foods.

Peltier Coil

Peltier devices, also known as Peltier modules or thermoelectric coolers, are indeed used for refrigeration purposes in certain applications. These devices utilize the Peltier effect to create a temperature difference across their junctions when an electrical current is passed through them. In a refrigeration application, Peltier devices are typically sandwiched between two heat sinks. One side of the Peltier device is in contact with the area to be cooled (the cold side), while the other side is in contact with a heat sink to dissipate the absorbed heat (the hot side)

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B.Working of Machine



Preparation :
The coconuts are dehusked, which involves removing the tough outer husk to reveal the inner shell or nut. This can be done manually or using specialized machinery depending on the scale of operations.
Feeding Mechanism:
The dehusked coconuts are then fed into the machine using a feeding mechanism. This could be a conveyor belt, chute, or any other system designed to guide the coconuts into the processing area of the machine.
Cracking Mechanism :
The machine employs a cracking mechanism, which could be a rotating blade, a hydraulic press, or a combination of both, depending on the design of the machine. This mechanism applies controlled force to the coconut to crack open its hard shell while minimizing damage to the inner coconut meat.
Collection:
Once cracked, the coconuts are directed to a collection area where the broken shells and the coconut water are separated from the coconut meat.
Filtration:
The coconut water is then pumped or gravity-fed through a filtration system. This system typically consists of one or more filters designed to capture suspended solids, impurities, and any remaining particles in the coconut water.
Cooling System:
Cooling coconut water using a Peltier cooling device, also known as a Peltier cooler, cooling coconut water using a Peltier cooling device involves employing the thermoelectric effect to transfer heat away from the coconut water, thereby lowering its temperature.
Peltier Device Integration:
A Peltier cooling device consists of semiconductor materials sandwiched between two ceramic plates. These devices are compact and can be integrated into a cooling system easily. The Peltier device is positioned in contact with the container holding the coconut water.

5. RESULT AND DISCUSSION

A. Capacity of Machine

Time taken to break one coconut = 3 seconds
Capacity of machine = 600 coconuts /hr

B. Efficiency of Machine

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Power = 1hp = 746 W
Efficiency = ((o/p power)/(i/p power))*100
= ((746/750))*100
= 99.4%

C. Force of Heavy Plate Knife

Force = Blade Spinning Speed x Blade Weight x No. of. Blade
Force = 28.8 x 14.715 x 1 = 423.7 N

The capacity of 1 hp motor 250 V at 50 hz frequency, they can break up to 600 coconuts /hour with 75 % of its efficiency under the force of 423 N.

6. CONCLUSION

The current paper summarizes the substantial research efforts and findings on the usage of mature coconut water and collection machines in order to make the material useful. We created the technologically advanced coconut breaking and water collection machine to address the issues that the copra industry was having. Our equipment not only helps to preserve aquatic life by lowering the biological oxygen demand (BOD) level, but it also minimizes the amount of coconut water wasted during the breaking process. Our machine's primary goal is to mechanically gather coconut water without the need for labor. It also maintains the cleanliness of the coconut water, increases breaking efficiency, and is equipped with a Peltier cooling system to stop the fermentation of the coconut water while it is being collected and stored for later use. Additionally, we computed the machine's efficiency, capacity, and cooling capacity to assess its overall functionality and running capability.

7. REFERENCE

1. Lopez, A. S. (2023). A concise review on tender and mature coconut water: Its application in food.
2. Gangwar, A. S., Bhardwaj, A., & Sharma, V. (2018). Fermentation of tender coconut water by probiotic bacteria Bacillus coagulans. International Journal of Food Studies, 7(1).
3. Prades, A., Dornier, M., Diop, N., & Pain, J. P. (2012). Coconut water preservation and processing: a review. Fruits, 67(3), 157-171..
4. Satheeshan, K. N., Seema, B. R., & Meera Manjusha, A. V. (2020). A successful innovative model for promoting value addition with emphasis on coconut.
5. Vinay, M. J., James, J., Joy, J., Abin, S., & Chandy, B. (2016). Design and fabrication of coconut breaker extractor grater machine. International Journal for Innovative Research in Science and Technology (IJIRST), 2(11), 2349-6010.
6. Thadathil, S. T. (2023). A comprehensive review of chemical composition and nutritional health benefits of coconut water.
7. Burns, D. T., Johnston, E. L., & Walker, M. J. (2020). Authenticity and the potability of coconut water-a critical review. Journal of AOAC International, 103(3), 800-806.
8. Lee, P. R., Boo, C. X., & Liu, S. Q. (2013). Fermentation of coconut water by probiotic strains Lactobacillus acidophilus L10 and Lactobacillus casei L26. Annals of microbiology, 63, 1441-1450.
9. Aziz, N. S., Chin, Z. K., Mohd Razali, N. S., Sofian-Seng, N. S., & Kasim, K. F. (2023). Development of mature coconut (Cocos nucifera L.) probiotic beverage: Physicochemical characteristics, microbial count, antioxidant activity, and sensory acceptance. International Food Research Journal, 30(1).
10. Roshni, T., Jippu, J., Ratheesh, C. S., Sachin, J., & Sreevisakh, K. L. (2009). Development of a household coconut punch-cum-splitter. CIGR Journal, 10(1).
11. Tonpe, K. K., Sakhare, V. P., & Sakhale, C. N. (2014). Design and performances of coconut de-shelling machine. Int. Journal of Engineering Research and Applications, 4(7), 39-44.
12. Mownesh, R., & Mehatha, A. (2015). Design and fabrication of punch cum splitter for tender coconut. Int J Eng Res Gen Sci, 3(4), 299-305.
13. Augustine, S. P. (2007). Wine produced using tender coconut and product. Patent US2007/017897 A, 1..
14. Yong, J. W., Ge, L., Ng, Y. F., & Tan, S. N. (2009). The chemical composition and biological properties of coconut (Cocos nucifera L.) water. Molecules, 14(12), 5144-5164.
15. Lazim, M. I. M., Badruzaman, N. A., Peng, K. S., & Long, K. (2015). Quantification of cytokinins in coconut water from different maturation stages of Malaysia's coconut (Cocos nucifera L.) varieties. J Food Process Technol, 6(11), 1.

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16. Fontan, R. D. C. I., Santos, L. S., BONOMO, R. C. F., Lemos, A. R., Ribeiro, R. P., & Veloso, C. M. (2009). Thermophysical properties of coconut water affected by temperature. Journal of food process engineering, 32(3), 382-397.
17. CAMPOS, C. F., SOUZA, P. E. A., COELHO, J. V., & GLÓRIA, M. B. A. (1996). Chemical composition, enzyme activity and effect of enzyme inactivation on flavor quality of green coconut water 1. Journal of food processing and preservation, 20(6), 487-500.
18. Tzeng, E., & Chen, H. E. (1998). Preventing nonenzymatic browning in coconut water during sterilization. Food Sci.(Taiwan), 25, 304-313.
19. Chowdhury, M. M., Aziz, M. G., & Uddin, M. B. (2005). Development of shelf-stable ready-to-serve green coconut water.
20. Alaban, C. A. (1962). Studies on the optimum conditions For nata de coco bacterium or nata formation in coconut water. Philipp. Agric, 45, 490-516..
21. Nunes, L. A., Silva, M. L., Gerber, J. Z., & Kalid, R. D. A. (2020). Waste green coconut shells: Diagnosis of the disposal and applications for use in other products. Journal of Cleaner Production, 255, 120169.
22. Viana, F. M. P., Uchôa, C. N., Vieira, I. G. P., Freire, F. C. O., Saraiva, H. A. O., & Mendes, F. N. P. (2008). Minimal processing, modified atmosphere, chemical products and cooling to control post-harvest basal rot of fresh green coconut fruits (Cocos nucifera). Summa Phytopathologica, 34, 326-331.
23. Nasution, Z., Jirapakkul, W., & Lorjaroenphon, Y. (2019). Aroma compound profile of mature coconut water from tall variety through thermal treatment. Journal of Food Measurement and Characterization, 13, 277-286.
24. Krishna, P. R. R. V., Rao, K. R., & Rao, S. S. (2020). Design and Fabrication of Semi-Automated Tender Coconut Drilling Device.

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Development of Active Packaging Film by Extraction of Anthocyanin from Red Cabbage-A New Cult

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***ABSTRACT*- Anthocyanins are brilliant cell reinforcement/antimicrobial specialists as well as pH-delicate markers that give new possibilities to encourage imaginative savvy bundling frameworks because of their capacity to further develop food time span of usability and identify physicochemical and organic changes in bundled food. Contrasted and anthocyanins from other normal sources, red cabbage anthocyanins (RCAs) are of extraordinary interest in food bundling since they address a variety range over a wide scope of pH values.There is a rising interest in anthocyanins, as normal food colorants, in food items and furthermore in drug items because of their antioxidative potential. The current review manages extraction and cleaning of anthocyanins from red cabbage. Besides, the utilization of RCAs as colorimetric pH-responsive specialists can dependably screen the subjective properties of the packaged food items in a continuous evaluation. Hence, the improvement of brilliant biodegradable movies utilizing RCAs is a promising way to deal with the possibility of food packaging**

Keywords: Anthocyanins, Biodegradable packaging, pH-values, red cabbage, antimicrobial.

I. INTRODUCTION

Active packaging is a packaging framework that is composed to keep up with and even further develop the wellbeing properties, organoleptic properties and nature of the packaged food product, in this way expanding its time frame of realistic usability.[1].

Regular packaging plastic innovations or dynamic sachets are bit by bit being traded by active nanocomposites for working on the quality and security of packed food items. active nanocomposite films that integrate oxygen scroungers could be utilized for packaging an assortment of oxygen-touchy food items. Additionally, nanocomposites could be applied as antimicrobial packaging to control bothersome microorganisms in food varieties. Because of purchaser inclinations for negligibly handled and normally protected food sources and the food business' revenue in putting resources into item quality and security, active packaging will foster from now on. Further examinations are required in regard to various areas of active packaging frameworks [2].

II. REVIEW OF LITERATURE

A. Red Cabbage

Red cabbage has a high nutritional value since it is high in minerals, vitamins, oligosaccharides, and a variety of bioactive chemicals that are beneficial to human health, such as anthocyanins, flavanols, and glucosinolates [3]. Red cabbage has its own distinct anthocyanin pattern. It contains a substantial amount of anthocyanins, the major structure of which is cyanidin glycosides in most cases. The major anthocyanin compounds in red cabbage are acylated [4,5].



Fig.1. Red Cabbage (ecovidx.com)

B. Anthocyanin

Anthocyanins are compounds with complicated patterns of hydroxylation, methylation, glycosylation, and acylation [4,5]. Anthocyanins are water-soluble pigments found in fruits and vegetables that are red, orange, blue, or purple. Anthocyanins are ingested by humans in amounts that may be physiologically relevant as components of plant food products [4.5.6].



Fig.2. Anthocyanin structure (robertbarrington.net)

C. Extraction of Anthocyanin

Anthocyanins are natural pigments found in many plant sources, including fruits, vegetables, flowers, and grains. These pigments can be extracted from various plant materials using different extraction methods [7,8].

Different extraction procedures have been investigated, including regular techniques like dissolvable extraction (utilizing ethanol, methanol, or water), as well as present day approaches like ultrasound-helped extraction (UAE) and supercritical liquid extraction (SFE) [9,10].

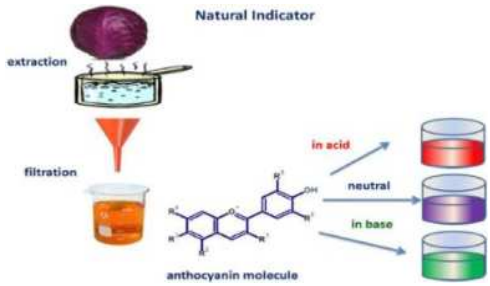


Fig.3. Extraction of anthocyanin (researchgate.net)

D. Confirmation of Anthocyanin

Anthocyanins can be confirmed using NaOH and HCl tests. These tests are because anthocyanins are pH sensitive and undergo a color change when exposed to alkaline or acidic solutions [11].

NaOH Test: In this test, a small amount of the sample containing anthocyanins is mixed with a few drops of sodium hydroxide (NaOH) solution. The mixture is then observed for any color change. If anthocyanins are present, the mixture will turn blue or green [12].

The reaction is as follows:
Anthocyanin + NaOH → Red color

HCl Test: In this test, a small amount of the sample containing anthocyanins is mixed with a few drops of hydrochloric acid (HCl) solution. The mixture is then observed for any color change. If anthocyanins are present, the mixture will turn red or pink [13].

The reaction is as follows:
Anthocyanin + HCl → Brownish color

Both tests can be used as preliminary tests to confirm the presence of anthocyanins in a sample. However, they do not provide any information about the identity or concentration of the anthocyanins present. Further analysis, such as high-performance liquid chromatography (HPLC), may be required to identify and quantify the specific anthocyanins present in a sample [14].

E. Barrier properties of film

Total Anthocyanin content: Anthocyanins are colored water-soluble pigments belonging to the test. The responsible for the colors, red, purple, and blue, are in fruits and vegetables. Berries, currants, grapes, and some tropical fruits have high anthocyanins content [15].

pH sensitivity: pH-sensitive visual indicators, as the most widely used freshness indicator, include the water-soluble natural dye anthocyanin (ACN). It can be either acidic or basic, responding to either basic or acidic pH values [16].

Storage stability: To measure changes in substances over time when the substance is exposed to various factors such as temperature, humidity, and light control. The exposure to these conditions helps determine the stability of a product under specific storage conditions. A long-term item can be stored without visible changes or a change in its taste, flavor etc. [17]

Antimicrobial: Antimicrobial agent kills microorganisms or inhibits their growth. Antimicrobials that (or) treat illnesses caused by microbes [18].

Antioxidant: Antioxidant active food packaging can extend the shelf life of foods by retarding the rate of oxidation reactions of food components [19].

Permeability test: Permeability testing is used to measure oxygen transmission rates and water vapor transmission rates through plastic films and containers (or) permeability is the rate at which gases can pass through a material [20].

F. Optimization of film

Barrier Properties: Packaging films should prevent the ingress of moisture, which is crucial for protecting products sensitive to humidity. ○ Oxygen can affect the freshness and shelf life of certain products, so films need to provide an effective barrier against oxygen transmission [21].

Mechanical Strength: The film should possess sufficient tensile strength to withstand the stresses encountered during packaging, transportation, and handling. Tear resistance is important to prevent accidental tearing during packaging and handling [22].

Flexibility: Packaging films need to be flexible enough to conform to the shape of the product and elastic enough to recover after deformation.

Sealing Properties: Many packaging films are heat-sealed to form pouches or bags. Good heat sealability ensures proper sealing and enhances the integrity of the package [23].

The strength of the seal is crucial for maintaining the barrier properties of the packaging [24].

Optical Properties: For retail packaging, clarity and transparency are important to showcase the product. For other applications, opacity might be preferred for UV protection or to prevent product visibility.

Glossy films enhance the visual appeal of the packaging.

Chemical Resistance: Packaging films should resist interaction with the packaged product or external environmental factors, such as oils, acids, or other chemicals.

Printability: If the packaging requires printing for branding or information, the film should be receptive to printing inks.

Environmental Impact: Increasingly, there's a focus on sustainable packaging. Films that are recyclable or made from recyclable materials are preferred.
Films designed to be biodegradable can contribute to reducing environmental impact [25].

Cost-Efficiency: The cost of the packaging material and the efficiency of the manufacturing process are critical factors in optimization.

Product Compatibility: The film must not adversely affect the quality or safety of the packaged product.

G. Packaging Film

Anthocyanins can be sensitive to light, heat, and oxygen. Research may focus on stabilizing these compounds through various methods, including the addition of stabilizing agents or encapsulation within a protective matrix [26]. Studies may explore different biodegradable polymers or other materials suitable for film formation. The compatibility of these materials with anthocyanins and their impact on film properties (mechanical strength, flexibility, barrier properties) are crucial considerations [27].

Comprehensive reviews might discuss the analytical techniques used to characterize the developed films, such as Transmission electron microscopy (TEM), Fourier-transform infrared spectroscopy (FTIR), and mechanical testing [28]. Evaluating the performance of anthocyanin-based packaging films is essential. This includes assessing their ability to act as barriers against moisture and oxygen, their mechanical properties, and their overall suitability for food or other product packaging [29].

As there is a growing emphasis on sustainable packaging, reviews may discuss the environmental impact of anthocyanin-based films, including their biodegradability and potential for reducing the use of conventional, non-biodegradable packaging materials [30].

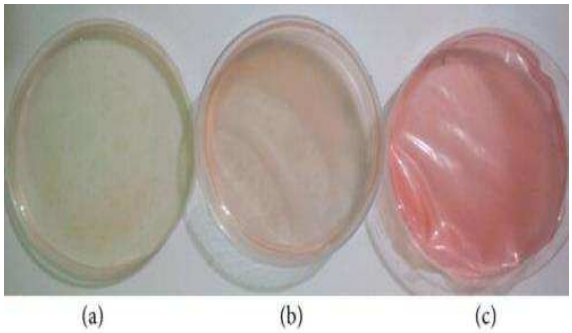


Fig.4. Packaging Film (researchgate.net)

III. CONCLUSION

Active packaging films in light of regular anthocyanins can screen the continuous freshness of food and expand the timeframe of realistic usability of food. This paper explored the extraction, construction, and capability of anthocyanins, and summed up the kinds of active packaging films and their applications in protein-rich food sources. The outcomes showed that anthocyanins could work on the mechanical properties and obstruction properties of the substrate. As a simple to-involve film for food freshness maintenance and checking, active packaging films have extraordinary business likely in the packaging of protein-rich food varieties. Besides, these films' normal anthocyanins are still far from business applications. For instance, profoundly stable anthocyanins with distinct designs should be investigated; film fabrication processes reasonable for business large scale manufacturing are still being scrutinized; and the variety changes brought about by the awareness, security, and reproducibility of packaging films. Consequently, helpful ought to be produced for new cut products of the soil, meat, fish,

and milk that lessen food waste and medical issues brought about by food quality and wellbeing.

REFERENCES

[1] A.K. Mohantya, G. Misraa, Hinrichsen, Biofibres biodegradable polymers and biocomposites, Macromol. Mater. Eng. (2000) 1–24.

[10] Nizamutdinova, I. T., Jin, Y. C., Chung, J. I., Shin, S. C., Lee, S. J., Seo, H. G., et al. (2009). The anti-diabetic effect of anthocyanins in streptozotocin-induced diabetic rats through glucose transporter 4 regulation and prevention of insulin resistance and pancreatic apoptosis. Molecular Nutrition & Food Research, 53, 1419–1429.

[11] Luthria, D. L., et al. "Anthocyanin content, antioxidant capacity, and acidity values of wild and cultivated berries in Alaska." Journal of Agricultural and Food Chemistry 50.7 (2002): 1901 1907.

[12] Zhou, Y., et al. "Identification and quantification of anthocyanins in purple-fleshed sweet potatoes cultivated in China." Food Chemistry 113.4 (2009): 1006-1013.

[13] Oliveira, H., et al. "Anthocyanin profile of black rice (Oryza sativa L.) subjected to different processing methods." Food Chemistry 128.2 (2011): 460-466.

[14] Giusti, M. M., and R. E. Wrolstad. "Characterization and measurement of anthocyanins by UV-visible spectroscopy." Current Protocols in Food Analytical Chemistry (2001): F1.2.1 F1.2.13.\

[15] Ayu,A.C.; Ida, M.; Moelyono, M.; Fakhriati, S.G. Total anthocyanin content and identification of anthocyanidin from Plectranthus scutellarioides (L.) R. Br leaves. Res. J. Chem. Environ. 2018, 22, 11–17.

[16] Cavalcanti, R.N.; Santos, D.T.; Meireles, M.A.A. Non-thermal stabilization mechanisms of anthocyanins in model and food systems—An overview. Food Res. Int. 2011, 44, 499–509.

[17] Moldovan,B.;David,L.; Chi ¸ sbora, C.; Cimpoiu, C. Degradation kinetics of anthocyanins from European cranberrybush (Viburnum opulus L.) fruit extracts. Effects of temperature, pH and storage solvent. Molecules 2012, 17, 11655–11666. [CrossRef]

[18] Sawatzky P, Liu G, Dillon JA, Allen V, Lefebvre B, Hoang L, Tyrrell G, Van Caeseele P, Levett P, Martin I. Quality Assurance for Antimicrobial Susceptibility Testing of Neisseria gonorrhoeae in Canada, 2003 to 2012. J Clin Microbiol. 2015 Nov;53(11):3646-9. [PMC free article] [PubMed]

[19] Re, R., Pellegrini, N., Proteggente, A., Pannala, A., Yang, M., & Rice-Evans, C. A. (1999). Antioxidant activity applying an improved ABTS radical cation decolorization assay. Free Radical Biology & Medicine, 26, 1231–1237.

[2] Jung H. Han, ... Evangelina T. Rodrigues, in Innovations in Food Packaging, 2005

[20] ASTM. (1995). Standard test methods for water vapor transmission of materials. E96-95. In Annual Book of ASTM Standards American Society for Testing and Materials, Philadelphia.

[21] Musa,M.N.I.; Marimuthu, T.; Rashid, H.N.M.; Sambasevam, K.P. Development of pH Indicator Film Composed of Corn Starch Glycerol and Anthocyanin from Hibiscus Sabdariffa. In Proceedings of the 7th International Conference for Young Chemists (ICYC 2019), Georgetown, Malaysia, 14–16 August 2019.

[22] Yong H, Liu J. 2020. Recent advances in the preparation, physical and functional properties, and applications of anthocyanins-based active and intelligent packaging films. Food Packaging and Shelf Life 26:100550

[23]Gengatharan A, Dykes GA, Choo WS. 2015. Betalains: Natural plant pigments with potential application in functional foods. LWT - Food Science and Technology 64:645−49

[24] Halász K, Csóka L. 2018. Black chokeberry (Aronia melanocarpa) pomace extract immobilized in chitosan for colorimetric pH indicator film application. Food Packaging and Shelf Life 16:185−93

[25]Wang S, Xia P, Wang S, Liang J, Sun Y, et al. 2019. Packaging films formulated with gelatin and anthocyanins nano complexes: Physical properties, antioxidant activity and its application for olive oil protection. Food Hydrocolloids 96(11):617−24

[26]Alzate, P., Miramont, S., Flores, S., & Gerschenson, L. N. (2017). Effect of the potassium sorbate and carvacrol addition on the properties and antimicrobial activity of tapioca starch–Hydroxypropyl methylcellulose edible films. Starch-Stärke, 69 (5-6), 1600261. https://doi.org/10.1002/star.201600261

[27]Cano, A. I., Cháfer, M., Chiralt, A., & González-Martínez, C. (2015). Physical and microstructural properties of biodegradable films based on pea starch and PVA. Journal of Food Engineering, 167, 59-64. https://doi.org/10.1016/j.jfoodeng.2015.06.003

[28]Espitia, P. J. P., Du, W. X., de Jesús Avena-Bustillos, R., Soares, N. D. F. F., & McHugh, T. H. (2014). Edible films from pectin: Physical-

mechanical and antimicrobial properties-A review. Food hydrocolloids, 35, 287-296. https://doi.org/10.1016/j.foodhyd.2013.06.005

[29] Otoni, C. G., Avena-Bustillos, R. J., Azeredo, H. M., Lorevice, M. V., Moura, M. R., Mattoso, L. H., & McHugh, T. H. (2017). Recent advances on edible films based on fruits and vegetables—a review. Comprehensive Reviews in Food Science and Food Safety, 16(5), 11511169.https://doi.org/10.1111/1541-4337.12281

[3] Jagdish Singh, A. K., Upadhyay, A., Bahadur, B., Singh, B., Singh, K. P., & Mathura Rai, A. K. (2006). Antioxidant phytochemicals in cabbage (Brassica oleracea L. var. capitata). Scientia Horticulturae, 108,233–237.

[30] Wrolstad, R. E., Durst, R. W., & Lee, J. (2005). Tracking color and pigment changes in anthocyanin products. Trends in Food Science & Technology, 16(9), 423-428.

[4] Clifford, M. N. (2000). Anthocyanins — Nature, occurrence and dietary burden. Journal of the Science of Food and Agriculture, 80, 1063–1072.

[5] Wu, X., & Prior, R. L. (2005). Identification and characterization of anthocyanins by high-performance liquid chromatography-electrospray ionization-tandem mass spectrometry in common foods in the United States: Vegetables, nuts, and grains. Journal of Agricultural and Food Chemistry, 53, 3101–3113.

[6] Wu, X., Beecher, G. R., Holden, J. M., Haytowitz, D. B., Gebhardt, S. F., & Prior, R. L. (2006). Concentrations of anthocyanins in common foods in the United States and estimation of normal consumption. Journal of Agricultural and Food Chemistry, 54, 4069–4075.

[7] Azeredo, H. M. C. (2009). Betalains: properties, sources, applications, and stability — A review. International Journal of Food Science and Technology, 44, 2365–2376.

[8] Galvano, F., La Fauci, L., Lazzarino, G., Fogliano, V., Ritieni, A., Cappellano, S., et al. (2004). Cyanidins: Metabolism and biological properties. The Journal of Nutritional Biochemistry, 15,2–11.

[9] Nielsen, I. L. F., Rasmussen, S. E., Mortensen, A., Ravn-Haren, G., Ma, H. P., Knuthsen, P., et al. (2005). Anthocyanins increase low-density lipoprotein and plasma cholesterol and do not reduce atherosclerosis in Watanabe heritable hyperlipidemic rabbits. Molecular Nutrition & Food Research, 49, 301–308.

Leveraging Dragon Fruit's Potential: A Comprehensive Review of Value-Added Products and Analytical

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Abstract- **The dragon fruit (Hylecereuspolypus) is widely recognised for its abundant nutrient composition and is marketed globally to address various health issues. The fruit pulp manufactures wine, jam, jellies, preserves, and juice. Minimum processing was applied during product production to retain the essential sensory qualities of items. With the use of sensory, instrumental, physical, biochemical, and microbiological investigations of the finished product, the study aimed to design formulations of H. undatus Haw. Dragon fruit products and assess nutritional components and textural attributes. Preservatives and pulp at varying quantities were combined to create and assess formulations after the fruit was chosen, cleaned, pulped, and ground. Dragon fruit can be used to create products with value additions. The amount of total protein, ash, fat, moisture, carbohydrates, and yield are all impacted by using dragon fruit concentrate. The sensory research revealed that adding dragon fruit concentrate substantially impacted colour, scent, smell, appearance, taste, aftertaste, and overall acceptability.The findings indicate that using dragon fruit as a raw material could create functional foods that consumers would find acceptable.**

Keywords:Dragon fruit, Preservatives, value-added products, Sensory analysis.

I. INTRODUCTION

Dragon fruit (Hylocereuspolymers) is a non-climacteric fruit from one of the cactus species. It is also known as Pitaya, and its colour ranges from dark red to pink, with green overlapping on the surface **(Virendra*et al*., 2018).**It belongs to the genus Trigonocarpus in the Cactaceae. This cactaceous plant produces edible fruits and attractive blooms **(Prisa*et al.*, 2022).**A pitaya or pitahaya is the fruit of various cactus species, particularly the genus Hylocereus (sweet pitayas). These fruits are dragon fruit**(Islam*et al.,* 2012).**They are grown commercially in Taiwan, Nicaragua, Colombia, Vietnam, Israel, Australia, and the United States **(Wu*et al.,* 2006).**The nutritional and colour properties of dragon fruit make it an attractive ingredient for various beverages, including fermented ones**(Naika *et al.,* 2021).**Hylocereuspolyrhizus is a tiny fruit-climbing cactus that has gained worldwide popularity as an attractive plant due to its enormous, fragrant, night-blooming flowers. The translucent dark-red flesh of the skinned fruit weighing up to 1kg is considered a rich source of nutrients and minerals such asnutritional supplements, proteins, fat, carbohydrates, Essential fibre, flavonoid compounds thiamine, Niacin, pyridoxine, cobalamin to its glucose, phenolic substances, betacyanins, polyphenols, or carotene, the mineral phosphorus iron, and phytoalbumin **(Ruzainah *et al.*, 2009)**. It is grown in at least 22 tropical nations, including Australia, Cambodia, China, Malaysia, Thailand, Sri Lanka, and Bangladesh **(Islam*et al.,* 2012).**Bright red dragon fruit (Hylocereusmonacanthus) with a dark purple colour has received greater consumer interest in recent years because it is rich in natural pigments of betalains and water-solublenitrogen-containing colours. These chemicals have been shown to have antioxidant and anti-inflammation characteristics, as well as anticancer, antilipidemic, and antibacterial capabilities **(Li*et al.,* 2022).**Red Dragon Pulp may provide health benefits due to its high phenolic content **(Al-Radadi*et al.*, 2022).**Dragon fruit is high in nutritional and medicinalproperties. Fruit pulp is high in vitamin C, antioxidants, carotenoids, polyunsaturated fatty acids, protein, and minerals like calcium, salt, potassium, and iron**(Naika*etal*, 2021).** It is a popular tropical fruit worldwide due to its attractive appearance, sweet and juicy taste and high nutritional value **(Li*et al.*, 2022).**The fruit comes in numerous kinds, each distinguished by characteristics such as the colour of its epicarp and mesocarp, the latter of which bears black seeds. According to research, dragon fruit contains antioxidants helpful to consumers **(Castro *et al.,* 2021).** Dragon fruit can be processed into various goods, such as RTS beverages, jam, juice, nectar, squash, smoothies, and many other delicious flavours and essences. Its delicious pulp can also be used to make soft drinks. According to studies, dragon fruit enhances the formation of probiotics, improving digestibility **(Vishakha *et al.*, 2021).** As a result, the present effort has been to optimise this fruit's utilisation through value-addition approaches and by-product utilisation **(Jalgaonkar*et al.,* 2022).**This study employs response surface methodology (RSM), one of food science's most widely utilised optimisation techniques. If there are many components and interactions in the food production research, RSM may offer information to clarify the aspects impacting the final answer **(Faridah*et al*., 2020).**

II. BOTANICAL CLASSIFICATION

Dragon fruit belongs to the cactus family Cactaceae and is under the name Hylocereus.This genus is most famous for

its climbing vine cactus, which has aerial roots and produces beautiful, glabrous fruit onmassive scales. Dragon fruit is a plant that grows on lengthy days. It is a member of the genus Hylocereus and the family Cactaceae. Many names were previously assigned to the plant, including dragon fruit, pitaya, pitahaya, night-blooming cereus, strawberry pear, Belle of the Night, and Cinderella plant(**Perween*et al.,* 2018).**This fruit is usually red and green scaly, but the flesh of the fruit is of different colours, namely red, purplish-red and white **(Fitri*et al.,* 2022).**Dragon fruit (H. undatus) is popular throughout Southeast Asia. It is a nutritious vine plant species from the Cactaceae family that achieved wide acceptance, first as an ornamental plant and later as a fruit crop(**Patwary*et al.,* 2013).**

2.1NUTRITIVE VALUE

Dragon fruit has numerous nutritional and health benefits. It contains minerals, glucose, fructose, dietary fibre, and vitamins. It can also boost the human body's immune system, treat diabetes and heart disease, and maintain a healthy body weight. By referring to the benefits associated with dragon fruit, it can be used in improving dragon fruit-based products **(Sulistyowati*et al.,*2023).**Because of its nutritional richness, this fruit is recognised as an essential economic fruit species worldwide. The fruits can be consumed fresh or in salads and used for making jam, jelly, ice cream, juice, wine, face packs, and various products(**Patel*et al.,* 2023).**

Nutrient	Amount (per 100 g)	Daily value (%)
Water	87 g	-
Protein	1.1 g	2.1
Fat	0.4 g	-
Carbohydrates	11.0 g	3.4
Fiber	3 g	12
Vitamin B1 (Thiamine)	0.04mg	2.7
Vitamin B2 (Riboflavin)	0.05mg	2.9
Vitamin B3 (Niacin)	0.16mg	0.8
Vitamin C (Ascorbic Acid)	20.5mg	34.2
Calcium (Ca)	8.5mg	0.9
Iron (Fe)	1.9mg	10.6
Phosphorus (P)	22.5mg	2.3

Source: 1 Nutritional values of dragon fruit**(Sharma et al., 2021).**

III. MATERIALS AND METHODS

Dragon fruit, often called pitaya or pitahaya, is a tropical fruit in demand. Due to its unique look and claimed health advantages. It is grown commercially in over 20 tropical and subtropical countries. Red dragon fruit contains vitamins, antioxidants, and nutrients, including amino acids, dietary carbohydrates, and vitamins B2, B1, B3, and C.Red dragon fruit, on the other hand, is exceedingly perishable and relatively inexpensive over the time of the year. As a result, more research into purple dragon fruit products is needed to use this nutritious resource fully.Dragon fruit can be processed into various goods, such as RTS beverages, jam, juice, nectar, squash, smoothies, and other delicious flavours and essences **(Vishakha*et al.,* 2021).** In this study,the industry has purchased dragon fruits for this research. Other main ingredients used in product manufacture were sugar, citric acid, pectin, and other chemicals obtained from the laboratory store **(Islam*et al.,* 2012).**

3.1SAMPLE PREPARATION

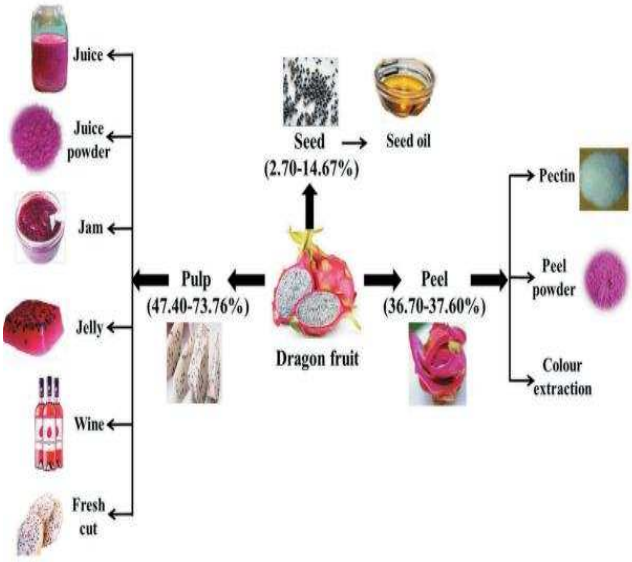
Dragon fruits with red flesh were purchased. The fruits ranged in age from 28 to 32 days and were harvested and weighed after flowering. They were then washed and skinned, and the flesh was used immediately after pressing to prevent oxidation and preserve product quality **(Dao *et al.*,2023).**

3.2 MATERIALS

The dragon fruit (Hylocereusundatus) was purchased at a nearby market. Sugar, citric acid, pectin, and other chemicals from the laboratory store were utilised as the main ingredients in the product's creation**(Islam*et al.,* 2012).**The remaining ingredients were analysed and bought from a locallyrecognised supplier**(Li *et al.*, 2022).**

3.3PROCESSING AND VALUE ADDITION IN THE DRAGON FRUIT MARKET

Ice cream, yoghurt, jelly, preserves, candies, and pastries are all flavoured with frozen pulp. Unopened blossoms and buds are edible and can be boiled, roasted, or soaked like tea. The fruit is eaten with tiny black seeds, which are indigestible and have a moderate laxative effect. It is frequently used to decorate banquet or buffet tables, whole or sliced. In the culinary and cosmetic industries, skin can be utilised to create beta cyanin, dye pigments, and mucilage. Hylocereus stems and flowers have been used in treating diabetes as a diuretic and aiding in wound healing **(Sharma *et al.,* 2021).**



Source: 2 Different processed/valorised products can be prepared from dragon fruit**(Jalgaonkar*et al.*, 2022).**

IV. VALUE-ADDED PRODUCTS FROM DRAGON FRUIT

4.1DRAGON FRUIT SQUASH

According to the explanation, the finest organoleptically acceptable dragon fruit squash can be created by utilising

25% dragon fruit juice, 45° B of TSS, and 1% acidity. The pH of the squash increased during storage in the current investigation, with the highest pH recorded in treatment T1, followed by T3, and the lowest pH recorded in T9 at the end of storage. During storage, the squash's betalains (betacyaninsand betaxanthins) content decreased significantly**(Naika*et al.,* 2021).**

4.2 DRAGON FRUIT COOKIE

Dragon fruit cookies are made with a combination of the substances both tuber flour and jack legume grains in addition to dragon fruit prioritise, which can affect the percentage of fat, moisture content, amount of ash, amount of carbohydrates, amino acid content, and generate the outcome of the finished cookie data.The sensory analysis revealed that the quantity of flour and dragon fruit concentrates substantially affected colour, taste, scent, texture, and flavour. The sensory analysis results became flavour, aftertaste, and overall cookie approval **(Nurfirdausi*et al.,* 2023).**

4.3 DRAGON FRUIT RTS

An RTS beverage with dragon fruit was prepared. The RTS fruit drink criteria were used to conduct preliminary investigations to produce an appropriate recipe. The influence of dragon fruit juice percentage, citric acid, and storage time at room temperature on overall acceptability, TSS, pH, acidity, and ascorbic acid in RTS beverages was investigated.It concluded that the dragon fruit-based RTS beverage with 12 per cent juice, 0.4 per cent citric acid, 12 per cent sugar, and 0.01 per cent KMS preservative was suitable for up to 50 days at room temperature. The acidity and TSS of the sample increased, increasing storage time. This increase in acidity may be attributed to the presence of more excellent vitamin C in the juice.RTS beverage's pH and ascorbic acid decreased slightly during storage, possibly due to increased acidity due to biochemical reaction response surface optimisation for developing Dragon fruit-based ready-to-serve drinks **(Virendra *et al.,* 2018).**

4.4DRAGON FRUIT PEEL JAM

The jam is a partially solid culinary product created by boiling sugar, vegetable or fruit pulp, pectin, vinegar, and additional components to the desired consistency.Jam should have 65% or greater TSS and at least 45% pulp **(Agbor *et al.*, 2014).**This study found that the quantity of dragon fruit peel, followed by processing time and sugar content, strongly affects the quality of the generated jam, which in turn affects consumer approval. The findings indicate that the dragon fruit peelcan be used as a raw material to manufacture a consumer-acceptable functional food. Future research should be undertaken to optimise dragon fruit jam recipes that alter phytochemical properties such as betacyanin levels or antioxidant capacities**(Faridah*et al.,* 2020).**

4.5DRAGON FRUIT BISCUIT

Using fruit such as dragon fruit biscuits and Moringa ends up in biscuit making significantly impacts the organoleptic and hedonic test aspects of colour, aroma, smell, and consistency.Biscuits with compositions, such as dried dragon fruit and Moringa foliage powder: Compared to other biscuits, wheat flour has the most choice and superiority regarding organoleptic and theatrical properties. The best and most famous composition included 10% hylocereus polarises and 5% Moringa leaves **(Ardianto*et al.,* 2019).**

4.6RED DRAGON FRUIT BAR

Using RSM, this study demonstrated that the red-coloured dragon fruit bar was effectively made with passion fruit and sugar to varying degrees. The amount of passion fruit and pectin in the red dragon's fruit bar substantially impacted its physical and chemical, biologically active compound content, antioxidant capability, and sensory characteristics.The fruit bar's TTA levels, AA, which stands for a Bachelor of Arts, the presence of TPC, the FC method, and DPPH radical elimination activities enhanced as the amount of passion fruit added grew. This study also showed how components affected the sensory appeal of the fruit bar.The resulting fruit bar was high in bioactive components, had outstanding antioxidant activity, and was well-liked by customers. Creating food supplements will decrease losses following harvest while increasing the market value of high-value crops**(Yen*et al.,* 2022).**

4.7REFRESHING DRINK

It can be concluded that the refreshing drink generated during the study has extremely acceptable sensory features, a cheap cost, good nutritional properties, and enormous health benefits. A delightful beverage made from the fruit of dragons, which is abundant in antioxidants, may enhance a person's wellness through enhanced immunity to various conditions. Fruit consumption in raw form is encouraged to preserve the fruit's nutritious value**(Vishakha *et al.*, 2021).**

4.8 DRAGON FRUIT JELLY

According to the study, dragon fruit has the potential to produce excellent, additional-value products. The fruit's flesh has a distinctly spiritual nature and medical, cultural and health advantages, so it is predicted to command a high price from people. Since this outcome, this research suggests a bright future for developing dragon fruit product processing. More research into the economic characteristics of the items is needed while advocating for commercial manufacturing **(Islam *et al.*, 2012).**

4.9DRAGON FRUIT JAM

Adding dragon fruit peel to jam demonstrated the potential for a waste-recovery-focused coproduct. The F3 formulation received positive feedback and contained beneficial components. This method reduces waste from personal consumption and industry and improves the taste of dragon fruit peel, which customers highly favour. Additionally, it provides significant antioxidants, vitamins (B1, B5, and B6),

and consumer-pleasing sensory qualities while adhering to food safety regulations. Further research is needed to determine the product's shelf life and effectiveness(**Castro *et al.*, 2021**).

4.10GLUTEN-FREE COOKIE

The proportion of konjac potato powder to soy pea wheat flour might affect the moisture, amount of ash, percentage of fat, total protein content, carbs, and production of the resulting cookie data. In addition to the visual assessment, the findings showed that the quantity of wheat and the proportion of dragon fruit are the qualities, aftertaste, and overall approval of cookies(**Nurfirdausi*et al.,* 2023).**

4.11 DRAGON FRUIT JUICE

Red dragon fruit appears to contain high iron levels, which boosts haemoglobin and erythrocyte levels.Red dragon fruit juice significantly affected the haemoglobin and erythrocyte levels on the seventh day of the treatment but not on the fourteenth day of intervention. It investigates how dragon fruit juice affects haemoglobin and erythrocyte levels. The study used white mice and discovered that dragon fruit (Hylocereusundatus) could boost haemoglobin and erythrocytes in female white mice in 7 to 14 days. The research presented here reveals that red dragon fruit juice could be an effective alternative treatment for anaemia in pregnant women(**Widyaningsih*et al.,* 2017).**

V. HEDONIC TEST

Organoleptic characteristics testing uses a hedonic quality test, which is more specialist and frequently aims to determine the panellist's reaction to general biological characteristics such as appearance, odour/taste, and colour. Simultaneously, one acceptability test is a preference test(**Ardianto*et al.*, 2019).**

Score	Criteria
1	Very dislike
2	Do not like
3	Rather dislike
4	Normal / Neutral
5	I like it a little
6	Like it
7	Really like

Source: 3 Hedonic scale. **(Ardianto, *et al*, 2019).**

VI. PROXIMATE ANALYSIS OF DRAGON FRUIT

A high nutritional content has the potential to prevent a variety of ailments. According to this research, dragon fruit's premature stem has more nutrients than the mature stem. By focusing on the chemicals in the premature stem, this selection of vitamins and minerals from the immature stem has a considerable nutritional quality that enhances the health and therapeutic potential. Red pitaya has the potential to be a valuable economic resource. The dragon fruit's premature stem has higher values than the developed stem, which may aid in reducing the risk of certain illnesses **(Ruzainah*et al.,* 2009).**

VII. SENSORY EVALUATION

The sensory qualities of dragon fruit products were investigated. The colour, flavour, turbidity, and overall acceptability of Dragon fruit products were tested. A panel of 10 semi-trained individuals employed a 9-indicate Hedonistic measure to assess their sensory attributes **(Islam et al., 2012).** A 9-point hedonic scale was utilised, with scores ranging from 9 = strongly like, 8 = very much like, 7 = moderately like, 6 = somewhat like,5 = neither like nor dislike; 4 = dislike mildly; 3 = dislike significantly; 2 = despise aggressively; and 1 = hate violently **(Okokon*et al.*, 2019).**The following essential elements were used to evaluate specific quality features: the external appearance of the product surface, structure, colour, consistency, scent, and taste **(Kamal *et al.,* 2020).**

VIII. STATISTICAL ANALYSIS

The experiment results were gathered and presented as the averages of treble data with deviations from the mean.The results were analyzed using Statistix version 9.0 analytical software, with analysis of variations (ANOVA) and a least significant difference (LSD) post hoc comparison of means at p 0.05. The correlation analysis conducted by Pearson was performed using OriginPro 9 **(Basseye*t al.*,2022).**

IX. IMPACT OF PACKAGING MATERIALS AND STORAGE FACTORS ON SHELF LIFE

Fruit packaging in various materials shows promise in reducing shrivelling and water loss during storage. The following are the various methods for packing dragon fruit: When stored in perforated plastic bags at 4.5°C, the fruit quality lasted 25-30 days, yet when maintained at the ambient temperature, the storage period remained less than ten days.The packaging has a shelf life of 18 and 21 days, with deterioration rates of under 5% and 10%, respectively. Fruit stored in a non-perforated plastic bag at five °C offered the best results, with less degradation and less chilling injury.However, when combined with decay-controlling techniques during storage, plastic bags with perforations can help to decrease weight loss. There was no substantial variation in shelf life among the two materials for packaging. Furthermore, plastic cups increase the fruit's quality by preventing petals from being damaged or broken in transit, interacting with, or storing.The PLW is highly essential during storage and handling. It is necessary to employ appropriate packaging materials and effective decay management measures that prevent weight loss and extend shelf life during storage. The packing material must also be low-cost, easily accessible, and environmentally friendly**(Jalgaonkar*et al.,* 2022).**

X. STORAGE STUDIES

Colour, flavour, texture, TSS, and pH changes were observed at one-month intervals during storage. All product metrics were satisfactory up to the fourth month of storage; however, the quality of the products degraded, with off-flavour created and pH decreasing for all items. It demonstrates that the shelf life of these products is at most four months **(Islam*et al.,* 2012).**

TABLE 1 COMPARISON TABLE

Author name	Year	Statistical analysis	Proximate analysis	Sensory evaluation	Storage studies
Islam	2012	✓	-	✓	✓
Okokon	2019	-	✓	✓	✓
Dao	2023	✓	-	-	-
Wu	2006	✓	-	-	-
Bassey	2022	✓	-	-	-
Ruzainah	2009	-	✓	-	-
Vishakha	2021	✓	-	✓	-
Naika	2021	-	-	-	✓
Castro	2021	✓	-	✓	-
Patel	2023	-	-	-	✓
Kamal	2020	✓	-	✓	-
Faridah	2020	✓	-	✓	-
Nurfirdausi	2023	-	✓	✓	-
Jalgaonkar	2022	-	-	-	✓
Yen	2022	✓	-	✓	-

XI. CONCLUSION

Dragon fruit contains minerals, glucose, fructose, dietary fibre, and vitamins(**Hossain *et al.*, 2021).**It is a new fruit crop in nations such as India, and its production area is expanding. Although fresh fruit is only available seasonally and locally, there is a significant opportunity for national and global marketing. Due to its nutritional and functional qualities, Pitaya can aid in preventing chronic diseases. This article offered detailed information on using dragon fruit and its derivatives in food manufacturing and value-added products. Currently, developed treated pitaya goods are uncommon on marketplaces, and further research needs to be conducted to enhance their commercial viability.Although fruit pulp is being used to create a variety of goods with added value, there appears to be a considerable shortage of advertising for such FOOD REVIEWS INTERNATIONAL 21 items globally.Focusing on this area could help make dragon fruit goods more accessible to the general public. Furthermore, it is imperative to optimise mechanisation to prepare additional value for dragon fruit goods regarding environmental health and productivity capability. At the same time, the manual process has been employed previously **(Jalgaonkar*et al.*, 2022).**Processed dragon fruit goods are rare in our markets, and more research needs to be conducted in our country on dragon fruit processing. If quality dragon fruit products are developed, they may be embraced by consumers who enjoy dragon fruit all year **(Islam*et al.*, 2012).** Dragon fruit quality can be evaluated. They are using physical, chemical, microbiological, and organoleptic tests. Physical tests include colour and total dissolved solids; chemical tests include antioxidant activity, pH, acid content, and alcohol concentration; and organoleptic tests evaluate colour, scent, and taste **(Batubara *et al.*, 2022).**

REFERENCES

1.Virendra, F., Amit, Z., Gaikwad, D. M., & Nikhil, A. (2018). Studies on ready to serve (RTS) beverage from dragon fruit. *International Journal of Processing and Post Harvest Technology*, *9*(2), 55-59.

2.Prisa, D. Pitahaya a New Superfood: Cultivation Methods and Medicinal Properties of the Fruit.

3. Islam, M. Z., Khan, M. T. H., Hoque, M. M., & Rahman, M. M. (2012). Studies on the processing and preservation of dragon fruit (Hylocereusundatus) jelly. *The Agriculturists*, *10*(2), 29-35.

4. Wu, L. C., Hsu, H. W., Chen, Y. C., Chiu, C. C., Lin, Y. I., & Ho, J. A. A. (2006). Antioxidant and antiproliferative activities of red pitaya. *Food chemistry*, *95*(2), 319-327.

5. Naika, B. N., &Praveenakumar, S. G. (2021). Standardization of protocol for dragon fruit (Hylocereuspolyrhizus L.) squash.

6. Ruzainah, A. J., Ahmad, R., Nor, Z., & Vasudevan, R. (2009). Proximate analysis of dragon fruit (Hylecereuspolyhizus). *American Journal of Applied Sciences*, *6*(7), 1341-1346.

7. Li, X., Zhang, Z. H., Qiao, J., Qu, W., Wang, M. S., Gao, X., ... & Qi, X. (2022). Improvement of betalains stability extracted from red dragon fruit peel by ultrasound-assisted microencapsulation with maltodextrin. *Ultrasonics Sonochemistry*, *82*, 105897.

8. Al-Radadi, N. S. (2022). Biogenic proficient synthesis of (Au-NPs) via aqueous extract of Red Dragon Pulp and seed oil: Characterization, antioxidant, cytotoxic properties, anti-diabetic anti-inflammatory, anti-Alzheimer and their anti-proliferative potential against cancer cell lines. *Saudi Journal of Biological Sciences*, *29*(4), 2836-2855.

9. Castro, J. C., dos Anjos, M. M., Hoinatski, A., Klososki, S. J., Mikcha, J. M. G., Matshushita, M., ... & de Abreu Filho, B. A. (2021). Dragon fruit (Hylocereusundatus Haw.) jam: Use full, development and characterization. *Research, society and Development*, *10*(7), e6510716255-e6510716255.

10. Vishakha, M. S., &Dunkwal, V. (2021). Formulation of refreshing drink using dragon fruit (Hylocereusundatus) as an immunity booster. *The Pharma Innovation Journal*, *10*(3), 80-83.

11. Jalgaonkar, K., Mahawar, M. K., Bibwe, B., &Kannaujia, P. (2022). Postharvest profile, processing and waste utilization of dragon fruit (Hylocereus Spp.): A review. *Food Reviews International*, *38*(4), 733-759.

12. Faridah, A., Holinesti, R., Azhar, M., Cahyani, N., &Syukri, D. (2020). Short Communication The Optimization of Recipe on the Production of Natural Jam from the Peel of Dragon Fruit (Hylocereuspolyrhizus). *Pakistan Journal of Nutrition*, *19*(4), 212-216.

13. Sharma, S. C., Mittal, R. A. M. E. S. H., Sharma, A. M. I. T. A., & Verma, V. I. K. A. S. (2021). Dragon fruit: A promising crop with a growing food market that can provide profitable returns to farmers. *Int. J. Agric. Sci. Res*, *11*, 1-14.

14. Perween, T., Mandal, K. K., & Hasan, M. A. (2018). Dragon fruit: An exotic super future fruit of India. *Journal of Pharmacognosy and Phytochemistry*, *7*(2), 1022-1026.

15. Fitri, Z. E., Baskara, A., Madjid, A., & Imron, A. M. N. (2022). Comparison of Classification for Grading Red Dragon Fruit (HylocereusCostaricensis). *Jurnal Nasional Teknik Elektro*, 43-49.

16. Patwary, M. A., Rahman, M. H., Barua, H., Sarkar, S., &Alam, M. S. (2013). Study on the growth and development of two dragon fruit (Hylocereusundatus) genotypes. *The Agriculturists*, *11*(2), 52-57.

17. Sulistyowati, E., Ningsih, R. P. A., Trinata, Y. P., Suharyanto, S., &Soetrisno, E. (2023). Salad dressing soft candy made of dairy goat milk with the addition of red dragon fruit (hylocereuspolyrhizuz): Nutritional content, physical and organoleptic properties. In *E3S Web of Conferences* (Vol. 373). EDP Sciences.

18. Patel, D. P., Bisen, A., & Sukul Singh Porte, P. L. (2023). Dragon fruit: A health potential and remunerative fruit crop for Chhattisgarh.

19. Dao, T. P., Nguyen, L. P. U., Le, D. T., Tran, T. Y. N., & Huynh, X. P. (2023). Effects of pectinase treatment on the quality of red dragon fruit (Hylocereuspolyrhizus) juice. *International Food Research Journal*, *30*(4).

20. Nurfirdausi, A., Aini, N., &Dwiyanti, H. (2023, June). Characteristics of gluten-free cookies from konjac, jack beans and dragon fruit (Hylocereusundatus). In *IOP Conference Series: Earth and Environmental Science* (Vol. 1200, No. 1, p. 012025). IOP Publishing.

21. Agbor, G. A., Vinson, J. A., & Donnelly, P. E. (2014). International Journal of Food Science, Nutrition and Dietetics (IJFS) ISSN 2326-3350.

22. Ardianto, E. T., Subaktilah, Y., Widiyawati, A., &Elisanti, A. D. (2019, December). BISCUIT ORGANOLEPTIC TEST OF DRAGON FRUIT (HYLOCEREUS POLYRHIZUS) AND MORINGALEAVES FOR ANEMIA. In *Proceeding of the 1st International Conference on Food and Agriculture* (Vol. 2).

23. Yen, T. T., Quan, T. H., Nhung, H. T. H., Tram, G. P. N., Karnjanapratum, S., &Benjakul, S. (2022). Development of antioxidative red dragon fruit bar by using response surface methodology for formulation optimization. *Applied Food Research*, *2*(2), 100173.

24. Widyaningsih, A., Setiyani, O., Umaroh, U., Sofro, M. A. U., & Amri, F. (2017). Effect of consuming red dragon

fruit (Hylocereuscostaricensis) juice on the levels of hemoglobin and erythrocyte among pregnant women. *Belitung Nursing Journal*, *3*(3), 255-264.

25. Okokon, E. J., &Okokon, E. O. (2019). Proximate analysis and sensory evaluation of freshly produced apple fruit juice stored at different temperatures and treated with natural and artificial preservatives. *Global journal of pure and applied sciences*, *25*(1), 31-37.

26. Kamal, L. E. G. R. I. N. E., Djahida, B. E. N. A. O. U. A. N. A., & Dalila, A. B. D. E. S. S. E. M. E. D. (2020). Physicochemical characterization and sensory analysis of jams produced from Opuntia ficus-indica cladodes. *Asian Journal of Pharmaceutical and Clinical Research*, *13*(12), 69-72.

27. Bassey, E. J., Cheng, J. H., & Sun, D. W. (2022). Thermoultrasound and microwave-assisted freeze-thaw pretreatments for improving infrared drying and quality characteristics of red dragon fruit slices. *Ultrasonics Sonochemistry*, *91*, 106225.

28. Hossain, F. M., Numan, S. M. N., & Akhtar, S. (2021). Cultivation, nutritional value, and health benefits of Dragon Fruit (Hylocereus spp.): A Review. *International Journal of Horticultural Science and Technology*, *8*(3), 259-269.

29. Batubara, S. (2022). Study on Kombucha Tea From Dragon Fruit Peel Potential as a High-Antioxidant Functional Drink. *Current Developments in Nutrition*, *6*(Supplement_1), 506-506.

Studies on Ice Apple Squash(*Borassus Flabelifer*) and it's Quality Evaluation During Storage -A Review

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***Abstract*— Ice apple is a summer fruit which is widely found in coastal regions of India. The botanical name of ice apple is *Borassus flabelifer.* It is a super fruit highly loaded with nutrient composition and has rich source of vitamins and minerals. It is well known for its anti-inflammatory properties to treat various skin allergies. This fruit contains specific phytochemicals that might contribute to the diabetics for the sugar lowering effect. The present studies were undertaken for the development of squash from ice apple and to improve its availability throughout the year despite its seasonal. The squash was prepared by unique formulation, following pulping of fruit. The pulped fruit was mixed with sugar syrup and preservative in order to concentrate for 10 – 20 minutes at simmer. The product had appealing colour, taste and consistency. Sensory evaluation is carried out to assess the product's increased shelf life period. The shelf life of the squash can be up to 6 months.**

Keywords—Ice apple, squash, anti-inflammatory, phytochemicals, shelf life.

I. INTRODUCTION

Borassus flabellifer, generally known as double win, palmyra, Palm, cod win, toddy win, vine win, or ice apple in Southeast Asia including the Indian key and Nepal, India, Bangladesh, Sri Lanka, Cambodia, Laos, Burma, Thailand, Vietnam, Malaysia, Indonesia, Philippines. It's presumably natural. Manufactured in Pakistan, Socotra and corridor of China. Borassus flabellifer, generally known as nung, is a hardytree.It's generally linked by its growing characteristics. Wood reaches heights of 30 measures(98 bases) and lives over 100 time. In the early stages, youthful Palmyra triumphs grow sluggishly. But it grows briskly with age. Loop and cover with splint injuries. Dozens of blue-green leaves can be seen. Spread the leaves transversely his 3 m(9.8 bases). girdled by splint scars. The large box of the tree resembles the box of a coconut wood. Squash(cordial in British English, dilute juice in Scottish English, dilute in Hiberno English)(1) is a concentrated saccharinity soft drink used in the manufacture of potables. It's generally fruit seasoned and made with fruit juice, water and sugar or a sugar cover. ultramodern pumpkins may also contain food coloring and fresh seasonings. Some traditional gourds contain herbal excerpts, most specially elderflower and gusto. Adulterate the pumpkin with a certain quantum of water or carbonated water and drink. The quantum of water you add is a matter of taste, and the more adulterated the squash, the less potent it'll be. As a drink mixer, you can combine it with alcoholic potables to make amalgamations. Citrus fruits(particularly oranges, limes, and failures), or fusions of fruits and berries, are generally used as the base for squash. It's seasoned with currants. snorts and blackberries are popular in Eastern Europe, and currants are a common component in the Netherlands. can be Mix double strength pumpkin with a thicker traditional liqueur at a rate of 1part concentrate to 9 corridor water. Some pumpkin concentrates are veritably weak and may be mixed at a rate of 1part concentrate to 2 or 3 corridor water. utmost liqueurs and squash are intended for shelf storehouse and thus contain preservatives similar as potassium sorbate and(in traditional liqueurs) sulfites. is longer. nevertheless, some people choose to store pumpkins in the refrigerator. Borassus flabellifer, commonly known as double palm, palmyra, Palm, cod palm, toddy palm, vine palm, or ice apple in Southeast Asia including the Indian subcontinent and Nepal, India, Bangladesh, Sri Lanka, Cambodia, Laos, Burma, Thailand, Vietnam, Malaysia, Indonesia, Philippines. It's probably natural. Manufactured in Pakistan, Socotra and parts of China.



FIGURE: 1Source: https://www.timesfoodie.com/nutritional-facts/ice-apple-or-tadgola-health-benefits/90779122.cms

II.ORIGIN AND DOMESTICATION

- Kingdom: Plantae
- Clade: Tracheophytes
- Clade: Angiosperms

- Clade: Monocots
- Clade: Commelinids
- Order: Arecales
- Family: Arecaceae
- Genus: Borassus
- Species: B. flabellifer

The ice apple is popular in India, where it may have began, and it's grown in Vietnam, Cambodia, Sri Lanka, Pakistan, Malaysia, Thailand, Singapore, regions of tropical Africa, as well as in Hawaii and Florida. The fruit has different names across different areas of India, like in Tamil Nadu, where it's known as nungu. It's also known as palm fruit. The ice apple is truly dark purple in colour when ripe. The size of the fruit makes it slightly act an eggplant, although its texture is similar to that of a coconut. high season for these fruits is between May and August, which is also when they're most readily available from road merchandisers.

III.NUTRITIONAL VALUES

Ice apple fruit is low calorie fruit which is rich in carbohydrates, calcium and phytochemicals. It's a great source of vitamin C, A, E, K, B7 and minerals including phosphorous, zinc, iron and calcium. this fruit doesn't contain fat and cholesterol. this fruit is considered as line due to presence of high water content.

TABLE I. NUTRIENT VALUES

Nutrient	**Measure(per 100g)**
Calorie	40g
Carbohydrates	9g
Fat	-
Sodium	-
Dietary fibre	10g
Sugar	-
Protein	-
Potassium	-
Cholestrol	-
Vitamin A	-
Vitamin C	8%
Calcium	26%
Iron	2%

This fruit act as a coolant due to presence of high water content so they help dehumidification. The sweet fruits are high source of energy and prevents heat stokes. these fruits also replace minerals which are lost through sweat and it maintains the electrolyte balance of the body. Since the fruit is rich in vitamin C, it boosts the vulnerable system and support the body's cellular system. It also strengthens the capability to fight against complaint causing pathogens. Vitamin c preserves skin from problems like heat rashes by precluding free radical damage and gives cooling effect. Ice apples are ideal apple for weight loss, rich in antioxidants, prevents constipation and good for digestion. As they're rich in phytochemicals, it possesses strong antioxidant parcels that are useful in decelerating down the geriatric process and reduces the threat of heart problems. these apples ado contain rich quantum of potassium which helps to cover cover liver from damage by sanctifying the poisons out of the body. The addition of ice apple fruit diurnal diet eases the digestion and reduces nausea feeling for pregnant women. The combination of antioxidants and phytochemicals in this fruit also helps in reducing colorful stress makers stimulated by brain in our body. Diabetes is a habitual condition that affects the body by too important sugar in the blood. the colorful studies indicate that consumption of apples can reduce diabetes.

III.MATERIALS AND METHODS

1)Materials required

The trial was conducted in the laboratory in the department of food processing and preservation technology, Avinashilingam university, Coimbatore, India. The fresh and well canted ice apple(Borassus flabellifer) and sugar collected from the original request were used in the study. Citric acid and potassium met bisulphite(KMS) needed were used from the laboratory.

2)Extraction of ice apple juice

Fresh and completely ripe ice apple was used for birth of juice. Tender Ice apples are removed from the shell and sliced into small pieces. The slices were made into juice. the juice was uprooted using a high electric tippler. The uprooted juice was strained duly. juice was pasteurized at 82 degrees Celsius. after pasteurisation the juice was cooled duly.

3) Preparation of ice apple juice

Juice, sugar, citric acid and KMS were counted independently. Water was measured with the volume of juice according to the computation. small volume of water was taken out from the measured volume of water to dissolve KMS latterly. sugar and citric acid were mixed with water and hotted to prepare saccharinity. also the saccharinity is filtered and cooled. Measured juice was also mixed with the sugar saccharinity. also KMS result was added. it was mixed completely and squash was prepared. I was also poured in castrated glass bottle and limited. The ice apple squash was stored at room temperature.

V.PRESERVATION

Jams, jellies and squashes are preserved by sugar and also used sodium metabisulphite . Why we are using Sugar draws out moisture from the microbes and so kills them. Sodium benzoate ,sodium metabisulphite are common used as chemical preservatives in foods it is generally check the growth of microorganisms .Actually the Sodium metabisulphite or sodium pyrosulphite It is used as a food additive mainly the preservatives are used to preserve the food are increasing the shelf life. The code of preservatives identified as E223. Sometimes the additives may cause health issues like Allegri, skin irritation . excema; gastric irritation and asthma like that.. It is no need for childrens . The preservatives are present in many dilutable squashes. It was commonly used in home brewing preparations the sanitize equipment. It is used a cleaning agent for potable water reverse osmosis membranes in desalination systems. It is used also to remove chloramine from drinking water after treatment. The brand Stump it is used in almost a pure form (98%)

to caused by degradation of lignin, creating pores for fuel adsorption, and consequently, ignition.

VI.CONCLUSION

The present studies conclude about the medication of squash using ice apple. The damage of squash the main reason damage of immature fruit. The squash prefer in youthful and immature stages.. operation of sodium metabisulphite it's used as a preservative in the squash medication" Uholmal" offers superior yield in terms of zquality, and reduced fruitly infestation in squash Although, squash is easy to prepare locally and is effective for the operation of fruit cover, it requires further frequent operations more labour cost and empty in fruit cover operation options. The unborn sweats is may to reduce the cost of operation. The main motive is to give the food product in the healthy way to be satisfied the client and cover terrain. The present studies conclude that the ice apple squash can be reused and saved successfully. Hence developing ice apple squash are economically feasible of approach for getting fruitful returns.

REFERENCE

[1]Bijlani, Samhita, Shanbhog, Ragavendra,Godhi,Brindha , Talwade, Priyanka,Tippeswamy.H, Godhi,Brinda, Suhas, Tippeswamy.HM “An evaluation of ice apple water,and propolis as a storage to preserve to viability of human periodontal ligament fibroblasts”,Journal of the Indian society of Predodontis &Prevenive Dentistry, Apr –Jun 2022.

[2]Tharmaratnam V,Comparative nutritional analysis of fresh preserved palmyrah young fruit(Ice apple),Uva wellassa University,Sri Lanka,2016.

[3] SH Choi, SY Baek ,SH Yeo ,” Rapid fermentation on freeze-concentraed ice apple wine by a sugar tolerant yeast,Saccharomyces cerevisiae SS89”, Korean journal of Food …,2012

[4] S Bijlani, R Shanbhog,BS Godhi, P Talwade ,”An In Vitro evaluation of ice apple water,Aloe vera, and propolis as a storage medium to preserve viability of Human periodontal ligament fibroblasts ,Journal of Indian society of Predodontis & Preventive Dentistry , 2022.

[5] S Siju &K.K.Sabu,”Genetic resources of Asian palmyra palm (Borassus flabllifer L.): a comprehensive review on diversity characersization and utilization”,Cambridge university,8h January ,2021.

[6] Anitha C.S “Coolers au naturel”,THE HINDU,march 31 ,2011.

[7] PC Vengaiah,S Kaleemulla,M Madhava,A Mani and B Sreekanth” Palmyrah fruit(Borassus flabellifer L.): Source of immunity and healthy food: A review ,The pharma innovation Journal ,2021.

[8] Ruby rani,Vishwa Vandhu Patel,H.P.Maheshwarappa”Perspecive of Planation crops in Bihar with Special reference to coconut and palmyrah,Taylor & Francis group and infroma business,2020.

[9] B.S.Sandeep,T.C.Kishor Mohan& K Murugan” Purification and kinetic characterization of polygalacturonase-3 from palmyrah palm(Borassus flabellifer L),Springerlink,20 March 2013.

[10] U Rinas”Canning of palmyrah young fruit kernel (Ice apple)using in palmyrah sweet toddy)”, Uvawellassa university, Sri Lanka,2013.

A Review on Fruit Leather Production from Raw Materials to Application

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ABSTRACT

Having natural flavours and healthful attributes, Fruit leather, an increasingly popular snack, is being favourably viewed. This paper is a comprehensive research of fruit leather production using traditional fruits such as sapota and dragon fruit. The full contents include raw materials, testing methods, and uses. The purpose is to optimize manufacturing processes and raise fruit leather quality.

Keywords: Fruit, Fruit Leather, Quality and Testing, Sapota and Dragon Fruit

INTRODUCTION

In recent years, the food industry has seen a renaissance of interest in natural, minimally processed snacks as people become more conscious of their health and well-being. Among these, fruit leather emerges as a shining star, enticing consumers with its wonderful taste, vibrant colours, and healthful components. As we dig into the enthralling world of fruit leather, benefits in the modern culinary environment, and the numerous reasons for its growing appeal. Fruit leather combines simplicity and culinary inventiveness. This delectable treat, made from pureed fruits and typically enhanced with natural sugars and additives, is gently dehydrated, giving in a malleable, chewy feel reminiscent of conventional leather. Its rich, concentrated flavour profiles range from acidic berries to gentle tropical fruits, providing a sensory trip with each bite. Furthermore, as society deals with the difficulties of modern existence, convenience takes precedence. Fruit leather confidently fulfils this call, providing a portable, on-the-go snack solution that meets the needs of busy people looking for nutrients without sacrificing quality or taste. Its compact shape and extended shelf-life make it an excellent companion for school meals, business breaks, or outdoor expeditions, filling times of repose with blasts are some of its best properties.

Fruit leather can be made from a wide variety of fruits, but at this point, we will be focusing on two traditional fruits: sapota and dragon fruit. Sapota, also known as sapodilla or baneberry, is a tropical fruit that is native to Mexico and Central America. It has a sweet, malty flavour and a soft, slightly gritty texture. Dragon fruit, on the other hand, is a cactus fruit that is native to Central and South America. It has a unique appearance, with a bright pink or yellow skin and a white or red flesh speckled with tiny black seeds. Dragon fruit has a mildly sweet and slightly tart flavour.

Combining these two fruits in a fruit leather recipe will create a snack that is not only delicious but also packed with nutrients. Sapota is a good source of fibre, vitamin C, and iron, while dragon fruit is high in vitamin C, fibre, and antioxidants. Together, these fruits will create a fruit leather that is both sweet and tangy, with a unique and exotic flavour. Making fruit leather at home is a simple and easy process, and it allows you to control the ingredients and sweetness level.

BENEFITS OF USING FRUIT LEATHER

Based on the search results, the key benefits of fruit leather include:

1. **Nutritional Benefits:**
   - ✓ Fruit leathers are infused with natural fibres, vitamins, minerals, and antioxidants from the fruit, providing essential nutrients.
   - ✓ The drying process helps concentrate the nutrients compared to the original fresh fruit.
   - ✓ Fruit leathers can be a healthy alternative to sugary snacks, especially for diabetics when made without added sugar.

2. **Digestive and Skin Benefits:**
   - ✓ The natural fibre content in fruit leathers helps improve digestion and cleanse the digestive system, which can also benefit skin health.1
   - ✓ Consuming fruit leathers can aid in weight management by providing a filling, low-calorie snack option.

3. **Convenience and Versatility:**
   - ✓ Fruit leathers are portable, shelf-stable snacks that are convenient for activities like school, camping, and hiking.
   - ✓ They can be made from a variety of fresh, frozen or canned fruits, allowing for creative flavour combinations.
   - ✓ Homemade fruit leathers allow control over ingredients and sugar content compared to store-bought options.

TESTING METHODS IN FRUIT LEATHER

1. Total Soluble Solids (TSS): This metric determines the concentration of dissolved solids in fruit leather, predominantly sugars, and is often given in degrees Brix. TSS is calculated with a refractometer, which measures the bending of light as it passes through the sample. Higher TSS scores typically suggest sweeter fruit leather.

2. Overall Titratable Acidity (TTA): TTA quantifies the overall quantity of acid in the fruit leather, which is primarily organic acids like citric, malic, and tartaric acid. It is determined by titrating the sample with a standardised base solution (often sodium hydroxide) to a particular endpoint while using a pH indicator such as phenolphthalein or bromothymol blue. TTA is calculated as a percent of citric acid or another standard acid.

3. Fixed Acidity: Fixed acidity refers to non-volatile acids in fruit leather that do not



Figure:1 Sapota

Evaporate when heated. These acids help to determine the product's tartness and flavour profile. The fixed acidity of a sample is determined by titrating it with a standardised base solution, much like TTA.

4. Volatile Acidity: Volatile acidity is a measure of the amount of volatile acids, such as acetic acid, that can evaporate when heated. Excessive volatile acidity may suggest fermentation or spoilage in the fruit leather. It is determined by distilling the sample and then titrating the distillate with a standardised base solution.

5. pH: pH assesses the acidity or alkalinity of the fruit leather on a scale of 0 to 14, with 7 indicating neutrality. A pH below 7 implies acidity, while a pH greater than 7 indicates alkalinity. pH influences the texture, flavour, and shelf life of a product. It's measured with a pH metre or pH indicator strips.

6. Vitamin C (Ascorbic Acid): Vitamin C, a vital component found in fruits and vegetables, is known for its antioxidant effects. It degrades with time, particularly when exposed to heat, light, and air. Fruit leather's vitamin C content can be measured using a variety of methods, including iodometric titration, spectrophotometric analysis, and enzymatic assays.

Figure:2 Dragon Fruit



METHODOLOGY

To create fruit leather utilizing traditional fruits such as sapota and dragon fruit, the first step is to prepare them. This entails carefully washing the fruit and removing any seeds or unpalatable components. Sapota skin can be left on or removed according to personal desire. Dragon fruit skin is normally not eaten and should be removed.Once the fruit is prepared, puree it in a blender or food processor until smooth.Depending on how sweet the fruit is, you may need to add a tiny bit of sweetener like honey or agave nectar. Addition of stabilizers such as gelatine, corn starch etc are optional in this process. It is critical to taste the fruit mixture before spreading it on a baking sheet to ensure that the proper sweetness is reached.

Spread the fruit puree thinly and evenly on a prepared baking sheet. To prevent fruit leather from sticking to the baking sheet, use a Silpat or parchment paper. It is critical to spread the puree thinly enough to achieve a leathery texture, but not so thin that it becomes brittle.The baking sheet should then be

placed in an oven or dehydrator at a low temperature, usually about 140-150°F (60-65°C), for 6-8 hours. The fruit leather should be checked on a regular basis to ensure that it is drying evenly and without burning.

Once the fruit leather is dry and no longer sticky in the middle, it can be removed from the baking sheet and cut into strips or squares. It can be stored in an airtight container at room temperature for up to a month.It is crucial to note that the cooking time and temperature will vary depending on the oven or dehydrator used, as well as the fruits used in the recipe. To get the ideal texture and consistency, cook time and temperature may need to be adjusted. After the cooking is over the fruit sheet is taken and kept out for cooling at room temperature. And later it is rolled and stored in containers for future consumption.Fruit leathers can be stored for up to 9 months if they are properly dried and wrapped. Fruit should be washed in clean water, peeled, and stones removed. To chlorinate washing water, use 1 teaspoon bleach to 4.5 liters of water.

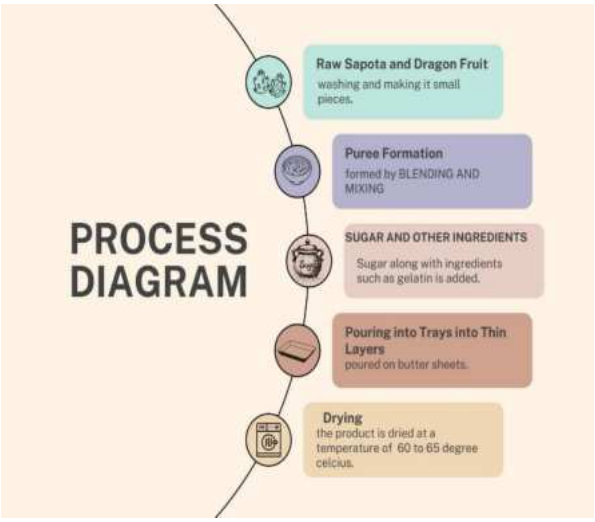


Figure: 3 Flowchart of the Process

APPLICATION

Fruit leathers are a delicious, chewy dried fruit product. It's a simple way to add fruit to your lunch or snack. They are created by placing pureed fruit onto a drying rack and then drying in an industrial dehydrator or oven. They are quite similar to commercial fruit roll-ups and dried fruit sheets, but with less sugar and a more authentic fruit flavour. Fruit leathers can be created with leftover fruits, fruit that is too ripe to keep, surplus fruit pulp from jellies, or canned and frozen fruit. When preparing fruit leather at home, you have control over how much sugar is added. For diabetics, sugar-free fruit leathers are a nutritious snack or dessert option.

Fruit leather has several culinary uses; it is just pureed fruit that has been dried into a chewy, flexible sheet. Its main purpose is to provide a nutritious snack substitute that is high in fibre, vitamins, and natural sugars. Because of its adaptability, it can be creatively used:

- **Snack**: When eaten on its own, fruit leather is a portable, wholesome snack that is perfect for on the go consumption
- **Ingredient**: Its pliability adds flavour and texture, making it a perfect addition for homemade granular bars
- **Topping**: Fruit leather, when cut into strips or tiny bits, is a tasty and vibrant garnish for ice cream, yogurt or muesli
- **Smoothie**: Fruit leather adds a concentrated fruit flavour and a natural sweetness to smoothies.
- **Dessert**: You may improve the taste and appearance of dessert recipes like cakes or cupcakes by adding fruit leather.
- **Lunchbox**: Fruit leather is a great addition to packed meals and a healthier substitute for store bought snacks. It is ideal for school or work lunches.
- **Outdoor Activities:** It is a great option for outdoor activities like hiking, camping, or picnicking because of its portability and durability, which also provides a handy energy boost.
- **Baking:** Fruit leather gives a burst of fruity flavour and wetness when used as a filling for pastries or turnovers.

CONCLUSION

Fresh fruits include high levels of vitamins, minerals, fibre, carbs, and other beneficial substances. Fruit leathers are appealing, colourful, and flavourful products for consumers. Several studies have been conducted to investigate the impact of various preparation procedures, drying conditions, and packaging and storage circumstances on fruit leathers.Most fruit leathers were prepared by sorting, washing, peeling, and removing seeds before being sliced into slices that could be readily pureed or pulped. Purees are cooked, boiled, or blanched in a water bath to deactivate the enzymes. Sugar, pectin, acid, glucose syrup, and colour are commonly added before or during mixing. Potassium met bisulphite, sodium bisulfide. These substances are combined with the fruit puree to create fruit leathers of superior quality, longer storage life, and better organoleptic quality than the original fruit.Drying of fruits into leather will help to reduce the post-harvest losses due to highly perishable nature of the fruits as a result of high moisture content and help in the utilization of seasonal fruits such as Sapota and dragon fruit to extend their shelf life.

REFERENCES

1. C. Raab and N. Oehler, *Making Dried Fruit Leather*, Fact Sheet 232, Oregon State University Extension Service, Tillamook, Ore, USA, 1976.
2. E. Ayotte, *Fruit Leather*, Publication no. P-228, University of Alaska Cooperative Extension Service, Fairbanks, Alaska, USA, 1980.
3. X. Huang and F.-H. Hsieh, "Physical properties, sensory attributes, and consumer preference of pear fruit leather," *Journal of Food Science*, vol. 70, no. 3, pp. E177–E186, 2005

4. https://www.sciencedirect.com/science/article/pii/S0189724115000053
5. Che Man, Y.B,Taufik ,Y.C.M & Karim, M.N.A.(1992).Storage stability of ciko leather.
6. Tropical Science,35, 245-250.

7. Gujar.H.S and G.Khannna 2002.Effect of skimmilk powder.Soyprotein concentrate andsucroseon the dehydration behavior.texture,color,and acceptability of mango leather.

8. S. Vatthanakul, A. Jangchud, K. Jangchud, N. Therdthai, and B. Wilkinson, "Gold kiwifruit leather product development using quality function deployment approach," Food Quality and Preference, vol. 21, no. 3, pp. 339–345, 2010.
9. H. T. Chan Jr. and C. G. Cavaletto, "Dehydration and storage stability of papaya leather,"
10. Raab C., Oehler N. Making Dried Fruit Leather. Tillamook, Ore, USA: Oregon State University Extension Service; 1976. (Fact Sheet 232).
11. Ayotte E. Fruit Leather. Fairbanks, Alaska, USA: University of Alaska Cooperative Extension Service; 1980. (Publication no. P-228).
12. Huang X., Hsieh F.-H. Physical properties, sensory attributes, and consumer preference of pear fruit leather. Journal of Food Science. 2005;70 (3):E177–E186.
13. Diamante L, Li S, Xu Q, Busch J. Effects of apple juice concentrate, blackcurrant concentrate and pectin levels on selected qualities of apple-blackcurrant fruit leather. Foods. 2013; 2: 430-443.
14. Raab C, Oehler N. Making Dried Fruit Leather. USA: Oregon State University Extension Service; 1999.

A Review on Development of Table Top Shallot Peeling Machine

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ABSTRACT:

The aim of this project is to design and develop a compact and cost-effective Shallot peeler suitable for small-scale food processing operations. With the increasing demand for processed onions in various culinary applications, especially in regions where manual peeling is labour-intensive and time-consuming, there is a need for an efficient peeling solution. This project focuses on addressing this need by proposing a mechanical onion peeler that can automate the peeling process while maintaining product quality and minimizing waste. The design incorporates principles of simplicity, affordability, and ease of maintenance to cater to the requirements of small-scale food businesses and entrepreneurs. The project involves conceptualization, prototyping, testing, and optimization phases to ensure the functionality and reliability of the onion peeler. Additionally, considerations for safety, hygiene, and energy efficiency are integrated into the design to meet industry standards and regulations. The successful implementation of this project is expected to contribute to enhancing efficiency and productivity in small-scale food processing ventures, thereby fostering economic growth and sustainability in the food industry.

Key words: Onion peeler, peeling solution, product quality, efficiency

1. Introduction

In the culinary world, shallots are prized for their delicate flavor and versatility in a wide array of dishes. However, the labor-intensive process of peeling shallots has long been a challenge for chefs and home cooks alike. Traditional methods are time-consuming and often result in wasted shallot layers, leading to inefficiency and frustration in the kitchen.To address this issue, a new innovation emerges: the Tabletop Shallot Peeling Machine. This groundbreaking device promises to revolutionize shallot preparation, offering a seamless solution to the arduous task of peeling these small, delicate bulbs. By automating the peeling process, this machine aims to save time, reduce waste, and streamline kitchen operations for professionals and enthusiasts a like. In this paper, we will delve into the design, functionality, and potential impact of the Tabletop Shallot Peeling Machine. From its inception to its practical applications in culinary settings, we will explore how this innovative technology stands to transform the way shallots are prepared and utilized in the kitchen. Join us as we uncover the future of shallot peeling with this groundbreaking invention.

1.1 Evolution of Shallot Skin Peeling Machines

The evolution of shallot skin peeling machines has progressed through distinct stages, beginning with manual methods that relied on labour-intensive processes such as hand peeling with knives. In the mid-20th century, mechanical peelers emerged, employing rotating drums or rollers with abrasive surfaces to expedite the peeling process. These early machines, while more efficient than manual methods, lacked precision and required manual supervision. The late 20th century saw the integration of automation and technological advancements, resulting in automated peelers equipped with sensors and control systems to optimize efficiency and quality. Pneumatic and abrasive techniques gained prominence in the 21st century, offering gentler and more uniform peeling processes. Present-day machines integrate advanced technologies such as machine learning and robotics, enabling adaptive peeling and high-speed processing with minimal human intervention. Throughout this evolution, the focus has been on enhancing efficiency, precision, and scalability to meet the demands of modern food processing operations.



Fig.1 Existing onion peeling machine

1.2 Design principles for peeler

When designing a shallot peeling machine, several key principles must be considered to ensure efficiency, effectiveness, and safety. Firstly, simplicity in design is paramount. The machine should be straightforward to

operate, maintain, and troubleshoot, minimizing complexity to enhance user-friendliness and reduce the likelihood of errors.Secondly, reliability is crucial. Components should be robust and durable to withstand the rigors of continuous operation, minimizing downtime and maintenance requirements. Additionally, incorporating redundancy where feasible can help ensure uninterrupted performance even in the event of component failure.Efficiency is another critical factor. The machine should be designed to maximize throughput while minimizing waste, energy consumption, and operating costs. This involves optimizing the peeling process to achieve high yields and minimizing the need for manual intervention or adjustments.Moreover, safety considerations are paramount. The machine should be equipped with appropriate safeguards to protect operators from hazards such as moving parts, high temperatures, and electrical risks. Clear warning signs, emergency stop mechanisms, and protective enclosures should be implemented to mitigate potential risks effectively. Furthermore, versatility can enhance the machine's utility and appeal. Designing adjustable settings or interchangeable components can enable the peeling machine to accommodate different sizes and varieties of shallots, as well as adapt to varying production requirements or preferences.

2. Operational Mechanism

- **Feeding Mechanism:**

Shallots are loaded into a hopper or feeding tray at the top of the machine.The feeding mechanism ensures a steady supply of shallots into the peeling chamber.

- **Peeling Chamber:**

The peeling chamber is where the actual peeling process occurs.It usually consists of rotating or oscillating rollers or brushes made from materials like food-grade rubber or silicone.These rollers or brushes grip the shallots and rub against their surface, causing the skin to loosen and peel off.

- **Air Blowing System:**

An air blowing system can be integrated into the machine to assist in removing the loosened skin.Compressed air nozzles or fans blow air onto the shallots, helping to blow away the loosened skin particles.

- **Adjustable Settings:**

The machine may feature adjustable settings to accommodate different sizes and varieties of shallots. Settings such as roller/brush speed, air blowing intensity, and peeling chamber dimensions can be customized based on the specific requirements.

- **Waste Collection System:**

A waste collection system gathers the peeled skin particles and directs them away from the peeled shallots. This system ensures cleanliness and prevents the peeled skin from interfering with the peeling process.



Fig.2 Inner surface of the chamber



Fig.3 casing and frame

2.1 Materials used

The materials used for developing a tabletop shallot skin peeling machine may vary depending on the specific design and manufacturer. However, here are the common materials often utilized for different components of such machines

Frame and Casing: Stainless steel is a popular choice due to its durability, corrosion resistance, and ease of cleaning. It provides a hygienic surface for food processing equipment. Aluminum is lightweight yet sturdy, making it suitable for constructing the frame or casing of the machine.

Rollers/Brushes: Rubber rollers or brushes are commonly used for their flexibility and gentle yet effective peeling action. Silicone rollers or brushes offer similar advantages to rubber and are also heat-resistant and easy to clean.

Hopper/Feeding Tray: Hoppers or feeding trays are often made from food-safe plastics such as polyethylene (PE) or polypropylene (PP). These materials are lightweight, durable, and easy to mold into various shapes.

Air Blowing System Components: The nozzles used for directing compressed air onto the shallots may be made from plastic or metal, depending on the specific requirements.Fans used for blowing air onto the shallots may have blades made from plastic or metal.

Electrical Components: Electric motors used for driving the rollers or brushes may have housings made from

materials such as aluminum or plastic.Gears for transmitting motion within the machine may be made from metal alloys like stainless steel or hardened plastics.Control panels may have housings made from plastic or metal, with electronic components mounted inside for controlling the machine's operation.

These materials are selected to ensure the machine's efficiency, hygiene, and compliance with food safety standards. Additionally, they are chosen for their durability, ease of cleaning, and suitability for food processing applications**.**

2.2 Challenges Faced in designing

The development typically involves the utilization of various materials carefully selected for their durability, hygiene, and suitability for food processing. The frame and casing of the machine are commonly constructed from stainless steel, prized for its corrosion resistance and ease of cleaning, ensuring a hygienic surface for food contact. Components such as rollers or brushes, essential for the peeling process, are often made from food-grade rubber or silicone, chosen for their flexibility and gentle yet effective action on the delicate shallots. Hoppers or feeding trays, where the shallots are loaded, may be crafted from food-safe plastics like polyethylene or polypropylene, providing lightweight yet durable structures. For the air blowing system, components such as air nozzles and fans can be made from a combination of plastic or metal, selected based on their performance requirements. Electrical components such as motors, gears, and control panels may feature housings made from aluminum or plastic, ensuring reliability and ease of operation. Overall, these materials are carefully curated to meet the machine's functional needs while adhering to stringent hygiene and food safety standards.

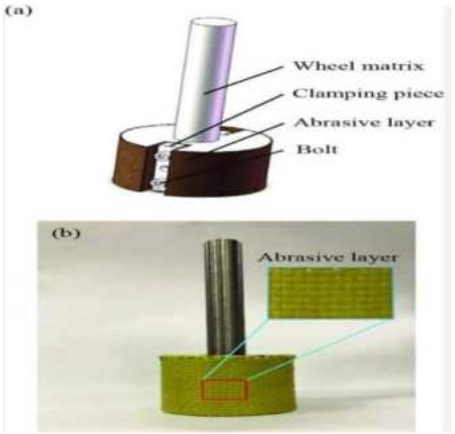


Fig.4 Fabricated abrasive tool

(Development of novel high shear and low pressure grinding tool with flexible composite)

2.3 Solution

The key lies in crafting a user-friendly, efficient, and cost-effective solution that simplifies the shallot peeling process. The design should prioritize ease of use, compactness, and affordability to cater to the needs of home kitchens. The machine would feature a sleek and compact design, making it easy to store and use on kitchen countertops. Utilizing manual operation with a hand-crank or lever mechanism ensures simplicity and eliminates the need for complex electrical components, reducing both cost and maintenance requirements. The peeling mechanism would employ soft and food-safe silicone or rubber rollers to gently remove shallot skins without damaging the delicate bulbs. Adjustable settings would allow users to tailor the peeling process to different shallot sizes, ensuring versatility. The machine's components would be constructed from durable yet affordable materials such as food-grade plastics for the casing and stainless steel for critical parts like the peeling chamber, balancing functionality with cost-effectiveness. Easy-to-clean detachable parts would facilitate hassle-free maintenance, promoting hygiene and user convenience. Clear user instructions would accompany the machine, guiding users on proper operation and maintenance. Through a combination of simplicity, efficiency, and affordability, this small-scale tabletop shallot skin peeler would offer a practical solution for domestic kitchens, streamlining the peeling process and enhancing overall cooking experiences.

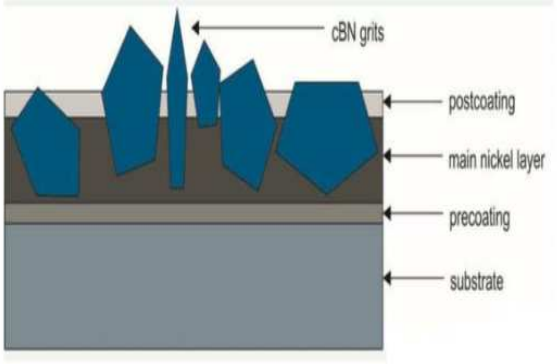


Fig.5 Abrasive layer diagram

(Experimental Analysis for the Use of Sodium Dodecyl Sulfate as a Soluble Metal Cutting Fluid for Micromachining with Electroless-Plated Micropencil Grinding Tools)

3. Factors influencing Machine Efficiency

Design and Technology: The design of the peeling machine and the technology used in its operation play a crucial role in determining efficiency. Machines with advanced peeling mechanisms, such as abrasive rollers or pneumatic peeling systems, tend to be more efficient in removing shallot skins quickly and with minimal wastage.

Speed and Throughput: The speed at which the machine can process shallots and its throughput capacity directly impact efficiency. High-speed machines capable of handling large volumes of shallots per hour are generally more efficient, especially in commercial or industrial settings where rapid processing is essential to meet demand.

Adjustability and Flexibility: Machines that offer adjustable settings to accommodate different sizes and

varieties of shallots are more versatile and efficient. Being able to tailor the peeling process to specific requirements can minimize wastage and optimize yield, improving overall efficiency.

Quality of Shallots: The quality of the shallots being processed can affect efficiency. Shallots that are uniform in size and shape are generally easier to peel efficiently compared to those that are irregular or damaged. Additionally, the freshness and moisture content of the shallots can impact peeling efficiency.

Maintenance and Downtime: Regular maintenance and prompt troubleshooting are essential to ensure optimal performance and minimize downtime. Machines that are easy to maintain, with accessible components and clear maintenance instructions, tend to be more efficient as they experience fewer disruptions due to breakdowns or malfunctions.

Operator Skill and Training: The proficiency of operators in operating the peeling machine can significantly influence efficiency. Well-trained operators who understand the machine's capabilities and operating procedures can maximize throughput and minimize errors, leading to greater overall efficiency.

Waste Management: Efficient shallot peeling machines should minimize waste, both in terms of shallot flesh and discarded skins. Machines that can effectively separate peeled shallots from skins and minimize damage to the edible portion of the shallot contribute to higher efficiency by optimizing yield and reducing waste disposal costs.

4. Emerging trends and future directions

Sustainable Solutions: With increasing emphasis on sustainability, there's a growing demand for shallot peeling machines that minimize energy consumption, water usage, and waste generation. Manufacturers are exploring eco-friendly materials, energy-efficient components, and recycling systems to develop more sustainable peeling solutions.

Smart Connectivity and IoT: Shallot peeling machines are being equipped with smart connectivity features and Internet of Things (IoT) capabilities. This allows for remote monitoring, predictive maintenance, and data analytics to optimize performance, reduce downtime, and enhance overall efficiency. Operators can receive alerts for maintenance needs or performance anomalies, enabling proactive interventions.

Modular and Customizable Design: Modular design approaches are becoming popular in shallot peeling machines, allowing for greater flexibility and customization. Manufacturers are offering modular components and accessories that can be easily integrated or swapped to adapt the machine to different processing requirements, such as handling various shallot sizes or accommodating specific production volumes.

Improved User Experience: User-centric design is a key focus in the development of shallot peeling machines. Emphasis is placed on intuitive interfaces, ergonomic controls, and enhanced safety features to improve the user experience for operators. Clear and user-friendly interfaces enable easier operation, maintenance, and troubleshooting, reducing the learning curve and enhancing productivity.

Hygiene and Food Safety: There's a heightened emphasis on hygiene and food safety in shallot processing equipment. Manufacturers are incorporating features such as easy-to-clean surfaces, sanitary design principles, and antimicrobial materials to minimize the risk of contamination and ensure compliance with food safety standards.



Fig.6 Silicon blades (silicon roller)

5. Conclusion

In conclusion, It represents a significant advancement in kitchen technology, offering a convenient and efficient solution for domestic users seeking to streamline their food preparation process. By leveraging gentle yet effective peeling mechanisms and user-friendly designs, this innovative appliance simplifies the often tedious task of peeling shallots, saving time and effort in the kitchen. With its compact size and easy-to-use features, the tabletop shallot skin peeler seamlessly integrates into home kitchens, providing users with a versatile tool for preparing a variety of dishes. Its adjustable settings ensure adaptability to different shallot sizes, while durable construction and easy-to-clean components promote longevity and hygiene. From everyday meal preparation to special culinary endeavours, the tabletop shallot skin peeler empowers users to enhance their cooking experiences with efficiency and convenience, making it an indispensable addition to any modern kitchen.

6. References

[1] Adnan, N.H. (2010). Design and development of a portable onion peeler machine. M.Sc. Thesis, Faculty of Mechanical Engineering, Indian.

[2] Ishak, M. S. I., & Wan Mohd Ali, W. K. A. (2019). Apparatus for Welding Training Program. Journal of Industry, Engineering and Innovation.

[3] Guldas, M. (2003). Peeling and the physical and chemical properties of kiwi fruit. Journal of Food Processing and Preservation.

[4] Naik, R; S. J. K. Annamali and D. C. P. Ambrose (2007). Development of batch type multiplier onion peeler. Proceedings of the International Agricultural Engineering Conference, Bangkok, Thailand, December 2007.

[5] Nik Hisyamudin Muhd Nor, Mohd Fahrul Hassan, Mohd Hafiz Mohd Ali, Mohd Hafiz Tuparman. (2019). Design and Development of Shallots Skin Peeler Machine.

[6] Haik, Y. &Shahnin, T. M. Engineering Design Process, Problem and Objective Tree Analysis. 2006.

[7] Dieter, E. G. & Schmidt, L. C. Engineering Design. Fifth edition,Mc-Graw-Hill.(2009).

[8] Elsanda Merita Indrawati, HisbullohAhlisMunawi, Agus Suwardono, Rachmad Santoso. Design of Automated Processing Equipment Shallots (PEBMO) To Improve Product Quality Shallots (2019).

[9] Ramadhan, Muhammad Hakam, Wahyu Arif Dharmawan.Diversification of Processed Onion Products as the Iconic Product in Darurejo Village, JombangRegency,(2022).

[10] Rashad A Hegazy, Hussein M Sorour, Ahmed A Ghazy, Atef El-Yamany, Yaser M Hafez. Development of Onion Peeling Machine,(2020).

[11] Annisa Nur Ichniarsyah, Linda Liswanti, Titis PuryPurboningtyas, Yul Harry Bahar, NawangwulanWidyastuti,Performance Test of Shallot Dehuller Machine (Type BEJE PB 01),(2022).

[12] Ravindra Naik Ravindra Naik, SJK Annamali, Dawn CP Ambrose. Development of batch type multiplier onion peeler, (2007).

[13] Marjun Caguay, Lyka Dela Cruz. Development Of Red Onion (Allium Cepa L.) Stem Cutting Machine,(2023).

[14]M Ravi Sankar, VK Jain, J Ramkumar, Abrasive flow machining (AFM): an overview,2008.

[15]Kursad Gov, Omer Eyercioglu, Effects of abrasive types on the surface integrity of abrasive-flow-machined surfaces,(2018).

[16] I nasaki, HK Tönshoff, TD Howes,Abrasive machining in the future,(2017).

[17]M Fryer, D Terwagne, Pedro M Reis, H Nepf, Fabrication of flexible blade models from a silicone-based polymer to test the effect of surface corrugations on drag and blade motion,(2015).

[18]Mohammad Vaezi, Davood Safaeian, Chee Kai Chua,Gas turbine blade manufacturing by use of epoxy resin tooling and silicone rubber molding techniques,2011.

[19]William R Luer, Matthew O Clohisy, Craig A Claire, Dylan L Newcomb, Automatic Onion Peeler,(2016).

[20]Nitin Dixit, Varun Sharma, Pradeep Kumar, Research trends in abrasive flow machining: A systematic review,(2021).

IoT – Based Animal Intrusion Detection System and Diversion by Sound Wave

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Abstract- suffers electrocution with intense pain cause animals too. In forest zone and agriculture field human animal conflict is a major problem where enormous amount of resources is lost and human life is in danger. Due to this people lose their crops, livestock, property and sometimes their lifes. So this zone is to be monitored continuously to prevent entry of wild animals. Adaption of solutions like electric fences, trenches, manual surveillance, guard dogs, etc. to protect the habitat have been proved to be temporary in life span, non- economic, and an unsafe solution for wildlife as well the humans. To initiate safety for both wild animals and humans, some mitigation plan is required to solve this issue. The proposed system aims in protecting human habitation and livestock at the outskirts of the forest area by developing an automated system that detects the intrusion of wild animals and repels them back to the forest without causing any harm. Hence minimizing the dangerous consequences caused by the conflict.

Keywords: Animal detection, PIR sensor, Camera, image processing, sound generator, GSM module

I INTRODUCTION

India holds around 708,273 sq. km of forest area which is almost 21.54% of the total area in our country which is home to nearly 500 species of mammals. India is a agricultural country, agriculture has been India population depends on agriculture, there are still a lot many problem faced by farmers. Human animal conflict is a major problem where enoromous amount of resources is lost and human life is in danger. This eventually led animals to intrude into human habitats for food and shelter causing Human-Wildlife conflicts. Any interaction between humans and wildlife that causes adverse impacts on the social, economic and cultural life of people or wildlife population in the environment was defined as a Human-wildlife conflict by the World-Wide Fund for Nature. In 2020, admits of the pandemic situation caused due to coronavirus, various countries have declared lockdown which has led humans to empty the street and wild animals to take over. Consequently, society is facing many problems but is less concerned with the well-being of wildlife species. Some of the main issues are of life, human habitat damage, crop damage, etc. According to statistical data, on average one person is killed every day due to human-wildlife conflict. In response to that locals do adapt preventive techniques such as illegal installations of electric fencing, trenches to protect their fields and livestock. These solutions have been proved not just temporary but highly unsafe for both wild animals and farmers. Around 1300 wild animals died due to electrocution in India over a decade (between 2010- 2020) which included over 500 elephants, 220 flamingos. Around 60% of elephant deaths are caused due to electrocution, and few elephant calves do get trapped in trenches losing their lives. According to the survey carried out in , most of the wild animal fatality cases are kept unreported/unattended for months showing the overall negligence from the forest department. Even though the government performed numerous drives to eradicate illegal fences to control the overall fatality rate the cases have still occurred and to some extents are kept unreported. This shows that humans and animals both share losses equally. If the presence of these wild animals can be notified in time, these conflicts and fatality rates are likely to reduce. With the evolution in technology, many wild animal repellent systems were invented based on IoT solutions. The Proposed system employs Raspberry Pi board to detect any kind of movement, and trigger the pi cam to capture the scene. Further the object is identified in real time using automated AI solutions like real time intrusion detection build on OpenCV using object detection technique like YOLOv3 and darknet. Once the wild animal is detected the buzzer sound will be emitted in order to repel these wild animals back to the forest without causing any threat to their lives.

II. OBJECTIVES

1. The main objective for mitigating birds and animals damage to crops is to protect agricultural yields while minimizing harm to wildlife and the environment.

2. This project involves implementing which is effective and sustainable methods without causing any harm to animals as well as crops and environment.

3. The main goal is to reduce crop losses, promoting biodiversity and maintaining ecological balance with agriculture ecosystem.

4. The eco friendly approach for mitigating birds and animals damage to crops is through visual scare devices, noise makers or physical barriers. These methods are effective in real time applications because it doesn't cause any damage to animals and environment.

III. REVIEW OF LITERATURE:

The Proposed system employs Raspberry Pi board to detect any kind of movement, and trigger the pi cam to capture the scene. Further the object is identified in real time using automated AI solutions like real time intrusion detection build on OpenCV using object detection technique like YOLOv3 and darknet. Once the wild animal is detected the buzzer sound and flash light will be emitted in order to repel these wild animals back to the forest without causing any threat to their lives. In this section we will be discussing about the backgrounds of various architectures. For Animal Detection based applications, it is of utmost importance that the system monitoring should be efficient and reliable. These applications are used in various scenarios such as Maintaining Livestock, Wild-life Monitoring systems for preventing threatful animals entering the human created areas, behavioral analysis etc.
Tedious time-consuming techniques such as image processing in MATLAB for automated detection of animals were used earlier in. MATLAB is quite ideal but not available to all. For classification and identification of the animals, the NEC animal dataset is considered and pattern(template) matching technique is used to match the targeted image and template image database. Here the Normalized cross-correlation method is used to match these templates. Further the efficiencies are calculated Confusion matrix parameters

With advent of IoT solutions, the technology developed over the aid of different hardware's that generated information of the surrounding to help the machine take decisions and perform the expected outcomes. In the authors have given an overview of IoT-based animal monitoring systems. There are many IoT-based animal repellent systems which give false positives on not just animal but also Human Intrusion in the territory. In the author has proposed a system to locate pet animals in small cities. As we know, pet animal monitoring in smart cities is a challenging problem. Few of the classic approaches to identify the animal and surveillance techniques include air tags, GPS, and RFID. It proves to fail providing the full required level of monitoring and tracking of the pets. These devices have many limitations and costly. This paper has the approach to pet animal tracking on the video stream using deep learning capabilities with the goal to detect and classify the object of interest. But as the number of animals will increase this system will fail in terms of expenses and it will get difficult to monitor outdoor stray animals.

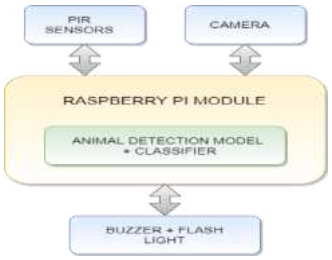
While Deep Learning got popular in 2006 due to advances in computing and labelled training data, many improvements were done in the architecture of neural networks. Before deep learning was widely accepted, computer vision researchers used the traditional machine learning algorithm for automatic detection of animals. These usually involved manual feature extraction and training of the models. This made the necessary requirement of domain knowledge to recognize significant features such as distinctive features of various animal species for Classification task. Earlier Template Matching Algorithm were widely used for animal detection problems. The first complete animal detection system was build using the same . Datasets created which consist the template image and the target image. The target image is matched with the template image with the algorithm. This algorithm moves over the template image over the target image to find the normalized cross-correlation. Eventually the process was tedious and slow which also gave false results in different lighting conditions e.g., during night time.

In 2014, the use of cascaded classifiers got widely popular. For e.g., in the author proposes a system to detect the moose on a stationary roadside placed cameras. The prerequisite for the system was dispense of camera over the targeted area to detect the presence of moose. This algorithm is split into two parts. At first the Ada-boost algorithm + LBP Features are run over the input image to generate region of interest. In second stage the ROI containing moose is run over the generated ROI with HOG-SVM detectors to reject the non-moose ROIs.

Similarly, as CNN got famous in 2016, researchers started using it as the image classifier that transforms an input image of 3D to a vector of classification score . There is a typical sequence of layers used to build the block of CNN including all the convolution, activation, pooling and fully connected layers . CNN gave a great success in computer vision classification task, but was trained to output a single label for an image. In the authors have used same CNN to classify label on videos. Other than Object Recognition, the future problems needed localization of the object in an appropriate position. This localization was represented by annotating a bounding box throughout the frame. This was known as object detection.
In Histogram of directed gradients (HOG) Descriptors are used to discover objects and extract features from images. The image is divided into blocks of small cells and the HOG descriptor is applied to them descriptor is. Histograms are then accumulated and formed on these normalized cell histograms Feature vector. Finally, the image is sent to a cascaded classifier, object. Cascade is a concatenation of classifiers. Output of these classifiers is retrieved and all layers of the window are considered objects Cascades are classified as objects. There is also a distance calculation method for Detected animal. However, the calculation of this distance depends on the height of the camera has been fixed. With the HOG
classifier, authors can achieve an accuracy of 82.5%. Average processing time of 100 milliseconds. The drawback here is that there are no efforts taken to detect animals during the night.

IV. PROPOSED SYSTEM

In this section we will be discussing the architecture of Proposed System. The system mainly focuses in providing an automated wild animal detection and repellent system, for human habitat near forest areas. The local area will be divided into strategic sub areas where the wild animals are likely to enter (suppose society or field). At each location, PIR Sensors will be place to detect intrusion activity by sensing the motions. If motion detection is positive it will initiate the camera to record the live streaming storing it on raspberry media. Further on running the model, only if there is a wild animal detected it will immediately play the buzzer sound and flash lights to divert the wild animal back to the forest preventing the fatal consequences for both the wildlife and humans/livestock caused due to wild animal-human conflicts.



The whole system flow can be divided into three major parts.

1. Training Model with standard datasets (Microsoft COCO)/custom dataset.
2. Building Animal Detection model which works on real time video streaming.
3. Repelling the hazardous intruder (only wild animals if found) without harming

The following are the layers of the Architecture and their specific roles:

A. Raspberry PI:

The Raspberry Pi is a low-cost, compact credit-card sized computer that can be connected to your computer's monitor or TV and uses a standard keyboard and mouse. It's a small device that allows people of all ages to explore computing and learn how to program in languages such as Scratch and Python. From browsing the Internet and playing high-definition video to creating spreadsheets, word processors, and playing games, we can do everything that can be expected from a desktop computer.

For the proposed system we will be using Raspberry PI Zero W. It's a Raspberry Pi model with a largely reduced size of



only 65mm long by 30mm wide and within a very economical price range. With the addition features of wireless LAN and Bluetooth makes the Raspberry Pi Zero

W is ideal for making embedded Internet of Things (IoT) projects.

B. PIR Sensors:

Passive Infrared Motion Sensors (PIR Sensors) comprises of a lens over a pyroelectric sensor which is generally made up with a crystal material that produces a voltage when exposed to any infrared light. That means any object containing any amount of heat will emit some infrared and a single pyroelectric sensor will produce voltage even when everything in view is normal and still. Hence to overcome this false positive two pyroelectric sensors can be connected in such a way that signals from respective infrared cancel out each other. Its only when something large and warm enough moves in front of the lens the two signals will stop cancelling out and the sensors will report motion/movement within its peripherals. Once Figure 02: YOLO V3 Network Architecture

the motion detections happen to be true; it will initiate to switch on the camera to capture live video streaming.

C. Camera:

The camera is connected to the Raspberry Pi module to initiate live streaming and capturing the video under Raspberry Pi media. The precision and confidence level the model solely depends on the resolution and camera calibrations. The camera position and the height from the ground should be firm and fixed.

Animal Detection Model:

This model will detect the animal species in the video using the yolo algorithm. This algorithm for object detection is based on regression. It is known to predict classes and bounding boxes for the whole image in one run of the algorithm. In the proposed system we will be using YoloV3 with Darknet Architecture. YOLO V3 is an improved version among the YOLO detection network family. In contrast to previous versions, it features multi-scalar detection, a stronger feature extractor network, and few modifications in the loss function. As a consequence, this network can now detect many more targets from big to small just like any other SSDs, YOLO V3 also runs quite fast and makes real-time inference possible on GPU devices. Motivated by ResNet and FPN (Feature-Pyramid Network) architectures, YOLO-V3 uses a feature extractor is called Darknet-53. Each of these layers processes the image at a different spatial compression.

D. Buzzer and Flash Light:

The Buzzer and Flash light are connected to the Raspberry pi module. On confirmation detection of the Wild animal intrusion, Buzzer alarm with flash light will be initiated to divert the wild animal back to its habitat without physically harm or causing life threating conceptions to animals or humans in any scenario.

V. IMPLEMENTATION AND EXPERIMENTAL RESULTS

For implementation we need to consider software than be integrated to our Raspberry Pi modules. As we know Raspberry Pi is a mini computer, we need an operating system for the same. Raspbian Buster Lite is an ideal Operating system to our Raspberry pi module. For ease we can opt for installing it on SD Card using Etcher(balenaEtcher). In the proposed system as we need to access just the command lines, we can download and install the lite version instead of the user interface. For Programming the logics and functionalities we shall beusing OpenCV with Python 3.

Data Preparation:

There are many online sources to obtain datasets. Few of the most commonly used datasets used on YOLO are Pascal VOC, Microsoft COCO and google open images V6. In this proposed we have used only COCO dataset. As we know COCO offers its user to have 80 classes detected, few target classes might not be included according to the varied requirements of the project. If these classes are not included, we need to manually download images files and create xml files that contains annotations for training the Animal detection We will be using combine the datasets and have a greater numberof images for better training.

Building the Animal Detector:

A pre-trained convolutional neural network named YoloV3 will be used for object detection in our proposed system. The output will be a series of bounding boxes (bboxes) around the

detected object. We can associate multiple bboxes with the same object. For example, one can be around the animal's head and the other can be associated with other body parts. Further a common non-maximum suppression technique to merge duplicate bboxes of the same object to get the best bounding box. Yolo is trained to classify common objects such as bicycles and dogs, but is not specifically trained to classify livestock or some wild animals. We will be using OpenCV Libraries to load the image/video

Steps Involved in building the Animal Detection Model:

1) Load dependencies
2) Set up the Neural Network
3) Load the dataset
4) Convert BGR images to RGB images
5) Set Non maximal Suppression Threshold for the best bounding box
6) Set Intersection Over Union threshold.
7) Detect the object using utiles module.

Results: we see the implementation for and image. Performance matrix considered here is Confidence score and time take to detect the animal. we see the same model implemented in real time with the help of the web cam. Note: While working with video streaming, we need to consider that the confidence score may vary due to poor video resolution or night scenarios. This can be improved by the Method of edge detection.

VI. CONCLUSION

As the human population spreads around the world and we infiltrate the wilderness. Wildlife on the other hand find natural habitats destroyed and migration routes blocked. Humans and wildlife have become increasingly conflicting about living space and food, causing personal injury, loss of income from crop attacks and predation by livestock, and even loss of life. Wildlife can be killed in defenses and retaliation, and support for protection can be diminished. Human-wildlife conflict is a global issue. From elephants eating crops in India, Tigers being predators of Nepalese livestock, to polar bears invading trash cans in Arctic villages. Finding a safe way to live with wildlife is important. Along with education, profit sharing schemes and better land use planning, many technologies have been developed to help reduce human-wildlife conflict. These include electric fences and ditches that act as barriers between humans and wild animals, and flashlights and guard dogs that prevent wildlife from human settlements and their possessions. But this might physically hurt the animal. Hence to avoid hampering both the safeties the proposed architecture promises a new platform to ensure conservation of trespassed wild animal and also the human settlements.

REFERENCE

[1] Saxena A., Gupta D.K., Singh S. “An Animal Detection and Collision Avoidance System Using Deep Learning.” In: Hura G., Singh A., Siong Hoe L. (eds) Advances in Communication and Computational Technology, Springer,2020.

[2] T. Fan, R. Sadeghian and S. Aram, "Deer-Vehicle Collisions Prevention using Deep Learning Techniques, “In Preceding of IEEE Cloud Summit, 2020.

[3] Z. Zhao, P. Zheng, S. Xu and X. Wu, "Object Detection with Deep Learning: A Review," In Preceding of IEEE Transactions on Neural Networks and Learning Systems, 2019.

[4] Amr Mohsen Jadi, “Implementing a Safe Travelling Technique to Avoid the Collision of Animals and Vehicles in Saudi Arabia” In Preceding of International Journal of Advanced Computer Science and Applications,2019

[5] Sk. Nayab Rasool, T. SR.CH.Murthy, “Wildlife Monitoring in Zoological Parks Using RASPBERRYPI and Machine Learning” In preceding of International Journal of Recent Technology and Engineering(IJRTE),2019.

[6] C. Bhagya and A. Shyna, "An Overview of Deep Learning Based Object Detection Techniques," In Preceding of 1st International Conference on Innovations in Information and Communication Technology (ICIICT), 2019.

[7] N. Banupriya , S. Saranya, Rashmi Swaminathan, Sanchithaa Harikumar, Sukitha Palanisamy, “Animal Detection using Deep Learning Algorithm”, In Journal of Critical Review, 2020.

[8] Yu-Huei Cheng,” A Development Architecture for the Intelligent Animal Care Management System Based on the Internet of Things and Artificial Intelligence”, in Preceding of International Conference on Artificial Intelligence in Information and Communication(ICAIIC),2019.

[9] Singh, M. Pietrasik, G. Natha, N. Ghouaiel, K. Brizel and N. Ray, "Animal Detection in Man-made Environments" In Preceding of IEEE Winter Conference on Applications of Computer Vision(WACV),2022

A Review on the Detection of Adulteration in Spices

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***Abstract*—The adulteration of spices poses a significant challenge to food safety and consumer trust worldwide. This abstract presents the development of an innovative adulteration detector specifically designed for spices. Traditional methods for detecting adulterants often lack precision, efficiency, and portability, leading to compromised quality control in the spice industry.**

Our proposed adulteration detector utilizes advanced spectroscopic techniques, such as near-infrared (NIR) spectroscopy, coupled with machine learning algorithms for rapid and accurate identification of adulterants in spice samples. By analyzing the unique spectral signatures of authentic spices and common adulterants, including starch, flour, and synthetic dyes, our system can reliably distinguish between pure and adulterated samples.Key features of the adulteration detector include its compact design, user-friendly interface, and real-time analysis capabilities, making it suitable for both laboratory and on-site applications. Moreover, the integration of machine learning algorithms enables continuous improvement in detection accuracy through iterative data analysis and model refinement.

Preliminary testing of the adulteration detector has demonstrated promising results, with high sensitivity and specificity in detecting various types and levels of adulteration in spice samples. Future research aims to further optimize the detector's performance, validate its effectiveness across a broader range of spice varieties, and explore opportunities for commercialization and industry adoption. This review paper focuses on combating spice adulteration through an innovative system. A compact device, housing an ESP32-CAM, is employed to capture images of specific spices (black pepper, cardamom, clove) placed in containers. Upon pressing the trigger button, captured images are sent to a central system. Here, image processing techniques are applied to assess the adulteration levels. The crux of the system lies in the implementation of a Convolutional Neural Network (CNN) for adulteration classification. A robust dataset, encompassing various classes, is meticulously collected and utilized to train the CNN model. The trained model effectively classifies the adulteration status of the spices, providing a reliable assessment. This multifaceted approach, combining image capture, processing, and CNN-based classification, offers a comprehensive solution to tackle spice adulteration, ensuring the integrity of these essential culinary ingredients.

***Key Words: spices, detection, adulteration, quality*.**

INTRODUCTION

Since ancient times, spices have been used in cooking and are regarded as a vital dietary source of phytochemicals for both flavoring and therapeutic applications. "Any aromatic vegetable substance in the whole, broken, or ground form that is used primarily to season food rather than to contribute nutrients" is how the US Food and Drug Administration (US-FDA) defines spices (US-FDA, 2018). Due to their unique flavor profile, spices—such as extracts, tinctures, and essential oils—have been utilized for a variety of purposes by the food, cosmetic, and pharmaceutical businesses as well as by individuals at home.

Certain phytochemicals found in spices, such as eugenol in cloves and basil, cinnamaldehyde in cinnamon, thymol and carvol in thyme, curcumin in turmeric (Guldiken et al., 2018), gingerol in ginger, capsaicin in red peppers, piperine in black pepper (Valdés et al., 2015), crocins in saffron, linalool in coriander seeds, limonene in cardamom, allicin in garlic, quercetin in dill (Yashin et al., 2017), carvacrol in oregano, carnosol and rosmanol in rosemary and sage (Rubió et al., 2013) have been shown to have anti-inflammatory, antimicrobial, anti-rheumatic, anti-cancer, anti-mutagenic, and anti-ulcer properties in culinary spices (Lim,20).



II. REVIEW OF LITERATURE

According to Smith, In his 2017 review, "Adulteration of Spices: A Comprehensive Review," Smith, J. R. meticulously explores the multifaceted landscape of spice adulteration. This comprehensive overview delves into a variety of adulteration methods, shedding light on both traditional practices and modern detection techniques.

Smith's examination not only highlights the pervasive challenges of maintaining spice integrity but also offers insights into the evolving strategies employed to detect and combat adulteration. This review is an invaluable resource for anyone in the field, providing a nuanced understanding of the complexities surrounding spice authenticity and the ongoing efforts to ensure the quality of these essential culinary ingredients.

AccordingtoPatel A.K., He presented a cutting-edge examination in "Chemical Analysis of Spice Adulteration: Recent Advances." This review meticulously explores the chemical composition of frequently adulterated spices, emphasizing recent strides in analytical methodologies for precise detection. Patel's work contributes to the forefront of understanding spice integrity, offering insights into the sophisticated techniques that have emerged to combat adulteration.

This review is a valuable resource for researchers and professionals in the field, providing a contemporary perspective on the chemical intricacies of spice authenticity and the evolving tools at our disposal to ensure their purity

According to Gonzalez M.L, In 2020, He delivered a comprehensive overview in "Global Trends in Spice Adulteration: A Review of the Last Decade." This insightful review not only analyzes the evolving landscape of spice adulteration worldwide but also underscores emerging challenges faced by the industry.

Gonzalez's work brings attention to key patterns observed in the past decade and offers potential solutions to address the growing complexities of spice authenticity. This review serves as a valuable resource for industry professionals and researchers seeking a nuanced understanding of the global dynamics of spice adulteration and proactive measures to safeguard the integrity of spice supply chains.

III. NUTRUTIONAL BENEFITS OF SPICES

A. Utilization and Expertise Spices

According to data from the U.S. Department of Agriculture, the usage of spices has increased dramatically in the country over the past 50 years, with items like ginger and chili pepper being used more often than before (6). 5–10% of American adults utilize botanical supplements, such spices, for health advantages, according to the National Health and Nutrition Examination Survey (7, 8). Spices are more readily available than standard medications, have less side effects, and are thought to have numerous health benefits, which may account for some of their rising use (6–8). It's clear that more Americans are thinking about using herbs and spices for therapeutic and medicinal purposes.

Nearly half of the participants in a recent cross-sectional survey study involving 703 adults in the Midwest of the United States were interested in learning about the health benefits of spices (48%) and were willing to use spices as complementary and alternative medicine therapies (51%). The study also looked at consumers' perceptions about spices and their use, as well as predictors of spice use. Eight of the ten indicated spices were either well-known to or have been used by the majority of participants (>50%). The majority of participants (54%) said they presently use one or more spices daily and thought that garlic (58%), ginger (64%), and cinnamon (56%) might all help people stay healthy and happy. Additionally, most participants named seven out of ten spices as beneficial in preventing a particular disease, with more than two-thirds listing ginger (72%), garlic (68%), and cinnamon (67%) as effective. Spices have been studied in pediatric populations in addition to adult populations. For instance, spices were administered to more than 1/10 of the babies and kids, mostly to treat minor illnesses including colds, coughs, and gastrointestinal issues.

B. Biological properties of Spices

The Biological Properties of the Ingredients in Spices and Herbs Foods high in bioactive molecules, including sulfur-containing compounds, tannins, alkaloids, phenolic diterpenes, and vitamins, particularly flavonoids and polyphenols, can be found in culinary herbs and spices. Due to their high phenolic component concentration, spices and herbs like clove, rosemary, sage, oregano, and cinnamon are great sources of antioxidants. Over the last ten years, studies have revealed that the bioactive components of spices offer a wide range of health advantages

There is now a wealth of evidence supporting the use of culinary herbs and spices as sources of compounds with antioxidative, anti-inflammatory, antitumourigenic, anticarcinogenic, glucose- and cholesterol-lowering, and mood- and cognition-affecting properties in preclinical, clinical, and therapeutic trials looking into novel disease treatments. Furthermore, a growing body of research has shown how polyphenols affect gut microbiota to promote health (13, 14). In humans, this has been linked to a decreased risk of diabetes, heart disease, liver cirrhosis, and other conditions.

C. Spices Impact on Human Health

The health benefits of culinary herbs and spices have been documented in a number of ways. Spice use is specifically linked to a lower risk of death from ischemic heart disease, cancer, and respiratory disorders, according to a wealth of scientific data. People eat spicy food to improve their health, according to a new observational study that evaluated the use of spicy foods as part of a daily diet and the overall risk and causes of death in 487375 participants, aged 30-79, during a median follow-up of 7.2 years in China. Those who ate spicy food one or two days a week had a 10% lower chance of dying (hazard ratio for death was 0.90) compared to those who ate it less frequently than once a week. Furthermore, there was a 14% lower chance of mortality for individuals who consumed spicy cuisine three to five and six to seven days a week (both hazard ratios for death were 0.86). Put another way,

individuals who ate spicy food nearly every day had a death risk that was 14% lower than that of those who ate it fewer than once a week.

Regular consumption of spicy foods was also associated, and this association was stronger in women than in men, with a decreased risk of death from respiratory diseases, ischemic heart disease, and cancer. Fresh chili eaters tended to be less likely to die from diabetes, ischemic heart disease, and cancer. Furthermore, individuals who preferred spicy food consumed less salt and had lower blood pressure than those who didn't. Spicy foods increased salt sensitivity and decreased salt preference. The subjects' regional metabolic activity in the insula and orbitofrontal cortex (OFC) was correlated with their salt intake and preference. The administration of capsaicin, the primary spicy component of chili peppers, increased the insula and OFC metabolic activity in response to high-salt stimuli, reversing the salt intensity-dependent differences in the insula and OFC metabolism, according to a more recent multicenter, double-blind observational and interventional study. It was determined that simply altering how the brain processes salty taste, eating spicy meals can considerably lower blood pressure, daily salt intake, and individual salt preferences. Applying spicy flavor could be a fruitful behavioral intervention to lower blood pressure and excessive salt intake.

IV. ADULTERATION IN SPICES

According to Barretto, Cruz-Tirado, Siche, and Quevedo (2018), food adulteration involves the addition of exogenous ingredients, the replacement of natural ingredients, or the dissemination of inaccurate information about the composition of the meal. Herbs and spices are prone to adulteration at any point in their lengthy and intricate supply chain because they are most frequently consumed crushed or pulverized. Furthermore, some adulterants have the potential to harm a consumer's health (Lakshmi, 2012).[2]

A. Adulteration And Food Safety

Food safety and adulteration Adulterants such as starch, artificial coloring, dust, and even horse feces are frequently found in powdered spices and can lead to severe health issues. For all food enterprises and consumers, food safety is essential. The consumer needs to feel secure in the knowledge that the food they purchase and consume will meet their expectations, won't damage them, and will shield them from dishonesty. One must never undervalue the faith that customers have in them. Therefore, the Food Safety and Standards Act of 2006 (https://fssai.gov.in/dart) was passed by the parliament in this regard.

By creating the Food Safety and Standard Authority of India and consolidating related laws, the Food Safety and Standard Act of 2006 aims to ensure public health by establishing a science-based standard operating procedure for the safe and hygienic manufacture, storage, transportation, distribution, and import of food. These include the Meat Food Product Order, 1973; Fruit Products Order, 1955; Vegetable Oil Products (Control) Order, 1947 act; and the Prevention of Food Adulteration Act, 1954 (Meduri, 2005 and https://fssai.gov.in/dart). Therefore, before permitting spices to enter the food chain, each enterprise participating in the production process should closely inspect and adhere to the methodology. If someone is proven guilty of adulteration, they ought to face harsh consequences and punishment.

B. Types of Adulterant in Spices

Food adulteration is the term used to describe any substance that is added to or removed from a food portion in a way that eventually compromises the food's nature and quality. Adulterants are the compounds that are added in this instance. Sand, dirt, and earthly particles, as well as artificial coloring, starch, chalk powder, bark, stone, sawdust, horse dung, lead chromate, argemone, papaya seed, and other materials, are frequently found adulterants in spices. The most often used adulterants in turmeric powder include sawdust, maize flour, lead chromate, and yellow-colored talk. The artificial coloring materials that are added to the turmeric powder to give it a vivid yellow tinge are lead chromate and metanil yellow dye.

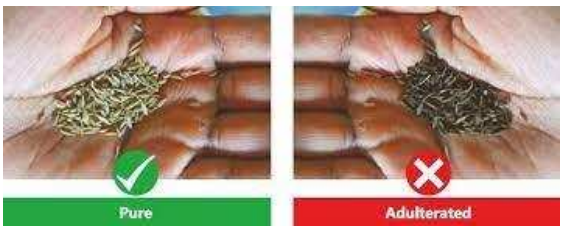
Turmeric powder is made fuller by adding fillers like sawdust, yellow-colored chat, or maize flour (starch). Adulterants such as sawdust, brick powder, and artificial coloring like Sudan Red are commonly added to red chili powder. Some of the often used adulterants in cumin powder include starch, food coloring, dust, horse dung, and others that might cause major health issues. Ash and husk are two frequent adulterants used in coriander powder. Due to their identical sizes and shapes, papaya seeds are the most common adulterant in black pepper.

C. Adulterant and home detection tests

1. Cuminseeds ;

(a) Adulterant: dust from charcoal and grass seed Pour a glass of water with a teaspoon of cumin powder and let it sit for a few minutes. The pure spice will sink to the bottom of the glass, while the charcoal dust will float on the surface.

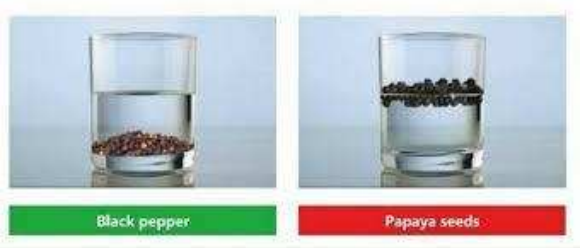
(b) Adulterant: Seed coated with color The cumin seeds are occasionally colored to give them a nice sheen and eye-catching hue. The cumin seeds are roughly rubbed on the palms to ascertain this. The cumin seeds' appearance in the palm suggests that they have an artificial coloring coating on them.



Source:https://vikaspedia.in/health/health-campaigns/beware-of-adulteration/quick-tests-for-some-adulterants-in-foods

2. Black Pepper ;

(a) Adulterant: Papaya seeds put a dash of black pepper in a water glass. The papaya seeds will float in the glass of water, but the black pepper will sink to the bottom.



Source;https://vikaspedia.in/health/health-campaigns/beware-of-adulteration/quick-tests-for-some-adulterants-in-foods

3,Mustard seeds;

(a)Adulterant Mustard Seeds: Argemone Seeds Seldom are seeds pushed or crushed against the palm. And examine them. Mustard seeds have a smooth outside and a yellow interior, but argemone seeds have a rough surface and a white interior.

V.AUTHETICATION TECHNIQUES

Stages of spice adulteration

Indian cuisine is heavily reliant on spices and condiments, which are typically used in modest amounts to various dishes. It offers pleasing flavors, colors, and aromas that are contributed by both fixed and volatile oils. The leafy portions of plants are called herbs, whereas the non-leafy parts, like seeds, fruits, bark, roots, stems, and bark, are called spices. The many plant parts are used to categorize the spices, and the processing of spices includes all forms of processing, including raw, rhizomes, grits, and powder.

A . Traditional Adulteration Detection Techniques:

Reviewing historical approaches, including microscopy, chemical analysis, and sensory evaluation, provides a foundation for understanding the evolution of detection methods. While these methods have their merits, limitations such as subjectivity, time-intensiveness, and the inability to detect certain adulterants underscore the necessity for more sophisticated technologies.

B. Chromatographic Techniques

Gas chromatography (GC) and high-performance liquid chromatography (HPLC) have become cornerstones in spice adulteration detection. The review explores the application of these techniques in separating and quantifying spice constituents, highlighting their sensitivity and specificity. Additionally, advancements in hyphenated techniques, such as GC-MS and LC-MS, offer enhanced capabilities for identifying complex adulterants.

C. Spectroscopic Methods

Infrared (IR), near-infrared (NIR), and Raman spectroscopy are powerful tools gaining prominence in spice adulteration detection. The paper discusses their non-destructive nature, rapid analysis, and potential for distinguishing authentic spices from adulterated counterparts. The integration of artificial intelligence and chemometrics further enhances the precision and reliability of these methods.

D. DNA-Based Techniques

The emergence of DNA-based methods, including polymerase chain reaction (PCR) and DNA barcoding, has revolutionized the identification of botanical and geographical origins of spices. This section explores the potential of DNA techniques in uncovering adulteration, especially in complex spice blends.

E. Sensor Technologies

Electronic noses (e-noses) and electronic tongues (e-tongues) represent innovative sensor technologies designed to mimic human olfactory and gustatory senses. The review delves into their application in detecting volatile compounds and taste profiles associated with spice adulteration.

F. Challenges and Future Perspectives

While advancements in adulteration detection methods are promising, challenges persist. This section examines issues such as sample complexity, method standardization, and the need for global regulatory frameworks. The paper concludes by outlining future directions, including the integration of multiple techniques and the development of portable, field friendly devices for on-site testing.

G. Final thoughts and prospective directions

The concern for food safety and quality led to the creation of a number of authentication methods. The main disadvantage of physical approaches is their precision and repeatability of outcomes, despite their simplicity and inexpensive cost. For more accuracy and validation purposes than physical procedures, microscopic techniques are used in conjunction with sensory approaches. Chemical and instrumental techniques are included in the analytical approach. High equipment and consumable costs, technical data expertise.

VI.MATERIALS AND METHODOLOGY

A. MATERIALS

ESP32 CAM Module

BasedonESP32, the ESP32-CAM is a compact camera module with low power consumption. It includes an on board TF card slot and an OV2640 camera. Intelligent Internet of Things applications like Wi-Fi image uploading, QR identification, wireless video monitoring, and more can make extensive use of the ESP32-CAM.

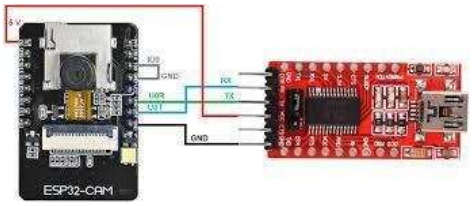


Figure 6.1 ESP32 cam module



LITHIUM ION BATTERY

A lithium- ion battery is a type of rechargeable battery that uses lithium ions as the primary component of its electrolyte. During the discharge cycle, lithium atoms in the a node are ionized and separated from their electrons. The lithium-ion move from the anode and pass through the electrolyte until they reach the cathode, where they recombine with their electrons and electrically neutralize.

Figure 6.2 Lithium Ion Battery

TP-4056CHARGINGPROCESSOR

The TP4056 is a complete constant-current/constant-voltage linear charger for single cell lithium-ion batteries. Its SOP package and low external component count make the TP4056 ideally suited for portable applications. Furthermore, the TP4056 can work within USB and wall adapter.



Figure 6.3 TP-4056 Charging processor

CNNCONVOLUTION NEURAL NETWORKS

These network have a very broad networking and revolutionized view in the field of A powered computer vision which includes detection and image classification of food adulteration techniques

TRAINING DATA SETS

Training neural networks for food image extraction ,image classification which involves a very detailed process to optimize the performance of datasets and achieve very precise best classification results. It begins with datasets collection, dataset preparation which involves a diverse and very vibrant dataset of food images with corresponding labels whether there is presence or absence of food contaminants.

TRANSFERLEARNINGANDFINETUNINGAPPROACH

These methods help in leveraging trained models which are implemented on large scale data set that includes VGG Net, Image Net. These methods helping utilizing knowledge on a source task on CNN architecture.

MODEL EVALUATION METRICS

Thesemetricsalwaysprovidesqualitativeandquantitativeapproachofthemodelsprecision, performance, and accuracy in detecting the adulteration in food. Receiver Operating Characteristics (ROC) curves are plotted that positive rate at various classification threshold techniques. These representation offers a very fine graphical representation of models various parameters, that determines optimal threshold value.

DATAAUGMENTATION

This involves artificially augmented techniques that is used for training data sets by introducing various variations to food images. Rotating augmentation method by various degrees helps the model to recognize the test patterns from various different angles for food adulteration. Flipping method creates additional instances of different orientation of food images. This augmentation technique helps in enhancing the quality of models ability. This method also recognizes the adulteration and contaminants mixed like: Ajinomoto, orany sweeteners added to the product. Translation method in data augmentation helps in shifting images vertically and horizontally Positional variations of translate food images. It is more robust to detect the changes in Food position images that helps to detect the contaminants or adulterates.

B. METHODOLOGY

ESP32 CAM Integration

AssemblethedevicewithanESP32-CAM,a trigger button and appropriate power supply. Develop firm ware to capture high-resolution images upon button press.

Data Collection

Create a diverse data set with images ofuncontaminatedandadulteratedspices.Considervariationsinlighting, angle, and background for a robust data set

Data Transmission

Establish a secure communication channel between the device and the central system. Use protocols like MQTT or HTTP to transmit captured images efficiently.

Image Processing

Employ image processing techniques (Open CV) to enhance captured images. Implement algorithms for feature extraction and region of interest identification.

CNN Model Development

Design Convolution Neural Network architecture suitable for spice adulteration classification. Split the data set into training and testing sets.

Model Training

Train the CNN model using the training data set. Fine-tune hyper parameters for optimal performance. Validate the model on the testing data set to ensure generalization.

Adulteration Classification

Integrate the trained CNN model into the central system for real-time classification Implement algorithms to interpret the model output and determine the adulteration level.

Result Presentation

Develop a user-friendly interface to display the classification results. Include visual indicators or reports to convey the degree of adulteration detected

Testing and Optimization

Conduct thorough testing under various conditions to validate system robustness. Optimize algorithms and parameters for improved accuracy and efficiency.

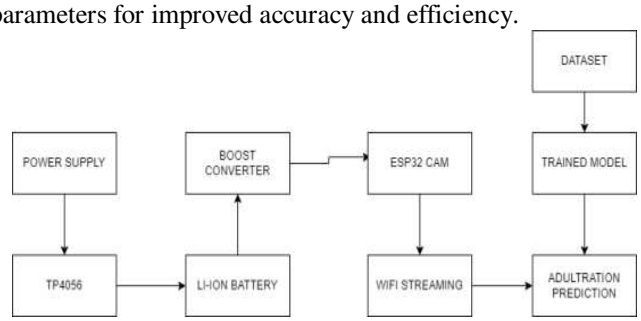


Figure 6.4 Working process of detector

VII. CONCLUSION

Spices are a necessary component in Indian cuisine. A person may experience health risks such as nausea, anemia, paralysis, brain damage, abortions, insomnia, vomiting, constipation, and even mental retardation if they regularly ingest contaminated spices. Buying spices that are correctly packed and have an Agmark or an ISI mark from a reliable source is the safest approach to prevent buying contaminated spices. The government should take strong measures against anyone found to be peddling tampered goods. Therefore, it's a good idea to buy raw spices and grind them yourself at home to create a real, fresh, and safer powder.

VIII. REFERENCES

Various Research Journals have been assessed and analysed.

[1] Kucharska-Ambrożej, Kamila, and Joanna Karpinska. "The application of spectroscopic techniques in combination with chemometrics for detection adulteration of some herbs and spices." *Microchemical Journal* 153 (2020): 104278.

[2] Osman, Ahmed Galal, et al. "Overview of analytical tools for the identification of adulterants in commonly traded herbs and spices." *Journal of AOAC International* 102.2 (2019): 376-385.

[3] Galvin-King, Pamela, Simon A. Haughey, and Christopher T. Elliott. "Herb and spice fraud; the drivers, challenges and detection." *Food Control* 88 (2018): 85-97.

[4] Negi, Aditi, Akash Pare, and R. Meenatchi. "Emerging techniques for adulterant authentication in spices and spice products." *Food Control* 127 (2021): 108113.

[5] Kaavya, R., et al. "Application of infrared spectroscopy techniques for the assessment of quality and safety in spices: a review." *Applied Spectroscopy Reviews* 55.7 (2020): 593-611.

[6] September, DanwilleJacqwin Franco. *Detection and quantification of spice adulteration by near infrared hyperspectral imaging*. Diss. Stellenbosch: University of Stellenbosch, 2011.

[7] Bharathi, S. K. V., et al. "Instrument-based detection methods for adulteration in spice and spice products–A review." *Journal of Spices and Aromatic Crops* 27.2 (2018): 106-118.

[8] Goyal, Kashish, Parteek Kumar, and Karun Verma. "Food adulteration detection using artificial intelligence: a systematic review." *Archives of Computational Methods in Engineering* 29.1 (2022): 397-426.

[9] Chakravartula, SwathiSirishaNallan, et al. "Use of convolutional neural network (CNN) combined with FT-NIR spectroscopy to predict food adulteration: A case study on coffee." *Food Control* 135 (2022): 108816.

[10] Jahanbakhshi, Ahmad, et al. "Detection of fraud in ginger powder using an automatic sorting system based on image processing technique and deep learning." *Computers in biology and medicine* 136 (2021): 104764.

Formulation and development of instant soup mix using *Brassica oleracea* (Kohlrabi) powder

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***Abstract*—Developing convenient and nutritious food products has become increasingly important in today's fast-paced society. Instant soup mixes, in particular, have gained popularity due to their convenience and versatility. This paper aims to formulate and develop an instant soup mix using Brassica oleracea (Kohlrabi) powder. Brassica oleracea, a vegetable known for its high nutritional content, has been utilized in various food products. By incorporating Kohlrabi powder into an instant soup mix, the nutritional value of the product can be enhanced while providing consumers with a quick and easy meal option. This study will explore the formulation process, evaluate the sensory characteristics of the instant soup mix, and assess its nutritional profile. The findings of this research can contribute to the development of new and innovative instant soup products using Brassica oleracea powder as a functional ingredient.**

Keywords*— *Kohlrabi, instant soup powder, nutritional composition, shelf life.

I. INTRODUCTION

Brassica oleracea, commonly known as kohlrabi, is a cultivar of the Brassica genus and belongs to the family Brassicaceae. It is a vegetable that is widely grown and consumed in various parts of the world. The name "kohlrabi" is derived from the German word "kohl" meaning cabbage and "rabi" meaning turnip, which reflects its characteristic shape and taste. Kohlrabi has a round bulbous shape with stems that resemble turnip greens. It is rich in various nutrients including dietary fiber, minerals, and vitamins. Kohlrabi is known for its versatility in culinary applications, as it can be eaten raw or cooked. It has a mild, sweet flavor and a crunchy texture, making it a popular ingredient in salads, soups, and stir-fries. Additionally, kohlrabi is recognized for its potential health benefits, as it contains compounds with antioxidant and anti-inflammatory properties. Understanding the background and characteristics of Brassica oleracea is important in developing an instant soup mix using kohlrabi powder as it provides insights into this vegetable's nutritional value and culinary potential. Dried soup powders have the advantage of protection from enzymatic and oxidative spoilage and flavor stability at room temperature over long periods(6–12months). Inaddition, they are ready for reconstitution in a short time for working families, hotels, hospitals, restaurants and institutional use as well as for military rations. Moreover, they are lightweight for shipping and available at all times of the year(Rekha,2010)[1].



Fig. 1 Kohlrabi

II. MATERIALS AND METHODS

A. Kohlrabi powder preparation

Good quality Kohlrabi was bought from the farmer's market, was cleaned properly, and sliced. Carrot, beans, and moringa leaves were also collected from the market and they also underwent the same cleaning and cutting process.

B. Dehydration of Kohlrabi and vegetables

The sliced pieces of Kohlrabi were kept in a hot air oven at 70 °C for 10 hours and flipping them for every 3 hours. The cut pieces of carrot, beans, and moringa leaves are then kept in a hot air oven at 60°C for 5- 6 hours Preparation of instant soup mix A proportion of components, various combinations of samples, cooking procedures, and corresponding supplementation percentages were determined based on sensory evaluations. Through extensive trials of different compositions of raw materials and primary ingredients, a formulation with the optimal percentage, as suggested by acceptability studies, was achieved. The experimental samples were prepared following the approach outlined by Amal et al. (2014)[3], with minor adjustments. Acceptability parameters such as consistency, color, appearance, flavor, taste, aftertaste, and overall acceptability were taken into account as decisive

factors, employing the methodology described by Amerine et al. (1965) [4].

The dehydrated kohlrabi is ground into a fine powder and the dehydrated vegetables are then mixed well with the seasoning powder in a ratio of 3:2 (Kohlrabi powder: Seasoning powder).

*Seasoning powder- Corn starch, Salt, Pepper powder, Cumin powder and Garlic powder along with dehydrated Vegetables.



Fig. 2 Kohlrabi instant powder

C. Benefits and potential challenges

The use of Brassica oleracea (kohlrabi) powder in an instant soup mix offers several benefits and potential challenges. One of the key benefits is that kohlrabi is a nutrient-rich vegetable, containing high levels of vitamins, minerals, and antioxidants, which can contribute to the nutritional value of the soup mix. Additionally, kohlrabi is known for its potential health benefits, including anti-inflammatory and anti-cancer properties, which could further enhance the overall health benefits of the soup. Furthermore, kohlrabi powder provides a natural flavor enhancement to the soup mix, adding a unique and fresh taste. However, there may be some challenges to consider when using kohlrabi powder in an instant soup mix. One challenge could be ensuring proper storage and handling to maintain the quality and shelf life of the powder. Another challenge could be potential interactions between kohlrabi powder and other ingredients in the soup mix, which may require careful formulation to achieve the desired taste and texture. Overall, the use of kohlrabi powder in instant soup mix has the potential to provide nutritional benefits and flavorful additions, but it is important to address any challenges that may arise in the formulation and development process.(Experts from Dole Food Company, Experts from The Mayo Clinic, Experts from UCLA Center)[5].

Parameters	Score
Color & Appearance	8.5
Flavor	8
Texture	7.5
Smell	8
Taste	8
Overall acceptability	8

Table 1: Score for sensory analysis

*Maximumscoreoutof9

D. Nutritional Composition

The nutritional composition of the instant soup mix with Kohlrabi powder is broken down into each ingredient used in the product for 100 grams of quantity. But every ingredient has other unique substances and different compositions.

Table 2: Nutritional values

	Calories	*Carbo-hydrate*	*Protein*	*Fats*	*Fibre*
Kohlrabi powder	*320*	*70*	*15*	*1*	*30*
Carrot	*317*	*75*	*7*	*1.7*	*18.3*
Beans	*341*	*60*	*21*	*1.4*	*25*
Moringa leaves	*185*	*38*	*27*	*2*	*19*
Seasoning powder	*80*	*20*	*3*	*2*	*2*

III. SENSORY ANALYSIS

Based on the sensory attributes of observing the prepared product, it is tabulated and analyzed based on the number of days since the product's production. Based on Amerine *et al.* (1965) [4] sensory analyzing characteristics of products, the sensory analysis was done.

Sensory attributes of instant soup mix during storage with *Brassica oleracea* (kohlrabi) powder

Colour and appearance:

The score for colour and appearance in the investigation of instant soup mix is presented in Table 1. The overall value for colour and appearance is given as 8.5 because of the attractive colour and appealing appearance.

Flavor:

The score for flavor is influenced by the natural flavors of the vegetables and the slow drying technique. The overall score

for the instant soup mix for the flavor is 8 because of the above-said factors.

Taste-

The taste of the kohlrabi powder is very unique and addictive. With the addition of the seasoning powder, the taste of the instant soup mix is enhanced. So the score for the taste is 8.

Consistency:

A slight difference was there with the difference in formulation. The first formulated mix was very thick because of the increase in corn starch present in the seasoning powder. In the second batch, the soup was very thin because very little corn starch was present in seasoning powder and Kohlrabi powder. In the final formulation, the consistency of the soup was accurate and the formulated consistency was achieved.

Overall acceptability:

The data regarding the overall acceptability of instant soup mix is presented in Table 1. It is observed from the experiments performed during the formulation. Similar findings of supplementation were reported by Amal et. al. 2014 [3]and Babayeju et. al. 2014 [6].

A. Factors affecting the shelf life of instant soup powder

Several factors can affect the shelf life of Brassica oleracea soup powder. One important factor is moisture content. High moisture levels can lead to microbial growth and spoilage of the product. To prevent this, it is important to ensure that the soup powder is properly dried before packaging.

Presence of oxygen is another factor to consider. Oxygen can cause oxidation of the soup powder, leading to changes in color, flavor, and nutritional value. Proper packaging, such as using oxygen barrier materials, can help to reduce oxygen exposure and extend the shelf life.

Furthermore, it is crucial to take temperature into account. High temperatures can accelerate chemical reactions and microbial growth, while low temperatures can slow down these processes. Therefore, it is important to store the soup powder in a cool and dry place to maximize its shelf life.

Overall, managing moisture content, oxygen exposure, and temperature are critical factors in maintaining the quality and extending the shelf life of Brassica oleracea soup powder. (Jean-Michel Mérillon, Kishan Gopal Ramawat) [7].

IV. RESULTS AND DISCUSSIONS

The investigations were carried out to test the suitability of *Brassica oleracea* (Kohlrabi) powder with other ingredients in the preparation of instant soup mix. The results obtained during the investigation have been described below.

Several trials were conducted by taking varying *Brassica oleracea* (Kohlrabi) powderparts corn starch, cumin, black pepper, salt, carrot, and garlic powder,Accordingly, the soup was prepare during the earlier mentioned basic recipe for soup with 10 to3 0% *Brassica oleracea* (Kohlrabi) powder parts, 10-38% seasoning powder.

2 to 5% salt, 7 to 10% cornstarch. Finally, soups were prepared using the optimum level of ingredients that arrived at the desired formulations from the earlier results of acceptability studies of soup formulations.

In the primary formulation test, The score for the product with 16 - 22% *Brassica oleracea* (Kohlrabi) powder, and 23- 46% seasoning powder were acceptable in terms of all sensory attributes. But in the second formulation, we added 4g of salt,0. 5g black pepper powder, and 10 to 11% seasoning powder for improving the taste and color of modified instant soup mixes. In the final formulation we took 8 g of corn starch for instant soup mix as the soup with 10% corn starch was too thick and 7g of corn starch was too thin. So to attain the final formulation we added the 16-22% *Brassica oleracea* (Kohlrabi) powder and 23-46% seasoning powder with the altering percentage of salt, black pepper powder, garlic powder, and cumin powder.

V. CONCLUSION

The formulation and development of an instant soup mix using Brassica oleracea (Kohlrabi) powder offer a promising avenue for creating a nutritious and flavourful product. Kohlrabi, known for its mild, cabbage-like flavor, brings a unique set of nutritional benefits, including vitamins, minerals, and fiber, to the soup mix. The powder form enhances convenience, allowing for quick and easy preparation of a nutritious soup.

Considerations in the formulation process may involve optimizing the ratio of Kohlrabi powder to other ingredients, such as dehydrated carrots, beans, and moringa leaves, to achieve a balanced nutritional profile. The inclusion of seasonings like salt, cumin powder, black pepper powder, and garlic powder contributes to the overall taste and aroma of the soup mix.

Quality control measures should be implemented to ensure the preservation of nutritional content, flavor, and shelf stability in the dehydrated Kohlrabi powder. Additionally, the development process should focus on meeting consumer preferences for taste, texture, and convenience.

In conclusion, the formulation and development of an instant soup mix utilizing Brassica oleracea (Kohlrabi) powder presents an opportunity to create a convenient,

nutritious, and flavourful product that aligns with the growing demand for healthy and convenient food options. Further testing, refinement, and market research may be necessary to optimize the product and ensure its success in the market.

VI. REFERENCES

[1] RekhaMNA,YadavR,DharmeshS,ChauhanAS,Ramteke RS. Evaluation of Antioxidant Properties of DrySoup Mix Extracts Containing Dill (*Anethum sowa* L.)Leaf.FoodandBioprocessTechnology.2010;3:441-449.

[2] David Finkelstein, Alistair McCleery, "*An Introduction to Book History" Routledge*,2006-03-13.

[3] Amal MH, Abdel-Haleem, Azza A, Omran. *Preparation of Dried Vegetarian Soup Supplemented with Some Legumes*. Food and Nutrition Sciences. 2014; 5:2274- 2285

[4] Amerine MA, Pangborn RM, Rosseier EB. Princ of sens.*Evaluoffood.*Acad.Press,London,1965.

[5] Experts from Dole Food Company, Experts from The Mayo Clinic, Experts from UCLA Center for H, "*Encyclopedia of Foods*" Elsevier, 2002-01-13

[6] Babayeju AA, Gbadebo CT, Obalowu MA, Otunola GA, Nmom IO, Kayode Rmo. Comparison of Organoleptic Properties of Egusi and Efo Riro Soup Blends Produced with Moringa and Spinach Leaves. Food Science and Quality Management 2014;1(28):2224-6088

[7] Jean-Michel Mérillon, Kishan Gopal Ramawat, "Glucosinolates" Springer, 2017-05-04

[8] Faruk Ansari, Alpana Singh, Karishma Baidya, Gajendra Kumar Rana and Ankit Bharti "*Formulation and development of instant soup mix using Moringa oleifera leaf powder*"

[9] KrokidaMK,KourisDM.Rehydrationkineticsofdehydrated products. Journal of food engineering. 2003;57:1-7.

[10] Niththiya,Vasantharuba,SubajiniMB,Srivijeindran "*FormulationofInstantSoupMixPowderUsingUncooked Palmyrah(Borassus flabellifer)Tuber Flourand Locally Available Vegetables*" Proceedings of JaffnaUniversityInternational ResearchConference,2014.

[11] Panse VG, Sukhatme PV. Stati. Meth. for Agril. Wo., 4thed.,ICAR,NewDelhi,1985,347p.

[12] Seung-Hyun Choi1, Dong-Kul Ryu1, Suhyoung Park2, Kyoung-Gu Ahn3, Yong-Pyo Lim4, and Gilhwan An *Composition Analysis between Kohlrabi (Brassica oleracea var. gongylodes) and Radish (Raphanus sativus)* Department of Food Science and Technology, Chungnam National University, Daejeon 305-764, Korea, National Institute of Horticultural & Herbal Science, Suwon 440-706, Korea, Joeun Seeds, Goesan-gun 367-833, Korea, Plant Molecular Marker and Food analysis Research Center, Chungnam National University, Daejon 305-764, Korea.

[13] Huxsoll, C.C., and H.R. Bolin. 1989. *Processing and distribution alternatives for minimally processed fruits and vegetables. Food Technol.*43(2):124–128.

[14] Kader, A.A., W.J. Lipton, and L.L. Morris. 1973. *Systems for scoring quality of harvested lettuce* HortScience 8:408–409.

[15] Kader, A.A., D. Zagory, and E.L. Kerbel. 1989 *Modified atmosphere packaging of fruits and vegetables*. Crit. Rev. Food Sci. 28:1–27.

[16] Kader, A.A. 1992. Methods of gas mixing, sampling, and analysis, p. 93–95. In: A.A. Kader (ed.). *Postharvest technology of horticultural crops*.Univ. of California Publ. 3311.

[17] Fahima Rokhsana, Rezwana Yeasmin and Akhter Nahar,"*Studies on the Development and Storage Stability of Legume and Vegetable based Soup Powder"* Bangladesh J. Agril. Res. 32(3): 451-459, September 2007.

[18] Wedyan Mahjoub Elrih, Inaam A. Ismael, "*Development of a Quick Dried Soup Powder Mixes and Easy to Prepare"* National Food Research Center, Ministry of Agriculture and Forestry, Khartoum, Sudan.

[19] Faruk Ansari, Alpana Singh, Gajendra Kumar Rana, and Karishma Baidya,"Formulation, development and shelf life assessment of instant soup mix using *Moringa oleifera* flower powder" pp.301-305

[20] V.H. Escalona, E. Aguayo, and F. "*Artés Quality and Physiological Changes of Fresh-cut Kohlrabi Postharvest and Refrigeration*" Group, Department of Food Engineering, Technical University of Cartagena, Paseo Alfonso.

Beyond Wheat- A Review on Gluten Free Cake Making

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Abstract
Gluten-free baking has witnessed a remarkable surge in popularity owing to the increasing prevalence of gluten-related disorders and the growing consumer demand for alternative dietary options. In this review article, we delve into the burgeoning domain of gluten-free cake production, focusing particularly on the innovative utilization of tapioca and little millet flour as conventional substitutes. Tapioca, derived from the cassava root, and little millet, a gluten-free ancient grain, offer unique characteristics that enhance the texture, flavor, and nutritional profile of gluten-free cakes. Through an in-depth exploration of the properties of these flours and their synergistic effects in cake formulations, this review sheds light on the mechanisms behind their success as viable alternatives to traditional wheat flour. Furthermore, we discuss the sensory attributes, shelf-life stability, and health benefits associated with tapioca and little millet flour-based gluten-free cakes, providing valuable insights for both consumers and industry stakeholders. By synthesizing current research findings and culinary practices, this review aims to contribute to the advancement of gluten-free baking techniques and the diversification of gluten-free product offerings in the food market.

Keywords*: Tapioca flour, little millet flour, cake making, sensory evaluation*

I] INTRODUCTION:

Gluten-free flours have gained immense significance in the culinary world due to the increasing prevalence of gluten-related disorders and the growing demand for gluten-free products among consumers. These flours are derived from grains, seeds, nuts, or tubers that naturally do not contain gluten, a protein composite found in wheat, barley, and rye. The significance of gluten-free baking lies in its ability to cater to individuals with gluten-related disorders such as celiac disease, wheat allergy, and non-celiac gluten sensitivity. Celiac disease is an autoimmune condition triggered by the ingestion of gluten, leading to inflammation and damage to the small intestine in genetically predisposed individuals. For these individuals, adhering to a strict gluten-free diet is essential for managing symptoms and preventing long-term complications. Moreover, gluten-free baking has become increasingly popular among health-conscious consumers who perceive gluten-free diets to improve overall well-being, alleviate digestive discomfort, and support weight management. As a result, there has been a surge in the availability and variety of gluten-free flours and baking products in the market. Gluten-free flours offer diverse nutritional profiles and flavor profiles, allowing for the creation of a wide range of baked goods that are not only safe for individuals with gluten-related disorders but also appealing to mainstream consumers. Common gluten-free flours include rice flour, almond flour, coconut flour, sorghum flour, chickpea flour, tapioca flour, and quinoa flour, among others. Each flour has unique characteristics, textures, and flavors, which can be leveraged to create gluten-free versions of traditional baked goods such as bread, cakes, cookies, and pastries.

II] REVIEW OF LITERATURE

TAPIOCA FLOUR

Tapioca flour, scientifically recognized for its potential as a gluten substitute in cake making, offers a multifaceted approach to addressing the challenges inherent in gluten-free baking. Structurally, tapioca flour's composition primarily comprises

carbohydrates, particularly amylose and amylopectin, which contribute to its unique rheological properties. During the baking process, tapioca flour's starch granules undergo gelatinization, absorbing moisture and swelling to form a viscous gel. This gel network mimics the viscoelastic behavior of gluten, providing essential structural integrity to cake batters and promoting gas retention during leavening. Moreover, tapioca flour's fine particle size and low protein content contribute to its smooth texture, facilitating uniform dispersion within the cake batter and yielding a homogeneous crumb structure upon baking. Additionally, tapioca flour's neutral flavor profile ensures minimal interference with the sensory characteristics of cakes, allowing for the expression of other ingredients' flavors and aromas. Beyond its functional attributes, tapioca flour's widespread availability, cost-effectiveness, and inherent gluten-free status make it an accessible and practical choice for both home and commercial bakers seeking to cater to gluten-sensitive consumers. Furthermore, tapioca flour's compatibility with other gluten-free flours, such as little millet flour, enables the formulation of diverse and nutritious cake recipes that offer. Although tapioca flour is relatively low in protein and dietary fiber compared to whole grain flours, it serves as a valuable source of energy due to its high carbohydrate content, providing a readily available source of glucose for fueling metabolic processes. While tapioca flour may not contribute significant amounts of micronutrients such as vitamins and minerals on its own, its role in gluten-free baking allows for the incorporation of other nutrient-rich ingredients to fortify the nutritional profile of cakes. For example, bakers may choose to include ingredients such as eggs, milk or dairy alternatives, nuts, seeds, fruits, and vegetables to provide essential vitamins, minerals, antioxidants, and dietary fiber. By combining tapioca flour with these nutrient-dense ingredients, gluten-free cakes can offer a well-rounded nutritional profile, contributing to overall dietary diversity and healthful eating patterns.Furthermore, the versatility of tapioca flour allows for the formulation of cakes that cater to specific dietary preferences and nutritional needs, such as vegan, paleo, or low-sugar options. Whether used alone or in combination with other gluten-free flours, tapioca flour serves as a valuable tool for creating indulgent yet nourishing baked treats that align with diverse dietary lifestyles and wellness goals. Thus, while tapioca flour may not be a significant source of nutrients on its own, its role in gluten-free baking contributes to the nutritional enrichment and sensory enjoyment of cakes, enhancing their overall appeal and nutritional value.

LITTLE MILLET FLOUR:

Little millet flour, derived from the small-seeded cereal grain Panicum sumatrense, emerges as a compelling substitute for gluten-containing flours in cake making, supported by its distinctive nutritional composition and functional properties. Rich in essential nutrients, little millet flour offers a favorable balance of macronutrients, including carbohydrates, proteins, and dietary fiber, along with essential micronutrients such as vitamins and minerals. Notably, little millet flour boasts a higher protein content compared to traditional wheat flour, providing valuable amino acids necessary for muscle repair, immune function, and overall health. Moreover, its inherent gluten-free status renders it suitable for individuals with gluten-related disorders, offering a safe and nutritious alternative for those seeking to avoid gluten in their diets. Functionally, little millet flour exhibits desirable rheological properties, characterized by its ability to form a cohesive dough or batter when mixed with liquid ingredients. This cohesion is attributed to the presence of proteins and polysaccharides in little millet flour, which contribute to its binding and texturizing capabilities during cake preparation. Furthermore, little millet flour contributes to the sensory attributes of gluten-free cakes, imparting a subtle nutty flavor and pleasant texture that enhances the overall eating experience. Its fine particle size and water-absorbing capacity help retain moisture in baked goods, resulting in cakes with a soft, tender crumb and prolonged freshness. Additionally, little millet flour's high fiber content supports digestive health and provides a sense of satiety, promoting dietary satisfaction and potentially aiding weight management efforts. As such, little millet flour represents a compelling option for gluten-free cake making, offering both nutritional enrichment and functional benefits that contribute to the formulation of wholesome and delicious baked goods suitable for diverse dietary preferences and health-conscious consumers.

Moreover, little millet flour stands out for its higher protein content compared to wheat flour, making it a valuable source of plant-based protein. These proteins contain essential amino acids necessary for muscle repair, growth, and immune function. Additionally, little millet flour is rich in dietary fiber, which supports digestive health, regulates blood sugar levels, and promotes a feeling of fullness, aiding in weight management efforts. Furthermore, little millet flour contains essential micronutrients such as iron, calcium, magnesium, phosphorus, and B vitamins, which play crucial roles in various physiological functions, including bone health, energy metabolism, and red blood cell production.

When used as a baking flour in cakes, little millet flour enriches the nutritional profile of the final product, offering a range of health benefits beyond mere caloric intake. Incorporating little millet flour into cake recipes enhances the protein content, thereby increasing the satiety value and providing essential amino acids for muscle repair and growth. Additionally, the dietary fiber present in little millet flour contributes to improved digestive health, promoting regular bowel movements and alleviating constipation. The micronutrients found in little millet flour, such as iron and B vitamins, offer nutritional support, helping to prevent deficiencies and support overall vitality. Moreover, little millet flour imparts a subtle nutty flavor and pleasing texture to cakes, enhancing their sensory appeal and palatability. By replacing conventional wheat flour with little millet flour in cake recipes, individuals can enjoy gluten-free baked goods that not only satisfy their taste buds but also nourish their bodies with essential nutrients, making it a valuable addition to a balanced and wholesome diet.

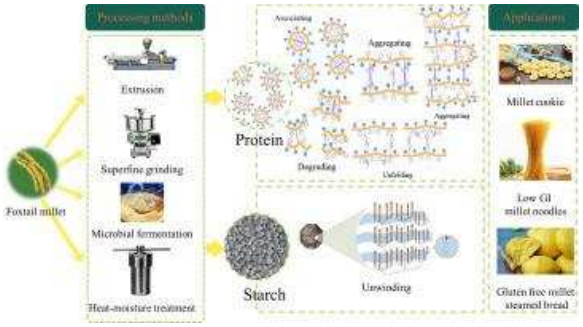


FIG 1.1: Little millet flour properties

1.ENZYMES AND EMULSIFIERS:

Emulsifiers and enzymes play crucial roles in gluten-free baking, particularly when using tapioca flour, to achieve optimal texture and structure in cakes. Emulsifiers, such as lecithin or mono- and diglycerides, function by interacting with both water and fat molecules in the cake batter. In gluten-free baking, where the absence of gluten can lead to challenges in achieving proper texture and volume, emulsifiers help stabilize the air bubbles created during mixing and baking, thereby improving the overall rise and texture of the cake. By forming a film around the air bubbles, emulsifiers prevent them from coalescing, resulting in a finer crumb structure and increased volume. Enzymes, on the other hand, catalyze specific chemical reactions that contribute to texture improvement in gluten-free cakes. For instance, enzymes such as xylanase and amylase can be utilized to break down complex carbohydrates present in tapioca flour into simpler sugars, thereby enhancing sweetness and promoting browning during baking. Moreover, enzymes like protease can hydrolyze proteins, leading to increased protein solubility and improved water absorption capacity in the cake batter. This results in a more cohesive batter and better moisture retention, ultimately contributing to a softer and more moist crumb texture in the finished cake.

When combined with other cake ingredients, such as eggs, fats, sugars, and leavening agents, emulsifiers and enzymes work synergistically to optimize the textural qualities of gluten-free cakes. Emulsifiers help stabilize the batter by forming a uniform dispersion of fat and water phases, while enzymes aid in modifying the starches, proteins, and sugars present in tapioca flour, leading to improved structure, moisture retention, and flavor development during baking. By carefully selecting and incorporating appropriate emulsifiers and enzymes into gluten-free cake formulations, bakers can overcome the challenges associated with gluten absence and achieve cakes with desirable texture, volume, and sensory attributes, satisfying the expectations of gluten-sensitive consumers without compromising on quality or taste.

2. PROCESSING:

The industrial processing of gluten-free cakes requires a systematic approach involving various unit operations and meticulous control over temperature and time parameters to achieve desired product characteristics. In this section, we provide an overview of the processing steps involved and the importance of temperature and time specifications in each unit operation.

The processing of gluten-free cakes typically involves the following unit operations:

a. Ingredient Mixing: Dry ingredients such as tapioca flour, little millet flour, sugar, leavening agents, emulsifiers, and other additives are mixed to form a uniform blend. This step may involve mechanical mixing equipment such as ribbon blenders or paddle mixers to ensure even distribution of ingredients.Mixing is typically conducted at room temperature (20-25°C) for a specified duration, ranging from 5 to 10 minutes, depending on the mixing equipment used and the desired level of ingredient dispersion.

b. Liquid Incorporation: Liquid ingredients such as water, oil, eggs, and flavorings are added to the dry mixture to form a cake batter. Proper mixing techniques are employed to achieve homogenous

dispersion of liquids and create a smooth, lump-free batter.Liquid ingredients are added to the dry mixture at room temperature, and mixing continues until a smooth batter is formed. This step typically takes 3 to 5 minutes to ensure thorough incorporation of liquids.

c. Leavening: Chemical leavening agents such as baking powder or baking soda are activated to produce gas bubbles, resulting in the expansion and rise of the cake batter during baking. The leavening process is crucial for achieving the desired volume and texture in the finished cake. During leavening, the cake batter is exposed to elevated temperatures (usually 350-375°F or 175-190°C) for a specified duration, typically 20 to 30 minutes, depending on the size and thickness of the cakes and the specific baking conditions

d. Baking: The cake batter is transferred to baking pans and subjected to controlled heat in an oven. During baking, heat causes moisture to evaporate, proteins to denature, starches to gelatinize, and sugars to caramelize, leading to the formation of a well-risen, golden-brown cake with a tender crumb.Baking temperatures may vary depending on the recipe and the characteristics of the oven used. Generally, gluten-free cakes are baked at moderate temperatures (325-350°F or 160-175°C) for 25 to 40 minutes, with periodic checks to ensure even baking and proper rise.

e. Cooling and Packaging: Once baked, the cakes are allowed to cool to room temperature before being packaged. Proper packaging techniques, such as vacuum sealing or modified atmosphere packaging, are employed to preserve freshness and extend shelf life.Once baked, the cakes are allowed to cool to room temperature (20-25°C) before being packaged. Proper cooling helps prevent condensation and moisture buildup, which can affect product quality. Packaging is typically performed immediately after cooling to maintain freshness and prevent contamination.

3. LIMITATION:

While these alternative flours provide viable solutions for individuals with gluten-related disorders and cater to the growing demand for gluten-free products, practical limitations exist that must be addressed to optimize their use in cake formulations.One of the primary practical limitations encountered when using tapioca and little millet flours is their unique textural and flavor characteristics, which may differ from traditional wheat flour. Tapioca flour, for instance, can impart a slightly chewy texture to baked goods, while little millet flour may contribute a subtle nutty flavor. Additionally, the absence of gluten in these flours can pose challenges in achieving the desired volume, structure, and crumb texture in gluten-free cakes.o overcome these limitations, innovative approaches and formulation strategies can be employed. Incorporating complementary ingredients such as xanthan gum, guar gum, or hydrocolloids can help improve the texture and elasticity of gluten-free cake batters, enhancing their overall quality and mouthfeel. Furthermore, the use of emulsifiers, enzymes, and other additives can aid in stabilizing batter consistency, promoting gas retention, and optimizing moisture retention during baking.

Despite these difficulties, the convincing attributes of tapioca and little millet flours make them compelling choices for future baking trends. Both flours offer unique nutritional profiles, including higher protein content, dietary fiber, and essential micronutrients compared to traditional wheat flour. Their gluten-free nature addresses the dietary needs of individuals with gluten-related disorders while appealing to health-conscious consumers seeking alternative grain options.

Moreover, the versatility of tapioca and little millet flours allows for creative formulation possibilities, enabling the development of diverse and innovative gluten-free cake recipes. With continued research and technological advancements in gluten-free baking, the practical limitations associated with tapioca and little millet flours can be effectively mitigated, paving the way for their widespread adoption in the baking industry.

III] CONCLUSION:

In summary, while challenges may arise when utilizing tapioca and little millet flours in gluten-free cake making, their nutritional benefits, versatility, and potential for innovation make them convincing candidates for future baking trends. By addressing practical limitations through formulationoptimization and technological innovation, tapioca and little millet flours can contribute to the development ofhigh-quality, flavorful, and nutritious gluten-free cakes that meet the evolving needsand preferences of consumers in the modern food landscape.

IV] REFERENCES

1) AOAC. 2000. Official Methods of Analysis, 17th ed. Association of Official Analytical Chemists, Gaithersburg. MD.

2) Bourne, M.C. 2002. Food Texture and Viscosity.
Concept and Measurement, 2nd ed. Academic
Press. London. 427 pp.

3) Conforti, F.D. 2006. Cake manufacture, pp. 393–410. In Y.H. Hui (ed.). Bakery Products:
Science and Technology, Vol. 22. Ames.
Blackwell Publishing, USA.

4) Fox, P., P.P. Smith and S. Sahi. 2004. Ultrasound
Table 4 Sensory scores of sponge cakes prepared from different ratios of WF and TS*.
Flour blend Appearance Color Odor Softness Overall likingmeasurements to monitor the specific gravity
of food batters. J. Food Eng. 65: 317–324.

5) Gelinas, P., G. Roy and M. Guillet. 1999. Relative
effects of ingredients on cake staling based on an accelerated shelf-life test. J. Food Sci. 64: 937–940.

6) Gomez, M., B. Oliete, C.M. Rosell, V. Pando and
E. Fern·ndez. 2008. Studies on cake quality made of wheat-chickpea flour blends. LWTFood Sci. Technol. 41: 1701–1709.

7) Gomez, M., F. Ronda, P.A. Caballero, C.A. Blanco
and C.M. Rosell. 2007. Functionality of different hydrocolloids on the quality and shelf-life of yellow layer cakes. Food Hydrocolloid 21: 167–173.

8) Gomez, M., L. Manchon, B. Oliete, E. Ruiz and
P.A. Caballero. 2010. Adequacy of wholegrain
non-wheat flours for layer cake elaboration. LWT-Food Sci. Technol. 43: 507–513.

9) Irene, A., R.B.E. Gaena, J.B. Gros and G. Trystram. 2006. Influence of egg type,
pressure and mode of incorporation on density
and bubble distribution of a lady finger batter.
J. Food Eng. 74: 198–210.

10) Karaoglu, M.M. and H.G. Kotancilar. 2009. Quality and textural behaviour of par-baked and rebaked cake during prolonged storage. Int. J. Food Sci. Tech. 44: 93–99.

11) Ketjarut, S., T. Suwonsichon and R. Pongsawatmanit. 2010. Rheological properties of wheat flour-based batter containing tapioca starch. Kasetsart J. (Nat. Sci.). 44: 116–122.

12) Loewe, R. 1993. Role of ingredients in batter
systems. Cereal Food World 38(9): 673–677.

13) Matz, S. A. 1992. Bakery Technology and Engineering, 3rd ed. AVI Publishing, New York. 853 pp.

14) Pongsawatmanit, R., T. Temsiripong and T. Suwonsichon. 2007. Thermal and rheological
properties of tapioca starch and xyloglucan mixtures in the presence of sucrose. Food Res.
Int. 40: 239–248.

15) Sahi, S.S. and J.M. Alava. 2003. Functionality of
emulsifiers in sponge cake production. J. Sci.
Food Agr. 83: 1419–1429.

16) Sakiyan, O., G. Sumnu, S. Sahin and G. Bayram.
2004. Influence of fat content and emulsifier type on the rheological properties of cake batter. Eur. Food Res. Technol. 219:
635–638.

17) Turabi, E., G. Sumnu and S. Sahin. 2008. Rheological properties and quality of rice cakes formulated with different gums and an emulsifier blend. Food Hydrocolloid 22(2): 305–312.

18) Wilderjans, E., B. Pareyt, H. Goesaert, K. Brijs
and J.A. Delcour. 2008. The role of gluten in a pound cake system: A model approach based
on gluten-starch blends. Food Chem. 110 (4):
909–915.

Biriyani Seasoning Edible Flavour Pods

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ABSTRACT
This research introduces a novel concept of biriyani seasoning edible flavour pods, composed of soy lecithin, potato starch, and vegetable glycerine as the edible film, filled with biriyani seasonings powder. The innovation aims to provide a convenient, environmentally friendly, and long-lasting solution for flavouring rice dishes. The product's formulation ensures biodegradability, ease of storage, and extended shelf life. Moreover, the pods exhibit heat resistance and dissolve seamlessly in hot rice, enhancing the dining experience. Through meticulous experimentation and analysis, this study showcases the feasibility and benefits of the biriyani seasoning edible flavour pods, offering a promising alternative to traditional seasoning methods.

Keyword: Edible flavour pods, encapsulation, biriyani seasonings, shelf life extension, flavour enhancement.

I.INTRODUCTION

Biriyani, a beloved dish celebrated for its rich flavours and aromatic spices, is enjoyed by millions worldwide. Traditional methods of seasoning biriyani often involve mixing various spices and condiments directly into the rice, which can be time-consuming and challenging to achieve consistent flavour profiles. To address these limitations and enhance the culinary experience, this research proposes the development of biriyani seasoning edible flavour pods. These innovative flavours pods are crafted from a blend of soy lecithin, potato starch, and vegetable glycerine, forming a biodegradable edible film. Filled with a carefully curated blend of biriyani seasonings powder, these pods offer a convenient and mess-free solution for flavoring rice dishes. The incorporation of biodegradable materials aligns with the growing demand for sustainable food packaging options, while also ensuring ease of storage and transportation.

These films allow the extension of the shelf life of food, giving it the appearance of freshness, with good shine, and color, improving its commercial value through the control of gas transfer and growth of microorganisms [potato starch and nopal mucilage], that in most cases accelerate their maturity and senescence. Furthermore, the unique composition of these flavor pods imparts heat resistance, allowing them to withstand the temperature of hot rice without compromising their integrity. Upon contact with the hot rice, the pods dissolve effortlessly, evenly distributing the flavorful seasonings throughout the dish.This paper aims to explore the formulation, properties, and potential benefits of biriyani seasoning edible flavor pods, offering a promising solution to streamline the seasoning process, extend shelf life, and elevate the dining experience for biriyani enthusiasts.

II. REVIEW OF LITERATURE

1. THICKNESS OF EDIBLE PACKAGING FILMS

1.1 Optimal Thickness for Edible Films

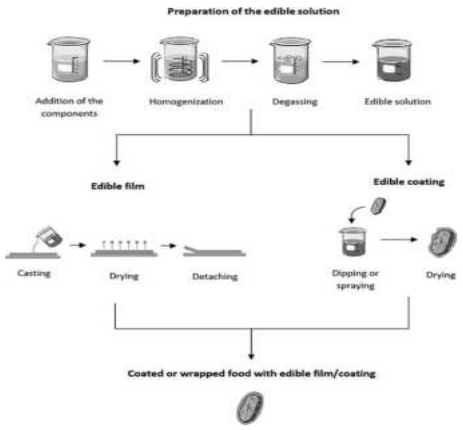
Edible films play a vital role in preserving freshness and quality. The optimal thickness for these films is considered to be less than 0.3 mm.

Barrier Properties: Thin films offer excellent barriers against oxygen, moisture, and light. They shield the food, ensuring it remains pristine.

Texture and Handling: Thinness ensures that the film doesn't alter the food's texture.

Eco-Friendly: Thin films align with sustainability goals. They use fewer resources, generate less waste, and contribute to a greener planet. Edible packaging isn't confined to films alone; it also includes sheets. Unlike films, sheets have a thickness greater than 254 µm2. These structures are manufactured separately from food and can be placed directly on food components or sealed as edible pouches.
Sturdiness: Sheets provide robustness. They can envelop larger food portions or act as protective layers for delicate items.

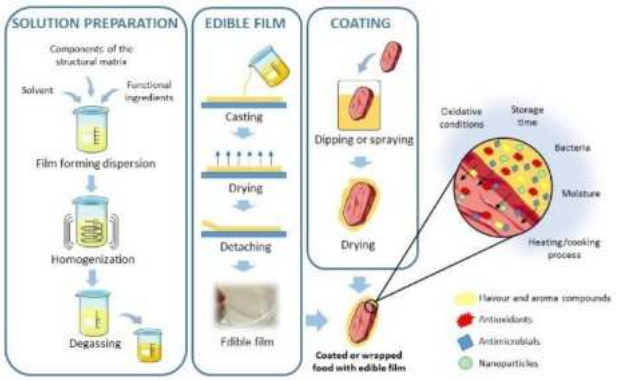
Customization: Thicker sheets allow for creative designs, embossing, and intricate patterns. **Versatility**: Sheets accommodate diverse food shapes and sizes. From wrapping sandwiches to encasing artisanal cheeses, they play a versatile role in edible packaging.



2. FILM FORMATION

2.1 Casting and Extrusion

Edible films are crafted through a process akin to artistic casting. Imagine a chef meticulously pouring a liquid film-forming solution onto a flat surface. This solution contains the essential ingredients—film-forming material, solvent, and additives (such as plasticizers and antimicrobials). The stage is set for transformation. As the solvent evaporates, the film solidifies, much like a delicate skin forming over a simmering pot of soup. This casting method ensures uniformity and precision. Their graceful arrangement creating a protective layer for food. Extrusion, another technique, involves pushing the film-forming solution through a fine nozzle, akin to a pastry chef piping delicate lace onto a cake.



2.2 Dipping and Spraying

Edible coatings, akin to elegant drapery, enhance the allure of food. Unlike films, coatings don't envelop the entire product; they delicately touch its surface. For instance, consider a luscious apple dipped in a shimmering solution The dipping method immerses the food into the coating solution, like a lover wading into a moonlit pond. The spray technique, reminiscent of dew settling on petals, gently spritzes the coating onto the food's contours. These methods ensure that the edible coating adheres seamlessly, enhancing shelf life and aesthetics.

3. MECHANICAL PROPERTIES OF EDIBLE FILMS

3.1 Strength and Resilience

Tensile Strength: This measures the maximum force exerted on the film per unit area before it breaks. A high tensile strength ensures that the film can withstand external forces without tearing or rupturing. Elongation: Elongation refers to how much the film can stretch before reaching its breaking point. Films with good elongation can adapt to the contours of food items without compromising their integrity. Moisture Resistance: Edible films should resist moisture to prevent food spoilage. Their mechanical properties play a role in maintaining this barrier against water vapor. Gas Permeability: The ability of edible films to allow or block the passage of gases (such as oxygen and carbon dioxide) affects food freshness. Optimal mechanical properties ensure controlled gas exchange.

3.2 Safety and Biodegradability

Antimicrobial Potential: Some edible films incorporate natural antimicrobial agents, enhancing food safety by inhibiting microbial growth. Safe Materials: Edible films are made from safe, food-grade materials. Consumers can trust that these films won't introduce harmful substances into their food. Biodegradability: Unlikeconventional plastic films, which persist in the environment, edible films break down naturally. They contribute to sustainability and reduce plastic waste.

4. OPACITY

Opacity in edible packaging is crucial to ensure that the packaging effectively shields the contents from light, which can degrade certain foods or alter their quality. However, it's equally important to maintain transparency standards for consumers to assess the product's condition. Finding the right balance between opacity and transparency is essential in edible packaging design.



(Fig.4)

MATERIALS AND METHODS

1. MATERIALS

1.1 Soy Lecithin

Soy lecithin serves as a natural emulsifier and stabilizer in the formulation of the edible film. It helps create a flexible and cohesive structure while enhancing the dispersion of seasonings within the pod.Choose non-GMO soy lecithin for its purity and sustainability.

1.2 Potato Starch

Potato starch acts as a thickening agent and binder in the edible film formulation.

It contributes to the texture and mouthfeel of the pod while providing stability and strength. Select high-quality potato starch free from additives or contaminants.

1.3 Vegetable Glycerine

Vegetable glycerine is used as a humectant and plasticizer in the edible film, imparting flexibility and moisture retention. It enhances the shelf life of the pods by preventing them from drying out or becoming brittle.Opt for food-grade vegetable glycerine derived from sustainable sources.

1.4 Biriyani Seasonings Powder

The biriyani seasonings powder comprises a blend of aromatic spices and herbs, customized to achieve authentic biriyani flavour profiles.Common ingredients may include cumin, coriander, turmeric, cinnamon, cardamom, cloves, and bay leaves, among others. Ensure the quality and freshness of each spice to enhance the overall flavour and aroma of the dish.

By carefully selecting and sourcing these materials, manufacturers can ensure the production of biriyani seasoning edible flavour pods that meet quality, sustainability, and performance standards, offering consumers a convenient and environmentally friendly seasoning solution for rice dishes.

2. PROCESSING AND EVALUATION

2.1 Ingredients Preparation

Soy lecithin, potato starch, vegetable glycerine, and biriyani powder from reliable sources, ensuring all ingredients are of food-grade quality and meet safety standards.

(Fig.6)

2.2 Formulation of Edible Film



Soy lecithin, potato starch, and vegetable glycerine in predetermined ratios are mixed to form a homogeneous mixture.The formulation is adjusted as needed to achieve desired properties such as flexibility, strength, and biodegradability. Appropriate equipment, such as mixers or blenders are utilised to ensure thorough blending of ingredients.



2.3 Production of Flavour Pod

A suitable method, such as moulding or extrusion is employed, to shape the edible film into pod-like structures. Ensure consistent sizing and shape to facilitate ease of handling and consumption. The mixture after pouring onto the mould are let to dry or set for atleast 2 days to achieve stability and structural integrity.

2.4 Filling with Biriyani Seasonings Powder

The biriyani seasonings powder according to a standardized recipe is prepared, ensuring a balanced blend of spices and flavours.Each pod with the prepared seasoning powder is filled manually according to the desired quantity. The pods are sealed securely by enclosing the ends with parchment paper and heat sealing it, to prevent leakage and preserve the freshness of the seasonings.

2.5 Testing for Biodegradability

Biodegradability tests following established protocols to evaluate the degradation rate of the edible film under simulated environmental conditions were conducted.Factors such as temperature, humidity, and microbial activity to assess the material's decomposition over time were monitored.

2.6 Storage and Shelf-Life Evaluation

The filled flavour pods in controlled conditions, including temperature and humidity monitoring, to determine shelf life. The pods were analysed and sample tests were done regularly for changes in flavour, texture, and microbial growth over time.The stability of the pods under various storage conditions to optimize packaging and storage recommendations were ensured and analysed.

2.7 Dissolution Testing in Hot Rice

The dissolution of the flavor pods in hot rice is checked by standardized methods. The parameters such as dissolution time, dispersibility of seasonings, and overall sensory experience were measured.Sensory evaluations to gauge consumer acceptance and satisfaction with the seasoning distribution and flavour intensity were conducted.

By following these methods, the production and evaluation of biriyani seasoning edible flavour pods can be systematically conducted to ensure quality, safety, and effectiveness.

3. VISUAL APPEARANCE OF EDIBLE PACKAGING



(Fig .8)

Edible biryani flavor pods coated with potato starch, soy lecithin, and vegetable glycerin offer a visually captivating addition to any culinary creation. Encased in a translucent sheet these pods gleam like miniature jewels, their surfaces

reflecting the light with a tantalizing allure. The potato starch coating lends a delicate matte texture, providing a subtle contrast to the glossy exterior. Each pod boasts a rich, earthy hue reminiscent of the aromatic spices that define traditional biryani dishes, evoking a sense of warmth and comfort. As they rest delicately atop a bed of fluffy rice or nestle within a fragrant curry, these flavor pods add a touch of elegance and sophistication to the plate, enticing diners with their irresistible visual appeal.

IV. CONCLUSION

The research demonstrates the practicality and viability of the biriyani seasoning edible flavor pods through meticulous experimentation. Results indicate that the pods effectively infuse the desired flavor into rice dishes without compromising taste or texture. This suggests that the concept of flavor pods as a seasoning method is feasible and has the potential for widespread adoption. One of the key findings is the environmental benefits of the biriyani seasoning edible flavor pods. The use of biodegradable materials such as soy lecithin, potato starch, and vegetable glycerine for the edible film significantly reduces plastic waste associated with conventional seasoning packaging. This addresses growing concerns about plastic pollution and aligns with sustainable consumption practices. The formulation of the flavor pods ensures an extended shelf life compared to traditional seasoning methods. This is attributed to the encapsulation of the seasoning powder within the edible film, which protects it from moisture and oxidation. Additionally, the pods offer convenience in storage, as they can be easily stacked or stored in compact containers, saving space in kitchens and pantries.

Another crucial aspect discussed is the heat resistance and dissolvability of the flavor pods. The pods demonstrate the ability to withstand high temperatures without melting or deforming, making them suitable for use in hot rice dishes. Moreover, they dissolve seamlessly upon contact with hot rice, evenly distributing the seasoning throughout the dish and enhancing the dining experience. The research highlights the potential for widespread acceptance of biriyani seasoning edible flavor pods among consumers. Convenience, environmental friendliness, and enhanced flavor delivery are identified as key factors driving consumer preference for this innovative seasoning method. Furthermore, the study suggests that the market potential for such products is significant, with opportunities for expansion into other culinary applications beyond biriyani.

V. REFERENCE

1. Fernández, D.; Bautista, S.; Fernández, D.; Ocampo, A.; García, A.; Falcón, A. Eatable films and coverings: A favorable alternative in the postharvesIng. Conservation of fruits and vegetables. Rev. Cienc. Téc. Agropecu. 2015, 24, 52–57.
2. Espino-Díaz, M.; Ornelas-Paz, J.D.J.; Martínez-Téllez, M.A.; Santillán, C.; Barbosa-Cánovas, G.V.; Zamudio-Flores, P.B.; Olivas, G.I. Development and Characterization of Edible Films Based on Mucilage of Opuntia ficus-indica (L.). J. Food Sci. 2010, 75, E347–E352.
3. Caillet S, Millette M, Salmieri S, Lacroix M. 2006. Combined effects of antimicrobial coating, modified ´ Atmosphere packaging, and gamma irradiation on Listeria innocua present in ready-to-use carrots (Daucus Carota). J. Food Prot. 69:80–85
4. Carlin F, Gontard N, Reich M, Nguyen-The C. 2001. Utilization of zein coating and sorbic acid to reduce Listeria monocytogenes growth on cooked sweet corn. J. Food Sci. 66:1385–89
5. Chan MA, Krochta JM. 2001a. Grease and oxygen barrier properties of whey-protein-isolate coated paper-Board. Solutions 84(10):57
6. Chan MA, Krochta JM. 2001b. Color and gloss of whey-protein coated paperboard. Solutions 84(10):58
7. Chen H. 2002. Formation and properties of casein films and coatings. In Protein-Based Films and Coatings, ed.A Gennadios, 7:181–212. New York: CRC Pres
8. Chen MC, Yeh GH, Chiang BH. 1996. Antimicrobial and physicochemical properties of methylcellulose andChitosan films containing a preservative. J. Food Proc. Preserv. 20(5):379–90
9. Chen MJ,Weng YM, ChenW. 1999. Edible coating as preservative carriers to inhibit yeast on Taiwanese-styleFruit preserves. J. Food Safety 19(2):89–96
10 Chick J, Ustunol Z. 1998. Mechanical and barrier properties of lactic acid and rennet precipitated casein-based Edible films. J. Food Sci. 63(6):1024–2
11. Choi JH, Choi WY, Cha DS, Chinnan MJ, Park HJ, et al. 2005. Diffusivity of potassium sorbate in K-Carrageenan based antimicrobial film. LWT-Food Sci. Technol. 38:417–23
12. Coma V, Martial-Gros A, Garreau S, Copinet A, Salin F, Deschamps A. 2002. Edible antimicrobial films based on chitosan matrix. J. Food Sci. 67:1162–69
13. Coma V, Sebti I, Deschamps A, Pichavant HF. 2001. Anti-microbial edible packaging based on cellulosicEthers, fatty acids and nisin incorporation to inhibit Listeria innocua and Staphylococcus aureus. J. Food Prot.64:470–75
14. Corrales M, Han JH, Tauscher B. 2009. Antimicrobial properties of grape seed extracts and their effectivenessAfter incorporation into pea starch films. Int. J. Food Sci. Technol. 44(2):425–33
15. Cuero RG, Osuji G, Washington A. 1991. N-carboxymethyl chitosan inhibition of aflatoxina production: roleOf zinc. Biotechnol. Lett. 13(6):441–44
16. Cunningham P, Ogale AA, Dawson PL, Acton JC. 2008. Tensile properties of soy protein isolate filmsProduced by a thermal compaction technique. J. Food Sci. 65(4):668–71
17. Cuq B. 2002. Formation and properties of fish myofibrillar protein films and coatings. In Protein-based FilmsAnd Coatings, ed. A Gennadios, 8:213–32. New York: CRC PressCuq B, Aymard C, Cuq JL, Guilbert S. 1995.
18. Edible packaging films based on fish myofibrillar proteins:Formulation and functional properties. J. Food Sci. 60(6):1369–74
19. Cuq B, Gontard N, Guilbert S. 1998. Proteins as agricultural polymers for packaging production. Cereal Chem.75:1–9
20. Cutter CN, Siragusa GR. 1997. Growth of Brochothrixthermosphacta in ground beef following treatments withNisin in calcium alginate gels. Food Microbiol. 14(5):425–30.

Review Paper on the Comparison of Moringa and Soy Based on their Nutritional Composition, Health Benefits, Affordability, Physical Factors - Colour and flavour

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Abstract-- **As the demand for healthy and sustainable high-protein food options continues to rise, plant-based alternatives are becoming increasingly popular. This trend is attributed, in part, to the adverse effects associated with animal-based protein, such as a heightened risk of cancer, liver disorders, and coronary artery diseases. This review paper focuses on comparing plant-based protein alternatives like soy protein and moringa protein, in terms of theirnutritional composition, bioavailability, affordability, medical value or health benefits, and physiochemical properties such as flavor, and color. This will help in examining the key similarities and differences between these two alternative proteins, providing valuable insights into the potential applications and benefits of these plant-based protein sources for consumers, food manufacturers, and the wider food industry.**

Keywords—Plant-based protein alternative, Soy protein, Moringa protein, Animal-based protein, Sustainable, High Protein

I INTRODUCTION

Protein is a crucial nutrient that acts as the building block of the human body. It is composed of amino acids, which are vital components required for the growth and repair of body tissues. Protein significantly contributes to human wellness and nutrition, as it plays an essential role in the development of the body. It is important to note that there are different types of protein, such as plant-based protein and animal-based protein, each having a unique structure and effect on the body. A balanced diet must include sufficient protein to ensure the proper functioning of the body. Protein has various primary functions, including muscle and bone growth, hormone and enzyme production, and acting as an energy source. It is also the main component of hair, skin, nails, and body organs. Without adequate protein intake, the body cannot function correctly, and every essential function of the body is affected. Therefore, it is crucial to consume enough protein in your diet to ensure optimal health and wellness.

In recent times, due to the rising concerns about health issues, there has been a significant increase in the popularity of plant-based diets. People are becoming more aware of the importance of consuming organic and healthy meals to maintain a healthy lifestyle. The plant-based diet mainly focuses on utilizing the nutritional value and health benefits of various types of plants to form a balanced diet that helps nourish and boost the body's immune system. One of the significant advantages of a plant-based diet is that it is rich in various types of plant-based protein alternatives that are essential to the body.[1][2]

A. PLANT-BASED PROTEIN

Plant-based protein is a category of dietary protein derived exclusively from plant sources, showcasing a diverse array of nutrient-rich options that contribute to overall health and well-being. As an alternative to animal-

based proteins, plant-based proteins offer a compelling and sustainable choice for individuals seeking a nutritious and environmentally conscious diet. One of the primary characteristics of plant-based proteins is their origin in a wide variety of plant-derived foods, encompassing legumes, grains, nuts, seeds, vegetables, and various processed plant-based products. Legumes, such as beans, lentils, chickpeas, and peas, are excellent sources of plant-based proteins, packing a nutritional punch with fiber, vitamins, and minerals. Grains like quinoa, oats, barley, and whole grains contribute not only protein but also essential carbohydrates for sustained energy. Nuts and seeds, including almonds, peanuts, chia seeds, flaxseeds, and pumpkin seeds, offer a rich and diverse profile of proteins, healthy fats, and micronutrients. These plant-based protein sources contribute not only to meeting daily protein requirements but also to overall nutritional diversity. Certain vegetables, such as broccoli, spinach, and Brussels sprouts, also contain noteworthy amounts of protein, enhancing the protein content of meals and promoting a well-rounded, plant-centric diet. Moreover, plant-based protein products like tofu, tempeh, and seitan, derived from soybeans and wheat gluten, provide versatile options for those looking to incorporate plant-based proteins into their culinary repertoire.

B. ANIMAL-BASEDPROTEIN

Animal-based protein refers to the class of dietary proteins derived from animal sources, encompassing a diverse range of foods that play a crucial role in meeting the body's protein requirements. Unlike plant-based proteins, which come from plants, animal-based proteins are obtained from various animal products, including meat, poultry, fish, dairy, eggs, and other by-products. The rich spectrum of animal-based proteins offers a complete set of essential amino acids, which are fundamental building blocks necessary for the growth, repair, and maintenance of bodily tissues. This completeness makes animal-based proteins highly bioavailable, meaning the body can efficiently absorb and utilize them. Meat, whether from mammals like beef, pork, or lamb or poultry like chicken and turkey, is a prominent source of animal-based proteins. These proteins not only provide essential amino acids but also supply important micronutrients such as iron, zinc, and vitamin B12, which are crucial for various physiological functions.[3] [5]

II MORINGA

The Moringa plant, also known as the "miracle tree" or "drumstick tree," is originally from parts of Africa and Asia but is now grown in various tropical and subtropical regions worldwide.Moringa protein is the protein that is found in the Moringa oleifera plant. The protein in Moringa oleifera is mostly found in its leaves, which are rich in essential amino acids, the building blocks of proteins. Moringa leaves contain all nine essential amino acids, making it a complete protein source, which is quite rare in the plant kingdom. This makes Moringa protein particularly valuable, especially in areas where access to animal protein sources is limited. Moringa protein contains all nine essential amino acids, including histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. This makes it comparable to animal-based protein sources such as eggs, meat, and dairy. Moringa leaves can be consumed fresh, dried, or powdered, and they can be added to various dishes such as soups, salads, smoothies, and teas. Moringa powder is a convenient way to add protein and other nutrients to different recipes. Moringa trees are relatively easy to grow and are resilient in diverse climates, which makes them a sustainable source of protein and other nutrients, particularly in regions where food security is a concern. Although more research is needed, Moringa protein and its associated nutrients have been linked to various potential health benefits, including improved immune function, reduced inflammation, and enhanced energy levels. Overall, Moringa protein offers a valuable nutritional resource, particularly in areas where access to diverse and nutrient-rich foods may be limited. It presents an opportunity to address protein deficiencies and improve overall nutritional intake, contributing to better health outcomes for individuals and communities.[6][7]

A.NUTRITIONAL COMPOSITION

The Moringa oleifera plant is a rich source of nutrition, particularly its leaves, seeds, and pods. Here are the nutritional components that it contains:

1. *Protein*: Moringa leaves have all nine essential amino acids, making them an excellent source of plant-based protein. The protein content is high compared to other plant sources, making it a valuable supplement, particularly for vegetarians and vegans.

2. *Vitamins*: Moringa is rich in various vitamins, including Vitamin A (important for vision, immune function, and skin health), Vitamin C (supports immune function, collagen production, and iron absorption), Vitamin E (protects cells and supports skin health), and B Vitamins (essential for energy metabolism, nerve function, and DNA synthesis).

3. *Minerals*: Moringa is a good source of several minerals, such as Calcium (essential for bone health, muscle function, and nerve transmission), Iron (necessary for oxygen transport in the blood and energy metabolism), Potassium (important for maintaining fluid balance, muscle contraction, and nerve signals), Magnesium (important for energy production and muscle function), and Phosphorus (essential for bone and teeth health, DNA, and RNA synthesis).

4. *Antioxidants*: Moringa contains flavonoids, polyphenols, and beta-carotene, which help neutralize harmful free radicals in the body and reduce oxidative

stress. These antioxidants contribute to overall health and may help reduce the risk of chronic diseases such as heart disease and cancer.

5. *Fiber*: Moringa leaves and pods are rich in dietary fiber, promoting digestive health, regulating blood sugar levels, and helping maintain a healthy weight by promoting satiety.

6. *FattyAcids*: Moringa seeds contain beneficial fatty acids, including omega-3 and omega-6 fatty acids, which are important for brain health, heart health, and inflammation regulation.

Moringa's nutritional components make it a highly nutritious and versatile plant that can contribute to a well-balanced diet and promote overall health and well-being. Figure 1 shows the overall nutritional information per serving size for 10g and 100g.

	Per Serving (10g)		Per 100g	
Energy	128.1kJ / 30.6kcal		1281kJ / 306kcal	
Fat	0.6g		6g	
Of which: saturates	0.17g		1.7g	
Carbohydrate	2.6g		26g	
Of which: sugars	0.79g		7.9g	
Fibre	2.4g		24g	
Protein	2.5g		25g	
Salt	0.017g		0.17g	
		% NRV		% NRV
Vitamin A	151µg	18.9%	1510µg	189%
Vitamin E	8.1mg	67.4%	81mg	674%
Vitamin K	119µg	158.7%	1190µg	1587%
Vitamin C	2.3mg	2.9%	23mg	29%
Thiamin (B1)	0.08mg	7.3%	0.8mg	73%
Riboflavin (B2)	0.1mg	7.9%	1.1mg	79%
Vitamin B6	0.1mg	7.2%	1mg	72%
Vitamin B12	0.2µg	8.1%	2µg	81%
Potassium	145mg	7.3%	1450mg	73%
Calcium	198mg	24.7%	1980mg	247%
Magnesium	49.5mg	13.2%	495mg	132%
Iron	4.5mg	32.2%	45mg	322%
Zinc	0.25mg	2.5%	2.5mg	25%
Rich Source				
Source				

NUMBER OF VITAMINS & MINERALS AT 'SOURCE' OR 'RICH SOURCE' PER SERVING AND PER 100G

NRV = Nutrient Reference Value

Fig1: Nutritional Composition of moringa protein per serving size for 10g and 100g

B. BIOAVAILABILITY

The bioavailability ofmoringa refers to how much of it is absorbed and utilized by the body. Several factors affect its bioavailability, such as its digestibility, amino acid profile, and how it interacts with other nutrients. Moringa protein, particularly from its leaves, is considered to have good bioavailability for several reasons:

1. *Digestibility*: Compared to some other plant proteins, moringa protein is relatively easy to digest. During the digestive process, its protein content is readily broken down into amino acids, which allows for efficient absorption in the small intestine.

2. *Amino Acid Profile*: Moringa protein contains all nine essential amino acids, which are the building blocks of protein that the body cannot synthesize on its own. The presence of these essential amino acids makes moringa protein a complete protein source, similar to animal-based proteins.

3. *Processing Methods*: The bioavailability of moringa protein can also be influenced by how it is processed and prepared. For example, drying and grinding moringa leaves into powder form can help concentrate their nutrients.

4. *Interactions with Other Nutrients*: Moringa contains various nutrients, including vitamins, minerals, and antioxidants, which may enhance the bioavailability of its protein. For instance, vitamin C, found abundantly in moringa leaves, can improve the absorption of iron, another important nutrient present in moringa. These synergistic interactions among nutrients can contribute to overall better absorption and utilization by the body.

5. *Individual Factors*: Bioavailability can also vary depending on individual factors such as age, digestive health, and metabolic rate. Individuals with compromised digestive function may experience lower bioavailability of moringa protein compared to those with healthy digestive systems. Figure 2 shows the bioavailability of the leaves and seeds of the moringa plant.

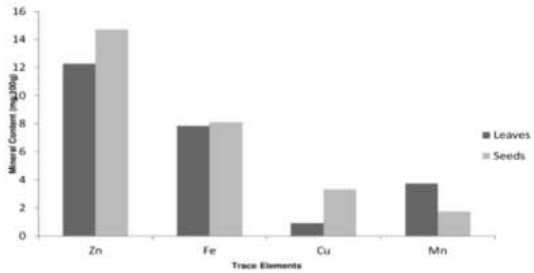


Fig 2: Bioavailability of the leaves and seeds of the moringa plant

C.AFFORDABILITY

The affordability of moringa can vary based on several factors, including geographic location, availability, demand, and local economic conditions. Here are some important considerations that can affect the affordability of moringa:

1. *Cultivation and Harvesting Costs*: The cost of cultivating and harvesting moringa plants can influence the overall affordability of moringa products. Factors such as labor costs, land availability, and agricultural inputs (such as fertilizers and pesticides) can impact production costs.

2. *Processing and Packaging*: Processing moringa leaves into powder or extracting oil from its seeds involves additional costs such as equipment, labor, and energy. The methods used for processing and packaging moringa products can affect their final price.

3. *Market Demand and Supply*: The demand for moringa products, both locally and globally, can influence their prices. Increased demand may drive prices up, especially if the supply cannot keep pace with demand.

4. *Local Availability*: In regions where moringa is native or widely cultivated, it may be more affordable due to lower transportation costs and greater availability. However, in areas where moringa is not locally grown, importation costs and transportation expenses can contribute to higher prices.

5. *Product form*: The form in which moringa is sold can also affect its affordability. For example, moringa leaves and powder may be more affordable compared to specialized products like moringa capsules or extracts.

6. *Economic Factors*: Local economic conditions, currency exchange rates, and inflation rates can impact the affordability of moringa products. In regions with weaker economies, moringa products may be relatively more expensive compared to regions with stronger economies.

D. HEALTH BENEFITS

Moringa, commonly known as the "miracle tree," is highly nutritious and rich in bioactive compounds that offer several potential health benefits.

1. *Nutrient-Rich*: Moringa is packed with essential nutrients, including vitamins (A, C, E, K, and B vitamins), minerals (calcium, magnesium, iron, and potassium), protein, and antioxidants which are vital for overall health and well-being.

2. *Antioxidant Properties*: Moringa contains various antioxidants such as flavonoids, polyphenols, and vitamin C, which neutralize harmful free radicals in the body. Antioxidants protect cells from damage, reduce inflammation, and may lower the risk of chronic diseases like heart disease and cancer.

3. *Anti-Inflammatory Effects:* Studies suggest that moringa may have anti-inflammatory properties that can help reduce inflammation in the body.

4. *Supports Immune Function*: The vitamins and antioxidants in moringa help support a healthy immune system, which defends the body against infections and illnesses. Moringa's immune-boosting properties may help reduce the risk of infections and promote overall immunity.

5. *Promotes Heart Health*: Moringa may help support heart health by lowering cholesterol levels, reducing blood pressure, and improving blood sugar control. These effects can lower the risk of heart disease and improve cardiovascular function.

6. *Aids Digestive Health*: Moringa leaves are rich in fiber, promoting healthy digestion by promoting regularity, preventing constipation, and supporting a healthy gut microbiome. Moringa's anti-inflammatory properties may also help alleviate digestive issues like bloating and gas.

7. *May Help Manage Diabetes*: Some research suggests that moringa may help regulate blood sugar levels and improve insulin sensitivity, benefiting individuals with diabetes. Moringa's ability to lower blood sugar levels may help manage diabetes symptoms and reduce the risk of complications.

8. *Potential Anti-Cancer Properties*: Preliminary studies indicate that certain compounds found in moringa, such as quercetin and chlorogenic acid, may have anti-cancer properties.

9. *Promotes Skin and Hair Health*: Moringa oil is often used in skincare products due to its moisturizing and nourishing properties. It may help hydrate the skin, reduce inflammation, and protect against oxidative damage. Additionally, moringa's nutrient-rich profile may support healthy hair growth and improve hair texture.[11]

E. PHYSIOCHEMICAL PROPERTIES

1. *Moringa Leaves*:
- Color: Fresh moringa leaves are usually vibrant green due to the presence of chlorophyll, which is responsible for photosynthesis.
- Flavor: Fresh moringa leaves have a mild, slightly earthy taste with a hint of bitterness, similar to that of spinach or arugula. The flavor may vary based on factors such as growing conditions and plant variety.

2. *Moringa Flowers*:
- Color: Moringa flowers are typically white or cream-colored with hints of yellow or pink. The color may slightly vary depending on the variety of moringa.
- Flavor: Moringa flowers have a delicate, slightly sweet flavor with subtle floral notes. They are often used in culinary dishes, teas, and herbal remedies.

3. *Moringa Seeds*:
- Color: Moringa seeds are brown and encased in long, slender pods that start green and mature to a brown color.
- Flavor: Raw moringa seeds have a nutty flavor similar to peanuts or almonds. When roasted, the flavor becomes richer and more pronounced.
4. *Moringa Pods*:
- Color: Moringa pods, also known as drumsticks, are long and cylindrical. They are initially green and gradually turn brown as they mature.
- Flavor: Young moringa pods have a tender texture and a mild, slightly sweet flavor reminiscent of green beans or asparagus. As the pods mature, they become tougher and develop a slightly bitter taste.

5. *Moringa Powder*:
- Color: Moringa powder is finely ground and typically bright green. The color may vary depending on processing methods and storage conditions.
- Flavor: Moringa powder has a slightly earthy, grassy taste with a hint of bitterness. The flavor is more

concentrated compared to fresh moringa leaves and can be described as "green" or "vegetal."[13] [12

III. SOY

Soy protein is mainly defined as a type of protein that is extracted from soybeans. These legumes are native to East Asia and are widely used in dietary supplements and food products due to their many health benefits and high protein content.[14]

1. *High protein content*: Soybeans have one of the highest concentrations of protein among plant-based foods. Soy protein isolate, the most concentrated form of soy protein, contains around 90% protein by weight.

2. *Complete protein*: Soy protein is a complete protein because it contains all nine essential amino acids that our bodies cannot produce on their own.

3. *Health benefits*: Consuming soy protein has been linked to several health benefits, including improved heart health, stronger bones, and weight management.

4. *Versatility*: Soy protein is incredibly versatile and can be added to a variety of food products, including protein powders and shakes, meat alternatives, dairy alternatives, baked goods, and snacks.

5. *Allergies and sensitivities*: Although soy protein is generally safe for most people, some individuals may be allergic to soy or have sensitivities to it. Soy allergies are relatively common, especially among children, and can cause symptoms such as hives, itching, swelling, and difficulty breathing. People with soy allergies should avoid consuming soy products and carefully read food labels to identify soy-derived ingredients.[14][15]

A. NUTRITIONAL COMPOSITION

Soy protein is a highly nutritious food that provides a range of essential nutrients beneficial to overall health and well-being.

1. *Protein*: Soy protein is an excellent source of protein, making it a popular choice for vegetarians, vegans, and those looking for alternative sources of protein. Soy protein isolate, the most concentrated form of soy protein, contains about 90% protein by weight.

2. *Amino acids*: Soy protein is a complete protein, containing all nine essential amino acids that the body cannot produce on its own. Some of the essential amino acids include histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine.

3.*Carbohydrates*: Soy protein contains carbohydrates, though in smaller amounts compared to its protein content. The amount of carbohydrates varies depending on the form of soy protein and how it's processed. Whole soybeans and some soy products may contain significant amounts of carbohydrates, including dietary fiber, which promotes digestive health and helps regulate blood sugar levels.

4. *Fats*: Soy protein contains fats, including both saturated and unsaturated fats. However, soybeans are unique among plant-based protein sources because they contain a considerable amount of polyunsaturated fats, particularly omega-6 and omega-3 fatty acids. These fats are essential for brain function, heart health, and inflammation regulation.

5. *Fiber*: Soy protein is also a good source of dietary fiber, which supports digestive health, regulates bowel movements, and helps maintain healthy cholesterol levels. Dietary fiber can promote feelings of fullness and satiety, making it beneficial for weight management and appetite control.

6. *Vitamins and minerals*: Soy protein contains several vitamins and minerals that are essential for overall health, including:
- Iron: important for oxygen transport and red blood cell formation.
- Magnesium: involved in hundreds of biochemical reactions in the body, including energy metabolism and muscle function.
- Vitamin B complex: includes vitamins such as folate, riboflavin, and vitamin B6, which play roles in energy metabolism and nervous system function.

B. BIOAVAILABILITY

Bioavailability refers to the extent and rate at which the body absorbs and utilizes nutrients after consumption. The bioavailability of soy protein is influenced by several factors, such as its composition, processing methods, and interactions with other nutrients.

1. *Protein Digestibility*: Soy protein is highly digestible and has a protein digestibility-corrected amino acid score (PDCAAS) of 1.0. This means that soy protein provides all the essential amino acids needed by the body and is efficiently absorbed.

2. *Antinutritional Factors*: Soybeans contain natural compounds called antinutritional factors, such as trypsin inhibitors and phytic acid, which can interfere with the absorption of certain nutrients. However, modern processing methods, such as soaking, heating, and fermentation, can help reduce the levels of these antinutritional factors, thereby improving the bioavailability of soy protein.

3. *Processing Methods*: The bioavailability of soy protein products can be impacted by the processing methods used to produce them. For instance, soy protein isolate, which is made by removing most of the carbohydrates and fats

from soybeans, has a higher protein concentration and may be more easily absorbed by the body than less processed soy products.

4. *Isoflavones*: Soybeans contain phytochemicals known as isoflavones, which have estrogen-like effects. Isoflavones, such as genistein and daidzein, have been studied for their potential health benefits, including their role in reducing the risk of certain chronic diseases. However, the presence of isoflavones in soy protein products may also affect their bioavailability and metabolism in the body.

5. *Interactions with Other Nutrients*: The bioavailability of soy protein may be influenced by interactions with other nutrients consumed simultaneously. For example, consuming soy protein with foods that are rich in vitamin C may enhance the absorption of iron from soybeans because of vitamin C's role in enhancing non-heme iron absorption.

6. *Individual Variability*: The bioavailability of soy protein can vary among individuals based on factors such as age, gastrointestinal health, and genetic differences in nutrient absorption and metabolism. Figure 2 shows the bioavailability of soy protein

C. AVAILABILITY

The availability of soy protein refers to its accessibility and presence in various forms for consumption. Soy protein is widely available in many countries around the world, thanks to the global cultivation of soybeans and the diversity of soy-based products. Here's a breakdown of the availability of soy protein:

1. *Retail Stores*: Soy protein products can be found in most grocery stores, supermarkets, health food stores, and specialty food stores. Typically available various forms, including:
- Soy protein powders
- Soy milk
- Tofu
- Tempeh+
- Soy-based meat alternatives
- Soy protein bars

2. *Online Retailers*: Soy protein products are also available for purchase through various online retailers, making them accessible to consumers who prefer to shop online or have limited access to local stores.
3. *Food Service Industry*: Soy protein is widely used in the food service industry, including restaurants, cafeterias, and catering services. Many vegetarian and vegan dishes feature soy protein as a central ingredient, offering plant-based alternatives to traditional meat-based dishes.[16][17]
4. *Health and Fitness Market*: Soy protein is popular among individuals following vegetarian, vegan, or plant-based diets, as well as those seeking alternative protein sources for health or environmental reasons. As a result, soy protein products are often marketed to health-conscious consumers and athletes looking to increase their protein intake.
5. *Cultural Availability*: In regions where soy-based foods are traditional staples, such as East Asia, soy protein products are readily available and commonly consumed as part of the local diet. These regions often have a wide variety of soy-based dishes and culinary traditions centered around soybeans[18][19]

D.HEALTH BENEFITS

Soy protein offers a range of health benefits, making it a valuable component of a balanced diet.

1. *Heart Health*: Consuming soy protein has been linked to improvements in cardiovascular health. Soy protein can help lower levels of LDL cholesterol (the "bad" cholesterol) while increasing levels of HDL cholesterol (the "good" cholesterol). By promoting a healthier lipid profile, soy protein may reduce the risk of heart disease and stroke.

2. *Blood Pressure Regulation*: Studies suggest that soy protein may help lower blood pressure levels, particularly in individuals with hypertension or prehypertension. The presence of bioactive peptides in soy protein may contribute to its blood pressure-lowering effects.

3. *Weight Management*: Including soy protein in the diet can help promote feelings of fullness and satiety, which may aid in weight management and weight loss efforts. Soy protein-rich foods can help reduce overall calorie intake and curb cravings, making it easier to maintain a healthy weight.

4. *Bone Health*: Soy protein contains isoflavones, plant compounds that have been shown to support bone health and reduce the risk of osteoporosis, especially in postmenopausal women. Isoflavones may help improve bone density and reduce the risk of fractures by modulating bone metabolism and enhancing calcium absorption.

5. *Muscle Maintenance and Growth*: Protein is essential for muscle repair, maintenance, and growth. Soy protein provides all nine essential amino acids needed for muscle protein synthesis, making it a valuable source of protein for athletes, bodybuilders, and individuals engaging in regular exercise.

6. *Menopausal Symptoms*: Some research suggests that soy protein and its isoflavones may help alleviate menopausal symptoms

7. *Cancer Prevention*: There is evidence to suggest that soy protein consumption may be associated with a reduced risk of certain types of cancer, including breast cancer, prostate cancer, and colon cancer. Isoflavones found in soy protein have antioxidant properties and may

help protect cells from oxidative damage and inhibit the growth of cancer cells.

8. *Digestive Health*: The fiber content in soy protein-rich foods, such as whole soybeans and soy-based products, can promote digestive health by supporting regular bowel movements, preventing constipation, and promoting the growth of beneficial gut bacteria.

E. PHYSICAL PROPERTIES

The physical properties of soy protein, including its color and flavor, can vary depending on factors such as processing methods, the presence of additives, and the specific type of soy protein product. Here's an overview of the physical properties of soy protein:

1. *Color*: The color of soy protein products can range from pale beige to light yellow, depending on factors such as processing, degree of refinement, and the presence of additives or flavorings. Soy protein isolate, which is the most refined form of soy protein, typically has a lighter color compared to other soy products like soy flour or textured soy protein, which may have a slightly darker hue due to the presence of other components.

2. *Texture*: Soy protein products exhibit a range of textures depending on their form and processing. For example:
- Soy protein isolate: This form of soy protein is typically in powder form and has a fine, powdery texture.
- Tofu: Tofu has a soft and smooth texture, with variations in firmness depending on the type (silken, soft, firm, extra firm).
- Tempeh: Tempeh has a firm and slightly chewy texture with a nutty flavor, owing to its fermentation process.
- Textured soy protein (TSP): TSP, also known as soy meat or soy chunks, has a fibrous and chewy texture that resembles the texture of meat when rehydrated.

3. *Flavor*: The flavor of soy protein can be influenced by various factors, including the presence of natural compounds like isoflavones, processing methods, and the addition of flavorings or seasonings. In its natural state, soy protein has a mild, slightly nutty flavor. However, soy protein products can be flavored or seasoned to enhance their taste and versatility. For example:
- Soy milk: Unsweetened soy milk has a subtle, slightly bean-like flavor, while sweetened or flavored varieties may have added sugars and flavorings like vanilla or chocolate.
- Tofu: Tofu has a neutral flavor, making it versatile for use in savory or sweet dishes. It readily absorbs the flavors of marinades, sauces, and seasonings.
- Textured soy protein: TSP is often used as a meat substitute and can be flavored with spices, herbs, and sauces to mimic the taste of meat in dishes like chili, tacos, and stir-fries.

4. *Appearance in Food Products*: Soy protein is commonly used as an ingredient in a variety of food products, including meat substitutes, dairy alternatives, baked goods, and snacks. Its physical properties contribute to the texture, appearance, and taste of these products, making soy protein a versatile ingredient in the food industry.

II. RESULT AND DISCUSSIONS

Growing desire for nutritious and eco-friendly protein sources, with plant-based options gaining traction. The reasoning behind this shift is attributed to the harmful impact of animal-based protein consumption, which heightens the likelihood of developing cancer, liver ailments, and coronary artery disease.Protein is a vital part of a balanced diet that contributes significantly to the normal functioning of the body. Thus, the intake of protein in daily lifeis necessary for a balanced diet. Plant-based protein which is considered in this review paper is soy protein and moringa protein. Both the plant-based protein alternative has their benefits but compared to soy protein, moringa protein is more affordable, sustainable, has higher bioavailability, and provides more health benefits.[20][14]

III. CONCLUSIONS

Protein is a vital element in human nutrition and wellness, as it plays a crucial role in the development of the human body. Due to concerns about health issues, plant-based protein alternatives are gaining popularity over animal-based ones. This review paper focuses on comparing plant-based protein alternatives, specifically soy protein and moringa protein. After comparing the two, it appears that moringa protein is more beneficial, affordable, sustainable, and healthy compared to soy protein.

IV. REFERENCES

[1]Arango, Árbol de las Perlas, Behen, Ben Ailé, Ben Nut Tree, Ben Oléifère, Benzolive , Moringa – uses , side effects and more

[2] Aaron J Michelelder , Soy: A Complete Source of Protein

[3] Abdulkarim Addulmageed Amad , Jurgen Zentek, The use of Moringa olifera in ruminant feeding and its contribution to climate change mitigation

[4] Ahmad Faizal Abdull Razis, Muhammad Din Ibrahim2 , Saie Brindha Kntayya, Health benefits of Moringa olifera

[5] Aysha Riaz and Said Wahab , Efficency of moringa leaves powder as a supplement in whole wheat flour biscuits

[6] Dina M. Sakr, Yasser M. Abd El-Shafea, Marwa I. Eissa and

Gihan M. El Moghazy*, Composition, nutritive value of Moringa oleifera leaves and its
clinico - nutritional role in conserving bone integrity of albino rats fed on purified diet

[7] K Sukalingam , Kumar Ganesan , Srijit Das , Zar Chi Thent , An insight into the harmful effects of soy protein: A review

[8] Karina Citra Rani1*, Nani Parfati1, Nikmatul Ikhrom Eka Jayani2, Tan Sherly Evelina3 , Cherry Christianto, The Development of Moringa oleifera Leaves Cereal Using Full Cream and Soy Milk as Fillers
.
[9] Kristina S Petersen , The Dilemma With the Soy Protein Health Claim

[10] Kantilata Thapa. Moringa oleifera: A Review Article on Nutritional Properties and its
Prospect in the Context of Nepal

[11] Khavhatondwi Rinah Netshiheni, Mpho Edward Mashau, Afam Israel Obiefuna Jideani, Nutritional and sensory properties of instant maize porridge fortified with Moringa oleifera leaves and termite (Macrotermes falciger) powders

[12] Lakshmipriya Gopalakrishnan b, Kruthi Doriya a, Devarai Santhosh Kumar a, Moringa oleifera: A review on nutritive importance and its medicinal

[13] Lisa A van den berg , Jurrian J Mes , Marco Mensink , Anne J Wanders, Protein quality of soy and the effect of processing: A quantitative review

[14] Mark Messina , Soy and Health Update: Evaluation of the Clinical and Epidemiologic Literature

[15] Muhammad Sameem JAVED1 * , Adnan AMJAD1 , Mohibullah SHAH2 , Faiz-ul- Hassan SHAH3 , Isolation and characterization of moringa oleifera l. Flower protein and utilization in functional food bars

[16] Oluwole S. Ijarotimi, Oluwole A. deoti, Oluwaseun Ariyo , 10. Comparative study on nutrient composition, phytochemical, and functional characteristics of raw, germinated, and fermented Moringa oleifera seed flour

[17] Oluwadara Oluwaseun Alegbeleye, How Functional Is Moringa oleifera? A Review of Its Nutritive, Medicinal, and Socioeconomic Potential

[18] Olusanya a, U. Kolanisi a b, A. van Onselen c, N.Z. Ngobese d, M. Siwela a , 3. Nutritional composition and consumer acceptability of Moringa oleifera leaf powder (MOLP)-supplemented mahewu

[19] Pingxu Qin , Taoran Wang , Yanchao Luo , A review on plant-based proteins from soybean: Health benefits and soy product development

[20] Rocío Peñalver 1,Lorena Martínez-Zamora 1ORCID,José Manuel Lorenzo 2,3ORCID,Gaspar Ros 1ORCID andGema Nieto 1,*ORCID , Nutritional and Antioxidant Properties of Moringa oleifera Leaves in Functional Foods

[21] Tu Quang Hien1*, Hoang Thi Hong Nhung2 , Tu Quang Trung3 and Mai Anh Khoa1, Replacement of soybean meal by Moringa oleifera leaf meal in broiler diet

[22] https://aduna.com/blogs/learn/moringa-nutritional-table

[23]https://www.foodunfolded.com/article/bioavailability-of-plant-based-proteins

Advanced Smart Irrigation System Based on IoT Sensors

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ABSTRACT

The project aims to develop an advanced smart irrigation system that seamlessly combines IoT technology and machine learning to revolutionize agricultural water management. This system incorporates soil moisture and flow sensors placed throughout the agricultural field, transmitting data to the cloud via Wi-Fi or LoRa connectivity. Cloud services from platforms like AWS or Azure securely store and analyze this data in real-time, providing insights into soil conditions and water usage patterns. The core innovation lies in the integration of a machine learning prediction model, utilizing historical and real-time data to forecast precise water requirements for specific crops, considering factors like temperature, humidity, and historical weather data. Furthermore, the system integrates crop disease detection using Convolutional Neural Networks (CNNs), where ESP32 CAM streams images, enabling the identification of crop diseases and also NPK sensor for detection soil nutrients.This comprehensive approach holds the potential to enhance both water efficiency ,crop health and optimize the crop growth in agriculture.

KEYWORDS: Sensors, Real-time data, Machine learning, Crop growth

I INTRODUCTION

Internet of Things (IoT) plays a key role in smart agriculture. "Smart farming" is a notion that has emerged from IoT devices that may offer information on agricultural regions. The use of modern information technology with industrial agriculture has resulted in increased productivity in recent times. These days, there are new opportunities and special applications for more precise, site-specific, and sustainable agriculture. With or without human intervention, it enables networks and devices to connect, share, and store data on the cloud platform over the internet. From a device to the cloud to transfer data. In order to transfer data from a device to the cloud, the device must first be added to the cloud and its credentials, which consist of the device ID and username, obtained. To send data to the cloud, these credentials are used to establish a connection between Wi-Fi and the cloud. The data broadcast by the Wi-Fi can be received once it has successfully identified the Wi-Fi in the cloud. Water consumption problems can be resolved with the use of smart meters, which track and regulate the quantity of water used in agricultural systems. Sensor data from NPK (nitrogen, phosphorus, and potassium) sensors will be used by the system to learn more about the nutritional status of the soil. The data will be utilized to recommend crops that are likely to adjust in the particular soil condition through the application of machine learning algorithms.

II METHODOLOGY

The project aims to develop an agricultural monitoring system using Node MCU, moisture sensors, flow sensors, and Thing Speak cloud integration. The system primarily focuses on monitoring soil moisture levels and controlling irrigation pumps accordingly. Additionally, it collects data from various sensors and sends it to the ThingSpeak cloud platform for further analysis and visualization through a web application. This project also helps in precision agriculture, water conservation, remote monitoring, energy efficiency and predictive analysis.

III RESEARCH

The main aim is to make agriculture using IoT and automation technologies. It includes irrigation with the smart control system and intelligent decision making established on smart warehouse management and precise real-time field data. In Soil testing, the combination of IoT and cloud computing is very much familiar to applied with it. Likewise with the global increase in population, the need for an increase in food production is raised. IoT plays a vital role in drip irrigation with its network of interconnected devices and sensors. By deploying IoT-enabled smart sensors in agricultural fields, real-time data on soil moisture, water flow rate

and weather conditions can be collected and analyzed. Water is main resource for Agriculture. Irrigation is one method to supply water. In this irrigation process people are wasting water more by missing the timings. So too save water and time we have a excellent method called Smart irrigation system using IoT. By the smart irrigation system we are using various equipments like flow sensor and moisture sensor. These sensors will find the various situations of the soil and based on soil moisture percent, land gets automatically irrigated. It means when field needs water then automatically motor will get ON and it will get OFF when it's get enough. These sensed parameters and motor status will be displayed on user devices.This helps in water enhancing water efficiency and crop health.

IV BLOCK DIAGRAM

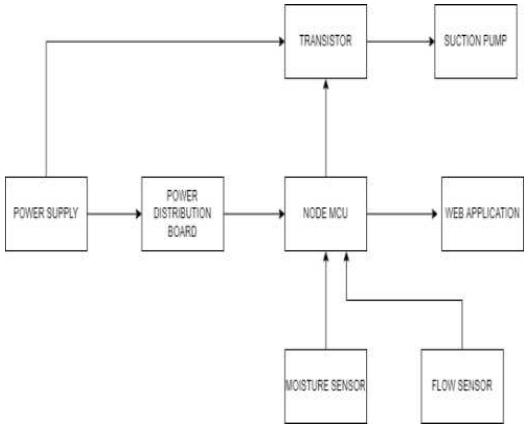


Fig:1 BLOCK DIAGRAM FOR PROPOSED SYSTEM

V HARDWARE SETUP

5.1 MICROCONTROLLER

The NodeMCU is an ESP8266 WiFi-based microcontroller board that helped overcome the difficulties associated with multiple board versions based on the ESP8266 WiFi module. The board contains everything that supports a microcontroller; just connect it to a computer with a USB cable or as a power supply. With AC-DC adapter or battery It interfaces with sensors and connects to the Internet to transmit data.



Fig:2 NodeMCU ESP8266

5.2 FLOW SENSOR

Flow sensors are used to measure the flow rate of water through irrigation systems. A flow sensor is a component that measures the flow of a fluid such as gas or liquid. Flow sensors use both mechanical and electrical subsystems to measure changes in the physical properties of a liquid and calculate its flow provide information on water consumption.



Fig:3 Flow sensor

5.3 MOISTURE SENSOR

Flow sensors are used to measure the flow rate of water through irrigation systems. A flow sensor is a component that measures the flow of a fluid such as gas or liquid. Flow sensors use both mechanical and electrical subsystems to measure changes in the physical properties of a liquid and calculate its flow rate. They provide information on water consumption.

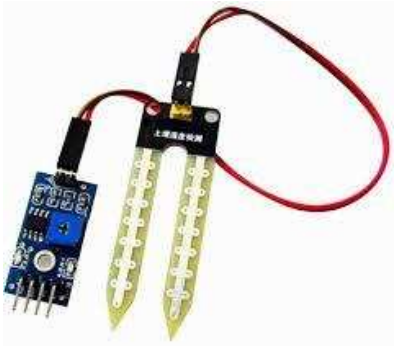


Fig: 4 Moisture sensor

VI SOFTWAREIMPLEMENTATION

Programming NodeMCU:

The NodeMCU is programmed using Arduino IDE or other compatible platforms. Code is written to read data from moisture and flow sensors periodically.

Data Transmission:

Wi-Fi connectivity is established using NodeMCU to send sensor data to the ThingSpeak cloud platform. HTTP or MQTT protocols can be used for communication.

ThingSpeak Integration:

ThingSpeak provides APIs for data upload and retrieval. The NodeMCU is configured to send data to specific ThingSpeak channels corresponding to soil moisture and flow rate.

Control Logic:

Control logic is implemented to activate the irrigation pump when the soil moisture falls below a certain threshold. This logic ensures efficient water usage and plant health.

VII THINGSPEAK CLOUD CONFIGURATION

Channel Setup: ThingSpeak channels are created to receive data from the NodeMCU. Each channel is associated with specific sensor data, such as soil moisture and flow rate.

Visualization: ThingSpeak offers visualization tools to display sensor data in the form of charts, graphs, and gauges. These visualizations provide insights into soil moisture trends and water usage.

Data Analysis: ThingSpeak allows for data analysis using MATLAB scripts. Advanced analytics can be performed to derive actionable insights for optimizing irrigation practices.

VIII WEB APPLICATION

Frontend Development: A web application is developed to visualize sensor data fetched from the ThingSpeak cloud. HTML, CSS, and JavaScript are used for frontend development.

Backend Integration: Backend services are implemented to fetch data from ThingSpeak channels using ThingSpeak APIs. Server-side scripting languages like PHP or Node.js may be utilized.

Real-time Updates: The web application is designed to receive real-time updates from ThingSpeak channels, providing users with the latest information on soil moisture and water flow.

The agricultural monitoring system developed using NodeMCU, moisture sensors, flow sensors, and ThingSpeak cloud integration offers an efficient solution for precision farming. By continuously monitoring soil moisture levels and water consumption, farmers can optimize irrigation schedules, conserve water resources, and improve crop yield. The integration with ThingSpeak enables data visualization and analysis, facilitating informed decision-making for better agricultural management.

VII RESULT AND DICUSSION

FIG: 5 ADVANCED SMART IRRIGATION SYSTEM

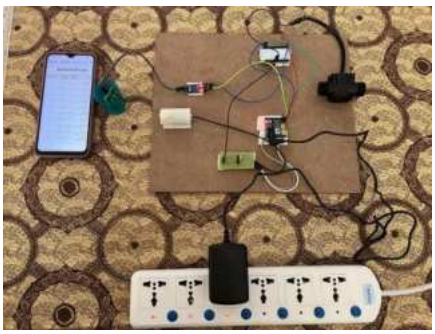
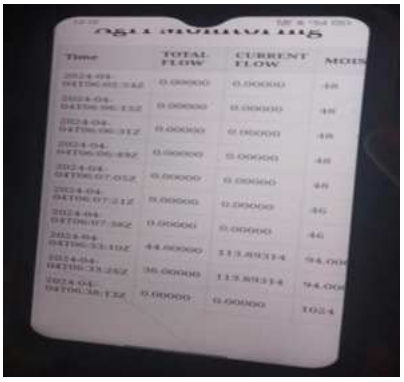


FIG: 6 REAL-TIME DATA



VIII FUTURE DEVELOPMENT

Furthermore, the system integrates crop disease detection using Convolutional Neural Networks (CNNs), where ESP32 CAM streams images, enabling the identification of crop diseases, NPK sensor for detection soil nutrients and also pH sensor to . This comprehensive approach holds the potential to enhance both water efficiency, crop health and optimize the crop growth in agriculture.

IX CONCLUSION

In conclusion, the integration of IoT technology into modern irrigation systems represents a significant advancement in agricultural practices. Through real-time data collection, analysis, and control, IoT-enabled smart irrigation systems offer several benefits. By continuously monitoring environmental factors such as soil moisture levels, weather forecasts, and crop water requirements, IoT systems can optimize water usage, leading to significant water savings compared to traditional irrigation methods. The precise control provided by IoT technology enables farmers to deliver the right amount of water to crops at the right time, promoting healthier plant growth, increased yields, and improved crop quality. Smart irrigation systems contribute to the conservation of valuable resources such as water and energy, reducing the environmental impact of agricultural activities and promoting sustainability in food production. Thereby, reducing water wastage and improving crop productivity, IoT-based irrigation systems can help farmers lower operational costs and increase profitability in the long term. With remote access capabilities, farmers can monitor and control their irrigation systems from anywhere, providing greater flexibility and convenience in managing agricultural operations.

X REFERENCES

1.Jan Bauer,Nils Aschenbruck ,"Design and implementation of an agricultural monitoring system for smart farming",2018 IoT Vertical and Topical Summit on Agriculture - Tuscany (IOT Tuscany)

2.S. R. Prathibha,Anupama Hongal,M. P. Jyothi,"IOT Based Monitoring System in Smart Agriculture",2017 International Conference on Recent Advances in Electronics and Communication Technology (ICRAECT)

3.Mohit Kumar Saini,Rakesh Kumar Saini,"Agriculture monitoring and prediction using Internet of Things

(IoT)",2020 Sixth International Conference on Parallel Distributed and Grid Computing (PDGC)

4.A. Lakshmi,Y. Ravi Kumar,N. Sai Krishna,G. Manisha,"IOT Based Agriculture Monitoring and Controlling System",2021 6th International Conference on Communication and Electronics Systems (ICCES)

5.Cong Hoang Quach,Minh Trien Pham,Truong Son Nguyen,Manh Duong Phung,"Real-time Agriculture Field Monitoring Using IoT-based Sensors and Unmanned Aerial Vehicles",2021 8th NAFOSTED Conference on Information and Computer Science (NICS)

6.Vijaya Vardan Reddy S,B. Jaison,A. Balaji,D. Indumathy,S. Vanaja,J. Joselin Jeya Sheela,"Agri-IoT: A Farm Monitoring and Automation System using Internet of Things",2023 Second International Conference on Electronics and Renewable Systems (ICEARS)

7.Navjot Rathour,Sapna Singh,Avinash,Suyash Ralhan,Rahul Purakayastha,"IoT Based Smart Agricultural Monitoring System",2023 2nd International Conference on Edge Computing and Applications (ICECAA)

8.Sahil Chari,Samrat Parab,Harsh Pawar,Durgesh Raut,Gauri Chavan,"Smart Agricultural Crop Monitoring System",2022 5th International Conference on Advances in Science and Technology (ICAST)

9.D.K. Sreekantha,Kavya A.M.,"Agricultural crop monitoring using IOT - a study",2017 11th International Conference on Intelligent Systems and Control (ISCO)

10.Tahni Humoud,Muneerah Alrushoud,Fatemah Almutairi,Wadhha Almutairi,Fay Almarri,Hassan Kanj,"Smart Agriculture Monitoring and Controlling System using Multi-agents model",2023 5th International Conference on Bio-engineering for Smart Technologies (BioSMART)

Instant Fruit Drink Powder Underutilization of Fruit Peel: A Review

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ABSTRACT

Fruit peel waste is created as a by product in home kitchens and by the food industry. Despite being rich in nutrients and bioactive chemicals, fruit peel debris generated at the food industry level is increasing daily. Peel waste poses a significant problem that needs to be addressed. Peels are safe to eat but are frequently thrown out, even though they are full of essential nutrients that support human health and well-being by preventing diabetes, heart disease, and cancer. Utilizing fruit peels to develop value-added products for food and industrial applications is a sustainable way to reduce peel waste. The approach improves the product's nutritional value and provides additional income for the industrial sector. Modern people prefer to consume feasible, efficiently served products like powdered drinks. Powdered drinks are dried versions of commercial beverages, categorized as instant food since they require minimal rehydration work before usage. This paper will overview the different types of instant fruit drinks made from fruit peels and their constituent components.

Keywords: ***fruit peel, instant drink, waste utilization, value-added product, powdered drink***

1. INTRODUCTION

The concept of "waste-to-wealth" signifies turning waste into a production that has to be discarded into possible goods with additional value. Approximately one-third of the edible portions of food produced for human consumption, or anywhere from one to three billion pieces, are predicted to be wasted globally. Tons annually, or 842 million servings produced, is the quantity of food made in Africa's sub-Saharan region. There needs to be more food for everyone. Food waste complicates environmental issues. It has implications for public health that negatively impact people's quality of life and their environment's joy. *et al.* (2022). On an annual basis, consumers waste 68 kg of food, 49 per cent of which might have been avoided. (FAO, 2018) Huho *et al.* (2020) Fruits are a fundamental component of a healthy diet and are essential for overall well-being. Frequently cooked in several ways, such as fully, partially, or eating raw, fruit and vegetable-based companies and home kitchens produce a significant quantity of peel waste. Fruit peel has been exposed to a sizable amount of waste; roughly 25–30% of the entire yield is produced during the preparation of fruits. Remarkably, rinds, seeds, pomace, and peels are the most common garbage in this situation. When utilized properly, they may help solve environmental issues and provide a sustainable way to improve health by generating food high in nutrients and containing substances that promote health. Kumar *et al*.(2020) The fruit industry faces significant losses due to inadequate handling techniques and infrastructure, with a surge in production and expansion aggravated by a lack of management techniques, particularly in developing countries. These losses affect the entire processing supply chain, highlighting unintended consequences within the food production and processing system. Parfitt *et al*. (2010) Fruit waste, including rind, seeds, pomace, and skin, offers beneficial bioactive compounds such as vitamins, enzymes, carotenoids, dietary fibers, and polyphenols. Fruit peel, or the outer layer that protects the fruit within, is rich in dietary fiber, carbs, and antioxidants, particularly pectin. Peels are safe to eat but are frequently thrown out, even though they are full of essential nutrients that support human health and well-being by preventing diabetes, heart disease, and cancer. Jung *et al*. (2006). Fruit peel is a byproduct that makes up about 50 to 65 percent of the total weight of the fruit Gunwantrao *et al*. (2016)

Despite being rich in a diverse range of nutrients and bioactive compounds, the increasing accumulation of fruit peels at the industrial level has become a significant cause for concern. The rising volume of fruit peel waste presents a critical problem that demands immediate attention. Considering the health-enhancing attributes of fruit peels, there is an increasing need for creative solutions to integrate them into various products. Wadhwa *et al.'s* (2015) research indicates that fruit peels have superior biological activities compared to other fruit parts, increasing their application's popularity. Moon *et al*. (2009)

2. LITERATURE REVIEW

Modern people prefer to consume feasible, easily served-up products like powdered beverages. Powdered drinks are dried versions of commercial drinks, categorized as instant food since they require minimal rehydration work before usage. T. A. Shittu *et al*. (2007)

2.1 FRUIT PEEL WASTE UTILIZATION

Due to the growing production and processing of fruit, one of the most challenging issues worldwide today is the waste utilization of fruit processing businesses. The availability of fruits and vegetables is increasing due to the plant material's

susceptibility to microbiological deterioration, thereby preventing additional use. However, the expense of storing, shipping, and drying byproducts limits the economy. Kodagoda e*t al.* (2017). Fruit peel is one of the most significant byproducts from which a wide range of active substances have been extracted; it has a high value and is used to increase the rate at which raw materials are utilized and turn trash into treasure. Chaoijn Wang et al. (2016).

After processing, the peel makes approximately 50 to 60 percent of the total citrus fruit mass discarded as trash. This peel can create value-added goods or fortify food items to improve their nutritional profile. Young L. (2006).Food scraps are resources meant for human consumption but are often removed, misplaced, degraded, or contaminated. Food waste is an issue that continues to grow. It is severe and affects every aspect of waste management, from collection to disposal. Everyone involved in the food supply chain, especially agribusinesses, industries, retailers, and end-users, actively seeks practical solutions to address this problem. Girotto et al. (2015)

Vegetables and fruits are the most frequently consumed foods as horticultural products. However, they also generate waste items, such as peels and seeds. In the juice extraction business, pomegranate peels and seeds are left as waste, which can contribute to environmental pollution. Lucarini *et al.* (2021)

2.2 FRUIT PEEL WASTE

2.2.1 POMEGRANATE PEEL

The most popular horticultural products to eat are fruits and vegetables. However, they also generate waste items, such as peels and seeds. In the juice extraction business, pomegranate peels and seeds are left as waste, which can contribute to environmental pollution. Lucarini *et al.* (2021)

Pomegranate (*Punica granatum L.*) holds significant economic value as a fruit crop and is widely grown in various regions of Asia, North Africa, and the Middle East. Tehranifa *et al.* (2010). The pomegranate fruit is characterized by its berry-like structure, featuring a leathery rind (husk or peel) that encases numerous seeds enveloped by juicy arils. The husk comprises the pericarp and the mesocarp (albedo). (Rafraf *et al.,* 2017).

A pomegranate shall consist of three distinct parts: the peels, juice, and seeds. The pomegranate peel is considered a byproduct or inedible portion obtained during the extraction of pomegranate juice. It is characterized by tannins and flavonoids associated with the peel's biological properties. Faria et al. (2010)

The pomegranate peel (*Punica granatum*) is rich in phytochemicals. About half of the weight of a pomegranate is made up of its peel, which is also rich in minerals, particularly potassium, calcium, phosphorus, magnesium, and sodium. Discovering creative uses for leftover pomegranate peels may be more viable, environmentally responsible, and economically advantageous. Magangana *et al*. (2021) Biologically active compounds found in pomegranate peel include anthocyanins, phytochemicals, organic acids, quercetin, and catechin, along with gallic acid, minerals, vitamins, antioxidants, and caffeine, and there are numerous potential advantages. (Li *et al*.,2014)

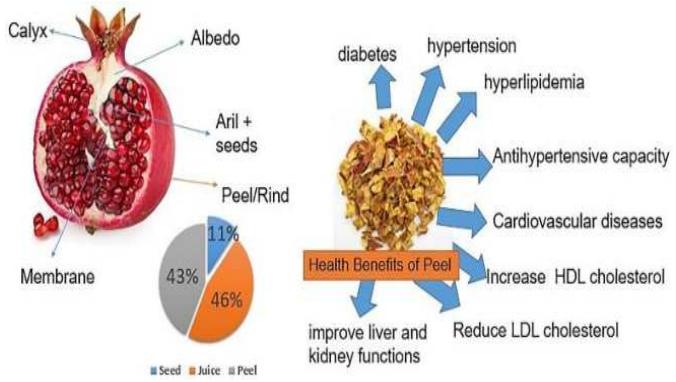


FIGURE 2.2.1: Benefits of Pomegranate Peel

Source: Ain et al. (2023)

2.2.2 CITRUS PEEL

Numerous health benefits can be obtained from the citrus fruit (*Citrus sinensis)*, which is rich in antioxidants and phytochemical nutrients. A single orange contains 170 phytonutrients and more than 60 with anti-tumor, anti-inflammatory, blood clot-inhibiting, and antioxidant properties. However, orange peels are often wasted, and suitable methods must be adopted to convert them into value-added products. India produces 25 lakhs of oranges annually, and the peels are nutrient-rich. Ravali *et al* (2021)

Orange peels, a significant byproduct of the citrus industry, are filled with pectin, cellulose, pigment, hemicellulose food fibers, and oil, and they have several bioactive substances like polyethoxylated flavanones, phenolic acids, flavones, and flavonols; these substances are likewise used as organic antioxidants for the food, pharmaceutical, and biotechnology sectors. Ahmudi F *et al.* (2014)

Byproducts such as peel and pomace are produced after sweet limes (Citrus limetta) are processed for juice extraction. After extracting the juice, they are made up of residue and the fruit's outer peel. These frequently consist of vitamin C, essential oils, flavonoids, pectin, and dietary fiber—both soluble and insoluble. D-limonene, naringin, and hesperidin are significant substances in the peel and pomace of flavorful limes. Chavan et al. (2018)

Novel techniques such as microwave steam distillation have been developed to extract essential oils from citrus peel, resulting in significant time and energy savings. Sweet lime peel has been used to enhance the functional properties of items like cookies and jam. Economic and environmental benefits may be gained by utilizing the potential of byproducts from sweet lime juice production, such as peel and pomace.Younis et al. (2016)

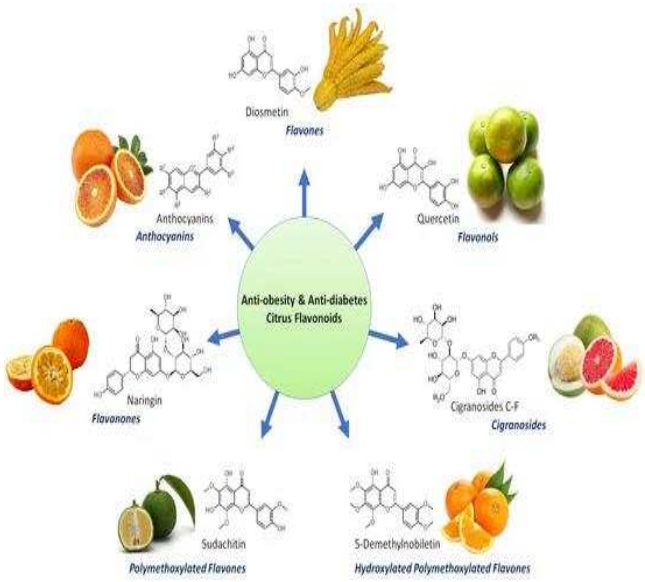


FIGURE 2.2.2: Representing Flavonoids with Anti-Obesity and Antidiabetic Properties

Fruit waste	Phenolic compounds	References
Pomegranate peel	anthocyanins, phytochemicals, organic acids, quercetin, and catechin, along with gallic acid, minerals, vitamins, antioxidants, and caffeine	Li *et al*. (2014)
Orange peel	polyethoxylated flavanones, phenolic acids, flavones, and flavonols	Ahmadi *et al.* (2014)
Mango peel	antioxidants, polyphenols flavonoids, anthocyanins, and vitamin C	Ahmed *et al.* (2020)

Source: Lu *et al*. (2023)

TABLE 2.2.1: PHENOLIC COMPOUNDS OF FRUIT WASTE

2.2.3 MANGO PEEL

The mango, a fruit with a pulp content of 33–70%, seeds of 7–24%, and peels of 15-20%, is processed into peels and kernels, which are often discarded as waste due to their high nitrogen, phosphorus, sugar, and water activity content. Sogi *et al.* (2013).

The nutritional qualities of the instant drink and the powdered mango peel were studied using proximate and physiochemical analysis. The most affordable source of valuable components and bioactive compounds, including antioxidants, polyphenols, flavonoids, anthocyanin, and vitamin C, may be an instant drink made with powdered mango peel. Ahmed *et al.* (2020)

2.2.4 PINEAPPLE PEEL

Pineapple is a tropical fruit consumed worldwide for its pleasant aroma and flavour, and it can be consumed fresh, in juice, jams, canned, and dehydrated, among other presentations. (Polanía *et al.,* 2023)(Hikal *et al.,* 2021)

The global harvest of pineapple (*Ananas comosus)* has expanded globally over the past ten years, reaching 25.4 million tons in 2019. The top three producers, in a million metric tons, are Brazil (2426), the Philippines (2747.86), and Costa Rica (3328.1).(FAO)This fruit contains vitamins, minerals, other nutrients, and antioxidants.Freitas, (2015) and D.R. Morai (2017)

The most significant number of pineapples cultivated for human consumption are utilised in fresh preparations at the agro-industrial level. Large volumes of trash are produced during processing, mainly from the peel, centre (core), and crown, constituting around 25–35% of the fruit's weight. (M. Selani,2014).During processing, 45–65% of the product is wasted, with the peel making up most of this loss.(Difonzo et al., 2019)

2.2.5 WATERMELON RIND

Despite the edible rinds of watermelon and containing many undiscovered minerals, their flavour turns off most people. They are commonly eaten like vegetables. They are stewed, stir-fried, or, more frequently, pickled in China. In the Southern US, pickled watermelon rind is a popular food. Rattray and Diana, 2012)

2.3 INSTANT DRINK POWDER

Health benefits can also known from instant beverages that have high bioactive components and natural ingredients. Nowadays, people consume useful and simple-to-serve products like powdered instant coffee. Powdered drinks are dry versions that are made and classified as quick food. It takes very little work to reconstitute the supper before eating it. (Shittu *et al.,* 2007)

Many now opt for non-dairy, probiotic-based meals and beverages over dairy products. The main reason for this shift is related to dairy products, such as lactose intolerance, dairy sensitivities, a vegan diet, and the limited shelf-life of probiotics in dairy products. Customers who face these issues choose non-dairy alternatives. Ranadheera *et al.* (2017)

The growing recognition among customers of the significance of leading healthier lifestyles has rapidly expanded the market for functional foods in recent years. Utilizing non-dairy foods such as fruits, vegetables, grains, legumes, and agricultural waste combined with probiotics and prebiotics to generate probiotic and symbiotic powders and drinks has drawn much attention. Chaturvedi *et al.* (2021)

2.4 FRUIT PEEL DRINK

2.4.1 SNAKE-FRUIT PEEL DRINK

The tropical fruit plant known as the snake fruit (Salacca zalacca) grows in Indonesia. It has an oval form with up to 10–14% brownish, scaly skin. The phytochemicals in salak bark, such as flavonoids, phenols, alkaloids, and tannins, are helpful or healthful for tea beverages and anti-aging products. Furthermore, salak-peel antioxidant activity observations were 229.27±6.35 (µg/MI).In addition to adding salak bark and completing the fermenting process, butterfly pea flower essence is added to prepare the kombucha tea for consumption. Damayanti *et al*. (2022)



Figure 2.4.1: Kombucha Tea Products From Snake Fruit Peel And Butterfly Pea Flower

Source: Damayanti *et al*. (2022)

2.4.2 POMACE DRINK

Peels after pre-treatment or the leftover pomace after juice production can frequently be sources of bioactive chemicals that are more concentrated than in the finished goods.Surek *et al.* (2016).Bober and Oszmianski discovered that the pomace infusion had a superior taste and more polyphenols than the entire fruit infusion. Anthocyanins and procyanidins, in particular, are abundant in phenolic compounds found in chokeberries as a raw material. Grunovaitė *et al.* (2016).Chokeberry pomace added to an infusion can help increase the quality of health-promoting components while delivering the ideal hue from the consumer's perspective. Kidon *et al.* (2023).

2.4.3 MANGO PEEL DRINK

Because of the fruit's high nutritional fiber content, instant powdered drinks derived from fruit-based products like mango peel powder are healthy and a great option for instant drink formulation. Ajila et al. (2013)

Additionally, companies that process mangoes typically suffer high transportation expenses to remove these byproducts. From production processes to preventing waste's harmful effects and cross-contamination of the area, it has the mango processing sector's future market prospects. According to recent studies, mango peel is a high source of many vitamins and other phytochemicals. Additionally, there are more antioxidants in the mango peel than in the pulp. Ajila (2007)

2.4.4ORANGE PEEL DRINK

Peels are the main byproduct of preparing citrus fruit for juice. Peels that have yet to be appropriately treated end up as waste and can harm the environment. Citrus peels are a great source of health-promoting phytochemicals such as flavonoids, carotenoids, and pectin.The drink used sour orange peels to produce nutritional powder drinks, considering the medicinal properties of acidic orange peels and the importance of the problems associated with waste disposal in the food processing industry. Hussain *et al.* (2010)

2.4.5 MANGOSTEEN PEEL DRINK

Natural or functional foods and beverages typically have an odd flavor. Similar to the sour taste of rose petals or the bitter flavor of mangosteen peel. It is anticipated that the bitter and sour taste combinations will work in concert to improve the product's functionality and mask its peculiar flavor. Due to the presence of chemicals with pharmacological action, such as antioxidants, anti-inflammatories, heart disease treatment, antibacterial, antifungal, and HIV medication therapy, mangosteen peels are presently being developed as medical treatments. The enhanced antioxidant capacity of functional instant drinks results from their higher phenol and tannin content. Mangosteen peels and Rosalind flowers were combined to create an instant drink with the highest antioxidant content. Dan Lu *et al.* (2015)

2.4.6 JOMBALON PEEL DRINK

The tropical edible fruit Jambolan (Syzygium cumini), often referred to as Jambolo, Jambul, Jamun, or java plum, can be found in Indonesia. Jambolan fruits have purple-dark skin. High concentrations of many phenolic groups, including flavonols, flavanonols, and anthocyanins, have been found in jambolan fruit. Tavares *et al*. (2016)

Jambolan fruits are often eaten raw or processed into wine, juice, and yogurt with freeze-dried fruit, spray-dried fruit juice powder, and powdered fruit used as a natural coloring substance. Santhalakshmy et al. (2015). Bezerra et al. (2015), Santiago et al. (2016).The fruit peel of jambolan, which has a high anthocyanin content, can continue to be utilized to produce tea and other culinary products through a straightforward drying procedure. Sari *et al*. (2012). The drying process can be experimented with using a dryer, such as an oven or the sun. Sari *et al*. (2019).



Sun drying Oven drying(50°C) Oven drying(60°C)

Figure 2.4.2: Jambolan Tea Infusions By Brewing

Source: Sari *et al*., (2019)

2.3.7 SWEET LIME DRINK

Most tea consumed in recent years has been instant tea blends, such as tea bags. Tea bags are becoming increasingly popular since they are easy to use, readily available, and can incorporate various components in the desired amounts. The infusion conditions regulate the bioactive ingredient that is extracted from tea bags.Bassi et al. (2023)

The byproducts of extracting juice from sweet lime fruit pulp include sweet lime peel and pomace.Sweet lime peel and pomace byproducts can be valuable materials for making herbal tea by utilizing their advantages in the economy and the environment.



Figure 2.4.3: Citrus Tea Prepared With Sweet Lime Peel-Pomace Powder Dipped in Hot Water

Source: Shaik et al. (2023)

Collecting raw material
(Different fruit peels)

⇩

Washing

⇩

Cutting

⇩

Blanching

⇩

Drying

⇩

Grinding

⇩

Packaging

3. METHODOLOGY

Ripe and fresh fruit peels are collected and washed adequately to produce fruit peel instant powder. After slicing into smaller pieces, the peels dry for hours at a specific temperature. The peels are dried, then ground into a coarse texture and processed again, grinding or milling until a desired consistency has been achieved, turning the peels into a fine powder.Consider experimenting with ratios to achieve the desired taste and balance when formulating a drink.Due to their distinct nutritional profiles and bioactive components, combining several peels in a drink can have multiple health advantages.

4. CONCLUSION

The instant drink powder made from fruit peel is a sustainable solution for repurposing natural resources and addressing food waste. It offers a quick, easy beverage suitable for various occasions and contains vitamins, antioxidants, and fibre. The fruit peel-based drink powder appeals to consumers who prioritize wellness and dietary preferences. Including antioxidants in fruit peels supports the body's defence against oxidative stress, enhancing its nutritional value. The product's versatility makes it a convenient choice for consumers, while its dietary benefits contribute to its appeal as a health-conscious option.

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REFERENCES

1. Ahmed, A. (2020). Utilization of mango peel in development of instant drink. *Asian Journal of Agriculture and Biology, 8*, 260-267.
2. Ahmudi, F., Zamiri, M.J., Khorvash, M., Banihashemi,Z. and Bayat, A.R. 2014. Chemical composition and protein enrichment of Orange Peels and Sugar Beet Pulp after fermentation by two Trichoderma species. Iranian Journal of Veterinary Research, 16(1):23-30.
3. Ain, H.B., Tufail, T., Bashir, S., Ijaz, N., Hussain, M., Ikram, A., Farooq, M.A., & Saewan, S.A. (2023). Nutritional importance and industrial uses of pomegranate peel: A critical review. *Food Science & Nutrition, 11*, 2589 - 2598.
4. Ajila CM, 2007. Isolation and Characterization ofValuable Components from Mango Peel and
5. Ajila, C.M., & Rao, U. (2013). Mango peel dietary fibre: Composition and associated bound phenolics. *Journal of Functional Foods, 5*, 444-450.

6. Anand, S., & Sharma, M. (2022) ORGANOLEPTIC EVALUATION OF PRODUCT DEVELOPED FROM BANANA BLOSSOM POWDER AND INDIAN GOOSEBERRY POWDER FOR ANAEMIC POPULATION.
7. APEDA (2022). Agricultural and Processed Food Products Export Development Authority.
8. Bassi P, Kumar V, Kaur R, Kumar S, Saini RK, Janghu S (2023) Valorisation of kinnow peel for development of phytochemical enriched tea infusion: standardisation of tea bag loading, dipping temperature and dips per minute for the better extraction of bioactive compounds. Int J Food Sci Technol 58(5):2715–2721
9. Bezerra, M., Araujo, A., Santos, K., Correia, R. 2015. Caprine frozen yoghurt produced with fresh and spray dried jambolan fruit pulp (*Eugenia jambolana* Lam) and *Bifidobacterium animalis subsp. lactis* BI-07. LWT - Food Science and Technology, 62(2), 1099-1104.
Black Gram Husk. PhD dissertation, Universityof Mysore, India
10. Braddock RJ (1995). By-products of citrus fruits. Food Technol49: 74–77. Cauvain SP & Young L (2006). Baked products: Science, technology and practice. Oxford, UK;Blackwell Publishing.
11. Chaojin,W. and Qinghua, L. 2016. Advances in Comprehensive Utilization of Fruit Peel in China. Academia Journal of Agricultural Research, 4(9):589-592.
12. Chaturvedi, S., Khartad, A., & Chakraborty, S. (2021). *The potential of non-dairy synbiotic instant beverage powder: Review on a new generation of healthy ready-to-reconstitute drinks. Food Bioscience, 42, 101195.* doi:10.1016/j.fbio.2021.101195
13. Chavan P, Singh AK, Kaur G (2018) Recent progress in the utilization of industrial waste and by-products of citrus fruits: a review. J Food Process Eng 41(8):e12895
14. Damayanti, A., Megawati, M., Astuti, W., Suwandi, L.A., Saputra, R.D., & Putrie, M.H. (2022). Training on making kombucha tea from snake fruit peel and butterfly pea flower. *Abdimas: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang*.
15. dan Luh, D. A. A. Y., & Wrasiati, P. (2015) Antioxidant Activity and Bioactive Compound in a Functional Instant Drink Made from Mangosteen Peel and Rosella Extract.
16. Dasaroju S and Gottumukkala KM (2014). Current trends in the research of Emblica officinalis (Amla): A pharmacological perspective. International Journal of Pharmaceutical Sciences Review and Research, 24: 150- 159
17. Difonzo, G., Vollmer, K., Caponio, F., Pasqualone, A., Carle, R., & Steingass, C. B. (2019). Characterisation and classification of pineapple (Ananas comosus [L.] Merr.) juice from pulp and peel. *Food Control*, *96*, 260-270.
18. Faria A, Calhau C. Pomegranate in human health: An overview. pp. 551-563. In: Bioactive Foods in Promoting Health: Fruits and Vegetables. Watson RR, Preedy VR (eds). Academic Press, Amsterdam, Netherlands (2010)
19. Girotto, F., Alibardi, L., & Cossu, R. (2015). Food waste generation and industrial uses: A review. Waste Management, 45, 32– 41.
20. Grunovaitė, L., Pukalskienė, M., Pukalskas, A., & Venskutonis, P.R. (2016). Fractionation of black chokeberry pomace into functional ingredients using high pressure extraction methods and evaluation of their antioxidant capacity and chemical composition. *Journal of Functional Foods, 24*, 85-96.
21. Gunwantrao, B. B.; Bhausaheb, S.K.; Ramrao, B.S. and Subhash, K.S. (2016). Antimicrobial activity and phytochemical analysis of orange (Citrus aurantium L.) and pineapple (Ananas comosus (L.) Merr.) peel extract. Ann. Phytomed., 5(2):156-160, Online ISSN: 2393- 9885.
22. Hikal, W. M., Mahmoud, A. A., Said-Al Ahl, H. A., Bratovcic, A., Tkachenko, K. G., Kačániová, M., & Rodriguez, R. M. (2021). Pineapple (Ananas comosus L. Merr.), waste streams, characterisation and valorisation: An Overview. *Open Journal of Ecology*, *11*(9), 610-634.
23. Huho JM, Kosonei RC, Musyimi PK (2020). Sociodemographic Determinants of Households' Food Waste in Garissa Sub County, Kenya. Budapest International Research and Critics Institute-Journal 3(2):932-994.
24. Hussain, A., Ali, J., & Abid, H. (2010). Chemical characteristics of instant powder drink prepared from sour oranges peel (Citrus aurantium L). *Pakistan Journal of Biochemistry and Molecular Biology*, *43*(2), 94-8.
25. Jain, P. K., Das, D., Pandey, N., & Jain, P. (2016). Traditional Indian herb Emblica officinalis and its medicinal importance. *Innov J Ayurvedic Sci*, *4*(4), 1-15.
26. Joy, G. F. F., Sunday, O. Z., Remilekun, A., & Olusegun, A. D. (2022). Waste-to-wealth; nutritional potential of five selected fruit peels and their health benefits: A review. *African Journal of Food Science*, *16*(7), 172-183.
27. Jung, K. H., Kim, M. J., Ha, E., Uhm, Y. K., Kim, H. K., Chung, J. H., & Yim, S. V. (2006). Suppressive effect of Punica granatum on the production of tumor necrosis factor (Tnf) in BV2 microglial cells. Biological and Pharmaceutical Bulletin, 29(6), 1258-1261
28. Kidoń, M., Marciszak, E., Uğur, Ş., Kuligowski, M., & Radziejewska-Kubzdela, E. (2023). Chokeberry Pomace Utilization for Improving Selected Quality Parameters of Green Tea Leaves or Hibiscus Flower Infusions. *Applied Sciences*.
29. Kodagoda, K. and Marapana, R. 2017. Utilization of Fruit processing by-product for Industrial

application: A review. International Journal of Food Science and Nutrition, 2(6):24-30.

30. Kumar, H. B. K.; Sharma, R.; Nepovimova, E.; Kuca, K.; Dhanjal, D.S.; Verma, R.; Bhardwaj, P.; Sharma, S. and Kumar, D. (2020). Fruit and vegetable peels: Utilization of high-value horticultural waste in Novel Industrial Applications. Molecules, 25(12):2812. 10.3390/molecules 251 22812.
31. Kumar, H., Bhardwaj, K., Sharma, R., Nepovimova, E., Kuča, K., Dhanjal, D. S., ... & Kumar, D. (2020). Fruit and vegetable peels: Utilization of high-value horticultural waste in novel industrial applications. *Molecules*, *25*(12), 2812.
32. Li X, Wasila H, Liu L, Yuan T, Gao Z, Zhao B, et al. Physicochemical characteristics, polyphenol compositions and antioxidant potential of pomegranate juices from 10 Chinese cultivars and the environmental factors analysis. Food Chem. (2015) 175:575–84 doi: 10.1016/j.foodchem.2014. 12.003
33. Lu, K., & Yip, Y. M. (2023). Therapeutic Potential of Bioactive Flavonoids from Citrus Fruit Peels toward Obesity and Diabetes Mellitus. *Future Pharmacology*, *3*(1), 14-37.
34. Lucarini M, Durazzo A, Bernini R, Campo M, Vita C, Souto E, et al. Fruit wastes as a valuable source of value-added compounds: a collaborative perspective. Molecules. (2021) 26:6338. doi: 10.3390/molecules26 216338
35. M. Selani, S. Guidolin, C. Tadeu, W.S. Ratnayake, R.A. Flores, A. Bianchini, Characterisation and potential application of pineapple pomace in an extruded product for fibre enhancement. Food Chem. 163, 23–30 (2014). https://doi.org/10.1016/j.foodchem.2014.04.076
36. Magangana, T. P., Makunga, N. P., la Grange, C., Stander, M. A., Fawole, O. A., & Opara, U. L. (2021). Blanching pre-treatment promotes high yields, bioactive compounds, antioxidants, enzyme inactivation, and antibacterial activity of 'Wonderful 'pomegranate peel extracts at three different harvest maturities. *Antioxidants*, *10*(7), 1119.
37. Moon, J. K., & Shibamoto, T. (2009). Antioxidant assays for plant and food components. Journal of agricultural and food chemistry, 57(5), 1655-1666
38. Parfitt, J., Barthel, M. and Macnaughton, S. (2010) Food Waste within Food Supply Chains: Quantification and Potential for Change to 2050. Philosophical Transactions of the Royal Society B: Biological Sciences, 365, 3065-3081.
39. Polanía, A. M., Londoño, L., Ramírez, C., Bolivar, G., & Aguilar, C. N. (2023). Valorization of pineapple waste as novel source of nutraceuticals and biofunctional compounds. *Biomass Conversion and Biorefinery*, *13*(5), 3593-3618.
40. Rafraf M, Hemmati S, Jafarabadi AM, Moghaddam A, Haghighian KM. Pomegranate (Punica Granatum L.) Peel Hydroalcoholic Extract Supplementation Reduces Pain and Improves Clinical Symptoms of Knee Osteoarthritis: A Randomized Double-Blind Placebo-Controlled Study. Iranian Red Crescent Medical Journal. 2017; 19(1):377-385.
41. Ranadheera, C. S., Vidanarachchi, J. K., Rocha, R. S., Cruz, A. G., & Ajlouni, S. (2017). Probiotic delivery through fermentation: Dairy vs. non-dairy beverages. Fermentatio, 3(4), 1–17.
42. Rattray and Diana. 2012. Southern U.S. Cuisine: Judy's Pickled Watermelon Rind. Southernfood.about.com.
43. Ravali, C. H., Kumar, I. S., & Srilatha, P. (2021). Utilization and processing of citrus fruit peel for product development.
44. Santhalakshmy, S., Don Bosco, S. J., Francis, S., Sabeena, M. 2015. Effect of inlet temperature on physicochemical properties of spray-dried jamun fruit juice powder. Powder Technology, 274, 37
45. Santiago, M. C. P. A., Gouvêa, A. C. M. S., Peixoto, F. M., Borguini, R. G., Godoy, R. L. O., Pacheco, S., Nascimento, L. S. M., Nogueira, R. I. 2016. Characterization of jamelão (Syzygium cumini (L.) Skeels) fruit peel powder for use as natural colorant. Fruits, 71(1), 3-8.
46. Sari, P., Fitriyah, N. E. A., Kuswardhani, N., & Niken, W. P. (2019, November). Antioxidative and sensory properties of tea made from Jambolan (Syzygium cumini) fruit peel. In *IOP Conference Series: Earth and Environmental Science* (Vol. 347, No. 1, p. 012085). IOP Publishing.
47. Shaik, L., & Chakraborty, S. (2023). Sweet lime pomace-peel powder as citrus tea: material balance and extraction kinetics. *Biomass Conversion and Biorefinery*, 1-13.
48. Sogi, D.S., Siddiq, M., Greiby, I., & Dolan, K.D. (2013). Total phenolics, antioxidant activity, and functional properties of 'Tommy Atkins' mango peel and kernel as affected by drying methods. *Food chemistry, 141 3*, 2649-55 .
49. Surek, E., & Nilufer-Erdil, D. (2016). Phenolic contents, antioxidant activities and potential bioaccessibilities of industrial pomegranate nectar processing wastes. *International Journal of Food Science and Technology, 51*, 231-239.
50. T. A. Shittu and M. O. Lawal, "Food Chemistry Factors affecting instant properties of powdered cocoa beverages," vol. 100, pp. 91–98, 2007.
51. T. A. Shittu and M. O. Lawal, "Food Chemistry Factors affecting instant properties of powdered cocoa beverages," vol. 100, pp. 91–98, 2007.
52. Tavares,I. M. C., , Gómez-Alonso,S., García-Romero, E., Da-Silva, R., Hermosín-Gutiérrez, I.2016.Comprehensive study of the phenolic composition of the edible parts of jambolan fruit (*Syzygium cumini* (L.) Skeels). Food Research International, 82, 1-13.
53. Tehranifar A, Zarei M, Nemati Z, Esfandiyari B, Vazifeshenas MR. Investigation of physico-chemical properties and antioxidant activity of twenty Iranian

pomegranate (Punica granatum L.) cultivars. Sci. Hortic. -Amsterdam 126: 180-185 (2010)

54. Wadhwa, M., Bakshi, M. P. S., & Makkar, H. P. S. (2016). Wastes to worth: value-added products from fruit and vegetable wastes. *CABI Reviews*, (2015), 1-25.

55. Younis K, Islam R, Jahan K, Kundu M, Ray A (2016) Investigating the efect of mosambi (Citrus limetta) peel powder on physicochemical and sensory properties of cookies. Qual Assur Saf Crops & Foods 8(3):393–398

Sensor Technology in Fish Quality Evaluation

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Abstract

The world is consuming more fish now because of its nutritional advantages. Traditional fish quality monitoring techniques are time-consuming, labour-intensive, and inappropriate for in-field use. As a potential solution to these drawbacks, sensors have surfaced. Thus, the need for quick, low-cost, non-invasive techniques to check seafood freshness in real time is increasing. This research explores the cutting-edge uses of many sensor types in fish quality assessment, including gas, colorimetric, electrochemical, and enzyme sensors. Despite the potential of these innovative sensors, their existing designs need to be improved in terms of flexibility, power consumption, detection limitations, sensitivity, specificity, robustness, and precision. The evaluation seeks to thoroughly examine fish quality indicators, state-of-the-art sensor technology, and machine learning integration. It critically evaluates research gaps in predicting fish quality, emphasizing the need for advancements in addressing these shortcomings. Furthermore, the review highlights current challenges and explores future perspectives to pave way for improvements in this crucial field.

Keywords: ***Fish spoiling, sensors, quality assessment, new methods, spoiling indications.***

Introduction:

Fish is regarded as a complete and healthful food because of its high protein, mineral, and vitamin content and unsaturated fatty acid content. Fish is perishable in nature, however, presents a severe obstacle to the food industry supply chain.

The growing troubles about food quality voiced by farmers and consumers highlight the necessity for efficient fish quality detection techniques. Conventional procedures provide some obstacles because of their destructive nature, non-ubiquity, time-consuming nature, dependence on skilled workers, and vulnerability to human mistakes. Furthermore, species, origin, capturing and processing methods, storage conditions, and environmental factors affect the chemical, metabolic, microbiological, and sensory characteristics of fish. Fish shelf life estimation still needs to be made more apparent after decades of research; thus, creative solutions are needed to overcome these obstacles. Because fresh fish and fish products can quickly change into undesired flavours, odour, and decomposition, they provide serious difficulty. Their biological makeupas well as several physical and chemical traits, including their neutral pH, high water activity, presence of autolytic enzymes, and minimal connective tissue content, are thought to be responsible for this fragility. The period between production and spoiling, which is impacted by biochemical processes and microbial activity, determines the shelf life of fresh fish. Fish deterioration occurs when the quality of the meat decreases, resulting in variations in texture, flavour, aroma, and appearance. Microorganisms multiply after the first stage of spoiling because of elevated pH and nitrogen compounds. The colourof eyes, skin, muscle and the abdomen are all significantly impacted by this microbial activity.

Significant advancements in gas sensor technology over the past few decades have produced a variety of sensor types with different operating principles. Research on sensor materials with improved intrinsic qualities is ongoing, emphasizing increased stiffness or flexibility.

SENSORS IN DETECTION OF FISH FRESHNESS

A food gas detection system based on gas sensors is depicted in Figure 1, which classifies the sensors into four types: MOX, SAW, colourimetric, and electrochemical.

Manjunath C.R. (2018) has investigated the techniques used to determine the fish freshness; three were connected to shape, and the other identified with shading. When fish are spoiled, a chemical substance, histamine, is released naturally by dead fish. The presence of histamine is detected using volatile amine with an ultrasonic process electrode-capped organic gas sensor system technique. A detecting framework containing an ultrasensitive amine gas sensor is used to identify the unpredictable amine gas from spoiled fish. A torrymeter instrument is used to assess the freshness of fish. The evaluation depended on changes in the dielectric properties of the fish as it ages.

METAL OXIDE SEMICONDUCTOR RESISTIVE GAS SENSORS FOR FISH FRESHNESS DETECTION

Metal-oxide-semiconductor resistive gas sensors are utilized for fish freshness detection, monitoring physical and chemical changes, volatile marker gases, and sensor array technology advancement for rapid spoilage detection. In this paper, the authors take the detection, classification, and assessment of fish freshness as the actual demand and summarize the physical and chemical changes of fish during the spoilage process, the volatile marker gases released, and their production mechanisms (Wu et al., et al. 2023).

EVALUATING THE QUANTITATIVE AMOUNT OF TROUT FISH SPOILAGE IN A THERMAL GRADIENT USING A SINGLE NANOWIRE GAS SENSOR

A single nanowire gas sensor system can rapidly detect trout fish spoilage by reacting to total volatile elemental nitrogen correlating with bacterial population and estimating microorganism concentration accurately.One tin oxide nanowire's reaction was recorded at various temperatures to build a virtual array of sensors that functioned as a nano-electrical nose. Capable of quantifying the amount of microorganisms present in the samples and classifying them based on how fresh they are (Tonezzer, M. et al. 2021).

CERIUM OXIDE-BASED HYPOXANTHINE BIOSENSOR FOR FISH SPOILAGE MONITORING

Cerium oxide-based biosensor detects fish spoilage by measuring hypoxanthine levels, offering a portable and cost-effective solution for monitoring freshness in fish. The release of hypoxanthine (H.X.), a byproduct of nucleotide degradation in meat and fish, is measured by a novel portable one-nano enzyme-based biosensor for fish freshness monitoring (Mustafa,f., et al., 2021).

HISTAMINE-RESPONSIVE DYE-INCORPORATED CARBON DOTS FOR VISUAL MONITORING OF FOOD SPOILAGE

The histamine-responsive carbon dots system with an ANQ reference signal enables visual monitoring of fish spoilage through fluorescence colour change, offering efficient real-time detection of food samples. This paper proposed a histamine-responsive carbon dots (C.D.s)- based sensing system for visually monitoring food spoilage where the aldehyde group on the surface of C.D.s serves as the recognition site to combine with the amino group on histamine to form a Schiff base that effectively enhances the fluorescence (Qin, Y. et al., 2022).

A SMARTPHONE-ADAPTABLE FLUORESCENT SENSING TAG FOR NON-CONTACT AND VISUAL MONITORING OF THE FRESHNESS OF FISH

A smartphone-adaptable fluorescent sensing tag, utilizing a ratiometric fluorescent probe, enables non-contact and visual monitoring of cadaverine in fish, indicating spoilage levels with high sensitivity and fast response. This article used a ratiometric fluorescent probe PTCN to determine cadaverine, a metabolic biomarker of fish spoilage, with reasonable specificity, high sensitivity and ultra-fast response (Jiang L. et al., 2022).

DUAL RESPONSIVE BENZO HEMOCYANIN BASED FLUORESCENT PROBE FOR DETECTION OF CYANIDE AND HYDROGEN SULFIDE: REAL-TIME APPLICATION IN IDENTIFICATION OF FOOD SPOILAGE

The research paper presents a dual-responsive fluorescent probe for detecting hydrogen sulfide gas produced by food spoilage, including fish, using probe-coated paper strips for visual identification. This paper synthesized a dual-approachable benzo-hemocyanin-based red-emitting fluorescent probe PBiSMe for distinct and instantaneous detection of C.N.- and H.S.- (Magesh, K. et al. 2023).

A CMOS FISH SPOILAGE DETECTOR FOR IOT APPLICATION OF FISH MARKETS

A CMOS fish spoilage detector utilizes analogue processing circuits for IOT applications in fish markets, providing low-cost freshness detection based on resistance measurements. A novel complementary metal–oxide semiconductor fish spoilage detector is proposed as an application of the Internet of Things (IoT) in fish markets, and the proposed analogue processing circuits were successfully used for detecting the freshness of swordfish (Chiang, C.T. et al. 2017).

DEVELOPMENT OF A NOVEL COLORIMETRIC SENSOR BASED ON ALGINATE BEADS FOR MONITORING RAINBOW TROUT SPOILAGE

A novel colourimetric sensor using alginate beads entrapping red cabbage extract was developed for monitoring rainbow trout spoilage based on P.H. changes, microbial growth and chemical indicators. Alginate beads containing the red cabbage extract can be used as a low-cost colourimetric sensor for intelligent packaging applications. They can monitor the spoilage of fish or other protein-rich products through their wide range of colour changes (Majdinasab M. et al., 2018).

USE OF A LARGE STOKES SHIFT NEAR-INFRARED FLUORESCENT PROBE TO DETECT HYDROGEN SULFIDE IN FOOD SPOILAGE, LIVING CELLS, AND ZEBRAFISH

A near-infrared fluorescent probe with a significant stokes shift (DDM-H2S) can detect hydrogen sulfide gas produced during fish spoilage by changing the colour of test paper strips from pink to purple.This study describes the design and synthesis of an NIR fluorescent turn-on responsive probe (DDM-H2S) with a substantial Stokes shift (190 nm) for the detection of H_2S (Yang, X. et al. 2022) .

Conclusion:

Sensors are far more suitable for industrial monitoring than traditional techniques (sensory, physical, and chemical properties), which call for highly trained operators and are costly and time-consuming. This is because their acquisition approach is faster and less intrusive. This review's gas sensors provide a scalable and affordable way to identify fish rotting early on, allowing for the prompt removal of tainted goods from the market and reducing the health concerns that could arise from eating undesirable fish.By combining real-time

monitoring with quick alarm mechanisms, integrating these elements results in a comprehensive and dependable fish spoilage detection system that improves food safety procedures. This review attempts to develop a scalable and economical system for the early detection of fish spoilage to reduce any health risks related to eating rotten fish and to facilitate the timely removal of affected products from the market.

References:

1. Chang, L.; Chuang, M.; Zan, H.; Meng, H.; Lu, C.; Yeh, P.; Chen, J. An ultrasensitive porous electrode-capped organic gas sensor system is used to test the volatile amino gas and determine the freshness of fish in under one minute. 2017, 2, 531–539. ACS Sens.
2. Cheng, J. H., Sun, D. W., Qu, J. H., Pu, H. B., Zhang, X. C., Song, Z., ... & Zhang, H. (2016). Developing multispectral imaging for simultaneous prediction of freshness indicators during chemical spoilage of grass carp fish fillet. Journal of Food Engineering, 182, 9-17.
3. Lawal, A.T.; Adeloju, S.B. Progress and recent advances in fabrication and utilization of hypoxanthine biosensors for meat and fish quality assessment: A review. Talanta 2012, 100, 217–228.
4. Novel methods for assessing fish freshness quality attributes: An overview of recent advancements Wu, L.; Pu, H.; Sun, D. Food Science and Technology Trends 2019, 83, 259–273.
5. Parlapani, F.F.; Mallouchos, A.; Haroutounian, S.S.; Boziaris, I.S. Microbiological spoilage and investigation of the volatile profile during storage of sea bream fillets under various conditions. Int. J. Food Microbiol. 2014, 189, 153–163.
6. Saeed, R., Feng, H., Wang, X., Zhang, X., & Fu, Z. (2022). Fish quality evaluation by sensor and machine learning: A mechanistic review. Food Control, 137, 108902.
7. Saeed, R., Feng, H., Wang, X., Zhang, X., & Fu, Z. (2022). Fish quality evaluation by sensor and machine learning: A mechanistic review. Food Control, 137, 108902.
8. Silva, F.; Duarte, A.M.; Mender, S.; Pinto, F.R.; Barroso, S.; Ganhão, R.; Gil, M.M. CATA vs. FCP for rapid descriptive analysis in the sensory characterization of fish. J. Sens. Stud. 2020, e12605.
9. The State of World Fisheries and Aquaculture 2020.
10. Tonezzer, M. (2020). Fish spoilage detection using a gas sensor based on a single SnO2 nanowire for mackerel. chemosensors 9(1), 2.
11. Tonezzer, M. (2020).Fish spoilage detection using a gas sensor based on a single SnO2 nanowire for mackerel. chemosensors, 9(1), 2.
12. Tonezzer, M. (2021). A single nanowire gas sensor can distinguish fish from meat and evaluate their degree of freshness. Chemosensors, 9(9), 249.
13. Tonezzer, M. Selective gas sensor based on one single SnO2 nanowire. Sensor Actuators B Chem. 2019, 288, 53–59.
14. Torre, R., Costa-Rama, E., Nouws, H. P., &Delerue-Matos, C. (2020). Food deterioration control using screen-printed electrode-based sensors: detecting bacteria and biogenic amines. biosensors, 10(10), 139.
15. Tryggvadóttir, S.V.; Olafsdottir, G.; Nesvadba, P.; Di Natale, C.; Careche, M.; Oehlenschläger, J.; Schubring, S.; Kroeger, M.; Heia, K.; Esaiassen, M.; et al. Multisensor for fish quality determination. Trends Food Sci. Technol. 2004, 15, 86–93.
16. Yazdanparast, S., Benvidi, A., Abbasi, S., &Rezaeinasab, M. (2019). Novel methods for assessing fish freshness quality attributes: An overview of recent advancements Wu, L.; Pu, H.; Sun, D. Food Science and Technology Trends 2019, 83, 259–273. Microchemical Journal, 149, 104000.
17. Zambotti, G., Capuano, R., Pasqualetti, V., Soprani, M., Gobbi, E., Di Natale, C., &Ponzoni, A. (2022). Monitoring Fish Freshness in Real Time under Realistic Conditions through a Single Metal Oxide Gas Sensor. Sensors, 22(15), 5888
18. Zambotti, G., Capuano, R., Pasqualetti, V., Soprani, M., Gobbi, E., Di Natale, C., &Ponzoni, A. (2022). Monitoring Fish Freshness in Real Time under Realistic Conditions through a Single Metal Oxide Gas Sensor. Sensors, 22(15), 5888.
19. Zhou, D. Y., Wu, Z. X., Yin, F. W., Song, S., Li, A., Zhu, B. W., & Yu, L. L. (2021). Chitosan and derivatives: bioactivities and application in foods. Food science and technology annual reviews,12 407-432.

Real Time Onion Spoilage Detection using Gas Sensor – A Review

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***Abstract*— The perishability of onions presents a significant challenge in the agricultural supply chain, leading to substantial economic losses. Addressing this issue requires innovative approaches for early spoilage detection. This project presents a novel approach to monitor onion quality by utilizing a fusion of gas sensors (MQ15 and MQ6), alongside temperature and humidity sensors. The collected data undergoes analysis via a pre-trained K-nearest neighbors (KNN) machine learning model. The main aim is to predict onion quality by detecting internal defects. Integration of NodeMCU as the controller, a Li-ion battery powered by TP4056, and an I2C LCD display facilitates real-time information display, enhancing system efficiency and portability. This system offers a promising solution for ensuring onion quality assessment, crucial for both producers and consumers. The combination of sensor technology and machine learning enables accurate and timely evaluation of onions, potentially reducing waste and ensuring product quality throughout the supply chain.**

Keywords*— Onion Spoilage, early detection of onion, Gas Sensors, Monitor onion Spoilage, Onion Quality Assessment, Reducing Wastage.

I.INTRODUCTION

Onion is a major bulbous crop among the cultivated vegetable crops and it's of global importance. India has varying climatic conditions and provides an occasion for growing a large number of horticulture crops including vegetables. The onion is an important vegetable and has been grown in nearly all the parts of India for thousands of times. The onion is regarded as a largely import acquainted crop and earn precious foreign exchange for the country. Though India produces a significant volume of onion it isn't regular and sufficient enough to meet the demands for both requirement and exports. Being an essential food item, it's also a largely politically sensitive commodity. India ranks second in global onion production after China and with an periodic product of 16 to 17million tonnes accounts for around 20 per cent of global product. Still, Indian onion yield is one of the lowest. The essential lower productivity in sub-tropical countries vis- à- vis European counties, deficit and high prices of quality seeds, high prevalence of pests and diseases typical under tropical conditions, humidity stressor redundant rains during critical growth stages are factors constraining yield. Wide price oscillations make it a risky crop discouraging large scale relinquishment of input intensive production ways and good operation practices by growers. In India onion is grown in three crop seasons, videlicet kharif (gathered in October-November), late kharif (January- February) and rabi (April – May). Rabi season crop is the largest account for about 60 percent of periodic product with kharif and late kharif accounting for about 20 per cent each. Onion is produced in the countries of Maharashtra, Karnataka, Madhya Pradesh, Rajasthan, Gujarat, Andhra Pradesh and Bihar which together constitute around 70 per cent of the area under onion. The studies have revealed that the actuality of high insecurity in import of onion the values of CV in export of onion have come down during the post WTO than preWTO period.(Borzykh, 2023)

This review paper aims to provide a comprehensive overview of recent advancements in onion spoilage detection using machine learning and computer vision techniques. Through a detailed analysis of existing literature, we seek to elucidate the underlying principles, methodologies, challenges, and future prospects of onion spoilage detection systems.The review begins by exploring the physiological and biochemical changes that occur during onion spoilage, laying the foundation for understanding the characteristics and manifestations of spoilage. By elucidating the mechanisms underlying onion deterioration, researchers can identify key features and parameters suitable for detection by machine learning algorithms.Furthermore, the review evaluates the performance of existing onion spoilage detection systems, highlighting their strengths, limitations, and areas for improvement. By comparing different methodologies and algorithms, researchers can gain insights into the optimal approaches for achieving high accuracy and reliability in spoilage detection.(Janas, 1999)

Moreover, the review examines the influence of various factors, such as environmental conditions, storage methods, and onion varieties, on the efficacy of detection systems. In conclusion, this review underscores the transformative potential of machine learning and computer vision in revolutionizing onion spoilage detection. By harnessing the power of data-driven algorithms and image analysis techniques, researchers can develop robust, cost-effective, and scalable solutions to combat onion spoilage effectively. As we navigate the complexities of modern food systems, innovation in spoilage detection serves as a beacon of hope, safeguarding both economic interests and public health.(Misirova, 2022)

II.REIVIEW OF LITERATURE

A.Post Harvest Losses in Onion

Achieving food production self-sufficiency is one of the major challenges facing many developing nations, especially those in sub-Saharan Africa. The two primary sources of this issue are these countries' inability to meet their agricultural production targets and food losses throughout their supply networks. The five stages of food loss are agricultural production, postharvest, processing, distribution, and consumption, according to the Food and Agricultural Organization. Food losses at production include food lost as a result of spills during harvest operations and mechanical damage. Crop value is reduced during processing and storage, leading to postharvest losses. Food losses that happen in the household and industrial phases are included in the food processing process. Food waste in the home consumption stage is primarily responsible for losses at the consumption level, whereas losses at the distribution stage include those at the market system.There are two ways to look at postharvest loss: Quantitatively and qualitatively.(Saranya, 2017)



Source : https://images.app.goo.gl/FKHphzsja93tVtvbA

The postharvest loss is quantified by the quantitative approach as a decrease in the physical count of food items in location and time. The postharvest loss of food products is measured using the qualitative approach in terms of the loss of nutrients, viability, aesthetic qualities, and nutritional qualities.Global food loss accounts for one-third of the food produced to feed the expanding population. Therefore, postharvest loss has harmed food security in a number of developing countries, including Nigeria.Over 25 percent of postharvest food losses in developing nations are thought to be caused by pest infestation, spoiling, and improper handling. This suggests that roughly 25% of food generated for human consumption does not end up in their mouths.Furthermore, because fresh vegetables are more perishable than cereals, postharvest losses have prevented the potential yield increase brought about by agricultural innovations from having an impact on the income of small-scale farmers in these nations.(Yuldosheva, 2023)

Onion is one of these vegetables.Onions, are an important vegetable crop that are grown mainly for domestic use and export in various regions of the world. The bulb varieties are particularly popular. Since they are rich in fiber, minerals, protein, vitamins, calcium, iron, ascorbic acid, insulin, sulfur, and calories, they are highly prized for their herbs, nutritional qualities, and flavor. In addition to their culinary use, onions are valued for their therapeutic qualities due to their intriguing technological attributes and health benefits, which include antithrombotic, hypolipidemic, prebiotic, antimicrobial, anticarcinogenic, and antioxidant qualities. It also has a big impact on the livelihoods of those who work in the value chain and production of it, both in developed and developing nations' rural and urban areas. Like many other vegetables, it does experience a fair amount of postharvest loss. Nigeria is the leading producer of onions in West Africa, with an annual production of about 1.1 million tons Nigeria, however, lost a large portion of its onion crop to other countries in Africa and worldwide.(Konstantinović, 2021)

B.Levels and Causes of Post Harvest Losses of Onions

In the research area, rot, pests and pathogens, drying, and bruising were the main reasons for postharvest loss in onions. Fungi and bacteria-caused rot greatly contributes to postharvest loss in onions. This causes wilting and dieback of the leaves, which in turn causes degradation of the leaves and bulbs. Pests and diseases include damping-off, purple blotch, Colletotrichum blight, black mold, and Stemphylium leaf blight also seriously reduce onions' postharvest yield. Disease-related losses to quantity and quality make for a significant portion of agriculture's financial losses. Postharvest loss brought on by early drying of onion leaves and bulb drying lowers onion quality and market value. Onion bruising is often caused by inadequate transportation and packaging, which results in onion damage and postharvest loss. This shows that on-farm operations and/or storage accounted for the majority of these main reasons for postharvest loss in the production of onions.To find out the secondary reasons for postharvest loss in onions as reported by the respondents, more research was done.(Sharma, 2023)

In decreasing order of significance, the study area's most significant secondary causes of postharvest loss in onions were: inadequate credit to enable timely operations; subpar storage facilities; absence of agricultural extension services to provide training on loss mitigation; subpar transportation infrastructure; and lengthy travel times to the marketing center.When these causes are examined closely, it becomes clear that the majority of them are outside the farmer's control. Problems in their control measures such harvesting methods, the kind of the harvest period and cultivar types were determined to possess little to no effect on postharvest loss in onion within the research area.(Khalifa, 2016)

In India, onions are one of the most significant commercial crops farmed for spices. The alliaceous smell of onions is what gives them their unique qualities and explains why they are used in salad dressings, food, medicine, and spices. India is the second-largest producer of onions among the nations that grow onions. According to a nationwide survey, 15-20% of the onion produce grown during the Rabi season is lost owing to storage disease damage, while 30–40% of the produce is kept to meet demand during the off-season. Numerous post-harvest diseases affect onions, including neck rot, brown rot, soft rot, blue mold, and smudging. Of these, black mold and blue mold are the most common ones that impair onions' capacity to be traded.(Elenany, 2024)

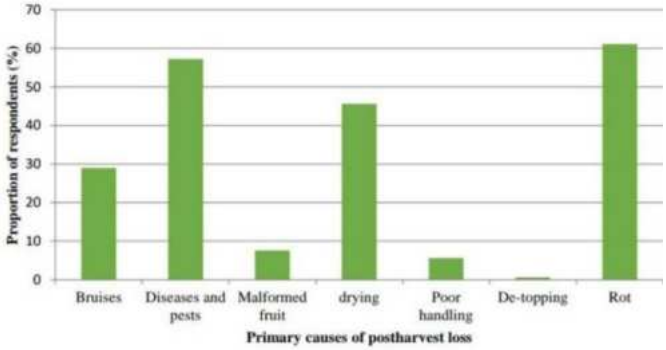


Figure.1 Primary Causes of Onion Post Harvest Loss in study area
Source: Field Survey, 2021

In India, onions are one of the most significant commercial crops farmed for spices. The alliaceous smell of onions is what gives them their unique qualities and explains why they are used in salad dressings, food, medicine, and spices. India is the second-largest producer of onions among the nations that grow onions. According to a nationwide survey, 15-20% of the onion produce grown during the Rabi season is lost owing to storage disease damage, while 30–40% of the produce is kept to meet demand during the off-season. Numerous post-harvest diseases affect onions, including neck rot, brown rot, soft rot, blue mold, and smudging. Of these, black mold and blue mold are the most common ones that impair onions' capacity to be traded both domestically and internationally.Aspergillus niger Van Tieghem, the culprit behind black mold, is more common in the nation's tropical regions. It results in rotting and post-harvest defects in onions that are cultivated and kept in hot climates. In India, the illness is widespread anywhere onions are kept(Yağmur, 2024)

Penicillium species are the source of blue mold. There are numerous types of diseases known worldwide to produce blue mold on bulbs. Often, the blue molds are isolated from sick bulbs that are being preserved by local cultivers. In order to avoid market gluts and price fluctuations, onions must be preserved for a short time after harvest before being sent to the market. The most crucial technique for maintaining the high quality of stored bulbs is proper storage. Thus, a review of various onion storage systems is both necessary and appropriate. The goal of the current study was to determine the optimal storage configurations and onion genotypes with minimal susceptibility to post-harvest infections by blue and black mold.(Diabankana, 2024)



Source : https://images.app.goo.gl/cNKXrJKTyF2hK6xr9

C.Diseases arises in onions during storage

Many illnesses that affect onions have been documented, and these lead to losses in yield both in the field and during storage. The reasons for onion bulb losses during storage are numerous. Onion bulbs naturally lose weight when stored because they are constantly losing water. The most significant loss results from storage rots brought on by different illnesses brought on by fungi that rot bulbs. Worldwide onion storage and transportation illnesses are discovered to be caused by approximately 15 distinct fungus species and 5 bacterial species. These illnesses cause a significant loss that can reach 40%. Many diseases, including Aspergillus niger (black mold rot), Penicillium spp. (blue mold rot), Fusarium bulb rot (Fusarium spp.), Basal rot (Fusarium moniliforme), Aspergillus rot (Aspergillus spp.), and Dry rot, degrade onions during storage. Green mold rot (Penicillium spp.), White rot (Sclerotium cepivorum), Grey neck rot (Botrytis allii), Smudge (Colletotrichum circinans), Soft rot (Erwinia spp.), and anthracnose (Colletotrichum chardonianum). A. niger, or black mold rot, is the most severe of all when it comes to storage. Onions become infected with A. niger and A. flavus when the temperature and relative humidity are high. Onions are destroyed by Penicillium spp. At low temperatures, however. Occasionally, Penicillium species generate Penitrem A, a mycotoxin that has been linked to tremorgenic toxicosis in the past. It has been observed that Aspergillus sp., Penicillium sp., and Fusarium sp. Were the main fungal infections linked to the storage illnesses of onions. However, the country's stored onion diseases' severity and intensity have received less researchattention.(Kiran, 2024)



Source : https://images.app.goo.gl/efqUnKq5yPhr2PGr7

The fungi linked to onion bulbs that were collected from various markets in the Bangladeshi districts of Mymensingh, Naogaon, and Sathkhira. Additionally, the prevalence of onion storage diseases and to determine the effects of storage variability and conditions on onion disease incidence. Reaching food self-sufficiency is a significant obstacle that many developing countries, particularly those in sub-Saharan Africa, must overcome. This problem stems from food losses throughout their supply chains in addition to these nations' incapacity to reach their agricultural production targets. Five phases of food loss have been identified by the Food and Agricultural Organization (2011): agricultural production, postharvest, processing, distribution, and consumption. Food losses at the point of production include those brought on by spills during harvesting and mechanical harm. Postharvest losses are caused by crop value reductions from spoiling during handling and storage. Food losses during processing include those that occur throughout both home and commercial processing phases. Food waste in the home consumption stage is primarily

responsible for losses at the consumption level, whereas losses at the distribution stage include those at the market system.(Wang, 2024)



Source : https://images.app.goo.gl/dDgjQ1FVCSs7KYSPA

D.Preventive Approaches for Disease arise in Onion during Storage

1) Heating and curing :

Onions have a higher moisture content and are a semi-perishable commodity. Farmers in developing countries require low-tech, simple solutions to boost onion bulb marketability and reduce postharvest losses. Onion bulbs must be immediately cured after harvesting because they are produced below the earth's surface. After harvesting, onions undergo a unit operation called curing, which removes moisture from the outermost layers, neck, and roots of the onion bulbs. This process lowers the risk of disease and encourages a darker skin finish, both of which improve the quality of the onion storage. The physical, chemical, and biological characteristics of bulb crops are impacted by this essential postharvest unit operation in long-term storage . Elevated temperature for Foliage exhibited an elevated rate of 35.91% of sprouting. Onions cured at 20°C were found to have a higher concentration of abscisic acid (ABA). Given that the concentration of ABA decreases with increasing storage time and that the curing process can sustain the concentration, prolonging storage life and dormancy, this is a crucial indicator of onion quality.(Kiran P. R., 2024)

2) Chemical processing :

Variations in storage conditions over time affect weight, color, ethylene synthesis, sprouting, and pathogen susceptibility to thrips, bacteria, and fungi. Chemical treatments are essential for reducing pathogenic activity while being stored. ECO2, which is phosphine gas diluted to 2% in liquid carbon dioxide, is more effective than methyl bromide at controlling thrips at 200–300 parts per million. The treatment of onions with 1-MCP (methylcyclopropene) and exogenous ethylene in gaseous form at 20°C, followed by storage at 4–12°C, significantly reduced sprout development, regarding sprout and rot control studies were undergone. But a single application of 1-MCP at 20°C was not enough to stop sprouting.(Li, 2009)

3) Biological control methods for onion preservation :

Onions can be effectively protected from rot-causing bacteria and other pathogens through the use of biological control. In comparison to the controls, the severity of black mold disease was significantly lessened by several strains of antagonistic yeast that were isolated from soil, such as AUN-AH14 and AUN-AH23, and their corresponding cultural filtrates at 80% concentration. It was discovered that soil actinomycetes, in particular Streptomyces spp rot losses brought on by Botrytis(Elenany, 2024)

4) Ozone treatment :

Fumigation can be replaced with gaseous ozone, which will protect the onions while they are being stored. When a high voltage discharge is applied between two electrodes in the air, gaseous ozone is produced. Microorganisms could be inhibited by gaseous ozone at the ideal dosage without degrading produce quality. During onion storage, ozone was able to limit contamination by inhibiting fungal colonies and reducing airborne spores. This treatment may slow down the activity of peroxidase and catalase while leaving no harmful residues behind. In addition to killing the bacteria, the ozone treatment can postpone physiological functions. There was less weight loss.(Khot)

5) Irradiation

Significant postharvest losses in onions are caused by rotting, sprouting, and physiological weight loss (PLW), all of which shorten the storage life and reduce the quality of onions. Elevated storage temperatures cause a physiological weight loss, while high relative humidity during the rainy season promotes sprouting and rotting. Because of this, cutting edge therapies are required to lower these losses. Onions are treated with radiation to preserve quality and minimize sprouting. Onions are exposed to minimal amounts of gamma radiation under carefully monitored circumstance.Doses of radiation ranging from 0.01 to 10 kGy can limit sprouting without compromising physiological traits. In radiation therapy, choosing the right dose and treatment duration is essential because larger doses can change the chemical and organoleptic characteristics. Onions can be kept fresher for three months at room temperature with gamma irradiation at a dose of 120 Gy, which can also help to prevent sprouting and rotting. Untreated samples had a greater rate of weight loss, whereas samples that were exposed to radiation had a lower rate of weight loss. Radiation has the ability to limit respiration, metabolic activities, and dehydration, which can impede weight loss. For sprouting, the same values were also found to be effective. Because of the higher levels of ascorbic acid and other hormone-like compounds, such as ethylene, the sprouting inhibition was not possible at lower doses. A 20 Gy x-ray dose combined with Onion bulb sprouting may be successfully inhibited at 3.2 mm depth.(Ahmed, 2022)

7) Edible coatings for preservation of onion

The quality of produce is impacted by enzymatic changes that result in color and flavor changes in both fresh and dried onions that have undergone minimal processing. Younes discovered that by maintaining color and successfully preventing microbial growth, carboxy methyl cellulose with nano-silver incorporated showed the highest level of TSS, sugar, phenols, vitamin C, and pungency. In contrast, microbial growth was inhibited in the case of dried onions by the incorporation of nanosilver into carboxymethyl cellulose, alginate, and starch. Coating with carboxy methyl cellulose infused with nano silver preserved the quality and extended the shelf life of both fresh and dried onions. It has been reported that applying a light heat and an edible alginate coating will slow down the rate of respiration and the decay process in minimally processed onion.(Banerjee, 2024, January)

E. Pre-existing Machineries/Devices for Detecting Onion Spoilage

1) Development of Personalized gas sensor for post-harvest disease detection of onion

Recent studies have shown that the types and concentrations of volatiles released by healthy and acid-skinned onions differ from those produced by botrytis neck rot. A custom gas sensor system consisting of five MOS (Metal Oxide Semiconductor) sensors sensitive to a wide range of volatile, electronic and mechanical components and a specially designed sensor chamber was developed to detect rotten onions in the warehouse. A gas supply system is attached to the chamber to transport volatile substances from the onion samples to the chamber. The device is automated using a specially designed electronic circuit consisting of a microcontroller (16F877A) that controls the functions of each component of the device. The microcontroller also transfers data between the device and the computer. The automated electrochemical sensor was exposed to acetone (ketone), acetonitrile (nitrile), ethyl acetate (ester), and ethanol (alcohol) to understand the sensitivity of each sensor to these compounds. Area under the curve, odor signature and slope characteristics were extracted from the sensors in real time in response to different concentrations of the four chemicals (1 ml, 2 ml and 3 ml diluted in 50 ml water). Area under the curve and slope values were used to identify the concentration of each chemical, and an odor signature was used to classify the chemical.(Labanska, 2022)

2) Two-Fold Spoiled Onion Detection using Soft Computing and IoT

As technology advances and people become addicted to phones, it is important to come up with solutions that incorporate technology. With traditional storage methods, farmers can prevent spoilage of onions. However, in some situations, people may not be able to spot a damaged onion, and in such situations, they can depend on technology that includes deep learning algorithms and sensors. With the existing technologies, the system consisting only of IoT framework faced many challenges because sometimes it can mispredict the data due to environmental conditions and lead to an ineffective technique to detect onion damage. To overcome such challenges, it is imperative to incorporate techniques such as image processing. This article discusses a model based on image processing created using the Google Co lab IDE. Combining the process of segmentation and object extraction improved the image properties, because it leaves the background and other unnecessary things around the main object of our application. The accuracy of the CNN model is 87%, which shows a good result after evaluation. After this image processing segment, work continues with the IoT framework, which detects onion parameters with esp8266 and sensors and displays the stages of damage on an LCD. With this system, farmers and retailers can get early information about onion damage by viewing real-time values via a website.(Shah, 2023, April)

3) Detection of onion postharvest diseases by analyses of headspace volatiles using a gas sensor array and GC-MS

Postharvest diseases of onions cause serious storage losses. The detection of volatiles using gas sensing system technology could be used as a promising alternative method for onion disease detection. The bulbs were inoculated with Botrytis allii and Burkholderia cepacia, which are the pathogens of Botrytis neck rot and sour cream. In the first step of this study, a gas sensor was used to measure 30 bulbs inoculated with equal amounts of B. allii and healthy control bulbs at 8-11 days post-inoculation (dai) and principal component analysis (PCA) plot. shown that the gas sensor array reacted differently to bulbs affected by Botrytis rot than to healthy bulbs. In the second step, 30 bulbs and 10 of each of the three treatments (Botrytis neck rot, sour cream, control) were measured by the gas sensor system for 5, 6 and 7 days. The PCA score plot showed that the three treatments formed three distinct clusters, while the hierarchical cluster analysis dendrogram showed that the response of the gas sensor group to Botrytis black rot and acid skin was similar. The correct classification rate of the linear discrimination model for the three treatments was more than 97.8%. GC-MS results showed that a total of 24 major volatiles were detected in the totals of the three treatments. B had sixteen compounds uniquely. allii and B. cepacia inoculated bulbs. The total amount of volatile compounds detected in bulbs infected with the pathogen was one to two orders of magnitude higher than that of healthy control bulbs. This study demonstrated that a gas sensor system can detect two postharvest onion diseases during storage.(Konduru, 2015)

4) Onion sour skin detection using a gas sensor array and support vector machine

In practice, regular manual physical inspection of the warehouse area is not a feasible solution. Aging, spoilage and infections of vegetables are associated with the emission of volatile organic compounds (VOC), which often have a bad smell. GC-MS-based chemical analysis shows that VOCs removed from vegetables vary significantly during storage, and VOC concentrations increase as the degree of spoilage increases. Regular chemical analysis is not a practical solution due to the high cost and time required for such a process. A likely alternative solution is rapid, inexpensive, on-site, online testing with an electronic nose (e-Nose). In this study, a new way to prevent spoilage of stored potatoes and onions at an early stage is tested using a purpose-designed and developed e-Nose called e-POT. The research shows encouraging results and can be further used to make it suitable for commercial applications.(Tahvonen, 1981)

5) Onion spoilage device :

New technologies such as the IOT method, we can control the environment of thesibula where they were kept using certain sensors. By reading articles about IOT and sensors, we got all the information. That is why we are developing an IOT-based device that enables real-time climate monitoring, detects early loss and alerts the farmer based on analyzed data or sends a signal to AC, fans, dehumidifier. This will help reduce wastage of onions and bulbs. helps to \preserve onions for 6-8 months. We developed the system and got results according to our implementation idea. Because we used temperature, humidity and gas sensors, they accurately detected the change of the microenvironment and all the real-time values that we received from the mobile application and web server, and according to the change of values exhaust fans and the dehumidifier will start until the temperature and humidity will reach the threshold, that is, constant values keep the onion values. Sensors and microcontroller are selected based on learning and reading various research papers, under the guidance of professionals in the field. So that we can accurately conclude our results.

F.Objectives of Device

- To develop a comprehensive onion quality monitoring system that utilizes gas sensors, temperature, and humidity sensors.
- To create a reliable data collection mechanism, implementing a trained machine learning model (KNN) for predictive analysis, and integrating the system into a compact and portable setup using NodeMCU as the controller.
- To accurately assess the internal defects of onions and provide valuable insights for quality control.

III. METHODOLOGY OF DEVICE

- The methodology involves setting up the hardware components, including gas sensors, temperature and humidity sensors, NodeMCU controller, Li-ion battery, and an I2C LCD display.
- Data is collected from the sensors, processed, and fed into the KNN machine learning model. The model is trained to recognize patterns associated with different onion qualities and internal defects.
- Real-time results are displayed on the LCD, offering a user-friendly interface for quality assessment. The system's portability and efficiency are maintained through the integration of a Li-ion battery.

IV. CONCLUSION

In conclusion, the development and implementation of a real-time onion spoilage detection device represent a significant advancement in food quality and safety monitoring. The device integrates cutting-edge technology with the critical need to mitigate food waste and ensure consumer health. Through the integration of various sensors and data processing techniques, it provides a reliable and efficient means of detecting spoilage in onions, a staple food item globally. The device offers several key advantages over traditional methods of spoilage detection, including its ability to provide instant feedback on the freshness of onions, thus enabling timely interventions to prevent waste and maintain product quality. Moreover, its real-time monitoring capabilities allow for early detection of spoilage, reducing the risk of contamination and enhancing food safety standards.Furthermore, the device's portability and ease of use make it suitable for deployment across various stages of the supply chain, from farms to retail outlets, ensuring that onions reach consumers in optimal condition. Additionally, its cost-effectiveness and scalability make it accessible to small-scale farmers and large-scale producers alike, thereby democratizing access to quality assurance tools in the food industry. Overall, the real-time onion spoilage detection device represents a significant step forward in addressing the challenges of food waste and safety in the agricultural sector. By harnessing the power of technology, it has the potential to transform the way onions and other perishable food items are monitored and managed, ultimately benefiting producers, retailers, and consumers alike. As further advancements are made, the impact of such devices on global food security and sustainability will continue to grow, making them indispensable tools in the quest for a more efficient and resilient food system.(Sansan, 2024)

REFERENCES

[1] Borzykh, O., Sergienko, V., Dzham, M., Shyta, O., & Mykhaylenko, S. (2023). Fungicidal control of the most common onion mycoses during the growing season. Quarantine and plant protection, (2), 3-9..

[2]Janas, R., & Robak, J. (1999). Effect of some fungicides on onion seed infection..

[3] Misirova, S. A. (2022). BIOLOGICAL CHARACTERISTICS OF FUNGAL SPECIES THAT CAUSE DISEASES OF ONION FLOWERS AND MEASURES TO COMBAT THEM

[4] Saranya, R., Anadani, V. B., Akbari, L. F., & Vanthana, M. (2017). Management of black mold of onion [Aspergillus niger (Van Teigh)] by using various fungicides.

[5] Yuldosheva, D., Nazarova, O., & Khujaev, O. (2023). FUNGI THAT CAUSE DISEASE IN ALMONDS (STIGMINA CARPOPHILUA (LEV), MONILIA CINEREA (SCHROET)) IN THE CONDITIONS OF UZBEKISTAN AND SOME OF THEIR BIOLOGICAL CHARACTERISTICS. Academia Repository, 4(9), 92-96.

[6] Konstantinović, B., Popov, M., Samardžić, N., & Stojanović, T. (2021). The weeds in onion and their control. Biljni lekar, 49(5), 675-685.

[7] Sharma, D. K. (2023). Strategies for Onion Post-Harvest Diseases Management. Asian Journal of Research in Botany, 6(2), 279-300.

[8] Khalifa, M., Mahmoud, N., & Abou-Zeid, N. (2016). Management of onion bulb rots during storage using pre-and post-harvest control treatments. Egyptian Journal of Phytopathology, 44(2), 1-16.

[9]Elenany, A. M., Atia, M. M. M., Abbas, E. E., Moustafa, M., Alshaharni, M. O., Negm, S., & Elnahal, A. S. M. A. (2024). Nanoparticles and Chemical Inducers: A Sustainable Shield against Onion White Rot. Biology, 13(4), 219..

[10]Yağmur, A., Demir, S., Canpolat, S., Rezaee Danesh, Y., Farda, B., Djebaili, R., ... & Pellegrini, M. (2024). Onion Fusarium Basal Rot Disease Control by Arbuscular Mycorrhizal Fungi and Trichoderma harzianum. Plants, 13(3), 386..

[11] Diabankana, R. G. C., Frolov, M., Islamov, B., Shulga, E., Filimonova, M. N., Afordoanyi, D. M., & Validov, S. (2024). Identification and Aggressiveness of Fusarium Species Associated with Onion Bulb (Allium cepa L.) during Storage. Journal of Fungi, 10(2), 161.

[12]Kiran, P. R., Aradwad, P., TV, A. K., Nayana N, P., CS, R., Sahoo, M., ... & Mani, I. (2024). A comprehensive review on recent advances in postharvest treatment, storage, and quality evaluation of onion (Allium cepa): Current status, and challenges. Future Postharvest and Food..

[13] Wang, M., & Chen, Y. (2024). Electronic nose and its application in the food industry: a review. European Food Research and Technology, 250(1), 21-67.

[14]Kiran, P. R., Aradwad, P., TV, A. K., Nayana N, P., CS, R., Sahoo, M., ... & Mani, I. (2024). A comprehensive review on recent advances in postharvest treatment, storage, and quality evaluation of onion (Allium cepa): Current status, and challenges. Future Postharvest and Food..

[15] Li, C., Gitaitis, R., Tollner, B., Sumner, P., & MacLean, D. (2009). Onion sour skin detection using a gas sensor array and support vector machine. Sensing and instrumentation for food quality and safety, 3, 193-202.

[16] Elenany, A. M., Atia, M. M. M., Abbas, E. E., Moustafa, M., Alshaharni, M. O., Negm, S., & Elnahal, A. S. M. A. (2024). Nanoparticles and Chemical Inducers: A Sustainable Shield against Onion White Rot. Biology, 13(4), 219.

[17] Khot, A. R., Kandale, S. S., Bhosale, R. K., Arun, P., Waghmare, D. A., & Kolekar, H. IOT Based Food (Onion) Spoilage Detection.

[18] Ahmed, S. M., Reddy, V., Chandrahas, R., & Gunjan, V. K. (2022). Effective Monitoring of Onion Production Stored in Ware House to Reduce the Commercial Commodity Wastage and Improve Reutilization. In Modern Approaches in Machine Learning & Cognitive Science: A Walkthrough (pp. 343-352). Cham: Springer International Publishing.

[19] Banerjee, S., Sarda, K., Khandelwal, S., Gajarushi, A., Gawande, S., Velmurugan, R., & Baghini, M. S. (2024, January). IoT-based Sensing System for Thrips Pest and Disease Management in Onion Crop. In 2024 IEEE Applied Sensing Conference (APSCON) (pp. 1-4).

[20] Labanska, M., Van Amsterdam, S., Jenkins, S., Clarkson, J. P., & Covington, J. A. (2022). Preliminary studies on detection of Fusarium basal rot infection in onions and shallots using electronic nose. Sensors, 22(14), 5453.

[21] Shah, K. A., Sri, M. U., Goud, B. V., & Mannem, K. (2023, April). Two-Fold Spoiled Onion Detection using Soft Computing and IoT. In 2023 International Conference on Inventive Computation Technologies (ICICT) (pp. 1357-1360). IEEE.

[22] Konduru, T., Rains, G. C., & Li, C. (2015). A customized metal oxide semiconductor-based gas sensor array for onion quality evaluation: System development and characterization. Sensors, 15(1), 1252-1273.

[23] Tahvonen, R. (1981). Storage fungi of onion and their control. Agricultural and Food Science, 53(1), 27-41.

A Review on Natural Food Color Extraction Natural Methods

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ABSTRACT

Consumer demand for natural coloursis growing as knowledge about the different toxicities of synthetic food colours emerges. The food industry commonly seeks natural plant colourants to replace synthetic colours. Many artificial food colourants, such as quinoline yellow, carmoisine, and tartrazine, have been removed for toxicity. Talks are going on in the plant of natural colours through natural colourant. Plantation pigment sources, like carotenoids, chlorophyll, anthocyanins, and betalains, commonly replace synthetic colourants. The replacement of synthetic pigments with natural colourants is a challenging effort. Due to light, oxygen, heat, pH, and other elements, synthetic colours appear more stable than natural colours. To be employed as a food colourant, it is essential to stabilise natural pigments. The hydrocolloid complications approach is one of the solutions emerging techniques. Conversely, replacing synthetic colours with natural colourants may be difficult because: "synthetic colorants are generally more stable toward light, oxygen, temperature, pH, etc." Stabilizing natural pigments are the main challenge to making them suitable for food coloring. To deal with the falling, the emerging techniques, such as hydrocolloid complications, metal complications, microencapsulation, and intermolecular and intramolecular co-pigmentation, have been developed to improve natural food colour stability.

Keywords: ***Natural food colorants, Plant pigments, Food industry, Color stability, extraction techniques***

INTRODUCTION

Colour constitutes a crucial sensory characteristic of food items, frequently influencing a product's market performance. Consumers commonly use colour as a gauge for various qualities of food products, including flavour, safety, nutritional content, and more. The practice of colouring foods has followed around 1500 BCE (Burrows 2019). Consumer acceptance of food goods is significantly influenced by colour. This is because people constantly associate food colour with attributes like freshness, ripeness, and food safety. Consequently, food colouring has been added to a lot of food products to increase their acceptability and desirability (Duangmal, K et al. 2004). Originally, food colourants were obtained from natural sources, such as saffron, paprika, turmeric, and different types of flowers. The introduction of the first synthetic organic colourant, mauveine, in 1856 marked the beginning of the discovery of numerous other sources (Burrows 2019). The cost-effective cost of manufacture, strong tinctorial strength, and chemical stability of these synthetic colourants made them popular as food colourings. The trend towards replacing artificial colourants with natural alternatives has been encouraged by consumer demand. The switch may be attributed to the desire of consumers for more "natural" products, the possibility that children's hyperactivity is caused by synthetic colourants, and the fact that certain populations are allergic to synthetic colourants (McCann et al. 2007, Potera 2010). The food business is looking for substitutes to satisfy shifting consumer needs and legal constraints despite the fact that synthetic colourants now in use have an extended record of safety reviews and strict controls. Natural sources, including plants, animals, insects, and minerals, are the source of natural colours (Devi, M et al 2013). Plant-based pigments are the most useful of all natural colours in terms of medicinal properties (Scotter, M. J. 2011).

Nature provides a wide range of compounds suitable for food colouring, including oil- and water-soluble carotenoids, chlorophylls, and anthocyanins. However, replacing synthetic colourants with organic alternatives can be challenging because plant pigments colour and stability depend on a number of variables, including the pigment's structure and concentration, light intensity, metals, pH, temperature, enzymes, oxygen, and ascorbic acid (Reshmi, S. K., et al. 2012), flexibility during processing, long-lasting effects, and profitability. In all of these respects, synthetic colourants are preferable (Nemeth, E). Even though there are many different kinds of natural source pigments, using them to colour food usually has more restrictions than using synthetic colourants. Naturally produced pigments are generally more expensive than their synthetic counterparts and need larger quantities of raw ingredients during synthesis. Numerous colourants derived from natural sources may also give products—like those made from red beets or radishes—unwanted tastes and scents. (Rodriguez-Amaya 2016, Wrolstad, and Culver 2012). The fact that natural pigments, particularly those with blue and green colours, cannot replicate the colour properties of synthetic colourants may potentially represent a barrier to the substitution of synthetic dyes. The majority exhibit greater sensitivity to heat, light, and oxygen, leading to changes in hue or loss of colour (Lakshmi 2014, Rodriguez-Amaya 2016, Wrolstad& Culver 2012). A review of the origins, chemical structure, and potential uses for food colouring of several colour compounds obtained from natural sources is provided in this article. There's also a brief overview of compounds that replicate natural colours through chemical synthesis. It is important to remember that some of the vibrant colours found in nature are caused by a phenomenon known as structural

colouration rather than pigments. Certain light wavelengths are reflected, refracted, or diffraction as a result of an optical effect, while other light wavelengths are absorbed, producing a multi coloured display (Newsome et al. 2014).

1. CHLOROPHYLLS

Chlorophyll is a natural green pigment responsible for photosynthesis, converting light into chemical energy. The green colour of plant leaves, chlorophyll, can serve as a natural food colourant. (Henry, B.S. 1996). The objective of the research is to determine the amount of carotene and chlorophyll in 17 samples of cucumbers, cherry tomatoes and peppers that were taken from several greenhouses in southern Romanian. The study identified chlorophyll a, b, and c as the primary pigments in vegetables. The researchers employed a spectrophotometric method and tested three organic solvents (methanol, diethyl ether, and acetone) to determine the most effective extraction solution. The most effective solvents for measuring chlorophyll a, b, and carotene at the exact time were methanol and acetone. Methanol was the best extraction solvent for chlorophyll in cherry tomatoes and tomatoes, while acetone was more effective for carotene in these vegetables. Peppers used acetone solvent, while researchers observed methanol as the most suitable solvent for cucumbers—however, high variation coefficients indicated significant variability between vegetable species. The findings contribute valuable insights into the pigment composition of different vegetables and the choice of extraction solvents for accurate analysis. (G. Neata 2012).

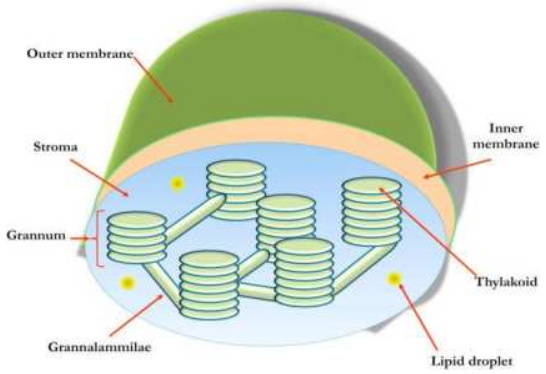


Figure: 2.1 TheStructure of the chloroplast contains chlorophyll, in green plants. (Mandal, R., &Dutta, G. 2020)

The study examined the chlorophyll and carotenoid composition of 13 marketed apple varieties, considering different outer peel colours such as red, green, and yellow. The significant compounds were chlorophylls a and b, lutein, β-carotene, and carotenoids. The researchers characterised the pigment profiles of these varieties and analysed the correlation between carotenoid and xanthophyll content. Peel samples exhibited high pigment content ranging from 58.72 to 1510.77 µg/g dry weight. In comparison, flesh samples showed comparatively lower levels, ranging from 14.80 to 71.57 µg/g dry weight (Delgado-Pelayo, R et al. 2014). In this study, chlorophyll extracted from the leaves of nine medicinal plants (*Melothiramaderaspatana, Clitoriaternatea, Boerhaviadiffusa, Pongamiapinnata, Aeglemarmelos, Phyllathusfraternus, Mimosa pudica, Pisoniagrandis, Acalyphaindica*) and characterised the extract using UV-Visible spectroscopy. Using the Arnon approach, the concentrations of both chlorophyll a and chlorophyll b were found. The green chlorophyll pigment shares the same structure as porphyrin pigments (heme) through the same metabolic activity. Total Chlorophyll content was higher in *Mimosa pudica*(82.6 µg/ml) than in other medicinal plants. (Rajalakshmi, 2015). The source of chlorophyll, *Alternantherasessilis*, was investigated. Chlorophyll a and b were extracted using buffered 80% (v/v) aqueous acetone at a temperature of 5 mL/g and an extraction duration of 45 minutes. The results showed that the yields of these extracts were 659 and 261 µg/g of *A. sessilis,* respectively. *A. sessilis* crushed mechanically yielded a higher than blanching and drying. - Fresh *A. sessilis* can be refrigerated at 15 °C for a maximum of three days without losing any of its chlorophyll content. Basic mass transfer equations might correctly describe chlorophyll extraction up to 30 °C; however, above this point, colour degradation prohibits the process from being completed (Jinasena, M. et al. 2016). Chlorophylls were the most abundant natural pigment molecules (K. Solymosi 2017). Chlorophylls are essential for photosynthesis and are significant in bacteria, algae, and green plants, especially in leaves. Chlorophyll derivatives, especially chlorophyllin, have many potential health benefits, including anti-carcinogenic, anti-mutagenic, antiviral, immune stimulatory, anti-inflammatory, and anti-thrombic effects. Chlorophyll derivatives have direct cancer therapeutic effects in vitro (K. Solymosi et al. 2017). To assess variations in the amounts of carotenoids, amino acids, total cyanide, proximate components, and chlorophyll that are present in cassava leaves. Six months after planting, the leaves of the 'Rayong 5' cultivar, specifically from the centre position, showed the highest amounts of proteins, amino acids, carotenoids, and chlorophyll out of the four cultivars. However, a significant overall cyanide level was found, necessitating efficient detoxification techniques. Aspartic acid, leucine, and glutamine were abundant in the protein found in cassava leaves, but cysteine and methionine were few. Cassava leaves were also identified as a valuable source of carotenoids and chlorophyll, suggesting their potential as an alternative protein supplement for extraction. Despite variations in nutrient content among cultivars, leaf positions, and plant ages, these findings highlight the opportunity to valorise this underutilised agricultural by-product. Researchers have identified strong correlations between chlorophyll, carotenoids, and protein levels, with the highest nutrient concentrations observed in the middle leaves of the 'Rayong 5' cultivar six months after planting (Chaiareekitwat, S. et al. 2022). Significant health advantages of chlorophylls include their anti-inflammatory and anti-cancer capabilities. Utilizing chlorophyll's bioactivity and implementing a circular economy depend on recovering chlorophylls from food byproducts. The research highlights how crucial it is to investigate sustainable methods for encouraging a circular economy, removing trash from the environment, and recovering valuable molecules from food by-products (Ebrahimi et al. 2023).

2. CAROTENOIDS

The food sector depended largely on marigold flowers as an important source of carotenoids. In conventional methods, silage, drying, and solvent extraction lead to a 50% reduction in carotenoids. This study suggests an alternative carotenoid extraction approach, incorporating simultaneous enzymatic treatment and solvent extraction. The proposed method utilises freshly milled flowers directly as raw material, eliminating the inefficiencies of silage and drying processes and addressing challenges associated with hard-to-manage aqueous effluents in traditional methods. The developed process was tested on an 80 L scale, achieving a carotenoid recovery yield of 97% under optimal conditions. (Bárzana, E., et al 2002). The extraction of carotenoids for food use has limited the availability of environmentally friendly solvents. The most potent solvents identified so far are derivatives of the petroleum industry, posing toxicity for human consumption. Ethyl lactate is a promising solvent for extracting trans- and cis-lycopene isomers from dried tomato powder. Adding antioxidants such as alpha-tocopherol and alpha-lipoic acid further enhances the extraction efficiency. Ethyl lactate also enhances the effectiveness of extracting lutein and beta-carotene from dried powders from white corn and carrots. Its advantages over petroleum-derived ethyl acetate include lower flammability and a more favourable origin as a by-product of the corn and soybean industries. (Ishida, B.K. et al. 2009). The study was to extract carotenes and xanthophyll pigments in vegetables, such as Red capsicum, Yellow capsicum, Red spinach, Carrot, Broccoli, and Beetroot. By solvent extraction method, hexane and acetone were in a ratio of 1:1. Using the thin layer chromatography method, the extract was purified. The results indicate that carrots exhibit a high concentration of carotenoids, with the sample containing 18.3 mg/100g. On the other hand, broccoli shows the least amount of carotenoids among the six vegetables, with a content of 1.3 mg/100g (Rebecca, L. et al. 2014).

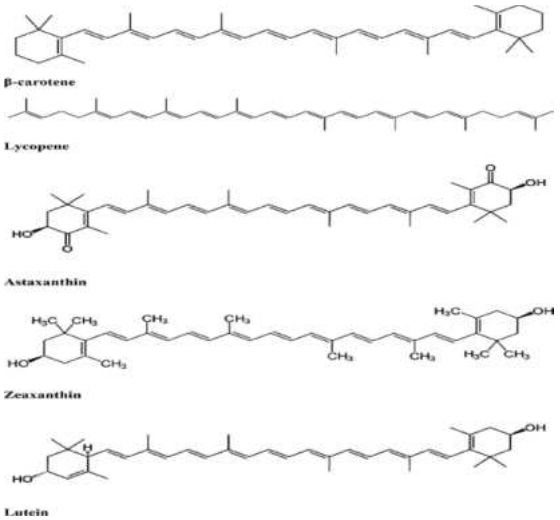


Figure: 3.1 Chemical structure of some common carotenoids (Langi, P. et al. 2018)

Various methods, such as solvent-free extraction, for extracting carotenoids from by-products of fruits and vegetables. Solvent-free extraction reduces environmental impact, enhances extract purity, and eliminates petrochemical solvent hazards. Green extraction methods like ultrasound and microwaves improve efficiency and reduce extraction time. CO2, a non-toxic supercritical fluid, is used in supercritical extraction due to its high penetration capability, affordability, and ease of removal from products (Kultys, E. et al. 2022). The study aimed to assess the total flavonoid content (TFC), total phenolic content (TPC), and total carotenoid content (TCC) in the ethanolic extract of Purslane (*Portulacaoleraceae L.*). The herb was extracted using ethanol, and TFC, TPC, and TCC were determined using a UV-VIS spectrophotometer with standard curve calibration. The results revealed TPC, TFC, and TCC values of 2.00 mg HE/g DW, 0.53 mg EQ/g DW, and 128 mg GAE/g DW, respectively. Additionally, a 200 mg/kg BW sample group exhibited the highest percentage decrease in anti-obesity effects compared to other groups (21.868%). In conclusion, *Purslane* was identified as a rich source of flavonoids, phenolics, and carotenoids, suggesting its potential as an anti-obesity agent in ethanol extract (Azizah, R. N et al. 2022).

3. FLAVONOIDS

Extracts from the leaves of Ficuscarica L., Ceratoniasiliqua L., and Pistacialentiscus L. plants, prepared using 70% ethanol, underwent analysis for total flavonoid content, Electrospray ionization-mass spectrometry (ESI-MS) sensors and reverse-phase high-performance liquid chromatography (HPLC) with UV/VIS arrays are utilized. Major flavonoids identified in Ficus were quercetin and luteolin, with 631 and 681 mg/kg extract, respectively. Ceratonia leaves revealed nine different flavonoids, with myricetin being the predominant one at 1486 mg/kg extract. Pistacia leaves contained myricetin at 1331 mg/kg extract (Vaya, J et al. 2006). The study contributes significantly to the phytochemical understanding of *Mauritiaflexuosa,* commonly known as the buriti palm tree. C-glucoside flavonoids in this species were reported for the first time, expanding the knowledge of its chemical composition. The research successfully isolated and identified six flavonoids from the leaves of Mauritiaflexuosa through chromatographic fractionation. Tricine-7-O-rutinoside, apigenin-6-C-arabinoside, 8-C-glucoside (isoschaftoside), quercetin-3-O-rutinoside (rutin), luteolin-8-C-glucoside (orientin), and luteolin-6-C-glucoside (isoorientin) are among the chemicals that have been found. While some of these flavonoids were previously reported in plants of the Arecaceae family, the study marks the first documentation of C-glucoside flavonoids in the analyzed species.A thorough examination of the compounds' spectral data, including 1H and 13C NMR, UV, and ESI-MS, with previous research, led to the structural clarification of the compounds. The results add significantly to the understanding of the chemical diversity of Mauritiaflexuosa and the makeup of flavonoids in the Arecaceae family (Oliveira 2013). Flavonoids have various bioactive properties, including antioxidant, anti-cancer, anti-inflammatory, and antibacterial effects. Classifying flavonoids into 14 groups based on their chemical nature and the positions of substituent groups in rings A, B, and C is essential for understanding their properties and potential applications. Enzymatic methods have demonstrated efficacy in the

extraction of polyphenols, particularly flavonoids and anthocyanidins, from their corresponding glycosides (Rodríguez De Luna et al., 2020).

4. BETALAINS

Betalains were extracted and assessed from *Opuntiajoconostle*, commonly known as xoconostle in Mexico, using two solvents, methanol/water and ethanol/water. The extraction process employed a three-variable Box-Behnken statistical design, considering solvent concentrations of 0-80%, v/v, 5–30 °C, and 10–30 min. Response Surface Methodology (RSM) actively studied the extraction and stability of betalains from xoconostle. Various techniques, including UV-vis, column chromatography, and HPLC, were applied to separate and analyze the predominant pigments in the extracts. The highest pigment concentration was 92 mg/100 g of fruit using methanol/water 20:80 at 15 °C and a time of 10 min. Optimal conditions actively observed stability at pH 5 and 25 °C. HPLC chromatograms revealed that the primary betalains in xoconostle included betalain, betanidin, and isobetalain (Sanchez-Gonzalez, N et al. 2004).

Natural food colourants, such as betalains, were gaining significance, and the presence of free sugars accelerated their degradation. As a result, there was a growing interest in actively separating sugars from beet extracts. Researchers employed a novel approach, aqueous two-phase extraction, as an effective alternative in downstream betalain processing. The study examined the effects of several parameters on the partitioning behavior of betalains, including tie line length, phase ratio of volume, and the concentration of phase-forming components. The findings showed that betalains and sugars may be partitioned differently when the tie line length was increased to 34%; almost 70–75% of betalains and more than 90% of sugars were partitioned into the top and bottom phases, respectively. Through organic aqueous extraction, betalains were successfully separated from the polymer, increasing concentration by 3.4 times (Chethana S et al., 2007). In this investigation, *Aeglemarmelos, Cocculuspendulus, Moringaoleifera, and Tinosporacordifolia* were grown on a medium supplemented with appropriate growth regulators. A. marmelos and M. oleifera were initiated from seeds, C. pendulus from nodal explants, and T. cordifolia from inflorescence explants. The study assessed the antimicrobial properties. Flavonoids were analyzed qualitatively and quantitatively using TLC, spectrophotometers, and infrared spectral studies. All species contain kaempferol and quercetin, with calli showing higher concentrations than plant parts. We assessed the antimicrobial efficacy of crude flavonoid extracts obtained from plants and calli against Bacillus subtilis, Staphylococcus aureus, Escherichia coli, Klebsiellapneumoniae, and Candida albicans. The results indicated that flavonoids extracted from calli demonstrated heightened antimicrobial activity, likely due to their higher concentrations of flavonoids (TamannaTalreja et al. 2012). This work examined the extraction of betalains from diced red beets using microwave-assisted extraction (MAE).

Applying 400 W at a 100% duty cycle for 90–120 s represented the ideal conditions to obtain the largest recovery of betanines, while 140–150 s represented the highest amount of betaxanthins. Pigment yield was increased by adding ascorbic acid (0.040 mol/L) to the extraction solvent and using a two-step MAE procedure with cooling intervals in between and after processing phases. The yield of betanines and betaxanthins was considerably influenced ($p < 0.05$) by the time of the second step. The yields of betalain produced by MAE were twice as high as those obtained by traditional extraction at 80 °C (Cardoso-Ugarte, G. A et al., 2014).

5. Miscellaneous Pigments

"Miscellaneous pigments" refers to a diverse group of natural compounds that contribute to the colouration of various organisms, including plants, animals, and microorganisms. Research on miscellaneous pigments in food colourants has identified several promising sources, including annatto, saffron, gardenia, cochineals, Monascus, and bili-proteins from algae (Francis, 1987). The analysis of lipophilic algal pigments, particularly chlorophylls and carotenoids, using high-performance liquid and liquid-chromatography–mass spectrometry methods and examined three fabricated pigments from ancient Chinese arte facts, identifying Han purple, indigo, and emerald green (Roy, 2000). Microalgae and microorganisms are potential sources of food colourants, focusing on carotenoids and phycobiliproteins (Dufosse, 2008). Different pigments can be produced by different bacteria, including Micrococcus, Bacillus, Rhodotorula, Monascus, Phaffia, Sarcina, and Achromobacter (Heer et al. 2017). These pigments often play roles beyond colouration, serving functions such as light absorption, protection against harmful UV radiation, and signalling within biological systems. A range of studies have explored the composition and use of various pigments. A broad spectrum of compounds with diverse chemical structures and functions falls under miscellaneous pigments. Certain organisms, such as corals and jellyfish, produce fluorescent pigments that emit light when exposed to specific wavelengths, a phenomenon frequently observed in marine environments. The use of microbial pigments in the food colour market has been highlighted as a natural and potentially beneficial alternative to synthetic colours, particularly emphasising their potential health and environmental benefits (Rana et al. 2021 &Heer et al. 2017). These studies contributed to understanding the diverse range of pigments and their applications. Porphyrazines contributed to the blue and green hues observed in certain algae and cyanobacteria. Indigoids, natural pigments with antioxidant properties, were responsible for the mentioned and observed in some flowers, fruits, and vegetables. Betalains' classification as miscellaneous pigments stems from their distinctive water-soluble nature and occurrence in specific plant orders. Melanin, found in the skin, hair, eyes, and some fungi of animals, produces brown and black colours, offering protection to tissues from UV radiation. Porphyrins, crucial components of molecules such as chlorophyll and haemoglobin, play a role in the colouration of specific flowers.

6. CONCLUSION

Food colour is divided into three categories: synthetic, natural, and identical natural colourants. Among the natural pigments,

Chlorophyll, Carotenoids, Flavonoids and Betalains were significant pigments extracted from various plant parts. The extraction of natural colours from plants was gaining popularity due to the demand for eco-friendly and non-toxic colourants. Techniques such as ultrasonication and microwave-assisted extraction have been explored to improve the efficiency of colour extraction. Different extraction processes are employed for various pigments obtained from plant sources. This review paper utilises spectrophotometric methods and diverse extraction solvents to investigate the composition of chlorophyll and carotenoids in different plant sources, including cherry tomatoes, peppers, cucumbers, apples, medicinal plants, and cassava leaves. As chlorophyll a, b, and c were the primary pigments found in plants, choosing suitable extraction solvents for precision analysis is essential. Marigold flowers are a valuable source of carotenoids in the food industry, and a study suggests an efficient extraction method using simultaneous enzymatic treatment and solvent extraction, achieving a remarkable 97% carotenoid recovery yield on an 80 L scale. Compared to ethyl acetate obtained from petroleum, ethyl lactate is a viable and ecologically friendly solvent that can be used to extract lutein, beta-carotene, and lycopene isomers from powdered dried tomatoes, white corn, and carrots. An examination of various vegetables, including red capsicum, yellow capsicum, red spinach, carrots, broccoli, and beetroot, reveals variations in carotenoid content, with carrots exhibiting the highest concentration. However, the application of food colour in the food industry is currently limited to stability concerns. A new method called encapsulation has been adopted to improve stability and maintain natural colour.

REFERENCE

1. Aberoumand, A. (2011). A review article on edible pigments properties and sources as natural biocolourants in foodstuff and food industry. World Journal of Dairy & Food Sciences, 6, 71-78.
2. Amchova, P., Kotolová, H., &Ruda-Kucerova, J. (2015). Health safety issues of synthetic food colourants. Regulatory toxicology and pharmacology : RTP, 73 3, 914-22 .
3. Azizah, R. N., Emelda, A., Asmaliani, I., Ahmad, I., &Fawwaz, M. (2022). Total phenolic, flavonoids, and carotenoids content and anti-obesity activity of purslane herb (portulacaoleracea L.) ethanol extract. *Pharmacognosy Journal*, *14*(1).
4. Bárzana, E., Rubio, D., Rubio, D., Santamaría, R.I., Garcia-Correa, O., Garcia, F., Sanz, V.E., &López-Munguía, A. (2002). Enzyme-mediated solvent extraction of carotenoids from marigold flower (Tageteserecta). Journal of agricultural and food chemistry, 50 16, 4491-6 .
5. Cardoso-Ugarte, G. A., Sosa-Morales, M. E., Ballard, T., Liceaga, A., & San Martín-González, M. F. (2014). Microwave-assisted extraction of betalains from red beet (Beta vulgaris). *LWT-Food Science and Technology*, *59*(1), 276-282.
6. Chaiareekitwat, S., Latif, S., Mahayothee, B., Khuwijitjaru, P., Nagle, M., Amawan, S., & Müller, J. (2022). Protein composition, chlorophyll, carotenoids, and cyanide content of cassava leaves (ManihotesculentaCrantz) as influenced by cultivar, plant age, and leaf position. *Food Chemistry*, *372*, 131173.
7. Chapter : Bio-Colours From Spices Dharini Chittaragi and Jalaja S. Menon
8. Chethana, S., Nayak, C. A., &Raghavarao, K. S. M. S. (2007). Aqueous two phase extraction for purification and concentration of betalains. *Journal of food engineering*, *81*(4), 679-687.
9. Damit, D. N. F. P., Galappaththi, K., Lim, A., Petra, M. I., &Ekanayake, P. (2017). Formulation of water to ethanol ratio as extraction solvents of Ixoracoccinea and Bougainvillea glabra and their effect on dye aggregation in relation to DSSC performance. *Ionics*, *23*, 485-495.
10. Delgado-Pelayo, R., Gallardo-Guerrero, L., &Hornero-Méndez, D. (2014). Chlorophyll and carotenoid pigments in the peel and flesh of commercial apple fruit varieties. Food Research International, 65, 272-281.
11. DeMaio, J., Worth, R., & Curtin, D. (1997). Introduction to Colour .
12. Devi, M., Ariharan, V. N., & Prasad, P. N. (2013). Annato: eco-friendly and potential source for natural dye. *International Research Journal of Pharmacy*, *4*(6), 106-108.
13. Duangmal, K., Saicheua, B., &Sueeprasan, S. (2004). Roselle anthocyanins as a natural food colourant and improvement of its colour stability. In *Proceedings of the AIC* (pp. 155-158).
14. Henry, B.S. (1996). Natural food colours.
15. Ishida, B.K., & Chapman, M.H. (2009). Carotenoid extraction from plants using a novel, environmentally friendly solvent. Journal of agricultural and food chemistry, 57 3, 1051-9 .
16. Jadhav, R.V., &Bhujbal, S.S. (2020). A REVIEW ON NATURAL FOOD COLOURS
17. Jinasena, M., Amarasinghe, A., Amarasinghe, B., &Prashantha, M.A. (2016). Extraction and degradation of chlorophyll a and b from Alternantherasessilis. Journal of The National Science Foundation of Sri Lanka, 44, 11.
18. Kendrick, A. (2012). Natural food and beverage colourings.
19. König, J. (2015). Food colour additives of synthetic origin.

20. Kultys, E., &Kurek, M.A. (2022). Green Extraction of Carotenoids from Fruit and Vegetable By-products: A Review. Molecules, 27.

21. Lakshmi, C. (2014). Food colouring: the natural way. *Research Journal of Chemical Sciences*, *4*(2), 87-96.

22. Langi, P., Kiokias, S., Varzakas, T., &Proestos, C. (2018). Carotenoids: From plants to food and feed industries. *Microbial carotenoids: Methods and protocols*, 57-71.

23. Mandal, R., &Dutta, G. (2020). From photosynthesis to biosensing: Chlorophyll proves to be a versatile molecule. *Sensors International*, *1*, 100058.

24. McCann, D., Barrett, A., Cooper, A., Crumpler, D., Dalen, L., Grimshaw, K., ...& Stevenson, J. (2007). Food additives and hyperactive behaviour in 3-year-old and 8/9-year-old children in the community: a randomised, double-blinded, placebo-controlled trial. *The lancet*, *370*(9598), 1560-1567.

25. Mortensen, A. (2006). Carotenoids and other pigments as natural colourants. Pure and Applied Chemistry, 78, 1477 - 1491.

26. Neață, G. (2012). Studies concerning the extraction of chlorophyll and total carotenoids from vegetables.

27. Németh, É. Colouring (Dye) Plants. *Cultivated Plants, Primarily As Food Sources*, *2*.

28. Nishiumi, S., Miyamoto, S., Kawabata, K., Ohnishi, K., Mukai, R., Murakami, A., ...&Terao, J. (2011). Dietary flavonoids as cancer-preventive and therapeutic biofactors. *Frontiers in Bioscience-Scholar*, *3*(4), 1332-1362.

29. Oliveira, D.M., Siqueira, E.P., Nunes, Y.R., &Cota, B.B. (2013). Flavonoids from leaves of Mauritiaflexuosa. RevistaBrasileira De Farmacognosia-brazilian Journal of Pharmacognosy, 23, 614-620.

30. Potera, C. (2010). Diet and nutrition: the artificial food dye blues.

31. Rajalakshmi, .. (2015). Extraction and Estimation of Chlorophyll from Medicinal Plants.

32. Rebecca, L. J., Sharmila, S., Das, M. P., &Seshiah, C. (2014). Extraction and purification of carotenoids from vegetables. *Journal of Chemical and Pharmaceutical Research*, *6*(4), 594-598.

33. Reshmi, S. K., Aravindhan, K. M., & Devi, P. S. (2012). The effect of light, temperature, pH on stability of betacyanin pigments in Basellaalba fruit. *Asian Journal of Pharmaceutical and Clinical Research*, *5*(4), 107-110.

34. Rodríguez De Luna, S.L., Ramírez-Garza, R.E., & Serna Saldívar, S.O. (2020). Environmentally Friendly Methods for Flavonoid Extraction from Plant Material: Impact of Their Operating Conditions on Yield and Antioxidant Properties. The Scientific World Journal, 2020.

35. Rodriguez-Amaya, D. B. (2016). Natural food pigments and colourants. *Current Opinion in Food Science*, *7*, 20-26.

36. Rodriguez-Amaya, D.B. (2016). Natural Food Pigments and Colourants. Bioactive Molecules in Food.

37. Sanchez-Gonzalez, N., Jaime-Fonseca, M.R., San Martín-Martínez, E., & Zepeda, L.G. (2013). Extraction, stability, and separation of betalains from Opuntiajoconostle cv. using response surface methodology. Journal of agricultural and food chemistry, 61 49, 11995-2004 .

38. Scotter, M. J. (2011). Emerging and persistent issues with artificial food colours: natural colour additives as alternatives to synthetic colours in food and drink. *Quality Assurance and Safety of Crops & Foods*, *3*(1), 28-39.

39. Sigurdson, G.T., Tang, P., &Giusti, M.M. (2017). Natural Colourants: Food Colourants from Natural Sources. Annual review of food science and technology, 8, 261-280.

40. Solymosi, K., &Myśliwa-Kurdziel, B. (2017). Chlorophylls and their Derivatives Used in Food Industry and Medicine. Mini reviews in medicinal chemistry, 17 13, 1194-1222 .

41. Vaya, J., &Mahmood, S. (2006). Flavonoid content in leaf extracts of the fig (Ficuscarica L.), carob (Ceratoniasiliqua L.) and pistachio (Pistacialentiscus L.). BioFactors, 28 3-4, 169-75 .

42. Wrolstad, R. E., & Culver, C. A. (2012). Alternatives to those artificial FD&C food colourants. *Annual review of food science and technology*, *3*, 59-77.

43. Yoshioka, N., &Ichihashi, K. (2008). Determination of 40 synthetic food colours in drinks and candies by high-performance liquid chromatography using a short column with photodiode array detection. Talanta, 74 5, 1408-13 .

Turning Trash into Treasure: Unlocking the Value of Fruit and Vegetable Waste- A Review

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***Abstract*-Fruit and vegetables are the most widely consumed raw, cooked, fully cooked, processed, or as a supplement to other foods (K. Selva Ganesh, 2022) (Harsh Kumar, 2020).Fruit and vegetable-based industries and household kitchens generate a substantial quantity of world-wide waste. The majority of wastes are composed of pomace, peels, rind, and seeds, which are rich in organic matter, phytochemicals, and compounds with nutraceutical qualities in addition to being extremely rich in useful bioactive components. Nevertheless, because there is inadequate infrastructure to manage such a massive amount of biomass and have no recognized commercial application for this priceless material, it is disposed improperly, which causes pollution issues in the environment. Because of its high nutrient concentration this waste has enormous potential for conversion into valuable products to ethanol, biofuels, bio fertilizers, edible films, and edible items (Harsh Kumar, 2020) (R. Sharma, 2016). This review paper focused on value-added products derived from peel scraps.**

Key word:* *Fruits and vegetables, Industries, solid waste management, environmental issues, peel and value-added products

I. INTRODUCTION

The Ministry of Food Processing Industries (MFPI) of India analyzed that fruit and vegetable losses at 12 and 21 million tons, respectively, for an approximate worth 4.4 billion USD, with a total food value loss and waste production of 10.6 billion USD(Harsh Kumar, 2020).Fruit and vegetable Wastes can be classified depending on their quality and site of origin within the Food Supply Chain (FSC).The important stages of Food Supply Chain (FSC) are production, distribution and transportation, processing and retailing, and consumer level. From the article (Microbial-processing of fruit and vegetable wastes for production of vital enzymes and organic acids: Biotechnology and scopes),

Author stated that according to India's organized sector, losses and wastage of fruits and vegetables are 25%, 10%,and 7% throughout processing, distribution, and consumption(Sandeep K. Panda, 2016).

Fruit and vegetable wastes containedhigh amounts of phytochemical constituents and studied for dietary fibers, phenolic compounds, essential nutrients, phytochemicals and bioactive compounds extractions which are abundantly found in the peels, seeds, and other constituents of commonly used vegetables and fruits. It is the need of the hour to develop solutions that can maximize the potential of these waste materials and assist in achieving social, environmental, and economic advantages from them. Furthermore, exploitation of fruit and vegetable waste, particularly peels, in generating value-added products such as Ethanol, Biofuels, Bio fertilizers, Oils, Edible films and Edible products etc(Harsh Kumar, 2020).

II. REVIEW OF LITERATURE

The management of fruit and vegetable wastes presents a significant challenge, based on the quantities generated globally and the associated economic, environmental, and social implications. However, through innovative approaches and technological advancements, these challenges can be transformed into opportunities for sustainable development.

Based on various studies conducted, harnessing the rich phytochemical composition of these wastes, researchers have been able to develop applications ranging from packaging materials to renewable energy sources. Moreover, the utilization of these waste materials not only adds economic value but also contributes to environmental preservation by reducing pollution and greenhouse gas

emissions associated with conventional waste disposal methods.

Furthermore, initiatives like vermicomposting offer a practical and eco-friendly solution for converting organic waste into nutrient-rich compost, thereby supporting organic agriculture and soil health. The involvement of earthworms in the decomposition process highlights the importance of biodiversity in waste management strategies.

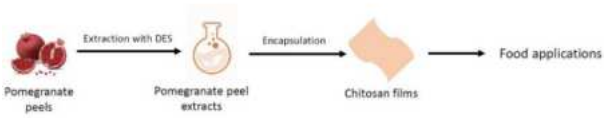
A. DIBLE FILMS FROMPOMEGRANATE PEEL AND POTATO PEEL

Environmentally friendly packaging is now expected by consumers, and the materials used to make the films should not alter the product's qualities, nutritional, or functional attributes. Edible films protect and extend the shelf life of products(María L. Zambrano-Zaragoza 1, 2018).

i. POMEGRANATE PEEL

Fruit and vegetable waste is utilized to create edible films. Pomegranate peel powder is used to create biofilm by combining it with gelatine. The inadequate degradation of pomegranate peel in the film matrix resulted in a more heterogeneous microstructure, which significantly improve the film's water vapor permeability. The hydrophobic and hydrophilic components found in pomegranate peel balance the hygroscopic qualities and do not affect the moisture content of the films(Harsh Kumar, 2020).

ii. POTATO PEEL



Potato peel is also used to manufacture films because it has adequate amounts of starch, cellulose, hemicellulose, and fermentable sugars(Purba Prasad Borah, 2017). The films with low concentrations of potato peel in comparison

Figure 2Pomegranate Peel Film(Aikaterini Kyriakidou 1, 2021)



to high concentrations of peel in the biopolymer film resulted in a higher Water Vapour Porosity (WVP) due to the larger pore size of the film matrix, despite its denser structure. Potato peel biopolymer film-coating has proven useful for developing biodegradable food packaging with higher economic value(Harsh Kumar, 2020).

Figure 1Potato Peel Film(Purba Prasad Borah, 2017)

B. ETHANOL FROM BANANA PEEL

Plantains processing organizations generate a large amount of unripe banana peel waste in one place. Unripe plantain peels can weigh up to 40% of the product's fresh weight. Every day, more people rely on fossil fuels for a variety of energy purposes.The most commonly used feedstocks are those that contain sugar and starch. Although lignocellulosic materials can also be utilized, it is challenging to turn them into sugar; this needs advanced equipment, which could raise operational costs. so that unripe banana peel is selected for feedstock and Dried unripe banana peel powder (DUBPP) was chemically evaluated.DUBPP has only 2.1% w/w of water-soluble reducing sugar, making it unsuitable for fermentative ethanol generation. However, DUBPP was discovered to be an abundant source of starch (41.2% w/w) and cellulose (9.3% w/w). These carbohydrates are quickly acid

hydrolysed into fermentable sugars. The chemical composition of DUBPP is favourable for the fermentative generation of ethanol by hydrolysis. Therefore, this fruit waste has the potential to be used as biomass for the manufacturing of ethanol(Ashish G. Waghmare, 2016).

Figure 3Ethanol from Banana Peel(Madhumala Y, 2020)

C. BIOFUEL FROM POTATO PEEL WASTE

One of the most widely consumed and important foods in the world is the potato. Environmentalists and garbage management have long expressed alarm about the



enormous amount of Potato Peel Waste (PPW) produced worldwide. PPW is produced when the skin or outer covering of a potato tuber is peeled, and it is produced in homes, restaurants, and the food processing industry.Phenols, amides, unsaturated fatty acids, and other phytochemicals are present in PPW. PPW being converted into biofuel, such as biogas and bioethanol by various methods. The chemical makeup and availability of PPW affect its conversion into biogas and bioethanol. Its conversion to biogas and bioethanol is influenced by the high concentrations of ash, water, carbohydrates, and starch. The process of turning PPW into biofuel has far too many benefits for economic, hygienic, and environmental reasons(Omojola Awogbemi, 2022).

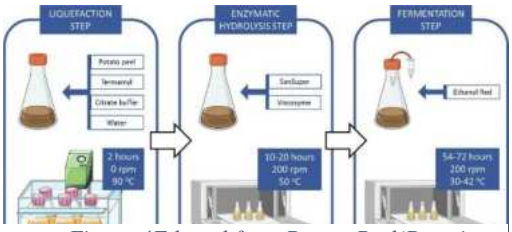


Figure 4Ethanol from Potato Peel(Beatriz Rodríguez-Martínez, 2023)

D. EXTRACTION OF PECTIN FROM TOMATO PEEL

Tomato peels, seeds, and a tiny quantity of pulp are among the many byproducts that are produced during the industrial processing of tomatoes. Currently, this material is either disposed of as solid waste or fed to animals, but the variety of bioactive compounds found in the by-products suggests that they could be used as an inexpensive source of high-value functional ingredients and other bioactive compounds, like soluble dietary fibres (i.e. pectin). Pectin helps to bind plant cells together and is present in both the primary cell walls and the intermediate lamellas that separate the cells. Pectins are mostly utilized in the food processing sector as stabilizers in fruit juices, jams, jellies, confections, and gelling and thickening agents. Pectin is also employed as a natural prophylactic, a binding ingredient in tablet formulations, and a medication carrier in the medical, pharmaceutical, and cosmetic industries. From the article (Utilization of tomato peel waste from canning factory as a potential source for pectin production and application as tin corrosion inhibitor), Author stated thatin the first set of extractions, pectin is extracted from two tomato peel samples, yielding 15.0% (batch A-I) and 14.9% (batch B-I). Tomato peel in batch A-I is richer in pectin than batch B-I, according to physio-chemical examination and structural characterization of cell-wall separated pectin. This indicates that sample origin has a significant impact on pectin quality(Antonela Ninčević Grassino, 2016).

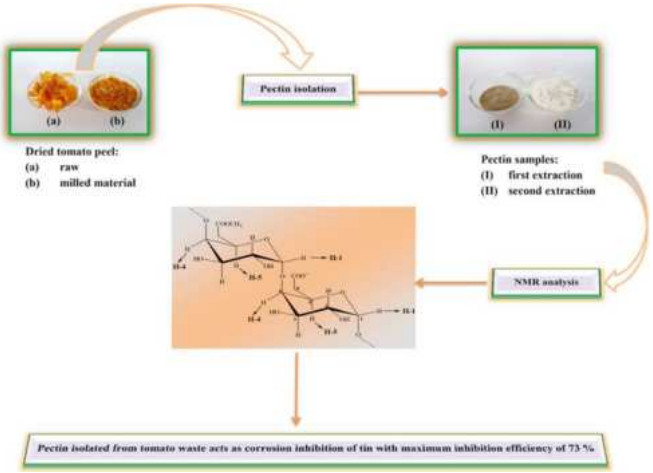


Figure 5Extraction of Pectin to Use as a Corrosion Inhibitor in Canning Process(Antonela Ninčević Grassino, 2016)

E. BIOFILM FROM PUMPKIN PEELS

Pumpkin processing resulted in a significant quantity of waste production, mostly in the form of peel and seeds. Pumpkin seeds are rich in oil and antioxidants; pumpkin seed flour has a protein and oil level of roughly 36.5% and 51.0%, respectively. Since pumpkin peels are high in pectin, they were utilized to extract the alcohol-insoluble polysaccharide and identify the pectic polysaccharides found in them. An attempt is made to optimize processing methods in order to reduce the number of wastes, taking into account the issues faced by the food processing business. After undergoing biological treatment, food processing sector wastes are used as feedstock or co-products, or as raw materials for other industries. Films made from biobased materials and co-products reduce the environmental impact of composting. These materials are biodegradable and derived from renewable resources; if handled responsibly, they could have a smaller disposal-related environmental impact than commercial films while also supporting sustainable development. High-barrier, multi-layer, biodegradable food packaging may be a good substitute for the existing multi-layered, non-recyclable, non-biodegradable packaging from the standpoint of waste management(C. Lalnunthari, 2019).

Figure 6Biofilm Produced from Pumpkin Seeds and Peels(C.



Lalnunthari, 2019)

F. Vermicompost from FVW

Vermicomposting is an economical and environmentally friendly method of handling fruit and vegetable waste that comes from homes, industries, and farms.The quality of the raw waste or substrate and the type of earthworms employed in the vermicomposting process determine the fertilizer value and amount of vermicompost that is produced(Monika Mago, 2022).

Vermicomposting is a practical way to transform fruit and vegetable wastes into healthy organic soil and supporting eco-friendly agricultural production systems. During the composting process, a variety of helpful organisms and microbes work as chemical decomposers to create compost, which is a stable organic end product. Decomposers such as earthworms are important because they accelerate the synthesis of stable organic end products and improve the nutritional value of compost(L. J. Chanu, 2018).

Materials used for construction of vermireactors are plastic containers, clay pots, wooden containers, metallic containers, glass jars and concrete rectangular pond-like structures. Based on the specific needs the dimensions, size, shape and construction materials are varied(Matthew Chekwube Enebe, 2023).



Figure 7Vermicomposting of Fruit and Vegetable Wastes(Wenjiao Li, 2020)

In vermicomposting process earthworms plays important role and microbes are responsible for the actual breakdown of organic matter(Jorge Domínguez, 2019). There are over 4400 different species of earthworms in the world, with about 3000 of those species being found in India alone (Ana Vuković, 2021)(L. J. Chanu, 2018). Earthworms are classified into three types based on deeding and burrowing strategies. they are *Epigeic, Anecic* and *Endogeic species*.

i. *Epigeic species*

The primary food source for *epigeic* earthworms is decomposing organic materials, such as vegetable and animal waste. They are found in the organic horizon, which is the area on or near the soil's surface. They are able to adjust to the shifting environmental conditions of the soil surface because they are typically tiny, pigmented, and have high metabolic and reproduction rates. In addition, they exhibit high rates of organic matter ingestion, digestion, and assimilation. An example of an *epigeic* earthworms is *Eisenia fetida, Eisenia andrei, Dendrodrilus rubidus, Eiseniella tetraedra, Allolobophoridella eiseni,* and *Dendrobaena veneta*, *hortensis*, and *octaedra* are examples of *epigeic lumbricids*(Domínguez, 2018).

ii. Endogeic Species

Endogeic earthworms are found further down the soil profile, where they primarily consume soil and its organic content. Due to their lack of pigmentation, these worms create horizontal galleries that are heavily branched and eventually fill with waste as they progress through the soil's organic-mineral horizon. In comparison to *epigeic* earthworms, *endogeic* earthworms reproduce less frequently, have longer life cycles, and are more resilient to adverse environmental factors including starvation and drought. This group includes the majority of earthworms, such as *Octolasion lacteum, Aporrectodea caliginosa,* and *Aporrectodea rosea*(Domínguez, 2018).



Figure 8Eisenia fetida(Domínguez, 2018)

Figure 9Octolasion lacteum(Octolasion lacteum)



iii. *Anecic Species*

Anecic earthworms inhabit vertical tunnels that can stretch several meters down the soil profile, where they reside almost continuously. These species come out at night to feed on waste, feces and decaying organic waste, which they take to their galleries. When their galleries open, they release their excrement onto the surface in the form of noticeable earthworm casts. Typically, these earthworms are big and have a dark brown hue. They have lengthy life cycles and comparatively modest rates of reproduction. An example of an *anecic* earthworm is the *Lumbricus terrestris*, or night crawler(Domínguez, 2018).



Figure 10Lumbricus terrestris(Lumbricus terrestris)

III. CONCLUSION:

The management of fruit and vegetable waste is a critical issue with significant implications for nutrition, economics, and the environment. This review has highlighted the substantial amount of waste generated by fruit and vegetable-based industries and household kitchens, leading to considerable losses in both nutritional value and economic potential. Moreover, improper disposal of this waste contributes to environmental pollution.

However, amidst these challenges lie opportunities for sustainable development. Through innovative approaches and technological advancements, fruit and vegetable waste can be transformed into valuable products, particularly focusing on peel scraps. Various studies have demonstrated the potential to extract bioactive compounds and valuable materials from these waste streams, ranging from edible films to biofuels.

The utilization of pomegranate, potato, banana, tomato, and pumpkin peels in the production of edible films, ethanol, biofuels, and pectin exemplifies the diverse applications of fruit and vegetable waste. These value-added

products not only contribute to economic growth but also promote environmental sustainability by reducing waste and greenhouse gas emissions.

Additionally, initiatives like vermicomposting offer practical and eco-friendly solutions for converting organic waste into nutrient-rich compost, supporting organic agriculture and soil health. The involvement of earthworms in the decomposition process underscores the importance of biodiversity in waste management strategies.

Moving forward, continued research, investment in infrastructure, and policy support will be essential to maximize the potential of fruit and vegetable waste and create a more sustainable food system. By turning waste into valuable resources, we can address nutritional, economic, and environmental challenges while advancing towards a more sustainable and circular economy.

1. REFERENCES

2. Aikaterini Kyriakidou 1, D. P. (2021). Physical Properties of Chitosan Films Containing Pomegranate Peel Extracts Obtained by Deep Eutectic Solvents. *MDPI Journal, 10*(6).
3. Ana Vuković, M. V. (2021). Vermicomposting—Facts, Benefits and Knowledge Gaps. *Agronomy*.
4. Antonela Ninčević Grassino, J. H. (2016). Utilization of tomato peel waste from canning factory as a potential source for pectin production and application as tin corrosion inhibitor. *Food Hydrocolloids*, 52.
5. Anupama Gaur, S. T. (2020). Bio-waste orange peel and polymer hybrid for efficient energy harvesting. *Energy Reports, 6*.
6. Ashish G. Waghmare, S. S. (2016). Utilization of unripe banana peel waste as feedstock for ethanol production. *Bioethanol, 2*(1).
7. Beatriz Rodríguez-Martínez, E. C. (2023). Potato peels waste as a sustainable source for biotechnological production of biofuels: Process optimization. *Waste Management, 155*.
8. C. Lalnunthari, L. M. (2019). Valorisation of pumpkin seeds and peels into biodegradable packaging films. *Food and Bioproducts Processing, 118*.
9. Domínguez, J. (2018). *Earthworms - The Ecological Engineers of Soil.*
10. Harsh Kumar, 1. K. (2020). Fruit and Vegetable Peels: Utilization of High Value Horticultural Waste in Novel Industrial Applications. *Molecules*.
11. Jorge Domínguez, M. A.-B. (2019). Changes in the composition and function of bacterial communities during vermicomposting may explain beneficial properties of vermicompost. *Scientific Reports*.
12. K. Selva Ganesh, A. S. (2022). Utilization of fruit and vegetable waste to produce value-added products: Conventional utilization and emerging opportunities-A review. *Chemosphere, 287*.
13. L. J. Chanu, S. H. (2018). *A Guide to vermicomposting-production process and socio economic aspects.* Umiam: The Director ICAR Research Complex for NEH Region Umroi Road, Umiam -793 103, Meghalaya, India.
14. Lumbricus terrestris. (n.d.). *Wikipedia, the free encyclopedia*.
15. Madhumala Y, V. N. (2020). Bioethanol Production from Waste Banana Peel. *NTERNATIONAL RESEARCH JOURNAL OF ENGINEERING AND TECHNOLOGY (IRJET), 7*.
16. María L. Zambrano-Zaragoza 1, *. G.-R.-M.-L.-C.-E.-G. (2018). Nanosystems in Edible Coatings: A Novel Strategy for Food Preservation. *nternational Journal of Molecular Sciences*.
17. Matthew Chekwube Enebe, M. E. (2023). Vermicomposting technology - A perspective on vermicompost production technologies, limitations and prospects. *Journal of Environmental Management, 345*.
18. Monika Mago, R. G. (2022). Sustainable treatment and nutrient recovery from leafy waste through vermicomposting. *Bioresource Technology, 347*.
19. Octolasion lacteum. (n.d.). *Wikipedia, the free encyclopedia*.
20. Omojola Awogbemi, D. V. (2022). Biofuel Generation from Potato Peel Waste: Current State and Prospects. *Recycling*.
21. Purba Prasad Borah, P. D. (2017). Ultrasound treated potato peel and sweet lime pomace based biopolymer film development. *Ultrasonics Sonochemistry, 36*.
22. R. Sharma, H. O. (2016). Chapter 2 - Fruit and Vegetable Processing Waste: Renewable Feed Stocks for Enzyme Production. *Agro-Industrial Wastes as Feedstock for Enzyme Production*.
23. Sandeep K. Panda, S. S. (2016). Microbial-processing of fruit and vegetable wastes for production of vital enzymes and organic acids: Biotechnology and scopes. *Environmental Research, 146*.
24. Wenjiao Li, S. A. (2020). Effect of excess activated sludge on vermicomposting of fruit and vegetable waste by using novel vermireactor. *Bioresource Technology, 302*.
25. Z.A. Nur Hanani, A. A. (2018). Effect of different fruit peels on the functional properties of gelatin/polyethylene bilayer films for active packaging. *Food Packaging and Shelf Life, 18*.

Review on Formulation And Development of Millet Spread

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Abstract—**Millet, a versatile and nutritious ancient grain, has garnered attention in recent years due to its numerous health benefits and culinary versatility. Millet spread offers a delicious alternative to conventional spreads like peanut butter or hummus, catering to individuals with diverse dietary preferences and restrictions. It is rich in essential nutrients such as fiber, protein, vitamins, and minerals, making it a wholesome addition to balanced diets. Millet spread, a novel product derived from pearl millet and finger millet, has emerged as a popular alternative to traditional spreads like peanut butter or almond butter. This paper provides a comprehensive review of millet spread using pearl and finger millets, focusing on its nutritional composition and health benefits.**

Keywords—Millet, Nutrition, Grains,Pearl millet, Finger millet, Spread.

I. INTRODUCTION

In the search for healthier and more versatile food options, ancient grains have become nutritional powerhouses that offer countless benefits to consumers and the planet. Among these ancient grains, pearl millet (Pennisetum glaucum) and finger millet (Eleusine coracana) stand out for their exceptional nutritional profile and culinary versatility. As interest in sustainable and nutritional options grows, the spotlight is increasingly on the trend towards innovative products derived from these grains, including millet spreads. Millet spreads derived from these ancient grains offer a convenient and delicious way to add the nutrients of pearl and finger millet to everyday meals. Reminiscent of traditional nut butters, these spreads are not only packed with nutrients, but also offer a unique flavour profile that adds depth and richness to a variety of dishes. Sugar is one of the most important natural binding agents.Binding agents are ingredients added to products that form its materials into a whole and provide structural stability to the final product. [1][21]

A. Origin of millets

The origins of millets can be traced back thousands of years to ancient civilizations in Africa and Asia. Millet was one of the earliest cultivated crops, with evidence of domestication dating back to the Neolithic period, some 10,000 years ago.[2]

B. Millet as staple food

Throughout history, millet has been a staple food for millions of people, providing food and nutritional security in areas where other cereal crops did not thrive. They were valued for their endurance, drought tolerance and nutritional value, making them indispensable to agricultural societies around the world. They are often used in traditional cuisines, rituals and celebrations. For example, finger millet (ragi) is a staple of South Indian cuisine and is used in various dishes such as dosa, idle and porridge. Pearl millet (bajra) is a staple food in parts of Africa and Asia, where it is used to make flatbreads, porridge and fermented drinks.[3]

II. REVIEW OF LITRATURE

A. Nutritional profile of millets

Finger millet had the highest carbohydrate content of the millets tested. However, compared to most typical grains such as rice and wheat, carbohydrates have a lower glycaemic index because they are primarily composed of resistant starch, fibre, and slowly digestible starch. Compared to other millets, finger millet has a lower protein content (about 7%), but has a higher amino acid score and more lysine, valine and threonine. Thus, it is rich in B vitamins including niacin, B6 and folic acid and trace elements such as Ca, Fe, Mg, K and Zn.It is a good source of lysine, which is low in most cereals, and sulphur-containing amino acids, with about 8.7% of its protein and amino acid content being balanced.

The energy value of pearl millet is similar to that of the main cereal. Compared to basic cereals, pearl millet has less carbohydrates and a higher percentage of amylose starch (20-22%). Its insoluble fibre component also

contributes to its reduced glycaemic response. People who are sensitive to gluten can benefit from pearl millet protein because it is gluten-free and contains higher levels of prolamin. Pearl millet has a decent amino acid score, although it is low in lysine, threonine, tryptophan and other sulphur-containing amino acids. Omega-3 fatty acids and other essential fatty acids such as docosahexaenoic acid, eicosapentaenoic acid and alpha-linolenic acid are found in pearl millet. There are other trace elements such as Fe, Zn, copper (Cu), K, Mg, P and manganese (Mn).[5]

B. Health benefits

1. Pearl millet

The magnesium in pearl millet helps asthma sufferers with breathing problems and reduces the effects of migraines. The fiber content of pearl millet reduces the formation of gallstones. Since gallstones are caused by excess bile in the body, the insoluble fiber in pearl millet helps lower this level.

2. Finger millet

One of the healthiest grains is finger millet, which has a good amount of natural calcium, which strengthens bones and reduces the risk of fractures. It is also a good natural source of iron, which can help with anaemia. Due to its high fibre content, it works well as a laxative and helps prevent constipation. Since finger millet contains a lot of calcium, it is useful for babies, the elderly and expectant mothers. It also helps lactating mothers produce enough breast milk, making it incredibly beneficial for them. Asthma, high blood pressure, heart problems and diabetes can benefit from finger millet, which is an excellent diet because it slows down the release of glucose in the blood and slows down digestion.[4]

C. Processing of millets

An economical, palatable and nutritious product needs to be urgently developed to address global food insecurity caused by inefficient use of millet crops. In order for millet grains to be cooked and flavoured, they must be processed to remove undesirable components. Processing is therefore necessary because it reduces anti-nutrients and improves nutrient bioavailability and sensory properties. Processing uses a variety of methods, including grinding, steeping, germination, fermentation, malting, heating and roasting. These processes cause changes in the physicochemical properties of food, which affect its physical, functional and nutritional values. Primary and secondary processing are two possible categories of processing.

Primary processing includes steps such as cleaning, washing (soaking/sprouting), peeling, milling (into flour and semolina), and refining to remove nutritional factors and unwanted seeds. Secondary processing means that the raw materials used in primary processing are transformed into ready-to-cook (RTC) or ready-to-eat (RTE) products by extruding, flaking, popping and frying. Traditional processing methods include breaking, grinding, roasting, soaking, mincing, shaking, steaming, salted grains and fermented products. Significant concentrations of trypsin inhibitors, tannins, phenols and phytates reduce nutritional quality and bioavailability, preventing millet from reaching its full nutritional potential. Because some millets are higher in unsaturated fatty acids than others, millet flour can become rancid over time due to lipolysis and oxidation of "de-esterified fatty acids" and produce off-flavours. [6]

D. Binding agent

Sucrose is commonly referred to as table sugar or cane sugar. Sucrose is a molecule composed of two monosaccharides, namely glucose and fructose. This non-reducing disaccharide has a chemical formula of $C_{12}H_{22}O_{11}$. When heated to temperatures above 186 degrees Celsius, sucrose undergoes a decomposition reaction to give rise to caramel. It also serves as a food thickening agent and as a food stabilizer. The syrup acts as a binding agent to create clusters while adding a mellow flavour. One of the functional characteristics that contributes to sugar's facilitating properties is that it is a humectant, meaning it binds water molecules easily. This makes it a crucial ingredient for manufacturers looking to preserve moisture in their products.[24]

III. MATERIALS AND METHODS

A. Selection of raw materials

The selected two millets namely pearl millet and foxtail millet were procured from local market of Vellore district, Tamil Nadu, India. The millets were cleaned properly and stored in sealed containers.[7]

B. Processing of millet flour

Methods of food processing have been developed over the centuries and are adopted to make the final product more attractive in flavor, appearance, taste, consistency etc. Besides these aspects of consumer preferences,several of the methods aim at making the food safe and wholesome and increase its shelf life. The common household practices of processing these foods include milling, germinating or sprouting, malting, soaking and cooking. Each of these processes qualitatively modifies the nutritive value of the food.[23]

1. Selection of raw material

Food processing is the transformation of raw ingredients, by physical or chemical means into food, or of food into other forms. It is widely accepted that simple and inexpensive traditional processing techniques are effective methods of achieving desirable changes in the composition of grains. The processing methods such as boiling, germination, pressure cooking and roasting were implemented with raw sample to test the effect of processing on functional, chemical, anti-nutritional and pasting characteristics of millet grains.[9]

2. Cleaning

Cleaned grains are collected which are free from Dust, stones, straws and other dust particles etc. All the foreign particles are separated by using Destoner, Aspirator and Grader. The good quality grade grains are separated and collected using grader.[10]

3. Soaking

After the process of cleaning, the cleaned pearl millet and finger millet are washed and cover them with 2 to 3 times the amount of pure and filtered water. Then leave it for 8 to 12 hours. Soaking softens the hull allowing the sprouts to grow.[11]

4. Roasting

In the production of MILLET SPREAD the followed ingredients need to be roasted using roaster before blending in order to remove the raw flavor. Finger millet and Pearl millet are roasted before grinding and then go for further processing.[20]

5. Grinding

Grinding is done in a flour mill or in a mixer. The roasted finger millet and roasted pearl millet are fed into the flour mill for grinding. After grinding the flour is collected at the respective outlet. [13]

6. Sieving

After making into flour the finger millet flour and pearl millet flour is passed into the flour sifter for sieving where the fine particles and coarse particles were separated depending upon the respective mesh size.[18]

C. Processing of millet spread

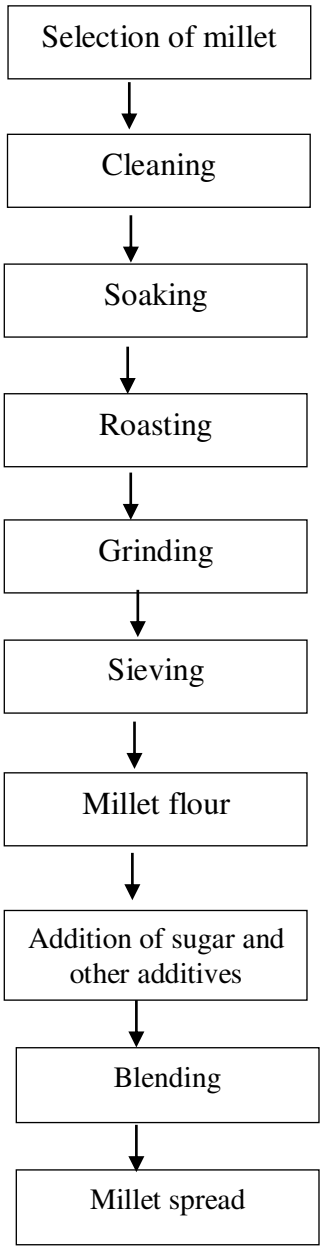
1. Addition of sugar, and other additives

First, Take 1 cup of sugar and ¾ cup of water in a pan. Heat this mixture until it melts and boil for 2 minutes in medium flame. This is done until the sugar to melt completely. Then strain to remove impurities. Then heat it up again and heat stirring for few minutes until you get a slightly sticky consistency and the sugar syrup also helps in binding, in addition oil is been added to the millet flour.[15] [16]

2. Blending

The blending process for making millet spread involves combining cooked millet flour with flavorings and optionally blending them to achieve a smooth and creamy consistency. The millet flour and sugar syrup are to be blended together to make millet spread. Hence the millet spread is prepared.[17]

D. Process flowchart



IV. CONCLUSION

In conclusion, the exploration of millet spread creation unveils a world of culinary possibilities and nutritional benefits.Millets are a nutrient-dense, low-carb alternative to traditional grains that can have a variety of health benefits. They are a great source of protein, minerals, and dietary fibre, and can be used in a variety of dishes to add nutritional value.Syrups are sweetened, viscous, concentrated solutions of sucrose or, other sugars in water which acts as a binding agent.Making millet food products that deliver convenience, taste, texture, colour, and shelf-stability at economical cost for poor people is needed.Our research highlights the versatility of millet spreads, as they fulfil different eating habits and culinary traditions.[18]

V. REFERENCES

[1] Dida, K., & Kebero, K. (2023). Finger millet-A possible source of human nourishment and health. *Advances in Nutrition and Food science*, *8*(1), 17-25.

[2] Tripathi, T., & Vyas, S. (2023). From ancient grains to modern solutions: A history of millets and their significance in agriculture and food security. *Int. J. Home Sci*, *9*, 72-78.

[3] Tiwari, H., Naresh, R. K., Kumar, L., Kataria, S. K., Tewari, S., Saini, A., ... & Asati, R. (2022). Millets for food and nutritional security for small and marginal farmers of North West India in the Context of Climate Change: A Review. *International Journal of Plant & Soil Science*, *34*(23), 1694-1705.

[4] Balasubramani.V, A. S. (2020). The Processing of Millet Spread Incorporting Finger Millet and Pearl . International Journal of Research Publication and Reviews, 6.

[5] Thapliyal, V., & Singh, K. (2015). Finger millet: potential millet for food security and power house of nutrients. International or Research in Agriculture and Forestry, 2(2).

[6] R.V. Jaybhaye, I. P. (2014). Processing and Technology for Millet Based Food Products: A Review. JOURNAL OF READY TO EAT FOOD, 17.

[7] Batagarawa, S. M., & Dayo, L. Y. (2017). Millet husk as efficient adsorbent for removal of lead, cadmium, and nickel ions from aqueous solution. *Dutse Journal of Pure and Applied Sciences (DUJOPAS) Vol*, *3*, 337-348.

[8] Kaushik, N., Yadav, P., Khandal, R. K., & Aggarwal, M. (2021). Review of ways to enhance the nutritional properties of millets for their value-addition. *Journal of Food Processing and Preservation*, *45*(6), e15550.

[9] Saleh, A. S., Zhang, Q., Chen, J., & Shen, Q. (2013). Millet grains: nutritional quality, processing, and potential health benefits. *Comprehensive reviews in food science and food safety*, *12*(3), 281-295.

[10] Rai, K. N., Gowda, C. L. L., Reddy, B. V. S., & Sehgal, S. (2008). Adaptation and potential uses of sorghum and pearl millet in alternative and health foods. *Comprehensive Reviews in Food Science and Food Safety*, *7*(4), 320-396.

[11] Lydia Pramitha, J., Ganesan, J., Francis, N., Rajasekharan, R., & Thinakaran, J. (2023). Revitalization of small millets for nutritional and food security by advanced genetics and genomics approaches. *Frontiers in Genetics*, *13*, 1007552.

[12] Modha, H., & Pal, D. (2011). Optimization of Rabadi-like fermented milk beverage using pearl millet. Journal of food science and technology, 48, 190-196.

[13] Disanth, E., Sethukali, A., Varthani, S., Piratheepan, S., & Jayasena, D. D. (2021). Effect of Incorporation of FingerMillet (Eleusine coracana) Flour Concentrate on Proximate Composition, Sensory and Microbial Properties of Functional Butter.

[14] Sehgal, S., Kawatra, A., & Singh, G. (2003). Recent technologies in pearl millet and sorghum processing and food product development. Alternative Uses of Sorghum and Pearl Millet in Asia, 60.

[15] Dias-Martins, A. M., Pessanha, K. L. F., Pacheco, S., Rodrigues, J. A. S., & Carvalho, C. W. P. (2018). Potential use of pearl millet (Pennisetum glaucum (L.) R. Br.) in Brazil: Food security, processing, health benefits and nutritional products. Food research international, 109, 175-186.

[16] Disanth, E., Sethukali, A., Varthani, S., Piratheepan, S., & Jayasena, D. D. (2021). Effect of Incorporation of FingerMillet (Eleusine coracana) Flour Concentrate on Proximate Composition, Sensory and Microbial Properties of Functional Butter.

[17] Rani, S., Singh, R., Sehrawat, R., Kaur, B. P., & Upadhyay, A. (2018).Pearl millet processing: a review. Nutrition & Food Science, 48(1), 30-44.

[18] Ushakumari, S. R., Rastogi, N. K., & Malleshi, N. G. (2007)Optimization of process variables for the preparation of expanded finger millet using response surface methodology. Journal of Food Engineering, 82(1), 35-42.

[19] Singh, P., & Raghuvanshi, R. S. (2012). Finger millet for food andnutritional security. African Journal of Food Science, 6(4), 77-84.

[20] Rathore, T., Singh, R., Kamble, D. B., Upadhyay, A., & Thangalakshmi, S. (2019). Review on finger millet: Processing and value addition. The Pharma Innovation Journal, 8(4), 283-291.

[21] Tiwari, A., Jha, S. K., Pal, R. K., Sethi, S., & Krishan, J. (2014). Effect of pre‐milling treatments on storage stability of pearl millet flour. Journal of Food Processing and Preservation, 38(3), 1215-1223.

[22] Joshi, T. J., Singh, S. M., & Rao, P. S. (2023). Novel thermal and non-thermal millet processing technologies: advances and research trends. European Food Research and Technology, 249(5), 1149-1160.

[23] Chandrasekara, A., Naczk, M., & Shahidi, F. (2012). Effect of processing on the antioxidant activity of millet grains. Food Chemistry, 133(1), 1-9.

[24] Wang, R., Chen, C., & Guo, S. (2017). Effects of drying methods on starch crystallinity of gelatinized foxtail millet (α-millet) and its eating quality. Journal of Food Engineering, 207, 81-89.

[25] Bhuvaneshwari, G., Nirmalakumari, A., & Kalaiselvi, S. (2020). Impact of soaking, sprouting on antioxidant and anti-nutritional factors in milletgrains. J Phytol, 12, 62-66.

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Incorporation of Herbs in Edible Cutlery

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Abstract—**Cutlery manufactured from edible plant materials that are frequently infused with herbs is referred to as herbal edible cutlery. The purpose of these utensils is to provide a sustainable substitute for conventional single-use plastic and even hardwood cutlery. The concept is to produce edible and biodegradable cutlery to cut down on waste and encourage sustainability. Flours made from wheat, rice, or millet are frequently utilized, and herbs are added for flavour and potential health advantages. Sorghum flour and other starch compounds are employed to give the edible cutlery structure and durability. These cutleries can be used for meals, and after use, they can be consumed or allowed to break down organically. With its blend of Tulasi, Bermuda grass, and Moringa leaf powder, our herbal edible cutlery offers a sustainable and nutritious alternative to traditional disposable utensils.Vitamins and antioxidants are contributed by moringa, which is well-known for its high nutrient content. Holy basil, or Tulasi, contributes flavour and therapeutic qualities, and powdered Bermuda grass adds a distinctive element that may have health advantages. The addition of these powders not only improves the nutritional profile but also adds unique flavours These cutlery items aim to reduce their environmental footprint in addition to being biodegradable, all the while offering a unique and enjoyable dining experience.These herbal edible utensils combine utility with a conscientious attitude to eating, perhaps promoting health and well-being in addition to their environmentally aware design. Innovative solutions that promote personal wellbeing and environmental sustainability are a step in the right direction toward a more environmentally conscious and health-conscious future.**

Keywords— edible cutlery, herbs, starch, sustainable development, waste management, dietary supplement

I. INTRODUCTION

In recent years, there was a rise in plastic output. Food (packing and vendor commerce) and hospitality (restaurants and cafes) are the industries that plastic companies strive in. The over use of plastic is a catastrophe for the environment because only 9% of it is recycled.The existence of plastic polymers in the environment leads to defragmentation since many of the plastics that are currently in use do not disintegrate into smaller pieces and particles Numerous alternatives have entered our lives as a result of the growing knowledge of the negative impacts of single-use plastics and their increasing use. Therefore, there is an urgent need for creative inventions that can solve this environmental catastrophe, and our study on edible cutlery focuses in part on that.In addition to being tasty and wholesome, edible cutlery is the solution to the environmental problem in the plastic world, where the market is growing at a rate of thirty percent and filling landfills with non-recyclable waste.Edible cutlery is a revolutionary concept which allows food to be consumed along with the cutlery. Therefore, when made from the ideal ratio of food groups, a creation like edible cutlery functions as an additional type of nutrition that enhances both its functionality and palatability.It acts as a functional food by using readily available local ingredients, such as whole wheat flour, salt, water, natural preservatives, binding agents, and herbs like Moringa leaves powder, Tulasi powder, and Bermuda grass powder, which are used in this study. In addition, the inclusion of all the aforementioned components in this study helps to prevent malnutrition and helps in achieving the daily recommended nutritional requirements in a cost-effective way.

New factors that should be considered while creating edible cutlery include functionality, palatability, nutritional profile, cost-effectiveness and nutraceutical profile, that may be of concern when making edible cutlery. Since plastic cutlery is comprised of chemicals, it can be harmful to both people and the environment. Therefore, the current study aims to lessen the gap between malnutrition andrecommended dietary intake by the concept of edible cutlery. To minimize plastic waste generated from disposable cutlery and to enrich the nutritional content, Edible cutleries are created.

II. REVIEW OF LITERATURE

A. Wheat flour

Locally available wheat flour is purchased from the market. Wheat flour, especially whole wheat flour, is a good source of essential nutrients. Along with fiber, which supports a healthy digestive system, it also contains iron and B vitamins, among other vitamins and minerals. Whole wheat flour has the potential to improve heart health and control blood sugar levels. When making edible cutlery, wheat flour is the main component. In addition to giving the dough structure and texture, it may be moulded into a variety of shapes when combined with water and other ingredients. The dough can be baked or dried to produce strong, edible utensils that provide a sustainable substitute for conventional plastic silverware.The inclusion of external grain and germ components has a negative impact on the dough qualities of whole grain-based bread items, even though they have health benefits. [16].

B. Rice flour

An alternative to gluten-containing flour that may be healthier is rice flour. It is a simple food to digest, a healthy energy source, and ideal for people who are intolerant to gluten. In addition, brown rice flour has more nutrientssuch as fibre, vitamins, and mineralsthan white rice flour. Since rice flour affects the final product's texture and structure, it is essential for the production of edible cutlery. It is also a source of starch. Rice flour creates a dough that can be formed into edible utensils when combined with water and other substances. It acts as an alternative for makingenvironmentally friendly and sustainable silverware.When preparing a diet that is both appropriate and preferred by the elderly, rice and rice flour would be good choices [18]. In order to achieve smooth and soft textures in food preparation, flour needs to have a high water-absorbing capacity. The ability of food to absorb oil is correlated with rancidity, which is a key indicator of shelf life [19]. Instead of the more widely used milk and soy proteins, rice proteins are utilized as value-added ingredients in nutritional goods, such as sport nutrition supplements and baby formulae [20].

C. Sorghum flour

Sorghum flour offers several health benefits. Sorghum is the fifth most important traditional crop and main basic food crops, in manydeveloping countries[23].It's a good source of dietary fibre, which helps regulate weight and supports digestive health. Furthermore, sorghum flour has a high antioxidant content, which may offer protection against a number of chronic illnesses. It is appropriate for people with celiac disease or gluten sensitivity because it is gluten-free. Additionally, sorghum flour contributes to general nutritional well-being by containing important elements including iron, magnesium, and B vitamins. Because of its high starch concentration, it can aid in the dough's binding and structure, which keeps the edible cutlery together. Sorghum flour gives the cutlery a distinctive flavour profile and is gluten-free, making it acceptable for anyone with dietary sensitivity. Sorghum is also a drought-resistant grain, which makes it a sustainable option for producing environmentally acceptable substitutes for conventional plastic utensils. Sorghum has been gaining popularity because it is devoid of gluten and novel hybrids that are suitable for human eating have been developed. Sorghum is becoming more and more popular as a wheat allergy sufferer's attractive substitute in snack meals and baked goods[24].

D. Moringa leaf powder

Moringa leaves have numerous health advantages and acts as a nutritional powerhouse. Along with minerals like calcium and potassium, they are full of vitamins, including vitamins A, C, and E. Rich in antioxidants, moringa can help to shield cells from the harm that free radicals do. The leaves may help decrease cholesterol and blood sugar levels and also contain anti-inflammatory chemicals. Moringa leaves can be a beneficial addition to your diet to enhance general health. Because they contribute nutritional value and possible health advantages, moringa leaves can be used in edible herbal cutlery. The combination used to make edible cutlery can have its nutritional value increased by adding moringa leaf powder.Malnutrition has been treated with moringa tree leaves, especially in small children and nursing moms. A single rounded tablespoon (8 g) of leaf powder provides nearly all of the vitamins, 40% of the calcium, 23% of the iron, and 14% of the protein that the body needs[5].Moringa's antioxidant and anti-inflammatory characteristics may provide extra health benefits, making the cutlery both environmentally friendly and nutritious.

E. Tulasi leaf powder

Tulsi, or holy basil, is associated with various health benefits. Its leaves contain essential oils and phytochemicals with antimicrobial and anti-inflammatory properties. The adaptogenic qualities of tulasi are well known for assisting the body in adjusting to stress. It might strengthen the immune system, promote respiratory health, and facilitate digestion.Incorporating Tulsi leaves into your diet or as herbal infusions can be a way to harness its potential health benefits. The inclusion of Tulasi (holy basil) leaves in edible herbal cutlery can add both flavor and potential health benefits. Tulasi leaves, known for their antimicrobial and anti-inflammatory properties, could enhance the overall profile of the cutlery. Additionally, they might impart a unique herbal essence to the cutlery, making it a more sensory and potentially therapeutic experience when used for eating. Several bioactive secondary metabolites found in Tulasi work alone or in concert to block inflammatory pathways. Additionally, there is data that suggests Tulsi may help treat metabolic problems in addition to pharmacotherapy and diet, which could lessen the need for high dosages of potentially harmful medications.[8].

F. Bermuda grass powder

Cynodon dactylon, popularly known as Bermuda grass, is a traditional herbal medicine with possible health benefits. It contains essential micronutrients such as calcium and iron and minerals such vitamins A and C. Bermuda grass has antioxidant and anti-inflammatory qualities and is utilized in certain cultures to treat digestive and respiratory disorders. Using Bermuda grass powder in herbal cutlery can increase nutritional value and offer potential health advantages. Bermuda grass is high in vitamins and minerals, which can improve the nutrient profile of flatware. Its antioxidant and anti-inflammatory characteristics may provide further health benefits.For centuries, Indian herbalists have been using C.dactylon (Bermuda grass) as an oral supplementation for many ailments like mucus, fevers, diarrhoea, diabetes, bleeding, cardiac arrhythmia andulcer [26].

III. METHODOLOGY

A. MATERIAL SELECTION

The selected ingredients used in the preparation of the edible cutlery are whole wheat flour, moringa leaf powder, thulasi leaf

powder, Bermuda grass powder, sorghum flour,rice flour was selectively procured from the local markets.

B. SAMPLE PREPARATION

Flour such as sorghum flour,whole wheat flour and rice flour and herbs such as Moringa leaves, Tulasi leaves and Bermuda grass are purchased from the market, and checked for its quality. Thereafter, it is sun-dried for a day within a mesh fabric cover. They are ground into a fine powder. Next, specific amounts of whole wheat flour were weighed out for every variant.

C. PREPARATION OF MORINGA LEAF POWDER:

Usually, drying and crushing moringa leaves into a fine powder is how moringa leaf powder is manufactured. Selecting healthy moringa leaves from mature trees is the first step in making moringa leaf powder. Thoroughly wash the leaves to get rid of any pollutants or debris. Let them air-dry in a shady spot to avoid losing any nutrients.Before proceeding to the following stage, make sure the leaves are totally dry. Since the stems of the dried leaves can be rough and may not grind smoothly, remove them. To make a fine powder out of the leaves, use a food processor or a clean, dry grinder. For improved usability, a smooth consistency must be achieved. To preserve the nutritious value of the moringa powder, keep it sealed and out of direct sunlight and moisture. The nutritious value of the leaves is preserved during this method. Rich in vitamins, minerals, and antioxidants, it may help with better energy, immune system performance, and general well-being, among other health benefits.Moisture is quickly absorbed by moringa leaf powder, and the product may reabsorb it during or after grinding. For this reason, in order to lower the moisture content, moringa leaf powder should be dried for 30 minutes at 50 degrees Celsius. Powder that has been stored will deteriorate and lose some of its nutrients if it is exposed to heat or light. Under the following circumstances, moringa leaf powder can be kept for up to six months: Pure, dehydrated powder kept below 24°C (75.2 °F) in airtight receptacles shielded from light and moisture[5].

D. PREPARATION OF TULASI LEAF POWDER:

To make Tulsi (Holy Basil) leaf powder firstly select fresh and healthy Tulsi leaves from the plant. Wash the leaves thoroughly to remove any impurities. Air-dry the leaves in a shaded area until they are completely dry. This helps preserve their nutritional content. Remove the stems from the dried leaves. Use a clean and dry grinder to finely grind the Tulsi leaves into a powder. Store the Tulsi leaf powder in an airtight container, away from sunlight and moisture. Health benefits of Tulsi leaf powder include its potential as an adaptive, helping the body cope with stress. It also has antimicrobial properties, supports respiratory health, and may have anti-inflammatory effects.

E. PREPARATION OF BERMUDA GRASS POWDER:

Bermuda grass, also known as Cynodon dactylon or Durva grass, is used in traditional medicine for its potential health benefits. Processing Bermuda grass into powder involves several steps: Choose fresh and healthy Bermuda grass, ensuring it's free from contaminants. Wash the grass thoroughly to remove any impurities. Air-dry the grass in a shaded area until it is completely dry. This can be done by spreading the grass in a thin layer. Use a clean, dry grinder or mortar and pestle to grind the dried Bermuda grass into a fine powder. Ensure a consistent and smooth texture. Store the Bermuda grass powder in an airtight container, away from sunlight and moisture, to preserve its quality. Bermuda grass haveantioxidant, anti-inflammatory and diuretic effects.

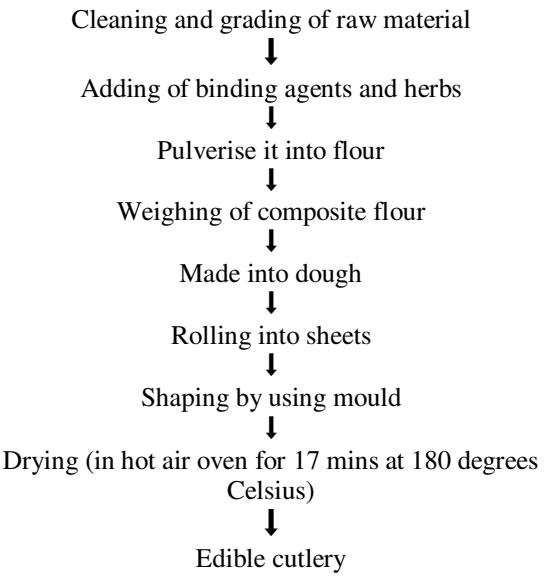
F. DOUGH MAKING

The ingredients are ready to be combined and worked into a dough once they have all been processed. The ratio required determines which percentage of substances to use. After the materials were ground into a fine powder and sieved to create a homogenous powder, wet ingredients like oil and water were added. The dough was then well kneaded after adding water, one teaspoon at a time. Once the water was incorporated, the dough with added value was prepared.

G. EDIBLE CUTLERY MAKING

Using a rolling pin, each was separately rolled out into a 2 mm sheet. The cutlery moulding machine is then used to form the edible cutlery. To maximize its functionality, a drop of vegetable oil (rice bran oil) is applied on the dough cutlery after it has been formed. To guarantee adequate sturdiness and overall cooking, tiny holes are pierced into them. An experimental temperature of 150°C was used to preheat the oven for about Ten minutes. To guarantee correct heating and browning, the moulded cutlery is then placed inside the preheated oven and baked for 17 minutes at 180°C. After baking, they are allowed to come down to room temperature before being kept. They are then transferred into airtight container and kept in a cold, dark place until they are evaluated.

H. FLOWCHART



IV. CONCLUSION

Thecreation of edible herbal cutlery from a composite collection of components resulted in a creative solution to the dietary and environmental challenges that modern society faces. Its equimolar proportion of whole wheat flour and herbs, when combined with the other ingredients, demonstrated the highest degree of structural, sensory, and functional stability, making it the optimal option. It is therefore advised that this edible cutlery be successfully promoted, commercialized, and advertised in order to raise their level of public acceptance. Its impact on our environment, health, and nutritional status should be made more widely known. It is observed that incorporation of edible starch with Moringa leave powder, Tulasi leaf powder, Bermuda grass powder and Wheat flour in the production of edible Cutlery is been nutritionally and sensorily superior in most quality attributes.

REFERENCES

[1] Iqbal B, Raza R, Khan N, Siddiqui KA.” Bio-friendly edible cutlery-an effective alternative to plastic disposable cutlery.” J Res (Science). 2022 Apr

[2] Roy TR, Morya S. Edible cutlery: “An eco-friendly replacement for plastic cutlery”. Journal of Applied and Natural Science. 2022 Sep

[3] Natarajan N, Vasudevan M, Vivek Velusamy V, Selvaraj M.” Eco-friendly and edible waste cutlery for sustainable environment”. International Journal of Engineering and Advanced Technology. 2019 Dec.

[4] Singh Y, Prasad K.” Moringa oleifera leaf as functional food powder”. Charact. Uses. 2013.

[5] Mishra SP, Singh P, Singh S.” Processing of Moringa oleifera leaves for human consumption”. Bulletin of Environment, Pharmacology and life sciences. 2012 Dec

[6] Devisetti R, Sreerama YN, Bhattacharya S. “Processing effects on bioactive components and functional properties of moringa leaves: development of a snack and quality evaluation”. Journal of food science and technology. 2016 Jan

[7] Mondal S, Mirdha BR, Mahapatra SC. “The science behind sacredness of Tulsi (Ocimum sanctum Linn.)”. Indian J Physiol Pharmacol. 2009 Oct

[8] Jamshidi N, Cohen MM. “The clinical efficacy and safety of Tulsi in humans: a systematic review of the literature.” Evidence-Based Complementary and Alternative Medicine. 2017 Mar

[9] Cohen MM.” Tulsi - Ocimum sanctum: A herb for all reasons” J Ayurveda Integr Med. 2014 Oct-Dec5

[10] Sowmya Binu ‘Bermuda grass: incredible health benefits’ 2021 Aug

[11] “Bakey’s edible cutlery allows you to eat with them, then gobble them up” The Hindu 2018 Jul1

[12] Kim Grundy, PT , “What Foods Are Binders?,” December 20, 2019.

[13] Shabaana, M., T. Fahima Firdouse, and P. Hema Prabha. "Development and Quality Evaluation of Eco Friendly Moringa Oleifera Leave Powder Incorporated Edible Cutlery." International Journal of Advances in Engineering and Management 3.3 (2021): 160-166.

[14] Rajendran, Sorna Prema, et al. "Optimization of composition for preparation of edible cutlery using response surface methodology (RSM)." AIP Conference Proceedings. Vol. 2240. No. 1. AIP Publishing, 2020.

[15] Atwell, William A., and Sean Finnie. Wheat flour. Elsevier, 2016.

[16] Boita, Elis RF, et al. "Rheological properties of wheat flour dough and pan bread with wheat bran." Journal of Cereal Science 71 (2016): 177-182.

[17] Deora, Navneet Singh. "Whole wheat flour stability: An insight." Acta scientific nutritional health 2.3 (2018): 8-18.

[18] Matsuda, Tsukasa. "Rice flour: A promising food material for nutrition and global health." Journal of nutritional science and vitaminology 65.Supplement (2019): S13-S17.

[19] Kraithong, Supaluck, Suyong Lee, and Saroat Rawdkuen. "Physicochemical and functional properties of organic rice flour." Journal of Cereal Science 79 (2018): 259-266.

[20] Amagliani, Luca, et al. "Composition and protein profile analysis of rice protein ingredients." Journal of Food Composition and Analysis 59 (2017): 18-26.

[21] Araki, Etsuko, et al. "Characteristics of rice flour suitable for the production of rice flour containing gluten and methods of reducing the cost of producing rice flour." Japan Agricultural Research Quarterly: JARQ 50.1 (2016): 23-31.

[22] Kabir, Mohd Hafizalrisman, and Nuramidah Hamidon. "A study of edible cutleries by using sorghum flour." Progress in Engineering Application and Technology 2.1 (2021): 292-300.

[23] Siminiuc, Rodica, and Dinu Ţurcanu. "Physico-Chemical and Nutritional Characteristics of Soriz Flour (Sorghum Oryzoidum)." Global Journals of Research in Engineering 21 (2021): 1-8.

[24] Marston, Kathryn, Hanna Khouryieh, and Fadi Aramouni. "Effect of heat treatment of sorghum flour on the functional properties of gluten-free bread and cake." LWT-Food Science and Technology 65 (2016): 637-644.

[25] Krishita Mukherjee,Arivuchudar Raju "Edible Cutlery - A prototype to combat malnutrition and plastic waste management". Asian Journal of biological and life sciences. 2023 Mar.

[26] Nalanagula, Manoj. "Cynodon dactylon against SARS-CoV-2 (COVID-19): exploratory considerations for quick-fix pandemic speed." 2020.

Sanitation Techniques in Dairy Industry-A Study

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Abstract—***This review explores contemporary sanitation techniques employed in the dairy industry to ensure product quality and safety. It delves into methods such as brushing systems, UV radiation, and chemical disinfection. The study examines their efficacy in mitigating bacterial contamination and maintaining hygienic processing environments. Additionally, it considers the industry's evolving regulatory landscape and the integration of technology for enhanced sanitation practices in dairy production where it focuses on advancements being done based on automation having UV (Ultraviolet) radiation for floor sanitation in Dairy Industries, that is being embedded in an Automatic UV Bot machine. This machine would facilitate user friendly action and surveillance for the entire cleaning process.***

Keywords—sanitation, dairy industry, uv radiation, user friendly, automation.

I. INTRODUCTION

There has been quick development of clean room innovation within the last two decades, especially within the food industry and the pharmaceutical industry with the objectives of killing tidy, particulate, and microbial contamination . In recent years, robotic cleaners have taken major attention in robotic research due to their effectiveness in assisting humans in floor cleaning applications [1].The expanding customer request for made strides item quality and extension of shelf life has driven different food businesses to assess clean room innovation, particularly those strategies pointed at control of microbial defilement. Areas and equipment that are in contact with milk and dairy products must be cleaned regularly to maintain hygiene standards. Furthermore, sanitizing must be carried out frequently. The relevant regulatory authority normally defines specific cleaning requirements [2].Floor cleaning is mainly of two types- dry cleaning and wet cleaning. In dry cleaning, which mainly involves removal of dust and fine substance and in wet surface cleaning consists of a sanitizer with water and other floor sanitizer to clean the floor of waste waters. Before the creation of the industrial revolution people blanketed their carpets/floor by means of covering them with drug gets or thick, heavy woolen items. Drugs get included in opposition to spill sand other stains [3]. Traditionally the floor is cleaned with the assistance of a mop or wet mop using the hand as a possible tool, they need to clean hard on the surface[4].The cleaning includes cleaning of varied surfaces, basically cement floors, highly polished wooden or marble floors. Among these floors the rough surface floor like cement floor, mostly present in semi urban areas, is covered with a lot of dust which needs longer for cleaning [4]. The residue accumulated on cold surfaces is mostly cleaned with alkaline and at times with acid solutions. The cleaning protocol includes rinsing the entire processing room, including walls and floors. If we clean the floor manually then there is a possibility that the operator will leave some portion of the floor. Also due to manual labor involved this is time consuming and irritating to clean the floor. Also in big offices the floor area is very huge and the people involved there for cleaning purposes cannot clean it much more efficiently [5].

Automatic floor cleaner is a compact robotics system which provides floor cleaning service in rooms and big offices reducing human labor[3].A robotics generally an electro-mechanical machine that can perform tasks automatically. The surveillance system is one which is used for the purpose of security in intruded areas[6]. Basically as a robot it eliminates human error and provides cleaning activity with much more efficiency[5].Cleaner machines are divided into their cleaning processes like floor mopping, vacuum cleaning, etc [3].

This study emphasizes the advancements required in sanitation strategies in such a way that the computerization of the method would dispose of the chance of human blunders and keep up tall cleanliness measures. Autonomous robot for floor cleaning application reduces much time in lifestyle [4]. An autonomous vacuum cleaner robot able to randomly navigate through a room or a house with the minimum human assistance, the following specifications were found ,i.e, obstacle avoidance, floor detection, collision detection, light sensing, real time clock and system with automation [7].

It performs sweeping and mopping tasks at a time, it also does obstacle detection, and also has automatic water spray [4]. An Automated UV Robot is being designed for efficient

floor cleaning in Dairy Industries .UV-C sanitation has been around since 1892 when Marshall Ward demonstrated that UV-C light killed bacteria [3]. Of the three types of UV light, UV-C light is the most effective in killing bacteria. UV-C utilizes short-wavelength ultraviolet radiation that is harmful to microorganisms [8].Moreover it incorporates a web cam, a 360 degree camera, mounted at the beat of the robot. The webcam that is being used is a camera which feeds its images in real time to a computer or computer network, often via USB. Other than that, with this webcam the project is better because as a security surveillance and there are also uses on sites like video broadcasting services and for recording social videos[9].Firstly,withone360 degree camera at the center of the scene, it is possible to sense the surrounding environment. This choice limits blind spots, common in standard multi-camera systems [10]. This surveillance robot is equipped with a LiDAR sensor for the autonomous navigation along with an option for manual override. The LiDAR sensor gives out light waves in 360 degrees and the light which is bounced back from the objects is used by the sensor to track its path and the robot moves accordingly[11]. The robot is specially built on the use of modernized technology. It has all the features that are required for a floor cleaner [4].

OBJECTIVES

The objectives of floor sanitation in the dairy industry include

- preventing contamination of milk and dairy by products
- To maintain hygiene standards is a main aim of dairy industries
- To minimize the risk of bacterial growth and ensure a clean environment to comply with regulatory equipments.
- Proper floor sanitation helps safeguard product quality and consumer health.
- To avoid human errors in the practice of floor sanitation which could highly contribute to the contamination of Dairy products.
- To assist in extending the shelf life of dairy products by minimizing the microbial load during processing and packaging.
- UV sanitation offers an energy-efficient and chemical-free method for microbial control compared to traditional methods like chemical disinfectants.
- It aligns with sustainable and environmentally friendly practices, reducing the reliance on chemical agents that may have negative environmental impacts.
- Thorough cleaning and sanitization of floors and surfaces for each batch of production and processing is very important to remove the dirt, impurities, residues, and other harmful material that could hamper the products.
- UV sanitation systems can be integrated into automated processes, contributing to operational efficiency by providing continuous and effective microbial control without significant manual intervention.

II. REVIEW OF LITERATURE

The existing techniques for floor sanitation of dairy industries widely follow a manual or semi-automatic process of cleaning with a sequential step of dry and wet cleaning. It has been a constant track of sanitation which has both pros and cons[1]. Areas and equipment that are in contact with milk and dairy products must be cleaned regularly to maintain hygiene standards[2]. In dry cleaning, which mainly involves removal of dust and fine substance and in wet surface cleaning consists of the use of sanitizer with water and other floor sanitizers to clean the floor[3]. The rough surface floor like cement floors are covered with a lot of dust which needs longer for cleaning. For saving the time the necessity was of the Cleaning Robot, which is an automatic system that works and cleans on its own without human control/intervention [4]. Automatic floor cleaner is a compact robotics system which provides floor cleaning service in rooms and big offices reducing human labor. Basically as a robot it eliminates human error and provides cleaning activity with much more efficiency. In industries the robot is very cost effective as compared to manual labor involved. The flexibility, time saving and efficiency make the robot a clean choice for cleaning the floor[5]. It performs sweeping and mopping tasks at a time, it also does obstacle detection, and also has automatic water spray. The ultrasonic sensor is connected with the servomotor, which helps within the rotation of the ultrasonic sensor. The ultrasonic sensor measures the space between the robot and therefore the obstacle ahead of it. Scan the obstacles ahead of the robot and to avoid collision when the robot is in motion. The moping operation will be started or stopped at any point of your time as per the need [4]. A new surveillance system for indoor surveillance is developed where it can be wirelessly controlled by a mobile phone. A mobile application has been developed that interfaces smart phones with the security system over Wi-Fi (Wireless Fidelity) network. The Wi-Fi technology is relatively new as compared to other technologies and there is huge growth in practical applications[6]. An autonomous cleaner robot able to randomly navigate through a room or a house with the minimum human assistance, the following specifications were found ,i.e, obstacle avoidance, floor detection, collision detection, real time clock and system with automation[7].An Automated UV Robotics being designed for efficient floorcleaning in Dairy Industries. UV-C sanitation has been around since 1892 when Marshall Ward demonstrated that UV-C light killed bacteria[3]. of the three types of UV light, UV-C light is the most effective in killing bacteria. UV-C utilizes short-wavelength ultraviolet radiation that is harmful to microorganisms[8]. It also has an Automatic water spraying system[4]. Cleaning agents can be a mixture of several chemical agents employed for a particular function to perform like washing of floors and walls etc[12]. Moreover it incorporates a web cam, a 360 degree camera, mounted at the beat of the robot. The webcam that has been used is a camera which feeds its images in real time to a computer or computer network. With this webcam the project is much better because as a security surveillance and there are also uses on sites like video broadcasting services and for recording social videos[9].Firstly,withone360-degree camera at the center of the scene, it is possible to sense the surrounding environment. This choice limits blind spots, common in standard multi-camera systems[10]. The LiDAR sensor gives out light waves in 360 degrees and the light which is bounced back from the objects is used by the sensor to track its path and the robot moves accordingly[11]. The robot is specially built on the use of modernized technology. It has all the features that are

required for a floor cleaner[4]

III. METHODS AND METHODOLOGY

Safe milk and milk products can only be produced through the applicability and maintenance of efficient cleaning, sanitation and hygiene practices [12]. Existing Common methods for dairy floor sanitation includes

1. Physical cleanliness – involves the elimination of any visible dirt from a surface that has been cleaned.
2. Chemical cleanliness – refers to the elimination of both visible and microscopic residues that cannot be seen with the naked eye but can only be detected by taste or smell.
3. Bacteriological cleanliness – attained by disinfection
4. Sterile cleanliness – process of destruction of all microorganisms [12].

STEPS TAKEN FOR CLEANLINESS

- Regular cleaning with detergents
- Disinfection using approved sanitizers
- implementing a robust drainage system to prevent water accumulation.
- To prevent water accumulation is important as it paves way for increased bacterial growth.
- Additionally, steam cleaning and pressure washing are effective for thorough cleaning. Regular inspections and adherence to industry regulations further ensure proper floor sanitation [12].

□ FLOWCHART

Identification of process flow

↓

Dry floor clean-up

↓

Pre-rinsing(moderate pressure)

↓

Soap in hand scrubbing

↓

Post-rinsing (low pressure)

↓

Dry clean-up

Fig.1.Process of existing Dairy floor sanitation technique.

A. All cleaning activities must be organized, labeled, and recorded as part of the cleaning procedure. Establish the timing, frequency, and sequence for completing cleaning tasks.

B. Start the cleaning procedure by performing the"dry floor clean-up," which involves getting rid of any remaining supplies, trash, and tools that were potentially used during the production process. Clean the floor and remove any leftover debris from the production process.

C. Clean the entire space, including the walls and floors, by rinsing it thoroughly. It's important to consider that using a high-pressure hose for rinsing could create spray aerosols that may carry microorganisms and contaminate other equipment surfaces

D. At this stage, it is important to remove any visible soil from the surfaces. First, clean the walls and floors with soap and a scrubbing brush, and then proceed to clean the equipment

E. Post-rinse using low pressure and low-volume water. Rinse walls and floors by spraying and splashing on the surfaces that have been soaped and scrubbed. Cleaning should cover conveyors, shields, and other additional equipment.

F. The floor that has been cleaned with water is then dried completely to meet hygiene standards and to prevent the growth of environmental pathogens in the important and high-risk areas of our food operations.

NOVEL TECHNOLOGY AND ADVANCEMENTS

Techniques for floor cleansing in the dairy industry are evolving. The UV radiation sanitation principle is being applied to improve sanitation methods. "Dairy Factotum" is its name, which translates to "all-rounder."

This equipment is an automated liquid duster, rotates and moves in a 360° circle while effectively cleaning floors with water. The UV radiation strip is used in its construction, and this machine functions on that premise. The Arduino microcontroller, which has been coded using the C++ programming language with certain changes, and the Raspberry Pi are used to automate this machine. The machine as a handle made of recyclable plastic linked toit, and a 360° webcam installed on it for overall super vision and monitoring the machine direction, obstacle detection and machine movement. The user's smart phone or the surveillance system is linked to the UV strip with the webcam using Bluetooth or Wi-Fi.

A. **Arduino UNO**: Arduino is a key component of automation. It serves as the machine's brain. A voltageof3.3voltsisneeded. It containsa16MHz crystal oscillator, 12 analog output pins, 4 UARTs (Universal Asynchronous Reception and Transmission), 54 digital input/output pins, a reset button, a power jack, an ICSP header, and a USB port [3].

B. **Bluetooth Module**: We are employing a Bluetooth device to enable communication between the robot and the mobile phone. The equipment that receives data from the mobile device is connected to the Bluetooth device (HC-06), which has the ability to transferdata.Itchangestheserialport into Bluetooth [3].

C. **UV Strip**: UV surface disinfection stops thegrowth of bacteria and fungi and eliminates germs. The type of material to be sterilized will determine the UV surface disinfection method. Thishas to do with the surface's roughness as well as the kind of germ (like bacteria coli and its stains). Only when the bacteria see the UVC can there be a disinfection. We utilize the UV LED strip for UV sterilization. This strip is fastened to the machine's back after the floor has been mopped. UV strips finish the UV sterilization procedure [3].

D. **Sensors:**

Ultrasonic Sensor- This device uses a small, ultrasonic sensor to measure distances between two and four meters. For any robotic utility or other effort requiring accurate ranging information, this ranger is the best. You can currently connect this sensor to your microcontroller's digital input/output lines[3].

IR Sensor- There are two eyes on the infrared sensor. The infrared light is sent by the first eye, and its reflection is caught by the second. It calculates the distance and sends it to Arduino via analog input so that it can be used to drive other activities. The machine direction, obstacle detection, and floor sanitation level will all be visible to the user[3].

- FLOWCHART

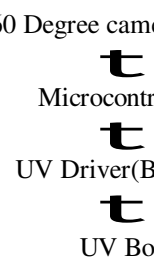


Fig.2.ModelflowchartofDairyFactotum

IV. CONCLUSION

This review highlights the importance of sanitation in the dairy industry for ensuring product quality and safety. The discussion starts with various contemporary techniques such as brushing systems, UV radiation, and chemical disinfection that have been used in the dairy industry, emphasizing their efficacy in mitigating bacterial contamination and maintaining hygienic processing environments. Continuing with the consideration of the industry's evolving regulatory landscape and the need for integration of technology, led to the development of the Automatic UV Bot machine. It represents a significant advancement in automation, easy access, and effective sanitation practices. As this machine uses AI and IoT, it is designed to provide user-friendly operation, 360-degree wireless navigation, and live surveillance, enhancing the overall cleaning process in dairy production. This project is currently in progress, nearing completion, and will soon be updated.

REFERENCES

[1] Prof.Dr. Witold Paluszyński Faculty of Electronics, Wroclaw University of Technology, “Floor Cleaning Robot Embedded Robotics)” issue: 29th Jan 2019,(Geo Babu , Mishal Ghayam)

[2] COWI Consulting Engineers and Planners. COWI consult UNEP Division of Technology, Industry and Economics; Denmark, “Cleaner production assessment in dairy processing”.

[3] Prof. Rupali Shinde,Prof. Soniya Joshi, Vishwajeet More, Onkar Bobale, Pavan Waghmare, Amar Giram, “Automatic FloorCleanerwithUVDisinfectionSystem”IJARIIE-ISSN(O)-2395-4396, Vol-6 Issue-5 2020

[4] Raveena Ishalavath M,Sandhyashree N,Rakshitha R,Arpitha Shankar, “Design and Development of an Automated Floor Cleaning Robot for Domestic Application” -2020International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181

[5] Rajaranjan Senapati, National Institute of Technology Rourkela, “Automation and Controlling of Automatic Floor Cleaner”

[6] K.Damodhar, B.Vanathi and K.Shanmugam,”A Surveillance Robot For Real Time Monitoring And Capturing Controlled Using Android Mobile” © IDOSI Publications, 2016,Middle-East Journal of Scientific Research 24 (S1): 155-166, 2016

[7] Shah Vatsal. (2015). “Floor Cleaning Robot with Mobile App or Autonomous”. 10.13140/RG.2.1.4565.9288

[8] Levi Nicolai, Bryan Burns, Marcy Vanderbei, “Automated Flat Surface UV Sanitizer”

[9] M. A. Meor Said, M.A.Othman, M.M.Ismail, H.A.Sulaiman, M.H.Misran,Z.A.MohdYusof“Wireless Controlled Omnidirectional Monitoring Robot With Video Support” International Journal of Engineering Research and Applications(IJERA)ISSN:2248-9622,Vol.2,Issue4, July-august2012,pp.2228-2232

[10] Liliana Lo Presti, Giuseppe Mazzola, Marco La Cascia “Activity Monitoring Made Easier by Smart 360-degree Cameras”

[11] Karthik Hebbar M, Skandapriya B N, Suhas Amarnath, Tejas CB, Nagesh Kumar D N, “Implementation of Smart Autonomous Surveillance Robotic Vehicle”JETIR June 2021, Volume8, Issue 6 (ISSN-2349-5162).

[12] Dr. Ganga Sahay Meena, “Cleaning, Sanitation & Hygiene Maintenance of DairyProcessingEquipment”, NationalDairy Research Institute, Haryana

A Review on Ash Gourd Peel Tutti Frutti Enlivened with *Cockcomb Cristata* Flower Color Extract

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***ABSTRACT*-As there is a growing demand for eco-friendly and non-toxic food colorants, the colors obtained from plant sources have proven to be an alternative to the synthetic food color ..An experiment was conducted to study the effect of addition of Celosia cristata flower color on the tutti frutti made from peel of ash guard pumpkin. Different levels (0.25–1%) of C. cristata extract rich in betalains were used as natural colorant in the tutti frutti extracted from peel of ash guard pumpkin. Experiments were conducted usingsingle-factor experiment design where only one factor was varied at a time keeping other factors constant. This abstract delves into the innovative process of crafting tutti frutti from the peel of the ash gourd, enriched with the infusion of cockscomb Cristata flower color. Combining culinary expertise with botanical ingenuity, this study showcases a sustainable approach to transforming overlooked agricultural byproducts into vibrant, flavour fuldelicacies. The methodology involves extracting the vibrant hues of cockscomb Cristata flowers and infusing them into the ash gourd peel, harnessing the natural pigments to create a kaleidoscope of colors. Through a series of meticulous steps including extraction, candying, and drying, the once-ignored peel undergoes a metamorphosis, emerging as tantalizing morsels bursting with sweetness and visual allure.The resulting tutti frutti not only tantalizes the palate but also embodies a commitment to sustainability, utilizing every part of the ash gourd in a creative and resourceful manner. Beyond its culinary appeal, this innovative fusion exemplifies the harmonious coalescence of tradition, innovation, and ecological consciousness. As society seeks solutions to minimize waste and embrace sustainable practices, the exploration of tutti frutti made from ash gourd peel induced with cockscomb Cristata flower color offers a compelling avenue for culinary creativity and environmental stewardship. This abstractinvites further exploration and appreciation of the intersection between nature's bounty and gastronomic innovation.**

Keywords: *Betalin, cockscomb, solvent.*

I.INTRODUCTION:

The striking red cockscomb (Celosia cristata.) belongs to the Amaranthaceae family and is loved by numerous as an cosmetic factory grown encyclopedically because of its seductive else colored inflorescences. It's mostly seen in India's Himalayan areas similar as Jammu and Kashmir, Uttarakhand, Northern Uttar Pradesh's (Mumbai) where it's an integral part of Himachal Pradesh and West Bengal regions. The factory is used by original healers to make several traditional medicines and also to give tasteless or odourless gravies a strong red colour. This is because it contains bioactive composites like tannins, phenolics, flavonoids, sterols, kaempferol and quercetin all of which have remedial goods. Betalains are classified into betacyanins and betaxanthins grounded on their structural characteristics and negotiation patterns. They've high coloring capacity, are non-toxic and non-allergenic, and offer colorful health benefits including anti-cancer ,anti-inflammatory and anti-lipidemic, antioxidant, and anti-microbial qualities. Red beet has been employed considerably in the food assiduity as a source of betalain coloring. The reason behind this is that there's no sensible smell and it lends no unwelcome taste or smell on food. This could reduce the goods of synthetic colorings on mortal health due to the increased demand if cutting edge ways and processing parameters were optimized for getting betalain out of new sources similar as C. cristata flower. therefore, herbal excerpt attained from C. cristata can be used as natural coloring color with specified remedial parcels and may open new openings in dairy and food assiduity to develop natural colour grounded functional dairy and food products. thus, the present disquisition was aimed to develop a tutti frutti incorporated with C. cristata excerpt and study the effect of the excerpt on the shelf- life of the developed product. Ash gourd (Benincasa hispida) is cultivated as a vegetable throughout India and in other South East Asian countries, Japan, China and Australia. It has been used in a variety of cookeries and as a traditional

Indian drug. Processing ash gourd generates waste that accounts for 25 of the whole fruit which includes peel, seeds and other corridor generallydiscarded undressed. The peel contributes about 15 of whole fruit. More application of ash gourd peel may give value addition at the patron and consumer situations. Our former studies showed that ash gourd peel is a good source of comestible wax having a implicit operation in shelf life enhancement of fruits. On the base of stem, shape and texture, pumpkins are grouped into Cucurbita maxes, Cucurbita pepo, Cucurbita mixta and Cucurbita moschata. Among the crops of Cucurbitaceae family, pumpkin is a major crop under rubric Cucurbita, conforming of at least 12 different species, including three most prominent are Cucurbita maxes, Cucurbita moschata and Cucurbita pepo. As compared to wild species, the fruits of these generally cultivated kinds are thicker, thick multicolored and containing lower stringy fruit meat. product of pumpkin including squash and gourd in the world exceeded27.6 million tons from an area of2.04 million hectare. We've chosen ash gourd peel to prepare tutti frutti to induce Cockcomb Cristacia flower as an natural food additive. The present study describes the application of Cockcomb Cristata color extract in ash gourd peel. The peel contributes about 15 of whole fruit. More application of ash gourd peel may give value addition at the patron and consumer situations.

II.REVIEW OF LITERATURE:

EXTRACTION OF COLOR FROM COCKCOMB FLOWER

To achieve the objects of the study, experimental work was carried out in the following way Raw Accoutrements and Chemicals Flowers of the indigenous red cultivar of Celosia cristata were attained from a private nursery in Budgam, Kashmir. For experimental studies, the flower petals were detached from the stalks, and the leafage was removed. The seeds and any remaining dirt were also removed by thrashing them. Using the conventional system the Celosia cristata blossoms were dried out. To save the biologically active rudiments, the gutted flowers were shade- dried beneath the roof, forgetting the seeds. To produce a finely pulverized greasepaint, the dried flowers were put through a pounding process. The chemicals and reagents employed in the tests were all of the logical kind. After drying the C. cristata flowers were pulverized in a hammer shop to the size of 1- 2 mm. The dried greasepaint was stored in glass jars till farther processing. Microwave oven supported/ Ultrasound- supported birth of Celosia cristata Flowers duly mixed Celosia cristata flower greasepaint and detergent blend at different liquid-solid rates were exposed to microwave oven radiations of colorful power and time combinations for the birth of Celosia cristata flower excerpt. For ultrasound supported birth, duly mixed Celosia cristata flower greasepaint and detergent blend at different liquid-solid rates were subordinated to ultra-sonication with different power and time combinations for the birth of Celosia cristata flower excerpt. latterly, the results were passed through muslin cloth followed by centrifugation and filtration through sludge paper. For farther disquisition, the supernatant was collected and kept at 4 °C. Single- factor trials were conducted by varying one parameter while keeping other parameters constant at the central position. Effect of Microwave oven birth time on total betalain content It's observed that total betalain content first increased with an increase in microwave oven time from 15 seconds to 45 seconds where it attained peak and upon a farther increase in microwave oven time total betalain content started decreasing., microwave oven treatment increases yield owing to quicker heating rates during microwave oven treatment in comparison to traditional heating and damage tovegetable towel from microwave oven fields. On theother hand, betalains exposure to high temperatures is to condemn for the declining tendency seen at longer birth durations. Betalains are heat- labile colors that suffer rapid-fire declination with adding temperature and heating. The quantification of betalains increased with an increase in power from 160 W to 480 W and latterly dropped slightly from 200 to 240W. Betalains are heat sensitive and converting the color to veritably high microwave oven power led to high thermal treatment which in turn changed its colour intensity.

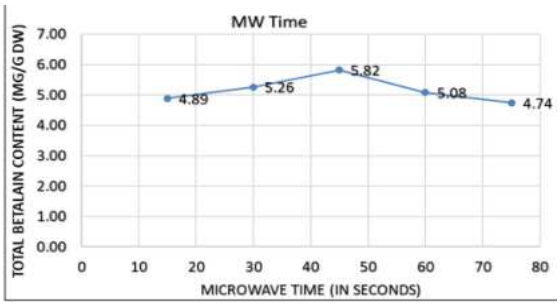


Fig 1: Total Betalinin content measured by microwave time in seconds

SOLVENT EXTRACTION

The CCF was first dried using traditional drying fashion. The gutted flowers banning seeds were hung upside down in bunch and shade dried under the roof so as to retain the biologically active constituents. The dried CCF was subordinated to pulverization to gain finely base greasepaint. This pulverized CCF was uprooted with 70 ethanol (v/ v) at room temperature(27 °C) in dark for 24 hrs. The birth was carried doubly and the combined excerpts were filtered through Whatman No. 1 and centrifuged at 10000 rpm for 15 min. Variables named for the trial were Temperature of (25, 40, 50 °C) & Time (1, 2, 3 h) in case of conventional birth; Power (150, 175, 200,225, 250 W), Time 10 min, 20 min, 30 min, 40 min, Liquid-Solid rate(ml/ g) 10, 20, 30, 40,50. The analysis showed the betalain product for betacyanin ranged from2.98 mg/ g dw to7.02 mg/ g dw. Three different temperatures (20, 40, and 60 o C) and three different detergents(distilled water, 30 ethanol, 50 ethanol) were also used for the birth. Optimum birth conditions for maximizing the total betalin content(17.67 mg/ 100g),

antioxidant exertion(38.54) and color yield(23.98) were temperature of 40 o C using distilled water for an birth period of 2 hours. Betalin content dropped at advanced temperature(60 o C) of birth that depicts the thermal declination of the betalin content. The solid liquid rate taken for birth was 110(w/ v). The performing excerpt was stored at 4 °C until use. birth was conducted by adding 5g of sample and 100 mL of solvent. The excerpt was further dried in hot air roaster to estimate the yield of the color attained.

COLOR EXTRACTION BY WATER SOLVENT METHOD:

I. Preparation:

Harvest fresh cockscomb flowers, ensuring they are clean and free from dirt or debris. Remove any stems or leaves attached to the flowers, focusing solely on the flower heads.

II. Chopping:

Chop the cockscomb flower heads into smaller pieces using a sharp knife or scissors. This increases the surface area and aids in the extraction process.



Fig:2 (Chopped flowers)

III. Boiling:

Fill a stainless steel pot with distilled water, enough to fully submerge the chopped cockscomb flowers. Place the pot on a heat source and bring the water to a gentle boil over medium heat for 10 minutes.



Fig: 3 (Flower being boiled in water)

IV. Steeping:

Once the water reaches a gentle boil, add the chopped cockscomb flowers to the pot. Allow the flowers to steep in the boiling water for approximately 10 minutes to 15 minutes. Stir occasionally to ensure even extraction.



Fig: 4 (Steeped flower)

V. Cooling:

After the steeping period, remove the pot from the heat source and allow the mixture to cool to room temperature. This allows the color compounds to fully diffuse into the water.

VI. Straining:

Place a strainer or a piece of cheesecloth over a clean glass jar or container. Carefully pour the cooled mixture through the strainer to separate the liquid extract from the solid plant material. Press down on the solids to extract as much liquid as possible.



Fig: 5 (Strained liquid from flower)

VII. Storage:

Transfer the strained liquid extract into glass jars or containers with airtight lids. Store the extracted color solution in a cool, dark place to preserve its freshness and potency. Refrigeration may prolong its shelf life.

PREPARATION OF TUTTI FRUTTI BY ASH GOURD PEEL:

I. Preparation:

Wash the ash gourd pumpkin thoroughly to remove any dirt or impurities. Peel the outer skin carefully, ensuring only the greenish-white peel is retained.

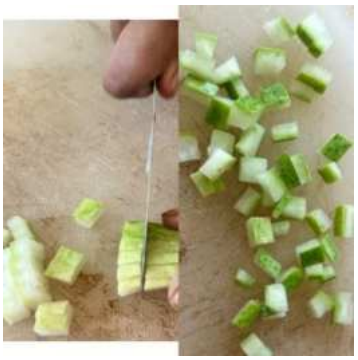


Fig : 6 (Chopped ash gourd pumpkin peel)

II. Boiling the Peel:

Cut the ash gourd pumpkin peel into small, uniform pieces or cubes. Place the peel pieces in a pot and cover them with water, ensuring they are fully submerged. Bring the water to a boil over medium heat and let the peel simmer for about 10-15 minutes until they become slightly tender. This helps to remove any bitterness from the peel.

III. Draining and Cooling:

Once the peel is tender, drain the water using a colander or sieve. Rinse the boiled peel pieces under cold water to stop the cooking process and allow them to cool completely.

IV. Preparing the Sugar Syrup:

In a separate pot, prepare a sugar syrup by combining equal parts water and sugar. For example, for every cup of water, add a cup of sugar.Heat the mixture over medium heat, stirring continuously until the sugar completely dissolves and the syrup begins to thicken slightly. You can add a few drops of food coloring and a dash of vanilla essence at this stage for added flavor and color if desired.

V. Candying the Peel:

Once the sugar syrup is ready, add the cooled ash gourd pumpkin peel pieces to the syrup. Allow the peel to simmer gently in the syrup over low heat for about 15-20 minutes or until they become translucent and absorb the syrup's sweetness. Stir occasionally to ensure even coating.



Fig :7 (Ash gourd peel dipped in sugar syrup)

VI. Cooling and Drying:

Once the peel pieces are candied and translucent, remove them from the syrup using a slotted spoon and transfer them to a wire rack or parchment paper to cool.Let the candied peel pieces dry for a few hours at room temperature or overnight until they are slightly tacky to the touch but not overly sticky.

VII. Storing:

Once the tutti frutti pieces are completely dry, store them in an airtight container or glass jar.

ADDITION OF COCKCOMB CRISTASIA FLOWER EXTRACT INTO THE ASH GOURD PEEL:

Once the color is extracted from cockscombcristasia flower, it is added to the ash gourd peel as a natural food color additive enhancing its texture and color.



Fig :8 (Ash gourd peel pieces induced in Cockcomb cristata flower extract)



Fig :10 (Ash gourd peel dipped in jaggery syrup)



Fig: 9 (Tutti Frutti made from ash gourd peel induced with cockscomb cristata flower color extracted)

III. CONCLUSION

In the pursuit of culinary innovation and sustainable practices, the transformation of ash gourd pumpkin peel into vibrant tutti frutti stands as a testament to the ingenuity of harnessing natural resources. By infusing the extract of

cockscomb Cristasia flower color into this humble ingredient, we embark on a journey that not only tantalizes the taste buds but also celebrates the rich tapestry of colors found in nature.Through a meticulous process of extraction and candying, the once-discarded peel of the ash gourd pumpkin blossoms into a spectrum of hues reminiscent of the cockscomb flower's vivid palette. Each tender morsel, infused with the essence of floral brilliance, promises a burst of sweetness and color in every bite.Beyond the realm of gastronomy, the creation of tutti frutti from ash gourd peel induced with cockscomb Cristasia flower color extract carries deeper implications. It embodies a commitment to sustainability by repurposing overlooked ingredients and minimizing waste. Moreover, it exemplifies a harmonious collaboration between nature and culinary artistry, where innovation flourishes through the fusion of tradition and creativity.As we savor the tantalizing flavors and hues of this homemade delicacy, let us reflect on the boundless possibilities that arise when we embrace the treasures of the natural world. May the journey of crafting tutti frutti from ash gourd peel serve as a reminder of our capacity to unlock the brilliance of nature and inspire future generations to explore, create, and celebrate the abundance that surround us.

IV. REFERRENCES

1. Wen L, Zhang Z, Sun DW, Sivagnanam SP, Tiwari BK. Combination of emerging technologies for the extraction of bioactive compounds. Critical Reviews in Food Science and Nutrition. 2020;60(11):1826-1841.
2. Zimare SB, Mankar GD, Barmukh RB. Optimization of ultrasound-assisted extraction of total phenolics and flavonoids from the leaves of Lobelia nicotianifolia and their radical scavenging potential. Current Research in Green and Sustainable Chemistry. 2021;4:100109.
3. Tabio-García D, Paraguay-Delgado F, Sánchez-Madrigal MÁ, Quintero-Ramos A, Espinoza-Hicks JC, MeléndezPizarro CO, et al. Optimization of the ultrasound-assisted extraction of betalains and polyphenols from Amaranthus hypochondriacus var. Nutrisol. Ultrasonics Sonochemistry. 2021;77:105680.
4. 2. Sayeed R, Thakur M, Gani A. Celosia cristata Linn. flowers as a new source of nutraceuticals-A study on nutritional composition, chemical characterization and invitro antioxidant capacity. Heliyon. 2020, 6(12).
5. Panayampadan, A. S., Alam, M. S., Aslam, R., & Kaur, J. (2022). Vacuum impregnation process and its potential in modifying sensory, physicochemical and nutritive characteristics of food products.
6. Food Engineering Reviews, 1–28. Park, H. R., & Shin, K. S. (2021).
7. Santarelli, V., Neri, L., Moscetti, R., Di Mattia, C. D., Sacchetti, G., Massantini, R., & Pittia, P. (2021)
8. Tiwari, P., Thakur, M., Joshi, A., Raigond, P., & Arora, B. (2022). Development of Iron fortified potato fries through Vacuum assisted processing strategies.
9. Journal of Food Science & Technology, 1–9. Wedamulla, N. E., Fan, M., Choi, Y. J., & Kim, E. K. (2022). Citrus peel as a renewable bioresource: Transforming waste to food additives. Journal of Functional Foods, 95, Article 105163.
10. Liu, Y., Benohoud, M., Yamdeu, J. H. G., Gong, Y. Y., & Orfila, C. (2021). Green extraction of polyphenols from citrus peel by-products and their antifungal activity against Aspergillus flavus. Food Chemistry X, 12, Article 100144
11. Mierzwa, D., Szadzinska, ´ J., Radziejewska-Kubzdela, E., Bieganska-Marecik, ´ R., Kidon, ´ M., & Gapinski, ´ B. (2022). Effectiveness of cranberry (Vaccinium macrocarpon, cv. Pilgrim) vacuum impregnation: The effect of sample pretreatment, pressure, and processing time. Food and Bioproducts Processing.
12. Nishad, J., Dutta, A., Saha, S., Rudra, S. G., Varghese, E., Sharma, R. R., … Kaur, C. (2021). Ultrasound-assisted development of stable grapefruit peel polyphenolic nano-emulsion: Optimization and application in improving oxidative stability of mustard oil. Food Chemistry, 334, Article 127561.
13. Nishad, J., Saha, S., Dubey, A. K., Varghese, E., & Kaur, C. (2019). Optimization and comparison of non-conventional extraction technologies for Citrus paradisi L. Peels: A valorization approach. Journal of Food Science & Technology, 56(3), 1221–1233.
14. Nishad, J., Saha, S., & Kaur, C. (2019b). Enzyme- and ultrasound-assisted extractions of polyphenols from Citrus sinensis (cv. Malta) peel: A comparative study. Journal of Food Processing and Preservation, 43(8), Article.
15. Assis, F. R., Rodrigues, L. G. G., Tribuzi, G., De Souza, P. G., Carciofi, B. A. M., & Laurindo, J. B. (2019). Fortified apple (Malus spp., var. Fuji) snacks by vacuum impregnation of calcium lactate and convective drying. Lebensmittel-Wissenschaft und -Technologie, 113, Article 108298. Banjongsinsiri, P., Shields, J., & Wicker, L
16. Abalos, R. A., Naef, E. F., Aviles, M. V., & Gomez, ´ M. B. (2020). Vacuum impregnation: A methodology for the preparation of a ready-to-eat sweet potato enriched in polyphenols. Lebensmittel-Wissenschaft und -Technologie, 131, Article 109773. Andr´es, A. (1995). Impregnaciion ´ a vacıo´ en alimentos porosos. Spain: Aplicacion ´ al salado de quesos. Ph.D. Thesis. Universidad Polit´ecnica de Valencia.

Review on Formulation of Value Added Nutribar

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Abstract*—This review paper discusses the different types of nutrition bar,their processing methods. Various types of bars such as cereal bar, millet bar, fruit bar, nut and seed barwere explored by highlighting theiringredients,processing techniques and nutritional profiles.Furthermore, the paper discusses the potential health benefits of millet-basedNutri bar,including their ability to support digestive health, boost energy and provide essential nutrients. Finally, the paper highlights the challenges and future directions for the development of millet-based nutribars, including the enhanced nutritional profiles and increased consumer acceptance.

Keywords*—millet, nutribar, development, processing, nutrition.

I. Introduction

As the world shifts towards a more sustainable and health-conscious future, the demand for the processed and convenience foods is increasing rapidly due to the increasing awareness about the health, changing socio-economic needs, and insufficient time to cook food with the correct/ balanced amount of nutrition. One such nutritionally balanced convenience food is the nutritious energy bars, which are gaining popularity in the global market after 1980s. Earlier, these energy bars were used by the sport persons who were involved in strong physical activities and therefore, needed greater source of energy during peak performance. But today, due to the increasing focus on the nutrition and healthy food habits and an increasing number of people involved in greater physical activities, energy bars have become a perfect choice as a quality source of energy [1]. Millet, a small-grained cereal, has been recognized for its exceptional health benefits and versatility, making it an ideal ingredient for a revolutionary new snack: the millet bar. Rich in protein, fiber, and essential micronutrients, millet has been linked to improved digestive health, reduced inflammation, and enhanced immune function. By combining millet with other wholesome ingredients and innovative processing methods, we can create a delicious, convenient, and sustainable food product that not only nourishes our bodies but also supports environmentally friendly agriculture and reduces food waste[2]. There are different types of nutrition bars referred by different names such as protein bars, meal replacement bars, granola bars, nutraceutical bars, breakfast bars, health bars and soon. Each bar has different characteristic with a different purpose [3]. Bars are prepared using different types of raw materials which includes nuts, cereal, seed, fruit, millet, rice etc. Either one or a combination of multiple materials are processed through simple methods and tightly packed by compression. This review explains the different types of nutrition bars their processing methods and physicochemical, nutritional and sensory evaluations are compared and summarized.

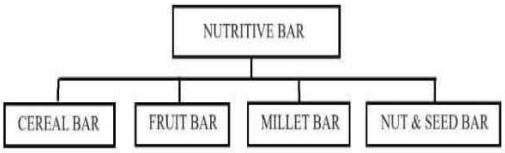


Figure1Nutritive bar (classified based on the ingredients contributing most weight /volume of the bar).

II. Types Of Nutritive Bar

A.Cereal Bar

In this paper to prepare the cereal bar, we separate the components into two categories: wet (brown sugar, bee honey and glucose syrup) and dry (CWF, cornflour biscuit flour, oat flakes, rice flakes, cashew nuts and raisin banana)[6].The primary purposes of dry ingredients are to add texture and nutrients. Wet components, on the other hand, serve as a binding agent to keep the bars together.In addition, it adds moisture and enhances flavour. The combination of these results in a delicious and well-balanced cereal bar[4]. Initially, the dry ingredients are combined in a rectangular baking pan made of stainless steel and baked for 15 minutes at 100 degree Celsius with a ventilator. After that, the components for the binding syrup were combined and heated to 100 °C for two minutes in a water bath. After 15 minutes, the binding syrup was combined with the dry ingredients to form a mass. This mass was then pushed and moulded with a spatula in a rectangular baking pan made of stainless steel that was covered with baking paper. It was then allowed to cool to room temperature.

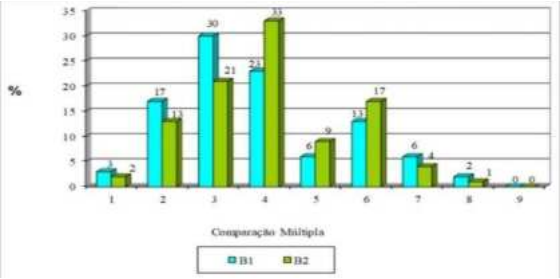


Figure 2Percentage of scores assigned to cereal bars made using CWF in the multiple comparison test (Canvalcante,2016)

Here the author described cereal bar is a dry granulated cereal-based product with low water activity made from a pressed mixture of cereals, dried fruits and nuts[5]. It is a snack made from oats, walnuts, almonds, dried figs, dried raisins (Vitis vinifera), coconut (Cocos nucifera), honey and sesame seeds (Sesamum indicum) and is usually fried until crispy and consumed as a snack. They are the most developed edible products because they are natural ingredients and are healthy[8]. The ingredients used in this bar are oats, corn, millet, Guinea corn, peanuts, coconut, nuts and honey. First, corn (yellow and white), millet and pearl corn were sorted to remove damaged kernels[8]. They were cleaned and aired. The grains were ground separately into flour using a dry mill. The cereal bar was then soaked in water, and consequently, nuts, dried fruits, roasted sesame seeds are also soaked in the cereal. Adding honey and seed oil to the mixture adds flavor and enhances the sweetness of the bar[6]. They were then spread out on a baking tray and baked at 140 degrees for 40 minutes. They were then allowed to cool and cut into the desired shape for packaging. From the results obtained in this study, it can be concluded that the use of local raw materials as raw materials for cereal bars improved the nutritional value of this snack. The developed cereal bars can be considered as a healthier alternative to many carbohydrate-rich (wheat)-based snacks because it has the potential to deliver energy and nutrients in a dense and digestible way, and is also useful for preventing cardiovascular diseases and revitalizing the nervous system due to the unsaturated nature of the products

The demand for prepared and ready-to-eat foods is growing rapidly due to increasing health awareness, changing socio-economic needs and insufficient time for a proper/balanced diet. One such nutritionally balanced convenience food is nutritional energy bars, which are gaining popularity due to their high nutritional value. These Energy bars are made into tablets using either compression technology or your choice of different binders. The bars contain a wide range of nutrients and a sufficient amount of proteins, fats and carbohydrates and are available in smaller packages or pouches that are very convenient to carry and can be eaten at any time[7]. Cereal bars are products obtained by pressing cereals, which contain dried fruits, nuts, flavourings and binders. Cereal bars usually contain mixtures of cereal, dried fruits and nuts, corn syrup, honey, sugar or lecithin, and flavourings. Among cereals, pulses are most used in the production of cereal bars due to their high protein content and quality, predominance of unsaturated fatty acids and dietary fibre composition[8]. Sweeteners provide the taste and texture that consumers enjoy in bars. High fructose corn syrup (HFCS) is a sweetener made from corn that is used as a sweetener in energy bars. The process was carried out in three steps: weighing the dry matter (roasted rice flakes, wheat flour and algae seeds). electronic food scale (F12ATCO) with an accuracy of 1 mg; Heating the syrup (corn syrup/honey, sugar, peanut butter, rapeseed oil, water) to 95 °C; mixing dry ingredients with syrup; The finished mixture was shaped, then cut into pieces suitable for baking and baked at 180 °C for 20 minutes in a preheated oven; allowed to cool after baking and packed in HDPE (high density polyethylene)

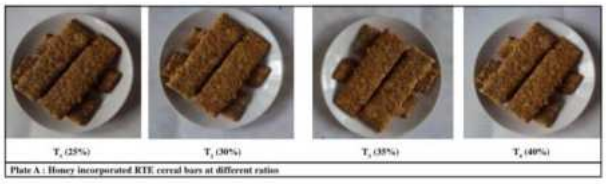


Figure 3Optimization of cereal bar using corn syrup(Yadav,2015)

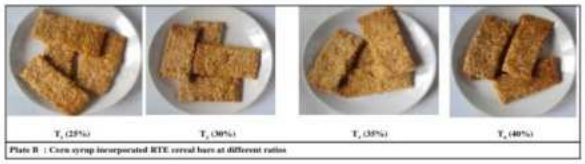


Figure 4Optimization of cereal bar using honey(Yadav,2015)

Cereal bar as an alternative to less healthy snacks, a quick snack source before exercise or a meal replacement. A total of 40 cereal bars were sampled from 20 different stores, but only 37 bars were selected from those pools[9] .All samples of this study were divided into two main groups with 17 coated and 20 uncoated rods. The main objective of this study was to analyse the ingredients of the bars - as declared on their product labels - and to conduct a fact-based analysis of the nutritional values declared on the bars. A nutritional analysis of the bar was carried out in the laboratory of the Institute. BIOR (Food Safety Institute BIORE Animal Health and Environment)[10]. The results showed that the nutritional information given on the labels mostly do not correspond to the actual values, but remain within the tolerance limits and are lower than the actual specified value. Cereal bars are a source of fibre, but they are high in sugar[12].

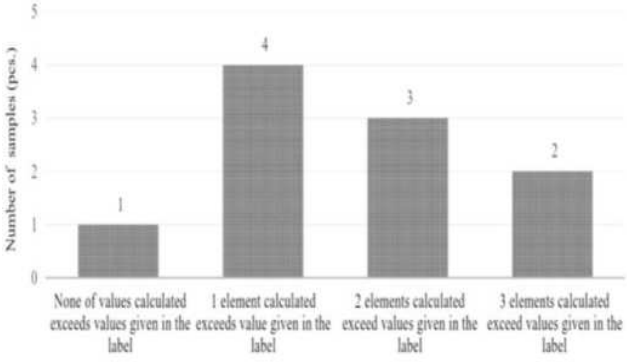


Figure 5Number of products with protein, carbohydrate and fat levels higher than values given in the labels.(Maki, K., Beisiegel, J, 2010.

B. Fruit Bar

Therefore, the broader objective of this study was to produce and evaluate the properties of fruit bars from mixtures of banana (Musa sapientum) and cashew (Anacardium occidentale) and to evaluate the microbiological quality and organoleptic characteristics of the prepared fruit bars[13]. Fruit bars, also known as fruit skin or fruit roll, are dried fruit pulp bars/sheets with a soft, chewy texture and sweet taste. Basically, the appropriate amount of sugar, pectin, acids (citric acid, ascorbic acid, etc.) are mixed with the pulp, then dyed and dried into sheet-shaped products[14].Fruit bars use optional ingredients such as sweeteners, preservatives, stabilizers, additives and nutrients. in the production of fruit bars is. Date palm,coconut and chopped almonds are used as filling in the preparation of the fruit bar. They are added before drying the fruit purée to improve the composition of the purée and facilitate drying. Different proportions of BCA (banana and cashew apple pulp) were taken, giving a total weight of 1000 g. other ingredients are the amount of added sugar 70g, Date powder 50g, Citric acid 5, Sodium metabisulfite 2g[15].

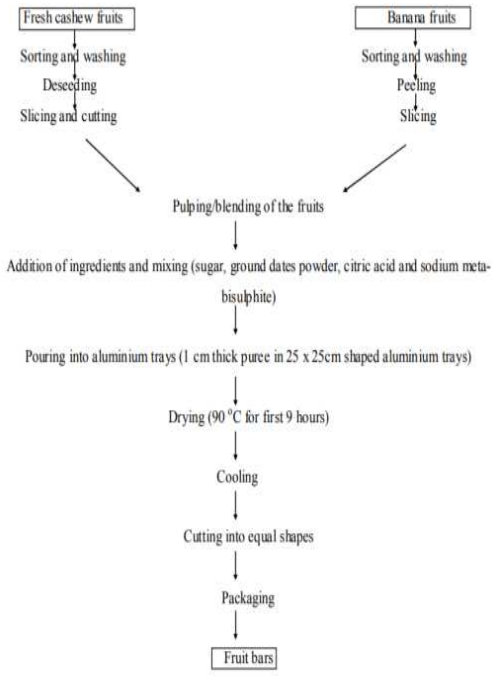


Figure 6Flowdiagram for the production of banana-cashew fruitbars(C.S Arinzechukwu,2019)

Efforts have been made to utilize the wood apple (feronialimonia L.) to value added products like bar, jelly, chutney and beverage. The study mainly focused on standardizing wood apple fruit bar by exploring and adopting different recipes and storage conditions. Ripe or slightly ripe wood apples which are not suitable for fresh consumption were selected for making fruit bar[16]. The fruit extract along with sugar and citric acid at different concentration were considered for chemical analysis and sensory evaluation. Preservation of fruit bar to satisfy population during off seasons is done by encouraging the advantage of drying. Parameters such as TSS, Acidity and their ratio, ascorbic acid, phosphorous and calcium content were studied in which, increase in TSS and decrease in acidity and ascorbic acid level were observed with the progressive of storage period at different refrigerated storage conditions.

Treat.	Ascorbic Acid (mg/100g)				Phosphorus (mg/100g)				Calcium (mg/100g)			
	Storage Period (DAS)				Storage Period (DAS)				Storage Period (DAS)			
	Fresh	30th	90th	150th	Fresh	30th	90th	150th	Fresh	30th	90th	150th
T_1	2.03	1.97	1.76	1.30	32.38	32.35	32.27	32.14	18.24	18.21	18.15	18.06
T_2	1.99	1.92	1.77	1.29	32.39	32.37	32.29	32.17	18.24	18.22	18.17	18.08
T_3	1.91	1.85	1.70	1.23	32.46	32.44	32.37	32.27	18.23	18.22	18.19	18.15
T_4	1.92	1.86	1.72	1.21	32.44	32.41	32.34	32.24	18.24	18.23	18.19	18.11
T_5	1.86	1.83	1.65	1.16	32.47	32.45	32.39	32.30	18.24	18.21	18.19	18.15
T_6	1.87	1.80	1.66	1.14	32.51	32.49	32.42	32.31	18.22	18.21	18.18	18.13
T_7	1.71	1.70	1.54	1.06	32.54	32.51	32.45	32.36	18.24	18.23	18.21	18.15
T_8	1.69	1.67	1.53	1.05	32.57	32.56	32.51	32.45	18.26	18.25	18.22	18.18
'F' Test	Sig	Sig	Sig	Sig	NS	NS	NS	NS	NS	NS	NS	NS
SE(m)±	0.007	0.018	0.005	0.008	0.04	0.04	0.06	0.06	0.010	0.008	0.015	0.028
CD at 5%	0.022	0.056	0.016	0.025	-	-	-	-	-	-	-	-

Table 1Effect of different receipes on ascorbic acid, phosphorous and calcium of wood apple fruit bar(Raut U.A,2021)

Ascorbic acid content decreased during storage due to oxidation of ascorbic acid to dehydroascorbic acid. The data is presented [table-2]. there is no significant difference in the phosphorus and calcium content of apple fruit strips between different treatments[18]. A premium wooden apple bar made from fruit extract containing 60% \sugar and 0.4% citric acid, chemical properties and sensory properties \with a shelf life of five months.

The aim of this study was to standardize the composition of fruit bars containing mahua flowers. The precise composition of any product is a decisive factor in determining its sensory acceptability and saleability. Therefore, multiple treatments, namely T0 (80:20:0), T1 (70:20:10), T2 (60:20:20), and T3 (50:20:30), were used to standardize the combination therapy[17]. fruit bar by concentration of mango pulp, papaya pulp and mahua flower pulp in the formulations. Although the content of papaya pulp was kept constant, mango pulp and mahua flower pulp varied in each treatment. The fruit bar was first prepared by pureeing mango, papaya and mahua flower pulp, the mixture was then heated at 70-80°C for 15 minutes to reach 50 0Bx. poured onto plates polished with glycerine and then dried in a cabinet dryer at 65°C for 7-8 hours. Based on the above treatments, it was observed that sample T2 containing mango pulp, papaya pulp and mahua flower pulp in the ratio of 60:20:20 achieved the highest hedonic score of 8. 2 with the semi-trained sensory panel[20], so it was successfully selected for the final formulation.

Physicochemical parameters	selected sample (T_2)
Moisture (%)	18.26±0.78
Protein (%)	3.12±0.07
Fat (%)	0.406±0.04
Carbohydrate (%)	72.94±1.21
Ash (%)	3.12±0.07
Crude fibre (%)	2.09±0.23
TSS (°Bx)	77.4±1.76
Total sugar (%)	64.83±1.47
Reducing sugar (%)	53.42±1.
pH	4.19±0.07
Acidity (%)	1.39±0.41
Ascorbic acid mg/100 g	53.2±0.97

*Each value is an average of three determination.

Table 2Physico-chemical composition of mixed fruit bar incorporated with mahua flower(Tathe DB,2023)

In another paper the, selection of bar proportion were done by considering the parameters like hardness, stickiness, ascorbic acid level and overall acceptability[21]. Response surface methodologies (RSM) were used for optimizing the ingredients proportion and central composite design (CCD) were applied to evaluate the effects of ingredients in the bar. Initially by mixing the pulp of banana and papaya, sugar, corn starch, pectin and citric acid the bars were prepared. Throughout the process of experiment the level of sugar in the bar were kept constant about 15% of fruit pulp[24]. Prepared mixture was heated for 10 min at 80°C to achieve 30°B. Initially thickness of the bar was kept as 10 mm and was dried in a tray dryer set at 1.16 m/s air velocity and at 65°C temperatures till about 15 % moisture content was obtained[23]. By using Stainless steel knife the bar were cut into rectangular shapes after drying. sensory quality evaluation for fruit bar was done on the basis of colour, texture, taste, flavor and overall acceptability, ascorbic acid content and texture profile analysis.

Parameters Variety	Banana pulp Grand Naine (*Musa acuminata*)	Papaya pulp Taiwan (*Vasconcellea pubescenes*)
Moisture, % wb	75.16±0.48	88.96±0.63
Protein, %	1.70±0.03	1.25±0.02
Fat, %	0.3±0.05	0.5±0.06
Carbohydrates, % by difference	21.81±0.23	9.29±0.37
Ash, %	1.03±0.13	0.99±0.08
Total Soluble Solids (º Brix)	20.8±1.5	10.2±1.3
Acidity, %	0.176±0.057	0.208±0.032
pH	5.2±0.4	4.8±0.3
Reducing sugars,%	6.08±0.16	1.96±0.13
Total sugars, %	11.98±0.38	5.20±0.23
Non-reducing sugars, %	5.9±0.22	3.24±0.10
Ascorbic acid, mg/100g	17.04±5.68	204.48±5.68

Table 3Bio-chemical characteristics of banana and papaya pulps(Mamta patel,2017)

In this paper, a fruit bar was prepared from a mixture of ripe papaya and tomato pulp (variety, Red Lady and C.V. Naveen, respectively) in a weight ratio of 75:25. The effects of hydrocolloids is. pectin (P), starch (S) and ethyl cellulose (EC) and its three different levels on the physiochemical, sensory and textural properties were investigated[25]. Seven different fruit bars were found to have a moisture content of 20.9-22.1% and a total soluble solids content of 78.1-78.8 Brix, while pH, browning rate and vitamin C content were in the ranges of 4 .3-4.50, 0.137–0.150 (OD) and 40.5–41.4 mg/100 g. A texture study showed that addition of hydrocolloids with 1% starch þ ethyl cellulose and pectin þ 1.5% starch resulted in a significant (P_0.05) increase in texture density/hardness. Examination of sensory properties revealed that all fruit samples were acceptable in terms of taste, colour and aroma, but differed significantly (P_0.05) in composition[26]. The samples were packed in LDPE bags (100) and stored at 35-45 °C for four hours. months It was observed that there were significant (P_0.05) changes in physiochemical properties such as acidity and vitamin C during four months of storage. No significant (P_0.05) effect on browning index (OD) or deterioration in colour, taste or aroma was observed in these samples[27]. During four months of storage, changes in colour and texture during treatment were not consistent. Additions of 0.5 and 1% of each starch in ethyl cellulose effectively preserved\colour, while 0.5, 1, and 1.5% of each PQS improved texture during four months of storage.

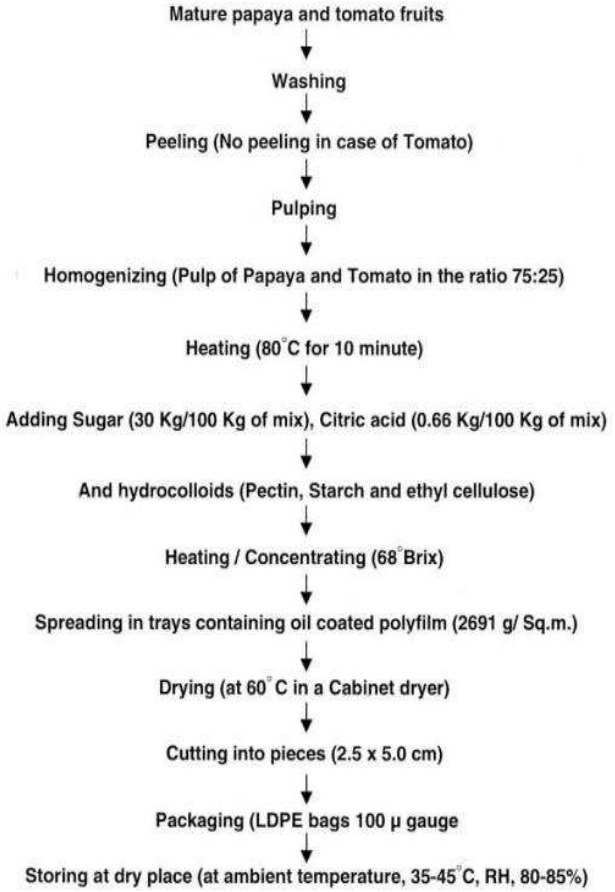


Figure 7Processflowchart for the preparation of fruit bar(S.Ahmad,2017)

C.Millet Bar

Sports snacks made from a combination of different ingredients ensure that nutrients complement each other to give athletes enough energy and develop muscle endurance [28]. Sports bars are a portable, lightweight, easy-to-use and compact source of nutrition and energy . Millet is a small seeded grain that has more minerals, fiber, protein and calories. They are affordable, healthy and vanilla essence readily available l°Cal foods. The aim of this study was to create a multi-nutrient sports bar and to evaluate its overall sensory, nutritional and storage properties[29]. Various millets were used as components in the preparation of the sports bar, including Foxtail millet, Pearl millet, Big millet and Small millet. Oats, wheat and red rice cereals are tainted. Additionally, pulses such as cowpea, green gram and Bengal gram were added. Flax, sesame, pumpkin, sunflower and peanut seeds; palm tree; nut butter; chocolate bars; skimmed

milk powder; and Mila bat technology consists of component selection, raw material pretreatment, link production and composite sports bat production[28]. The composite sports bar made of millet and other healthy ingredients proved to be very well tolerated, easily digestible and rich in protein and energy. Keeps at room temperature for 45 days. Creating a multi-sport bar from cheap and readily available ingredients makes it a nutritious and practical snack for athletes.

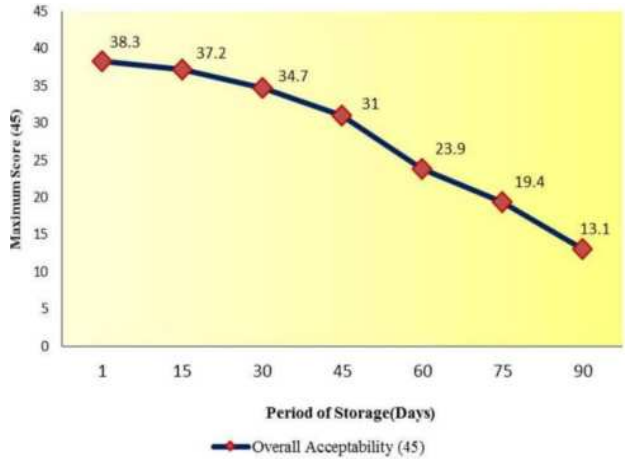


Figure 8Changes in Overall Acceptability of CNB during Storage (Mridula D, 2013)

Consumers tend to look for easy-to-prepare foods such as snacks, which are defined as alternatives to fast food with or without significant nutritional value. The energy bar was made from standardized foxtail and millet millet flakes in different proportions and other ingredients such as jaggery, liquid glucose, skimmed milk powder, cocoa powder, dates, linseeds, sesame seeds, peanuts and soybeans. skimmed milk powder, cocoa powder, dates, flax seeds, sesame seeds, peanuts and soy granules[30]. Nutritional analysis showed that moisture (21%), protein (32.04%), fat (49.02%), ash (29.08%) and energy content (7.81%) decreased during the period compared to the control stick (CNB). millet bar at the same time, an increase in crude fiber (121.42%) and carbohydrates (27.73%) was observed.Stored in LDPE bags, shelf life is 45 days[31]. The optimized millet bar retained 90% of its organoleptic characteristics even on the 45th day of storage. Mila stick had a serving size of 50g and a unit price of Rs.45.00. The energy content of MNB per portion was almost 211.67 kcal. Consumer rating of MNB was measured based on the approval of 60 respondents. This survey shows that 50% of consumers were very satisfied, 46.7% rated their satisfaction very good, 1.7% rated them good, and 1.7% rated them fair. These rods can be recommended to be scaled to an industrial level[30] developed an energy bar containing different proportions of whole hemp and defatted hemp seeds containing approximately 20%, 30% and 40% of rice flour. Of the three portions, the 40% lean hemp mixture had 14.09% protein, 2.95% fat, and 3.59% ash, while the 40% whole hemp mixture had 12.76 protein, 7.54 fat, and 4.67 ash. Whole hemp with 20% mixture was more organoleptically acceptable. The high antioxidant activity was 40% in the whole cannabis bar. In terms of moisture sorption isotherms, the fat-free hemp bar had a higher moisture content than the whole hemp bar.

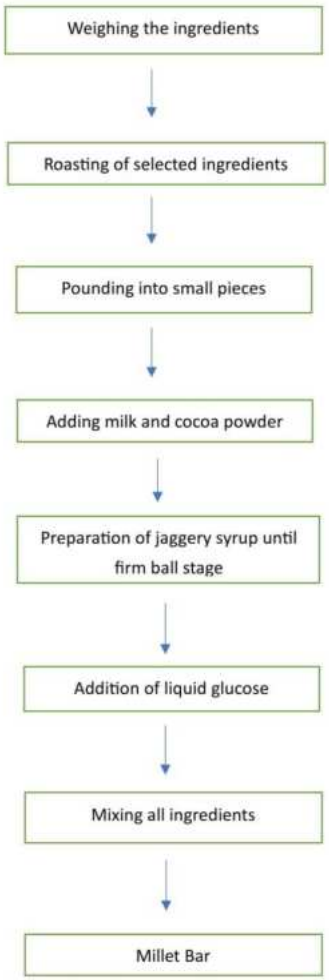


Figure 9Flow diagram for the preparation of millet flakes incorporated bar (Sobana RM, 2017)

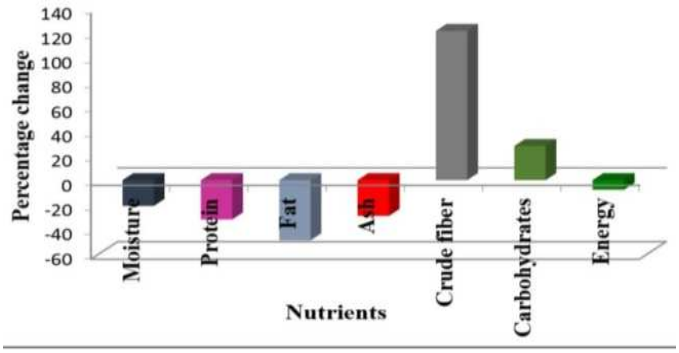


Figure 10Percentage change in proximate nutrients of millet snack bar (Sobana RM.,2017)

A ready-to-eat snack is prepared by mixing processed grains with various ingredients such as oil seeds, nuts, sugar, chocolate, etc. [33]. Fast-paced lifestyles and healthy food preferences have sparked interest in developing snacks with less refined sugar and cereals with more fiber. The cereal bar market is growing and has become the most popular

snack among consumers[34] revealed that currently the combination of cereals, nuts and other ingredients for the production of cereal bars depends on their health benefits, natural and organoleptic characteristics. Four cereal drink formulations were prepared with buckwheat (55 parts), prosomilia (15-30 parts), white amaranth (25-40 parts), walnut (27.5 parts), and walnuts (50 parts) varying the proportions. millet millet and white amaranth in the ratio of 15:40, 20:35, 25:30 and 30:25. Roasted cereals and walnut pieces were mixed with 73.7° Bx jaggery syrup and baked at 120°C for 20 minutes[35]. The proximate composition of the bars, the content of minerals (Ca, Fe and P) were evaluated and compared with the bars on the market. The textural analysis and sensory profile of the bar were also evaluated.The formulated bars had significantly higher levels of crude fibre, calcium, and iron ($p<0.05$) than the market sample, although the market sample had significantly higher levels of energy and fat ($p<0.05$).The designed bars qualified as an excellent energy-dense snack since they contained between 440.31 and 489.81 kcal of energy per 100 g. Based on texture analysis and sensory evaluation, formulation C (common buckwheat-55, millet-millet-25, white amaranth-30, walnut-27.5 and jaggery-50) was more challenging and preferred based on taste and overall acceptability[36].The study comes to the positive conclusion that underutilized crops have significant potential for making cereal bars.

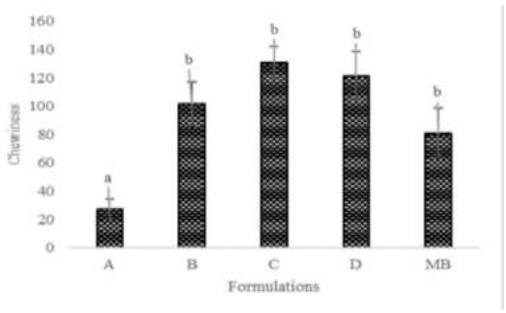


Figure 11 Chewiness of cereal bar and market sample (Carvalho, V. S., and Conti-Silva, A. C. (2018).

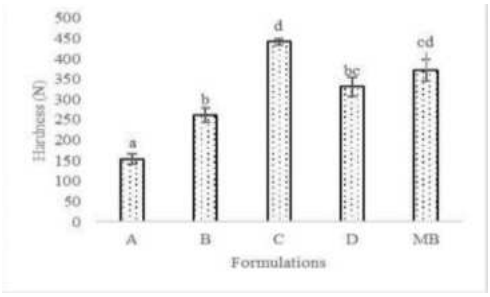


Figure 12Hardness of cereal bar and market sample (Journal of Food Science and Technology, 50(5), 950-957.)

D. Nut And Seed Bar

In this article, the author tried to develop a gluten-free energy bar that would contain a variety of nuts, seeds and grains. Muskmelon seeds, pumpkin seeds, flax seeds, almonds, cashews, walnuts, oats, sesame, kalonji, peanuts, date powder, jaggery powder, kiwi, cranberry, mango have been used in making energy bars[38]. Dates are added in dry form because they are an excellent source of protein, fiber, as well as calcium and vitamin C[37]. The process of manufacturing an energy bar mentioned by this author involves dry roasting all the ingredients and then adding seeds and nuts. finally mixing them with powder, dates and mint powder. Finally, the inserted energy bar is cooled for 1 hour[39]. A sample containing 15% flaxseed and 45% sweeteners and other ingredients was identified as a high-quality omega-3 fatty acid bar.

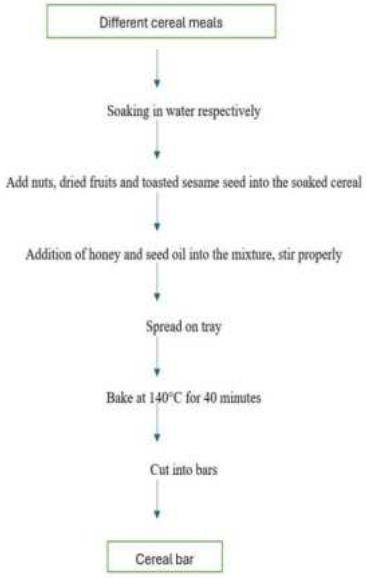


Figure 13Flowchart for preparation of cereal bar.(George et al. ,2018).

The development of new products and the use of waste have been studied more intensively due to the wide variety of raw materials available in indifferent segments of the Brazilian and global agricultural sector. Studies show that pumpkin seeds are rich in fiber (DF), a source of protein and contain a high percentage of polyunsaturated oils therefore, they can be used in the production of new foods[40]. An alternative use of pumpkin seed flour is in the manufacture of cereal bars, because they are small, easy to consume and require little or no preparation and are a source of vitamins, minerals, fibers, proteins and complex carbohydrates. Thus, the use of pumpkin seed flour in the production of cereals allows to diversify products and improve the general technological and nutritional value and reduce the environmental impact. The following ingredients were used to make the nut and seed bar: brown oats, rice flakes, raisins, rose syrup, brown sugar, glucose syrup and salt. Sampaion et al. prepared specimens and bars to contain a dry phase (53%) and a binding phase (47%). The ratio in which the components of the binder phase were combined was determined after pre-testing and this ratio was used to prepare the five treatments[41]. To select the most acceptable band, the sensory acceptability data were analysed using

three-way internal preference mapping called PARAFAC, a higher order data decomposition method that can be considered a generalization of PCA for multivariate data. The preference maps obtained by PARAFAC provide a graphical interpretation of the #39 of consumers; sensory data that takes into account multiple sensory properties evaluated simultaneously .

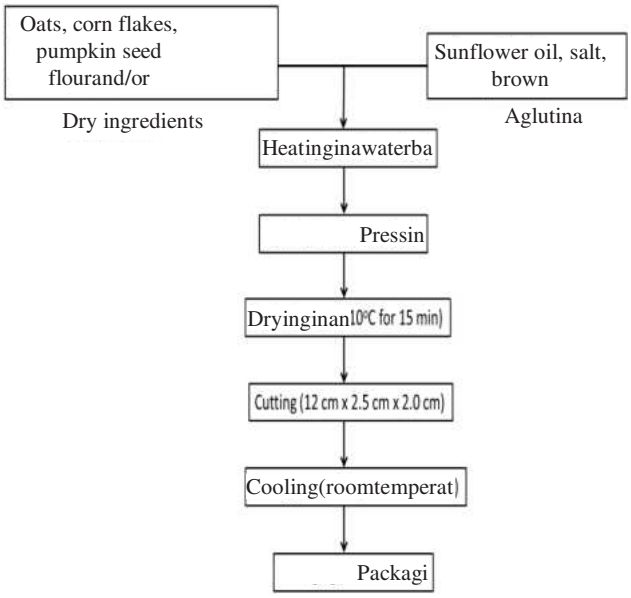


Figure 14Flowchart of nutrition bar production process(Rawat N,2015)

III. CONCLUSION

In conclusion, nutrition bars are a popular and convenient snack option for many individuals, but it's important to consider the various types of nutrition bars, their processing methods, and evaluation methods to make informed choices. From protein bars to energy bars, and from baked to extruded processing methods, each type of bar has its own unique characteristics and nutritional profiles. Furthermore, evaluating nutrition bars through methods such as nutritional labeling, sensory evaluation, and shelf-life testing can help consumers and manufacturers alike ensure the quality and safety of these products. By understanding the different types of nutrition bars and their processing methods, as well as the various evaluation methods available, we can make more informed decisions about the snacks we choose to fuel our bodies. Authors and Affiliations

REFERENCES

[1] Yadav, Latika and Bhatnagar, Vibha (2015). Optimization of ingredients in cerel bar. Food Sci. Res. J., 6(2): 273-278.

[2] Kylee, Sam (2015). The last bite What's in your cereal bowl? The protein makeover. FPD: Food Product Design. P: 9.

[3] Cindy, Hazen (2015). Clean-label bar Clean- label bars. FPD: Food Product Design. P: 5-10.

[4] ABREU, B. B. et al. Development of a nugget based on the acerola residue (Malpighia emarginata D. C) and cowpea (Vigna unguiculata L.). Brazilian Journal of Development, v. 6, n. 2, p. 9446-9453, 2020

[5] BARROS, N. V. A. et al. Effect of cooking on the bioactive compounds and antioxidant activity in grains cowpea cultivars. Revista Ciência Agronômica, v. 28, n. 5, p. 824-831, 2017.

[6] BRAZIL. Ministry of Health. Resolution n°. 54, of November 12, 2012. Provides for technical regulations on supplementary nutritional information. Diário Oficial da República Federativa do Brasil, Brasilia, DF, 19 out. 2012.

[7] MÁRQUEZ-VILLACORTA, L. F.; PRETELL-VÁSQUEZ, C. C. Evaluation of quality characteristics in cereal bars with high fiber and protein content. Revista Biotecnología en el Sector Agropecuario y Agroindustrial, v. 16, n. 2, p. 67-78, 2018.

[8] CAVALCANTE, R. B. M. et al. Effect of thermal pr°Cessing on chemical compositions, bioactive compounds, and antioxidant activities of cowpea cultivars. Revista Caatinga, v. 30, n. 4, p. 1050-1058, 2017.

[9] CAVALCANTE, R. B. M. et al. Mineral content, phenolic compounds and bioactive amines of cheese bread enriched with cowpea. Food Science and Technology, v. 39, n. 4, p. 843-849, 2019

[10] Sharma,C.,Kaur,A.,Aggarwal,P., and Singh, B. 2014 "Cereal Bars—A Healthful Choice a Review." Carpathian Journal of Food Science & Technology 6(2):29-36

[11] European Commission Health and Consumers Directorate-General. 2012. "Guidance D°Cument for Competent Authorities for the Control of Compliance with EU Legislation." Accessed April 01, 2016.

[12] Ministry of Health of the Republic of Latvia. Healthy Eating Recommendations for Adults. Accessed April 06, 2016

[13] Banana and cashewEvanie DN, Rumbold K, Daramola M, Falkon R, Sunny I. Evaluation of physiochemicalproperties of South African cashew apple juices as a biofuel feed st°Ck; 2015.

[14] Mbaeyi-Nwaoha IE, Iwezor-Godwin LC. Production and evaluation of yoghurt flavoured with fresh and dried cashew (Anacardium °Ccidentale) apple pulp. African Journal of Food Science and Technology. 2015;6(8):234–246

[15] Rehman SM, Nadeem M, Haseeb M, Awan JA. Development and physiochemicalcharacterization of Apricot-date bar. Journal of Agricultural Resources. 2012;50:409–421.

[16] Sharma H.P., Patel H., Sharma S. and Vaishali (2014) J. of Food Res. and Tech., 2(4), 148-152.

[17] Khusbu Namdev and Singh V.K. (2015) Technofame- A.J. of Multidisciplinary Advance Res, 4(2), 22-26

[18] Shere D.M., Pawar V.S. and Shere P.D. (2014) Int. J. of Pr°Cessing and Post Harvest Tech., 5(2), 141-144.

[19] Kuchi V.S., Gupta R. and Tamang S. (2014) J. Crop and Weed, 10(2), 77-81

[20] Raut U.A., et al., (2021) Standardization of Recipes for Preparation of Wood Apple Fruit Bar. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 13, Issue 12, pp.-10975-10977.

[21] Anonymous. 1st Advance Estimate, Indian HorticultureDatabase. National Horticulture Board, Ministry of Agriculture, Government of India, Gurgaon, India;c2018.

[22] Kourany MS, Khalil KI, Abd-Eltawab SA, Mohdaly AAA. Protein fortified mango and guava fruit bars: ingredients optimization, quality evaluation and storage stability. Int. J. Curr. Microbiol. App. Sci.2017;6(12):2865-2877

[23] Lebaka VR, Wee YJ, Ye W, Korivi M. Nutritional composition and bioactive compounds in three different parts of mango fruit. International Journal of Environmental Research and Public Health.2021;18(2):741.

[24] Prasad K, Paul JR. Post-harvest Losses of Papaya and Practice for Management. Food Sci. Rep. 2021;2(7).

[25] National Horticulture Board. 2015. Annual Report for year 2014-15.

[26] Panja, P., Marak, D.S. and Thakur, P.K. 2016. Effect of packaging on quality of enriched fruit bars from aonla (Emblica officinalis G.) during storage. International Journal of Agriculture, Environment and Biotechnology. 9(3): 411

[27] Srivastava, R.P. and Kumar, S. 2015. Fruit and vegetable preservation: principles and practices. CBS Publishers & Distributors Pvt. Limited.

[28] Mridula D, Singh KK, Barnwal P. Development of Omega3 Rich energy bar with flaxseed. Journal of Food Science and Technology. 2013; 50(5):950-957.

[29] Nadeem M, Rehman S, Anjum S, Murtaza MA, Din GM. Development, characterization, and optimization of protein level in date bars using response surface methodology. Scientific World Journal. 2012, 518702

[30] Sharma M, Mridula D. Development and Formulation and evaluation of maize-based fortified nutritious bar. Agriculture Research 2015;4(1):93-101

[31] Sobana RM. Formulation and evaluation of millet based composite sports bar. International Journal of Food Science and Nutrition 2017;2(4):65-68.

[32] Ojha, P., Karki, R., and Subedi, U. (2020). Comparative Evaluation of Nutritional Value and Bioactive Components of Proso Millet, Foxtail

[33] Shrestha, J., Shrestha, R., Joshi, B.K., and Subedi, S. (2020). Future smart food crops in Nepal: A necessity for future food and nutritional security. Natural Resources and Sustainable Development, 10 (1), 46-56.

[34] Subedi, B., and Upadhyaya, N. (2019). Preparation and Quality Evaluation of Flaxseed Incorporated Cereal (Oat) Bar. Journal of Food Science and Technology Nepal, 11, 65-68.

[35] Samakradhamrongthai, R. S., Jannu, T., and Renaldi, G. (2021). Physiochemicalproperties and sensory evaluation of high energy cereal bar and its consumer acceptability. Heliyon, 7(8), 1-9.

[36] Constantin, O. E., and Istrati, D. I. (2019). "Functional Properties of Snack Bars," in Functional Foods, V. Lagouri., Eds. Intech Open, pp 1-14

[37] AOAC (2012). Official Methods of Analysis, 17th Edition. Ass°Cation of analytical Chemists. Washington D.C USA. Bellisle F (2014).

[38] ke-Ejiofor J, Beleya EA, Gbarasosgo MN (2016). Preparation and Evaluation of Granola-a breakfast cereal, substituted with maize (Zea mays) and c°Conut (C°Cos nucifera) blend. Int. J. Nutr. Food Sci. 5(1):47-52

[39] Rafiu A, Check ZH, Norlelawati A, Asama AR (2014). Sensory Preference and Mineral Contents of Cereal Bars Made From Glutinous Rice Flakes and Sunnah Foods. IOSR J. Environ. Sci. Toxicol. Food Technol. (IOSR-JESTFT) e-ISSN: 2319-2402, p-ISSN: 2319-2399. 8(12):26-31

[40] Ho LH, Tang JYH, Suhaimi MK, Hamdan MA, Roslan A. Development of novel "energy" snack bar by utilizing l°Cal Malaysian ingredients. International Food Research Journal 2016;23(5):2280-2280

[41] Ravinder MP, Sunil MD. Development and Formulation and Evaluation of Puffed Cereal Bar. International Journal of Pure and Applied Bioscience 2018;6(5):930-936.

Citrus Fruit Quality Assessment: Gas Sensor Approach for Pesticide Residue and Ripeness Evaluation

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Abstract— ***The primary goal for quality evaluation of citrus fruits is to ensure that the product meets or exceeds established standards for safety, freshness, taste, and nutritional content. Quality evaluation aims to guarantee a consistent and high- quality product for consumers, meeting regulatory equipments and maintaining the reputation of the brand or product. Citrus fruits, which are cultivated worldwide, have been recognized as some of the most high-consumption fruits in terms of energy, nutrients and health supplements. The use of pesticides is widespread in citrus fruits production for pre- and post-harvest protection and many chemical substances may be applied in order to control undesirable moulds or insects. Traditional methods for pesticide detection rely on time-consuming laboratory techniques, while ripeness assessment often involves subjective visual inspections. The proposed solution addresses these limitations by integrating specialized gas sensors into a portable device, allowing for on-site and real-time analysis. The pesticide detection module exhibits high sensitivity to common pesticides, providing rapid identification of harmful residues on citrus fruits. Simultaneously, the ripeness assessment module employs ethylene gas sensors, accurately measuring fruit maturity through the detection of this natural plant hormone. The integration of these modules stream lines fruit quality control processes, offering a comprehensive solution for farmers, distributors, and consumers. By mitigating the reliance on labor- intensive and subjective methods, this gas sensor system enhances the efficiency and reliability of citrus fruit quality assessments. This innovation contributes to the advancement of sustainable agricultural practices, ensuring the safety and premium quality of citrus fruits throughout the production and supply chain.***

Keywords— ***citrus fruit, pesticide residue, quality evaluation, ripeness.***

I. INTRODUCTION

Citrus fruits (Citrusspp. Rutaceae) are subtropical to tropical perennial fruit trees, producing juicy segmented fruits with thick rinds. There are numerous named cultigens, with perhaps at least nine widely recognized, including mandarin or tangerine (C. reticulata Blanco), orange (C. x sinensis L. Osbeck), Seville, bitter or sour orange (C. x aurantium L.), the pomelo or shaddock (C. maxima Burm.), citron (Citrus medica Ferr), lime (C.aurantifolia Christm. Swingle), lemon (C.xlimonL.Burm.F.), and grape fruit (C. para disi Macfad.).The origin of citrus has generally been considered to be in southeast Asia1, a biodiversity hotspot13 with a climate that has been influenced by both east and south Asian monsoons. Principal coordinate analysis of 58 citrus accessions based on pair wise nuclear genome distances and metric multidimensional scaling. The first two axes separate the three main citrus groups (citrons, pummelos and mandarins) with interspecific hybrids (oranges, grapefruit, lemon and limes). (Gutherie, 1995) The classification of citrus is complexes however, the genus Citrus consists of more than 100 species. The number of species is variable and this species variation in a single genus is due to the admixture of wide morphological diversity, intra and inter specific sexual compatibility, apomixis, and spontaneous mutations. However, intergenic hybrids such as citranges, citrumelos, and citrandarins, citremons, citradias, and citrumquats are also reported and are getting increasing importance. Several indigenous varieties are developed and consumed locally in specific regions. The citrus fruits are tangy with pleasant flavor and taste, a combination of sweet and sour flavors. Oranges and mandarins are predominant species of genus Citrus, marketed as fresh or processed juice. The citrus plants in the orchards are confronted worldwide with increase in gbiotic and abiotic factors due to the changing climate. Amongst abiotic factors, fluctuating temperature and unexpected frosts are the main limiting factors whereas, bacteria, viruses, viroids, nematodes, fungi, and phyto plasmas are major biotic actors.



Figure1: Citrus fruit

Some factors result in a massive reduction in production and quality while others may destroy altogether the citrus industry. Citrus improvement through conventional approaches is discouraged due to the genetic and reproductive characteristics of

the plant.

The omics and biotechnology- based interdisciplinary interventions may allow combating such external factors and improving the health, nutritional quality of the fruit. (A.C. Matheyambath, 2016)

II. Review of Litrature

A. *Nutritional importance of citrus fruit*

Citrus fruits, diverse in color and size, are highly nutritious. They are beneficial for health, due to the presence of bioactive compounds such as carotenoids, flavonoids, and ascorbic acid . These compounds have antioxidant, antitumor, anti-inflammatory and blood clotting inhibiting characteristics. These fruits are also a rich source of vitamins and minerals like vitamin C, A, and B-complex , vitamin A benefits skin and vision whereas vitamin B-complex like thiamin, folates, and pyridoxine are required as external sources to replenish. Of minerals, potassium, magnesium, calcium, and sodium are present in citrus from very high to low levels in citrus fruits . However, zinc, iron, and manganese are present in trace amounts. (Ortega, 1997)

Nutraceutical is a combination of two words; 'nutrition' and 'pharmaceutical', hence the word infers that the nutraceuticals could be regulated as dietary supplements, medicine, and food ingredients. The word, 'nutraceutical' was first coined by Stephen L. DeFelice in 1989 who explained nutraceuticals as; "Food, or parts of food, that provide medical or health benefits, including the prevention and treatment of disease" . However, the government of Japan started approving foods with proven benefits for the general public in the 1980s. Nutraceuticals protect against diseases developed due to nutrient deficiencies and also have physiological benefits. These are used as dietary supplements and food ingredients. Being dietary supplements, these may contain vitamins, minerals, botanical extracts, essential amino acids, Poly Unsaturated Fatty Acids (PUFA), and enzymes that are probably deficient in most of our diets. Another category of nutraceuticals is nutrient-fortified food. For example, their on-fortified wheat flour protects the wheat-dependent population from diseases that develop due to iron deficiency. A salient example is iron deficiency anemias. Other examples include purple cauliflower and purple potatoes, having additional anthocyanin content. (Lv,2015) Goldenrice and Golden potatoes as well as Pro vitamin-A-fortified maize are the rich sources of Pro vitamin-A and carotenoids. These crops could reduce the disease development in humans caused by Vitamin A deficiency diseases e.g. night blindness, xerophthalmia, prevalent in Africa and Asia. Similarly, Quinoa is of great nutritional value. Laden with fiber, vitamins, and minerals, this plant also is rich in lysine, hence its proteins are nutritionally more complete than many vegetables. Thus, quinoa holds great potential as a Nutraceutical, to curb the malnutrition rampant in many third-world countries, the likes of Pakistan, India, Nepal, Bangladesh, and several African nations. (Khan, 2021)

B. *Composition of citrus fruits*

Citrus is one of the most important fruit crops, rich in carotenoids, flavonoids, terpenes, limonoids, and many other bioactive compounds of nutritional and nutraceutical value. Moreover, polymethoxylated flavones(PMFs),a unique class of bioactive flavonoids, abundantly occur in citrus fruits. In addition, citrus essential oil, rich in limonoids and terpenes, is an economically important product due to its potent antioxidant, antimicrobial, and flavoring properties. Mechanistic, observational, and intervention studies have demonstrated the health benefits of citrus bioactives in minimizing the risk of metabolic syndrome. Citrus phytochemicals distribution in various parts of fruits, phytochemicals exhibit the antibacterial, antiviral, antifungal, anti-carcinogenic, antithrombotic or anti-inflammatory properties, also, it assists in lowering cholesterol. These active compounds are phenols, carotenoids, phytoestrogen and sulfides having antioxidative potential, and marked as health promoter due to their broad spectrum in the human body .



Figure2: Composition of citrus fruit

Flavonoids:

Citrus fruit is a rich resource of flavonoids with many physiological properties involved in controlling antiviral activity and anti-microbial activity. They are present in the form of the glycoside or aglycone, especially in citrus juices as glycosyl derivatives (flavonoid glycosides, FGs)which showed potentialhealth benefits for the human body . It had excellent potential to control many chronic diseases and suppressed the infectious in the body. Hesperidin and quercetin involve in control of herpes virus, parainfluenza and polioviruses . The naringin metabolites area rich source of natural antimicrobials activity against the positive and negative bacteria . Mandarin fruit has the highest content of flavonoids, followed by common oranges and Grape fruit, however, there is no any flavonoids in lemon fruit.

Carotenoids:

The primary role of carotenoids pigment compounds to protect the various diseases of the human body and control-health-related elements; sweet orange, mandarin's and grapefruits are a rich source of carotenoids. Lutein and zeaxanthin are rich sources of citrus which are suitable for eyes and immunes system of the body. A vibrant source of carotenoids present in Caranavel oranges and mandarin fruits. The comparison of significant carotenoids present in citrus fruits (Table 2)clear that, Mandarins fruit has higher values followed by Grape fruit, then, orange fruits, however, lemon fruits haven't any carotenoids in their components.(Ranganna S, 1983)

Vitamin composition	Juice	Peel extract
Thiamin	0.55 ± 0.20^{a}	11.20 ± 2.34^{b}
Niacin	14.42 ± 1.71^{a}	224.16 ± 22.99^{b}
Pyridoxine	10.51 ± 4.84^{a}	279.63 ± 14.52^{b}
Vitamin C	26.36 ± 3.19^{a}	19.34 ± 3.75^{a}
Vitamin E	2.11 ± 0.08^{a}	4.45 ± 0.07^{b}
Folate	0.60 ± 0.02^{a}	1.36 ± 0.04^{b}
Calcium	132.76 ± 2.38^{a}	515.78 ± 14.49^{b}
Iron	2.17 ± 0.17^{a}	9.06 ± 0.79^{b}
Magnesium	1.88 ± 0.05^{a}	5.39 ± 0.09^{b}
Potassium	1.30 ± 0.06^{a}	8.75 ± 0.50^{b}
Phosphorus	38.96 ± 3.44^{a}	366.84 ± 16.47^{b}
Sodium	46.12 ± 1.46^{a}	274.77 ± 5.07^{b}

Values are mean ± SD of triplicate determinations. Values with different

Table1:NUTRIENT COMPOSITIONOF CITRUS FRUITS

Essential oil:

Citrus species considered a rich source of aromatic compounds, particularly, fruit peel, citrus fruit have about 400 compounds of volatile and nonvolatile compounds. From ancient time essential oil of used for medicine and aromatic purpose, now a days, the essential oil used in different pharmacy and cosmetic and other related industries, for their antispasmodic and antimicrobial activity .

Mucilage:

Mucilage is present in the seed, peel, and pulp of citrus fruits, it is a fiber-like and forms a gel-like structure which mixed with water. Citrus fruits have a higher ratio of fiber (soluble and insoluble) which reducing cholesterol levels, besides that; citrus seeds have psyllium, with improving the digestives system, and enhancing the elimination of cholesterol.

Tannins:

The grape fruit, lemon, and lime fruits have a higher content of tannins compounds than other citrus fruits, this tannins play an important role in stop diarrhea and decrease bleeding and controls other extreme secretions of the body .

C. *Existing methods*

-MS/MS analysis of pesticides was carried out using a Thermo Trace 1310 GC coupled to a TSQ 8000 Evo mass spectrometer operating with an EI source. The system was equipped with a TRPesticide II column(30 m × 0.25 mm × 0.25 µm, Thermo Scientific, Waltham, Massachusetts, USA),a split/split less inject or operating in splitless mode, and a Thermo Scientific TriPlus AS auto sampler. The volume of injection in the splitless mode was 1.0 µL. The PTV inlet temperature increased from75°C (initial hold: 1 min) up to330°C(in2min). The oven temperature program was 60 °C for 2.3 min, increasing to 90°C at a rate of 25°C/min and held for 1.5 min, then increasing to 180°C at a rate of 25°C/min and held for 0min , then increasing to 280°C at a rate of 5°C/min and held for 0min, and finally increased to300 °C at a rate of 10°C/min and held for 5min. The carrier gas was helium with a flow rate of 1.20mL/min. The MS transfer line temperature was 250°C, and the ion source temperature was 300 °C. (Farshad Soheilifard a, 2020)

LC-MS/MS analysis of pesticides was carried out using a Thermo Scientific (SanJose, California, USA) Accela HPLC system coupled to a triple-quadrupole mass spectrometer (Thermo Scientific TSQ Quantum Access MAX model), operating with a heated electro spray ionization(HESI) source. These parathion was performed on a Accucore a Q C18 HPLC Column (2.1 mm × 100 mm, 2.6 µm, Thermo Scientific). The mobile phase consists of (A) water containing 0.1% for mic acid and5 mM of HCOONH4 and (B) methanol containing 0.1% formic acid and 5 mM of HCOONH4. Gradient elution was performed as follows: start with 100% eluent A; then A:B = 30:70 at 7 min; then 100% eluent B at 9 min, holding for 3 min; then back to 100% eluent A at 12.5 min; and keep for 4 min. The column temperature was maintained at 40°C.The flow rate was 0.3mL / min with an injection volume of 10µL. (Farh M.Al-Nasirac.C.- D., 2020)

Quality Assurance/Quality Control:

To validate the method of analysis, the following parameters were evaluated: linearity, matrix effect, selectivity, sensitivity, accuracy, and precision. The European Union SANTE/11312/2021 regulatory guidelines were followed. Two calibration curves were constructed by analyzing standards in the solvent and standards in a matrix. For the HPLC-MS/MS analysis, standard solutions were prepared in acetonitrile and matrix extract at concentration levels of 5, 10, 25, 50, 100, 150, and 200 µg/L, and for the GC-MS/MS analysis, standard solutions were similarly prepared in acetonitrile and matrix extractat concentration levels of 5, 10, 25, 50,100, 150, and 200 µg/L. The linearity was accepted if the correlation coefficients (r2) from the calibration curves were equal to or higher than 0.99. (J. Blasco, 2020)

C. Ripeness of citrus fruits

Asnon-climacteric, citrus fruit are only harvested at their optimal edible ripening stage, and are required to meet the expectations of the current consumer who demands for fruit not only with the best appearance, flavor, and nutritional properties, but that also comply with safety, traceability, and the sustainability of the cultural practices used. Like any other commodity, citrus fruit are subjected to worldwide standard specifications within the value chain on their quality attributes (QA). Additionally, there are also adjustments to these requirements on quality and commercial ripening indices, that arise from the respective PGI normative of each commodity, growing regions and destination markets . The main external quality attributes (EQA) accounted for citrus fruit are general appearance, size, weight, and color. Among the internal quality attributes (IQA), soluble solids content (SSC), titratable acidity (TA),juiciness, maturity index(MI;MI=SSC/TA),and the absence of internal defects are the most relevant. Although firmness is not defined quantitatively, it represents an important IQA, since it is a limiting factor regarding postharvest handling, transport and shelf-life, fruit being expected to maintain a good consistency through the whole supply chain. (AnaM. Cavaco, 2021)



Figure3: Ripenessofcitrus fruit

III. DESIGNMETHODLOGY

The proposed system introduces a revolutionary approach to citrus fruit quality assessment by lever aging the power of spectroscopy technology and NodeMCU microcontroller integration. Spectroscopy enables the capture of detailed spectral signatures associated with key quality indicators in citrus fruits, offering a non- invasive and highly accurate method of assessment. By integrating NodeMCU microcontrollers, we facilitate wireless communication and real-time data analysis, empowering farmers with instantaneous insights into fruit quality directly from the orchard. This innovative system promises to streamline the assessment process, reduce post-harvest losses, and enhance overall fruit quality, all while offering a cost-effective and scalable solution for widespread adoption in citrus cultivation.

The project methodology involves integrating MQ-135 and MQ-2 gas sensors with a NodeMCU (ESP8266) micro controller to create a versatile as detection and monitoring system. These sensors, capable of detecting a range of air pollutants and flammable gases, respectively, collect data on environmental conditions. The NodeMCU facilitates wireless connectivity, enabling real-time data transmission to an online platform or local display. Additionally, an OLED display provides a user-friendly interface for immediate on-site information. The system employs data processing algorithms for gas concentration analysis, enhancing its efficiency. Calibration using standard gas concentrations ensures accuracy. Field testing validates the system's performance in diverse environments. The holistic approach integrates sensor data for comprehensive gas monitoring, making it an effective tool for applications such as air quality assessment or gas leakage detection in both industrial and domestic settings.

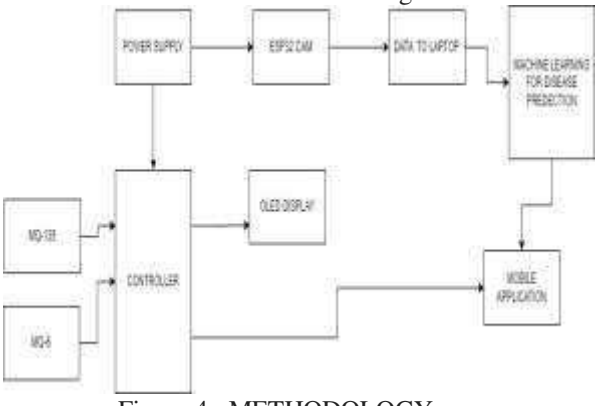


Figure 4: METHODOLOGY

The project methodology revolves around the integration of MQ-135 and MQ-2 gas sensors with a NodeMCU (ESP8266) microcontroller, aimed at developing a versatile gas detection and monitoring system. These sensors, renowned for their capability to detect a wide range of air pollutants and flammable gases respectively, serve as the primary data collection components.

The NodeMCU microcontroller acts as the central processing unit, facilitating wireless connectivity for real-time data transmission. The implementation begins with the physical integration of the gas sensors with the NodeMCU microcontroller, ensuring seamless communication and data exchange. The sensors are strategically placed in the environment to capture relevant gas concentrations effectively.

The NodeMCU microcontroller, equipped with Wi-Fi capabilities, enables the transmission of collected data to an online platform or a local display unit. This wireless connectivity feature ensures accessibility and real-time monitoring of gas concentrations, enhancing the system's usability and effectiveness.

To provide immediate on-site information, an OLED display is incorporated into the system, offering a user-friendly interface for data visualization. This display facilitates quick assessment of gas concentrations without the need for additional devices or complex setups. Furthermore, the system employs sophisticated data processing algorithms for gas concentration analysis, enhancing its efficiency and accuracy. Calibration procedures using standard gas concentrations are implemented to ensure the reliability and precision of the system's measurements. Field testing plays a crucial role in validating the system's performance across diverse environments. Through rigorous testing in various settings, including industrial and domestic environments, the system's effectiveness and reliability are evaluated, ensuring its suitability for real-world applications.The holistic approach adopted in this project integrates sensor data for comprehensive gas monitoring, making it an effective tool for applications such as air quality assessment and gas leakage detection. Whether deployed in industrial facilities or residential premises, this system of fersa robust solution for detecting and monitoring gas concentrations, thereby enhancing safety and environmental awareness.

IV. CONCLUSION

The study summarizes that, the development and implementation of the gas detection and monitoring system integrating MQ-135 and MQ-2 gas sensors with a NodeMCU microcontroller represent a significant milestone in the realm of environmental sensing technology. Through meticulous methodology encompassing sensor integration, wireless connectivity, data processing algorithms, and rigorous field testing, we have successfully created a versatile and reliable tool for gas detection in diverse environments. The system's ability to detect a wide range of air pollutants and flammable gases, coupled with its real-time monitoring

capabilities and user-friendly interface, positions it as a valuable asset for various applications, including air quality assessment and gas leakage detection in industrial and domestic settings. Moving forward, further refinement and optimization of the system, along with continued validation through extensive field testing, will enhance its effectiveness and broaden its potential impact on safety, environmental awareness, and public health. With ongoing advancements in sensor technology and data analysis techniques, our gas detection and monitoring system exemplifies the potential of interdisciplinary innovation in addressing pressing environmental challenges and fostering a safer and healthier future for communities worldwide.

REFERENCES

[1] A.C.Matheyambath,P.P.(2016).A.C.Matheyambath,P .Padmanabhan,G. Paliyath. 136-140.

[2] Ana M. Cavaco, D. P. (2021). Nondestructive Assessment ofCitrus Fruit Quality and Ripening by Visible–Near InfraredReflectanceSpectroscopy.

[3] Farh M. Al-Nasir a, A. G.-R.-D.-D. (2020). Determination ofpesticideresiduesinselectedcitrusfruitsandvegetablescultivated inthe Jordan Valley.

[4] Farshad Soheilifard a, A. M. (2020). Chemical footprint ofpesticidesusedincitrusorchardsbasedoncanopydepositionandof f-targetlosses.

[5] Gutherie,H.&.(1995).Humannutrition.

[6] J. Blasco, S. C. (2020). Computer Vision Technology for FoodQualityEvaluation.

7]Khan,M.S.(2021).IntroductoryChapter:CitrusforaHealthy Life.

[8] Lv,X.Z.(2015).Citrusfruitsasatreasuretroveofactivenaturalm etabolites that potentially provide benefits for human health.

[9] Ortega, R. R.-S. (1997). Dietary intake and cognitive function ina groupof elderly people. American Journal of Clinical Nutrition.

[10] Ranganna S, G. V. (1983). Citrus fruits--varieties, chemistry,technology, and quality evaluation. Part II. Chemistry, technology,and quality evaluation.

Development of Wireless RFID Based Smart Inventory Management System for Eggs and Mushrooms

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Abstract—

This project proposes a smart inventory system for perishable items like eggs and mushrooms. Each item is tagged with an RFID chip, and an RFID reader at the storage location tracks additions and removals. A central processing unit (Node MCU) interprets the RFID data, generates timestamps, and displays information on a small OLED screen. This data is then uploaded to a cloud storage service for further analysis. The system is powered by a lead-acid battery and features power-saving measures in the RFID system programming. For user interaction, a separate RFID reader can be used to scan items and retrieve information about them from the cloud, potentially through a web application. After rigorous testing, all components will be integrated into a permanent enclosure suitable for the desired location (indoors or outdoors). The final system will continuously monitor inventory levels and alert users of expiring products.

Keywords—.RFID, Smart Inventory Management, Egg, Mushrooms, High Quality Assurance

1. INTRODUCTION

The global food supply chain faces significant challenges, particularly with perishable items like eggs and mushrooms. Traditional inventory management methods often rely on manual counting, which is prone to human error and lacks real-time data on product freshness. This can lead to stockouts, overstocking, and ultimately, food waste. This project proposes a novel solution – a smart inventory management system utilizing Radio Frequency Identification (RFID) technology to address these shortcomings and revolutionize perishable goods management.

Problem Statement: The High Cost of Inaccurate Inventory Management

Inaccurate inventory data for perishables creates a domino effect of problems.Inventory shortages result in missed revenue opportunities and dissatisfaction among customers. Conversely, overstocking perishable items increases the risk of spoilage, resulting in significant financial losses and food waste. Traditional methods, reliant on manual counting and visual inspection, are time-consuming, labor-intensive, and susceptible to human error. Additionally, they lack the ability to track product age and expiration dates in real-time, making it difficult to optimize ordering and prevent waste. These limitations highlight the need for a more efficient and data-driven approach to perishable inventory management.

Advantages: Streamlined Operations and Reduced Waste

The proposed smart inventory system offers a multitude of advantages over traditional methods. Firstly, RFID tags provide automatic and accurate identification of each individual item, eliminating the need for manual counting and minimizing human error. This translates to real-time inventory data, enabling businesses to maintain optimal stock levels and avoid stockouts. Secondly, the system tracks the age of each product, allowing for informed decisions about product placement and prioritizing sales of older items to prevent spoilage. Furthermore, cloud storage facilitates data analysis, revealing trends in demand fluctuations and enabling businesses to optimize ordering schedules to minimize waste. These functionalities contribute to cost savings, improved operational efficiency, and a significant reduction in food waste, promoting a more sustainable food supply chain.

Necessity: A Data-Driven Approach for Food Security

The growing global population intensifies the need for efficient food production and distribution systems. Perishable goods like eggs and mushrooms are a vital source of nutrition, yet their susceptibility to spoilage presents a significant challenge to food security. Implementing this smart inventory system offers a compelling solution. Real-time data on inventory levels

and product freshness empowers businesses to make data-driven decisions regarding ordering and product placement, minimizing waste and ensuring sufficient availability of these essential food items. Additionally, the system can be integrated with expiration date alerts, further reducing spoilage and contributing to a more sustainable food supply chain. This project, therefore, addresses a critical need within the food industry, promoting food security and responsible resource management.

Technology Stack: Building a Smart and Connected System

The core of this system lies in the Node MCU (ESP8266), a versatile microcontroller that serves as the central processing unit. The Node MCU interacts with the RFID reader, interpreting data from the tags attached to each egg or mushroom container. An OLED display connected to the Node MCU provides a local visual representation of inventory changes and product movement. For secure and scalable data storage, the system leverages a cloud storage service. The Node MCU transmits collected data (RFID tags and timestamps) to the cloud, enabling comprehensive data analysis and trend identification. For user interaction, a separate RFID reader can be employed. This reader retrieves information about scanned items from the cloud storage, potentially displayed on a user-friendly web application interface. The system prioritizes power efficiency through software optimization of the RFID functionalities, ensuring optimal battery life and sustainable operation. This combination of technologies – RFID tags, Node MCU, cloud storage, and user interface – creates a robust and connected system, revolutionizing perishable inventory management.

IOT USES:

The smart inventory system described here is a prime example of the Internet of Things (IoT) in action. IoT refers to the interconnected network of physical devices embedded with sensors, software, and other technologies that enable them to collect and exchange data over the internet. In this project, RFID tags function as the intelligent "things" within the IoT network. Each tag, attached to an egg or mushroom container, becomes a data point, transmitting unique identification information to the RFID reader. The reader, another element of the IoT network, acts as a communication bridge, capturing tag data and relaying it to the Node MCU. The Node MCU, the brain of the system, interprets this data and interacts with other IoT components. It transmits the data to the cloud storage, another facet of the IoT ecosystem, for secure storage and analysis. The user interface, potentially a web application, also falls under the IoT umbrella, as it facilitates interaction with the data collected from the physical RFID tags. This interconnected web of intelligent devices – RFID tags, reader, Node MCU, cloud storage, and user interface – working together seamlessly exemplifies the power of IoT in transforming traditional inventory management into a data-driven and efficient process.

2. REVIEW OF LITERATURE

1. Title: IOT-Based Smart Inventory Management System

Authors: J K Kiruthika,S Manikandan,U Nithya,M Preethika, S Poorna, Publication: 2023 International Conference on Computer Communication and Informatics (ICCCI) With the rapid advancement of technology, tasks in our lives are becoming increasingly simple. The most important aspect of efficient retail management is inventory control. The world is moving toward a more intelligent future in which everything is automated and remotely controllable by using sensor technologies. This process not only takes time but sometimes results in mistakes that were not intended. Large storerooms present a particularly complex situation that makes it exceedingly challenging for humans to manually check the inventory on a regular basis. The well-known NodeMCU ESP8266 microcontroller, which is based on the Internet of Things and sensors, can properly provide the weight of a specific good as well as supports high in automatically counting the number of items on a shelf.

2. Title: Machine learning and its applications: A review

Authors: Sheena Angra,Sachin Ahuja, Publication: 2017 International Conference on Big Data Analytics and Computational Intelligence (ICBDAC) false, Nowadays, large amount of data is available everywhere. Therefore, it is very important to analyze this data in order to extract some useful information and to develop an algorithm based on this analysis. This can be achieved through data mining and machine learning. Machine learning is an integral part of artificial intelligence, which is used to design algorithms based on the data trends and historical relationships between data. Machine learning is used in various fields such as bioinformatics, intrusion detection, Information retrieval, game playing, marketing, malware detection, image deconvolution and so on. This paper presents the work done by various authors in the field of machine learning in various application areas.

3. Title: IoT Based Smart Inventory Management System for Kitchen Using Weight Sensors LDR LED Arduino Mega and NodeMCU (ESP8266) Wi-Fi Module with Website and App

Authors: Sifat Rezwan, Wasit Ahmed, Mahrin Alam Mahia, Mohammad Rezaul Islam,

Publication: 2018 Fourth International Conference on Advances in Computing Communication & Automation (ICACCA) false,Smart kitchen inventory management system (SIMS) is a system that is based on IoT, which will make managing kitchen, medicine, restaurant inventory more efficient and hassle free. This will not only notify users of their current inventory but also automatically order for new items if quantity gets low. Users can also manually order online to get any items delivered at their doorstep directly from their SIMS app. User can also generate list of a given timeframe so that user will be able to know about their expenditure. In addition, user can track their order status and order history through website. With the help of Smart Kitchen Inventory (SKI), a part of SIMS, people can forget about the hassle of grocery shopping as it can be operated from anywhere through the website or the android app and order anything they need anytime they want.

4. Title: Smart Inventory Access Monitoring System (SIAMS) using Embedded System with Face Recognition

Authors: Kanjana Eiamsaard, Pongsakon Bamrungthai, Songchai Jitpak deebodin,

Publication: 2021 18th International Joint Conference on Computer Science and Software Engineering (JCSSE)

"abstract":In this paper, we present a system called Smart Inventory Access Monitoring System (SIAMS) that integrates an embedded system with face recognition into an inventory system. It is developed to prevent theft in warehouses from authorized staff. The embedded system is attached with an RGB camera and deployed three software modules: image capturing, face detection, and face recognition. The face detection module sends detected face images to the face recognition module to identify a person as the personu2019s name or unknown class using a deep learning approach. The system achieved competitive accuracy by performing standard evaluation metrics for face detection and recognition. The inventory system that was developed will receive data via TCP/IP socket communication to log access history. The retrieved information can be used to investigate an unusual situation. The system can be improved with object detection and person tracking system to detect theft in real-time.

5. Title: IoT Based Smart Inventory Management System for Kitchen Using Weight Sensors LDR LED Arduino Mega and NodeMCU (ESP8266) Wi-Fi Module with Website and App

Authors: Sifat Rezwan,Wasit Ahmed, Mahrin Alam Mahia,Mohammad Rezaul Islam,

Publication: 2018 Fourth International Conference on Advances in Computing Communication & Automation (ICACCA) Communication & Automation (ICACCA)" abstract

6. Title: Smart Spare Part Inventory Management System with Sensor Data Updating

Authors: Jie Lin,Meimei Zheng,Jiayu Chen,Kai He,Ershun Pan,

Publication: 2019 IEEE International Conference on Industrial Cyber Physical Systems (ICPS) false,With the advent of Industry 4.0, more and more data can be available to companies. Especially in Cyber-Physical Systems (CPS) where sensors are connected to machines, rich sensor data can be collected. However, there is still a challenge to transform the data into useful information that enables a better decision. In this paper, we focus on the inventory decisions for the spare parts. The spare parts are expensive and it takes long lead time to procure them from overseas. It is critical for companies to make better inventory decisions for spare parts. We proposed a smart inventory management system for spare parts, which can take advantage of the updated sensor data and allow better decisions through modeling the degradation process of critical operating components. In this system, the ordering decision is updated dynamically based on real time sensor data.

7. Title: Smart RFID application in health care: Using RFID technology for smart inventory and logistic systems in hospitals

Authors: Arne Bochem,Ahed Abugabah,Ahmad Al Smadi,

Publication: 2022 45th Jubilee International Convention on Information Communication and Electronic Technology (MIPRO)

false,In todayu2019s hospital environments, many medical devices and tools are used. While some of these will be stationary due to size and bulk, many devices can also be moved from room to room. To facilitate an efficiently running hospital environment and protect expensive devices from being lost, it is important to keep track of the whereabouts of every medical device or utensil. We propose an RFID based system with a smartphone application - based frontend for tracking the locations of medical devices and utensils in a hospital environment, both enabling medical professionals to quickly locate required devices as well as allowing hospital administration to keep track of when and where devices leave hospital premises, optionally alerting security after a configurable grace period. In addition to this, our proposed application allows doctors and other medical personnel to reserve equipment and rooms such as examination or operating rooms and to easily find which rooms or pieces of equipment are available at a given time. This reduces administrative overhead and allows a smoother operation of the hospital, where efficiency is needed not only for the sake of profits but also to ensure the continued well-being of patients.

8. Title: Development of an IoT-based Inventory Management System for Retail Stores

Authors: V. Saillaja,M.Menaka,V. Kumaravel, Kamala kannan Machap,

Publication: 2023 International Conference on Sustainable Computing and Smart Systems (ICSCSS)

Controlling inventory is the essential component of an effective retail management system. Maintaining accurate records of inventories enables the user to engage in preplanning and decision-making. These days, the neighborhood stores and giant industries keep their inventory on enormous shelves or in enormous areas devoted to storage. To ascertain the current inventory level, the proprietors of these shops or enterprises must count the packets by hand. This paper proposes developing an IoT-based stock administration framework for retail locations to improve stock accuracy, optimize production network cycles, and enhance customer experience. The system integrates cloud-based analytics with IoT-enabled sensors to monitor and manage real-time inventory levels. As a result, retailers obtain current data on inventory levels, product availability, and demand trends. The proposed system enables retailers to optimize inventory levels, reduce stockouts and overstock, and improve sales performance by ensuring that popular products are always available. In addition, the system provides retailers with insight into their customersu00e2u20acu2122 purchasing patterns and preferences, enabling them to personalize products and increase consumer loyalty.

9. Title: Smart inventory control by using PID ACO controller and fuzzy logic controller

Authors: Hicham Sarir,BenkacemAbderhmane,

Publication: 2022 14th International Colloquium of Logistics and Supply Chain Management (LOGISTIQUA)

3. DESIGN METHODOLOGY

The implementation of the IoT-based monitoring and quality analysis system for alcoholic fermented beverages involves several key steps:

Sensor Integration:
Integrate pH and electrical conductivity (EC) sensors into the fermentation vessel. Ensure proper calibration and validation of sensor readings for accurate data collection.

NodeMCU Configuration:
Configure the NodeMCU microcontroller to read data from the sensors. Set up the WiFi module on the NodeMCU to establish a connection with the internet and the designated cloud platform.

Cloud Platform Setup:
Choose a suitable cloud platform (e.g., AWS, Azure, Google Cloud) and set up a dedicated account. Develop a data storage and retrieval mechanism to handle incoming sensor data securely.

Data Transmission:
Program the NodeMCU to transmit sensor data to the cloud at regular intervals. Implement error-handling mechanisms to ensure reliable data transfer.

Web Application Development:
Develop a web application using relevant technologies (HTML, CSS, JavaScript) to visualize the real-time status of the fermentation process. Integrate with the cloud platform to fetch and display data dynamically.

User Interface Design:
Create a user-friendly and intuitive design for the web application interface. Include features such as data visualization, historical trend analysis, and alert notifications for out-of-range conditions.

3. CONCLUSION

The proposed smart inventory management system for perishables offers a compelling solution to the challenges faced in the food supply chain. By leveraging RFID technology and the power of the Internet of Things, this system provides real-time data on inventory levels and product freshness. This data empowers businesses to optimize stock management, minimize food waste, and promote a more sustainable food ecosystem. The detailed methodology outlined in this document equips developers with the necessary knowledge to build and deploy this system, paving the way for improved efficiency and reduced waste within the perishable goods industry.

4. FUTURE SCOPE

This project serves as a foundation for further exploration and potential advancements. Here are some exciting possibilities for future development:

- **Integration with Machine Learning:** Machine learning algorithms can be incorporated to analyze historical data on inventory trends, product demand fluctuations, and expiration dates. This can lead to predictive inventory management, enabling businesses to proactively order supplies and minimize stockouts.
- **Environmental Monitoring:** Additional sensors can be integrated into the system to monitor environmental conditions like temperature and humidity within the storage unit. This data, coupled with product freshness information, can provide valuable insights for optimizing storage conditions and further minimizing spoilage.
- **Mobile App Development:** A mobile application can be developed to provide real-time inventory data and product information to users on the go. This user-friendly interface can empower store managers and staff to make informed decisions regarding inventory management and product placement.

By exploring these future possibilities, the smart inventory management system can evolve into an even more robust and comprehensive solution, fostering a more efficient and sustainable food supply chain for the years to come.

5. REFERENCES:

[1] J K Kiruthika, S Manikandan, U Nithya,M Preethika,S Poorna,"IOT-Based Smart Inventory Management System",2023 International Conference on Computer Communication and Informatics (ICCCI)

[2] Sheena Angra,SachinAhuja,"Machine learning and its applications: A review",2017 International Conference on Big Data Analytics and Computational Intelligence (ICBDAC)

[3] Sifat Rezwan,WasitAhmed,Mahrin Alam Mahia,MohammadRezaulIslam,"IoT Based Smart Inventory Management System for Kitchen Using Weight Sensors LDR LED Arduino Mega and NodeMCU (ESP8266) Wi-Fi Module with Website and App",2018 Fourth International Conference on Advances in Computing Communication & Automation (ICACCA)

[4] KanjanaEiamsaard,PongsakonBamrungthai,SongchaiJitpakdeebodin,"Smart Inventory Access Monitoring System (SIAMS) using Embedded System with Face Recognition",2021 18th International Joint Conference on Computer Science and Software Engineering (JCSSE)

[5] Sifat Rezwan,WasitAhmed,Mahrin Alam Mahia,MohammadRezaulIslam,"IoT Based Smart Inventory Management System for Kitchen Using Weight Sensors LDR LED Arduino Mega and NodeMCU (ESP8266) Wi-Fi Module with Website and App",2018 Fourth International Conference on Advances in Computing Communication & Automation (ICACCA)

[6] JieLin,MeimeiZheng,JiayuChen,KaiHe,ErshunPan,"Smart Spare Part Inventory Management System with Sensor Data Updating",2019 IEEE International Conference on Industrial Cyber Physical Systems (ICPS)

[7] Arne Bochem,Ahed Abugabah, Ahmad Al Smadi,"Smart RFID application in health care: Using RFID technology for smart inventory and logistic systems in hospitals",2022 45th Jubilee International Convention on Information Communication and Electronic Technology (MIPRO)
[8] V. Saillaja,M.Menaka,V. Kumaravel,KamalakannanMachap,"Development of an IoT-based Inventory Management System for Retail Stores",2023 International Conference on Sustainable Computing and Smart Systems (ICSCSS)
[9] Hicham Sarir,BenkacemAbderhmane,"Smart inventory control by using PID ACO controller and fuzzy logic controller",2022 14th International Colloquium of Logistics and Supply Chain Management (LOGISTIQUA)

Design & Development of Banana Pseudo stem Cutting Cum Cleaning Machine – A Review

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Abstract*—Banana (Musa sp.) is most grown horticultural fruit in worldwide as well as in India. The share of bananaproduction and average yield of bananas in India isabout 29% of the world and around 60 tons per hectare. Banana pseudo stems (Musa X paradisiac) have diverse applications worldwide. They're high in dietary fiberand utilized for making textiles, paper, and handicrafts due to their fibrous nature.The process of manually removing fibres from the banana pseudo-stem can be time-consuming and labor-intensive.Developing and optimizing a low-cost banana pseudostem processor for domestic use stands at the frontier of innovation, combining technology and sustainability to address a significant challenge in waste management. This comprehensive exploration will delve into the intricacies of this groundbreaking development, the challenges it seeks to overcome,the technological components involved, optimization strategies, its impact on households and the environment, and the broader implications for a sustainable future.

Keywords*—Banana, Banana Pseudostem, Dietaryfiber, Pseudostem processor, Sustainable future.

I. INTRODUCTION

Banana pseudostem (Musa X paradiza) has many applications in the world. In agriculture, they are used as organic mulch or animal feed. In addition, some cultures use pseudostems for cooking or medicinal purposes for their nutritional value. Banana pseudostem consists of three main parts namely the central core (10-15%), banana fiber (1.5-2%), and residual material after extraction of banana fiber (80-85%) containing juice (35- 40%) and scutcher (40-45%). Nutritional composition such as composed of protein (2.5), fat (1.7), free sugar (3.4), soluble dietary fiber (1.4), insoluble dietary fiber (27.4), starch (27.3), ash (0.3), and moisture (15.1). Mineral comprises Sodium (444.1) Potassium (944.1) Calcium (1335.3) Magnesium (255.0) Phosphorus (137.8) Iron (3.3) Zinc (8.1) Manganese (1.3). Automation was all the rage in technology in the late 1990s. Automation is used in many industries today, including manufacturing and food processing. Home applications are also designed with common people in mind in such a situation. The earlier manual processes are gradually becoming semi-automatic and automated. Banana pseudostem, also known as banana stem, is a fibrous waste product produced during banana cultivation. It is usually discarded or burned but has potential value as a source of fiber and other materials. The goal of this project is to design and manufacture a home helper that can automatically cut and clean banana pseudostems, making them more readily available for processing and use. The home assistant is made using a combination of traditional and advanced manufacturing techniques[20][21]. The cutting unit is made with disk shredders. Banana pseudostem could be used in food more than in other industries. environment and increase its economic value[23]. This study focused on the effective use of banana pseudostem by chopping and cleaning methods to obtain a high-quality fibrous pseudostem product for commercial use in terms of nutritional composition and physicochemical properties of fiber components [24]. The development and optimization of an affordable banana pseudo-vapor processor for home use is a groundbreaking innovation where technology and sustainability work together to solve a major waste management problem [25]. This comprehensive review examines the complexity of this pioneering development, going back to its early stages, the challenges it aims to overcome, the technological components involved, optimization strategies, its impact on homes and the environment, and the wider implications. sustainable future.

II. REVIEW OF LITERATURE

- **BANANA PSEUDOSTEM**
  Maharashtra ranks as the second-largest banana producer in India, with 71,072 hectares dedicated to banana cultivation. Jalgaon district accounts for a significant portion, ranging from 55,000 to 60,000 hectares annually, boasting the highest average productivity of 55-60 MT/hectare. The industry supports nearly 300,000 to 325,000 individuals who are engaged in various aspects of banana farming, including cultivation, harvesting, handling, and transportation [4]. In contrast, the leaves on the outer side, which develop later, are shorter. Banana leaves can reach widths of about 30 cm. Farmers face challenges in disposing of the pseudo-stem, incurring significant costs without generating any income. There is a need to convert the abundant waste biomass of banana pseudo-stems into high-value products, providing additional income to banana growers[1].The banana plant's pseudo-stem resembles a trunk, composed of a soft central core and up to 25 tightly wrapped leaf sheaths. As these sheaths mature, they unfurl to become the recognizable banana leaves. A mature banana plant can grow up to about 7.5 meters in height, and since the leaves emerge from the base of the plant, the inner leaves can be nearly as long as the plant itself [4].
- **NUTRITIONAL COMPOSITION**
  Banana pseudostem has a very high content of dietary fiber. It has caught the attention of food scientists in recent years. It could be used more in food rather than in the feed industry. It is composed of protein (2.5%), fat (1.7%), free sugar (3.4%), soluble dietary fiber (1.4%), insoluble dietary fiber (27.4%), starch (27.3%), ash

(0.3%), and moisture (15.1%). Mineral comprises Sodium (444.1%) Potassium (944.1) Calcium (1335.3%) Magnesium (255.0%) Phosphorus (137.8%) Iron (3.3%) Zinc (8.1) Manganese (1.3). For example, the ash value of that study was 0.3%. In contrast, **Ho et al. (2012)** reported that the total ash was 6.8% and mineral content including sodium, potassium, calcium, magnesium, phosphorus, iron, zinc and manganese was 3.1%. The total mineral value detected by the study was even more than 0.3% [2]. Other factors such as species, maturation stages, and measurement methods may all cause differences in the nutrient values of the banana pseudostem. For example, the research **(2011)** claimed that total phenolics and total flavonoids in various solvent extracts of different banana pseudostem cultivars are different. They may range from 7.58 to 291 mg gallic acid equivalent and from 4 to 80 mg catechin equivalent, respectively. Uppsala method **(Theander et al., 1990)**, to determine dietary fibre content in fruits. They found that the AOAC method always had a greater concentration of dietary fibre than the Uppsala method, and the two data sets were significantly different [2].

- **MORPHOLOGICAL PROPERTIES**

  Optical microscopy analysis of the banana plant's pseudo-stem revealed a multicellular fiber similar to other plants. The stem's cells have a diameter of about 10 µm and an average length of 4.5 µm, with an L/D ratio of 450. The cell wall thickness of banana fiber, at 8.3 µm, falls between sisal (around 12.8 µm) and ramie (around 11.5 µm). Scanning electron microscopy of raw and chemically treated banana pseudo-stem shows a scaly cellular structure with intact vegetable matter. Horizontal marks on the fiber surface result from the stem's bundle structure, with each bundle comprising multiple fibrils. The pseudostem's hollow nature suggests good insulation and absorbance properties, with alkali treatment being crucial[4].

- **PHYSICAL & MECHANICAL PROPERTIES OF BANANA FIBRES**

  The physical and mechanical characteristics of banana fiber are significantly influenced by the extraction method [14]. Fiber length and fineness are primarily determined by the plant variety, sheath length, and the extraction process. Hand extraction typically results in finer fibers compared to mechanical methods(Vigneswaran et al. Citation 2015) [5][8]. Banana pseudo-stems exhibit favorable physical and chemical properties, making them high-quality fibers [14]. They possess a good modulus of elasticity, tensile strength, and stiffness, showing promise as fiber material. Compared to ramie and bamboo, banana pseudo-stems have superior spin ability and fineness, with an average fineness of 2400 Nm. They are strong, with low strain at break, and have a shiny appearance influenced by extraction and spinning processes. With a low density and strong moisture absorption capacity, banana pseudo-stems rapidly absorb and release moisture. Their physical and mechanical properties include a width or diameter of 80-250µm, a cell L/D ratio of 150, a microfibrillar angle of 10 ± 1 degrees, a density of 1350 kg/m, an initial modulus of 7.7-20.0 GPa, tensile strength of 54-754 MPa, and elongation of 10.35%. X-ray studies reveal a high degree of crystallinity, with a spiral angle of about 15°, and treatment with acid or alkali results in a greater amorphous region than in untreated pseudo-stems.[4][6][8].

- **CHEMICAL PROPERTIES**

  Fat and waxes, primarily present on plant surfaces, can be extracted using benzene. Pectin, existing as calcium and magnesium forms of galacturonic acid, becomes butyric and acetic acids in biological retting. Hemicelluloses are amorphous short-chain polysaccharides partly linked with cellulose molecules. Cellulose is the fiber's major component. Lignin, an isotropic, non-crystalline polymer derived from phenyl propane, is present. The stem's aqueous extract is obtained by boiling the dewaxed stem[16]. The cellulose, hemicellulose, lignin, extractives, ash content, and moisture content average 49.33%, 12.04%, 13.88%, 5.23%, 4.95%, and 12.43%, respectively. The process includes determining lipo-soluble extractive (LSE) content, water-soluble extract (WSE) content, pectin content, lignin content, and separating cellulose-hemicellulose[4][8].

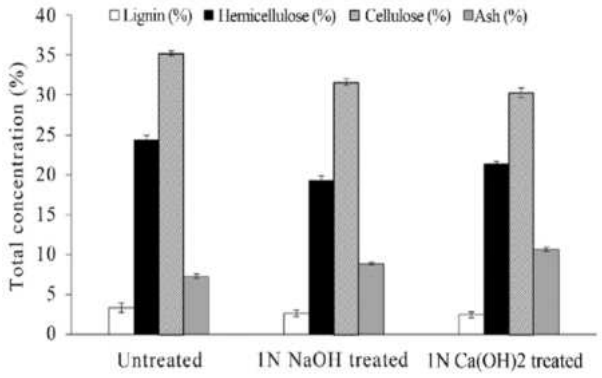


Figure 1 chemical composition

The primary constituents of banana fiber are cellulose (55–65%), hemicellulose (15–25%), lignin (10–15%), and pectin (3–5%)[16]. Cellulose, the main component, gives the fiber its structural strength, while lignin contributes significantly to the plant's mechanical support (Jústiz-Smith, Virgo, and Buchanan [5].

- **FIBRE EXTRACTION**

  The banana pseudostem cutting unit for fiber extraction comprises a lead screw, bearing, lead screw block and assembly, lead screw driving mechanism, cutting blade, power transmission system, feeding block, and supporting structure. The lead screw, or power screw, converts rotary motion into linear motion. Designing and developing this mechanism for feeding the pseudostem to the rotary cutter is complete, making the cutting process faster and more cost-effective [3]. When the tree's flowers bloom, the pseudostem is ready for harvesting. Fibers are extracted using a decorticating machine, which removes pulpy material through crushing, beating, and pulling. Pseudostems are pushed from the drum onto a conveyor belt, and the fibers are collected in a bucket [9]. Impurities before being washed and dried at room temperature (27-32°C). This machine can process around two tons of dry fiber[4]. By

employing the finest extractor machine, an oversized amount of fiber is obtained which can produce an additional income. The Banana Fiber Extractor Machine is the exclusive form invented for the extraction of fiber from waste portions of Banana stems, leaf stalks, and peduncles. The manual (or) semi-mechanical extraction of Banana Fiber Extractor Machine is the exclusive form invented for the extraction of fiber from waste portions of Banana stems, leaf stalks, and peduncles. The manual (or) semi-mechanical extraction of Banana Fiber is tedious, time-consuming, and damages the fiber. It's an economical portable device developed for a good cause of the farming community[5].



Figure 2 Banana pseudostem

- **FIBER EXTRACTION MACHINE**

The extraction of banana fiber presents a significant challenge due to its lack of established use in apparel textiles, leading to a lack of advanced extraction machinery. Despite attempts by researchers [7][10].

Few commercial extractors exist. Manual extraction, a primitive method involving sharp objects like blades or broken crockery, remains prevalent [11]. Manual extraction typically yields higher-quality fibers compared to mechanical extraction, as mechanical methods can cause significant damage due to high-speed beating[15]. The superior mechanical qualities of manually extracted fibers result from their high cellulose content and low microfibrillar angle, which remain undisturbed during manual extraction [17][12].



Figure 3 Banana pseudostemfibre extraction machine

- **DISTINCTIVE REVIEW**

This domestic banana pseudostem cutting cum cleaning machine offers a tailored solution for household and small-scale use, prioritizing simplicity, affordability, and ease of operation. Designed with the needs of individual users in mind, it provides efficient cutting and cleaning capabilities suitable for home gardens or small farms. In contrast, large industry-based banana pseudostem cutting machines are engineered for high-volume production in commercial settings, boasting advanced features, robust construction, and high-speed performance to meet the demands of industrial-scale operations. While industrial machines excel in efficiency and throughput, they often come with a higher price tag and may be less practical for individual or small-scale users. By focusing on user-friendly design, cost-effectiveness, and suitability for smaller applications, your domestic machine offers a compelling alternative tailored to the needs of individual growers and small-scale producers.

- **WASTAGE**

Banana is a fruit grown mainly in tropical countries of the world. After harvest, almost 60% of banana biomass is left as waste. Worldwide, about 114.08 million metric tons of banana stem waste are produced, leading to environmental problems such as the excessive emission of greenhouse gases. These wastes contain a high content of paramount industrial importance, such as cellulose, hemicellulose, and natural fibers that various processes can modify, such as bacterial fermentation and anaerobic degradation, to obtain bioplastics, organic fertilizers, and biofuels such as ethanol, biogas [6]. In addition, they can be used in wastewater treatment methods by producing low-cost biofilters and obtaining activated carbon from the rachis. Furthermore, nanometric fibers commonly used in nanotechnology applications and silver nanoparticles useful in therapeutic cancer treatments can be produced from banana pseudostems.[7].

The review aims to demonstrate the contribution of the recovery of banana production waste loss towards a circular economy that would boost the world's economy [6].



Figure 4 banana pseudosten wastage

- **VALUE ADDED OF BANANA PSEUDOSTEM**

The fiber is usually used due to its lightweight and comfort. Furthermore, banana pseudo-stem fiber is also utilized to produce cushion covers, bags, tablecloths, curtains, and others[20][21]. Additionally, there are some potential uses of banana fibers, such as: to be used as natural absorbent, for the production of mushrooms, arts/handicrafts, string thread, paper cardboard, tea bags,

high-quality textiles/fabric materials, currency note paper, and many other products [4].Organic Liquid Fertilizer, a patented product of Navasari Agricultural University, is made from organic inputs, suitable for organic farming. It can reduce chemical fertilizer use by 20-40% with a 10-15% yield increase [18]. Banana pseudostem byproducts include compost, vermicompost, paper, and microcrystalline cellulose, along with value-added products like rope, cordage, fishing nets, mats, packaging materials, textiles, bags, tablecloths, handicrafts, absorbents, and polymer/fiber Xi L, Qin D, An X, Wang G. Resistance of natural bamboo fiber to microorganisms and factors that may affect such resistance [19]. BioResources. 2013; 8:6501-6509composites [13]. The central core can be used for making pickles, candies, and soft drinks, and the pseudostem sap can serve as a mordant for fixing color and as an organic liquid fertilizer[1][19].



Figure 3 Banana pseudostemvalue-added product

IV. CONCLUSION

Banana (Musa sp.) is a widely cultivated fruit globally and in India, accounting for about 29% of the world's production with an average yield of around 60 tons per hectare. Banana pseudostems have diverse applications, being rich in dietary fiber and used for textiles, paper, and handicrafts. Manual extraction of fibers from banana pseudostems is labor-intensive but yields superior-quality fibers compared to mechanical extraction methods. Developing a low-cost, efficient banana pseudostem processor for domestic use is essential for waste management and sustainable agriculture. This review explores the innovation, challenges, technological aspects, optimization strategies, and the broader implications of this development for a sustainable future.

V. REFERENCES

1. Processing of banana pseudo stem into value-added products- Attempts for waste to wealth (Haribhau Jawale, Dr. R. M. Chaudhari, Sep 2013)

2. Banana Pseudo stem: properties nutritional composition and use as food (Jun Ma, September 2015)

3. Design and Development of Cutting Unit for the Banana Pseudo Stem by using a Power Screw Mechanism (*Shubham Pandey, Received 11 September 2022, Accepted 25 October 2022)*

4. Modelling of banana fiber extraction machine, (Mada Rukmi Sai Rupa Sri and Ankitha, CVR Journal of Science and Technology, vol 19, Dec 2020)

5. Banana pseudostem fiber: A critical review on fiber extraction, characterization, and surface modification PratikhyaBadanayaK,**Seiko Jose,** Gautam Bos31 Jan 2023.

6. Badrinath, R., and T. Senthilvelan. 2014. Comparative investigation on mechanical properties of banana and sisal reinforced polymer-based composites. *Procedia Materials Science* 5:2263–72. doi:10.1016/j.mspro2014.07.444.

7. Basak, S., S. Saxena, S. K. Chattopadhyay, R. Narkar, and R. Mahangade. 2016. Banana pseudostem sap: A waste plant resource for making thermally stable cellulosic substrate. *Journal of Industrial Textiles* 46 (4):1003–23. doi:10.1177/1528083715591580.

8. Benedetto, R. M. D., M. V. Gelfuso, and D. Thomazini. 2015. Influence of UV radiation on the physical-chemical and mechanical properties of banana fiber. *Materials Research* 18 (2):265–72. doi:10.1590/1516-1439.371414.

9. Jagadeesh, P., M. Puttegowda, S. MavinkereRangappa, and S. Siengchin. 2021. A review on extraction, chemical treatment, and characterization of natural fibers and its composites for potential applications. *PolymerComposites* 42 (12):6239–64. doi:10.1002/pc.26312.

10. Jayaprabha, J. S., M. Brahmakumar, and V. B. Manilal. 2011. Banana pseudostem characterization and its fiber property evaluation on physical and bioextraction. *Journal of Natural Fibers* 8 (3):149–60. doi:10.1080/15440478.2011.601614.

11. Paramasivam, S. K., D. Panneerselvam, D. Sundaram, K. N. Shiva, and U. Subbaraya. 2020. Extraction, characterization and enzymatic degumming of banana fiber. *Journal of Natural Fibers* 19:1–10. doi:10.1080/15440478.2020.1764456.

12. Jagadeesh, P., M. Puttegowda, S. MavinkereRangappa, and S. Siengchin. 2021. A review on extraction, chemical treatment, and characterization of natural fibers and their composites for potential applications. *Polymer Composites* 42 (12):6239–64. doi:10.1002/pc.26312.

13. Basak S, Saxena S, Chattopadhyay S, Narkar R, Mahangade R. Banana pseudostem sap: A waste plant resource for making thermally stable cellulosic substrate. Journal of Industrial Textiles. 2016;46:1003-1023

14. Liping, Z., Lixin, Z. and Weiqiang, Z. (2018). Fertilizer feeding mechanism and experimental study of a spiral grooved-wheel fertilizer feeder. *Journal of Engineering Science and Technology Review, 11*(6).

15. Ghosh, P., A. K. Samanta, and G. Basu. 2004. Effect of selective chemical treatments of jute fibre aimed at improved textile-related properties and

processibility. *Indian Journal of Fibre and Textile Research* 29 (3):85–99.

16. Karpuschewski, B., Kundrak, J., Varga, G., Deszpoth, I. and Borysenko, D. (2018). Determination of specific cutting force components and exponents when applying high feed rates. 8th CIRP Conference on High-Performance Cutting, Elsevier, 77, 30-33.

17. Mondal, M., & Sharma, A. K. (2021). Banana pseudostem fiber: A review on its extraction, processing, and applications. In Sustainable Natural Fibers (pp. 201-231). Springer, Cham.

18. Bello K, Sarojini BK, Narayana B, Rao A. A study on adsorption behavior of newly synthesized banana pseudo-stem derived superabsorbent hydrogels for cationic and anionic dye removal from effluents. Carbohydrate Polymers. 2018;181:605-615.

19. Phirke NV, Patil RP, Chincholkar SB, Kothari RM. Recycling of banana pseudostem waste for economical production of quality banana. Resources, Conservation and Recycling. 2001;31:347-353

20. Vigneswaran C, Pavithra V, Gayathri V, Mythili K. Banana fiber: Scope and value added product development. Journal of Textile and Apparel, Technology and Management. 2015;9:1-7

21. Khalil HSA, Alwani MS, Omar AKM. Chemical composition, anatomy, lignin distribution, and cell wall structure of Malaysian plant waste fibers. BioResources. 2007;1(2):220-232

22. Osorio L.L.D.R., Flórez-López E., Grande-Tovar C.D. The Potential of Selected Agri-Food Loss and Waste to Contribute to a Circular Economy: Applications in the Food, Cosmetic and Pharmaceutical Industries. Molecules.2021;26:515.doi:10.3390/molecules26020515

23. FAO. (2020). The State of World Bananas. Rome, Italy: Food and Agriculture Organization of the United Nations.

24. Mukhopadhyay S, Fangueiro R, Arpac Y, Şentürk Ü. Banana fibers—Variability and fracture behaviour. Journal of Engineered Fabrics & Fibers. 2008;3(2).

25. Anonymous (2021). FAO Statistics Food and Agricultural Organization Statistics.

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Abstract **- This work discusses the development of voice-based gender recognition. Speech recognition is used in many different applications, such as video categorization with tagging, gender classification of phone calls, and human-machine interaction. Deep learning is currently a prominent trend that has been widely used in many different disciplines and applications, taking advantage of the advantages of electronic media's storage capacity as well as recent advancements in digital technologies. In an effort to create classifiers with higher accuracy, recent research has concentrated on combining semi-supervised learning frameworks with ensemble learning techniques. The goal of the paper is to use the convolution neural network technique (CNN) with ResNet18, ResNet50, and voice recognition to identify gender. Our initial numerical tests show the suggested algorithm's categorization effectiveness in terms of accuracy. When compared to ResNet18 and CNN, which have 90% and 87% of gender classification accuracy, whereas Resnet50 has a high accuracy of 92%, which led to the creation of stable and robust predictive models.**

Keywords – Speech recognition, Deep learning algorithms, Gender classification

I. INTRODUCTION

Voice communication is ubiquitous across the globe, serving as one of the primary means through which people interact. Within the realm of voice recognition, the ability to discern an individual's gender is a notable application. The human voice encapsulates a diverse array of linguistic components, collectively forming what are known as voiceprints, which can be utilized to identify the gender of a speaker. Leveraging recorded voice data, a system processes these vocal characteristics to extract pertinent information, enabling the classification of gender based on sound analysis [1]. The human voice stands out as a paramount channel for interpersonal communication, offering a rich tapestry of environmental, biological, and regional cues. Within its output lies a wealth of information, ranging from linguistic factors such as language and accent to more nuanced aspects like age, emotion, and even current physical condition. Gender recognition, therefore, emerges as a methodical approach to delineating gender classifications through the analysis of voice signals. [6].

Central to gender recognition is the interpretation of speech signals to discern the gender category of a speaker. This involves extracting acoustic properties from recorded speech, including parameters such as frequency, duration, intensity, and filtering. Such attributes serve as the foundation for algorithms designed to classify gender, enhancing the efficacy of various applications ranging from voice-activated advertisements to human-computer interaction, emotion detection, person identification, and even gender-specific phone call sorting [2]. In the realm of gender recognition, the adoption of innovative methodologies such as the ensemble semi-supervised self-labeled algorithm has gained prominence. This approach focuses on harnessing voice data from both audio datasets and live sources to effectively discern gender. By employing a range of machine learning techniques for training datasets, this method demonstrates promising results in terms of classification accuracy, culminating in the development of robust prediction models [3].

Voice-based gender recognition represents a pivotal area of research and development, with implications across numerous domains. The efficacy of such systems relies on the integration of advanced algorithms capable of processing and analysing voice data with precision. By leveraging semi-supervised self-labeled techniques, researchers aim to enhance the reliability and stability of gender recognition models, thereby enabling more accurate classification outcomes. The process of gender recognition hinges on the meticulous analysis of various acoustic features inherent in speech signals. These features serve as discriminative markers that allow algorithms to distinguish between male and female speakers. By examining patterns in frequency, duration, intensity, and spectral characteristics, researchers can develop models capable of accurately classifying gender based on voice data. In practical terms, the deployment of gender recognition systems holds significant potential across a myriad of applications.

Voice-activated web advertisements, for instance, can benefit from targeted messaging tailored to the gender of the user. Similarly, in human-computer interaction scenarios, recognizing the gender of the user can enable more personalized and intuitive interfaces. Emotion detection systems can also leverage gender recognition to better understand and respond to the emotional states of individuals. Moreover, in tasks such as person identification and phone call sorting, gender recognition plays a crucial role in enhancing efficiency and accuracy. By automatically categorizing callers by gender, call centers can optimize their routing algorithms to ensure that calls are directed to the most appropriate agents, thereby improving overall customer experience.

II. RELATED WORKS

Mohd, Ali Yusnita, et al. (2022) Two recommended feature extraction techniques for obtaining important features from the voice data are LPC and MFCC. The dataset includes 1116 speech samples of speakers' brief utterances that were gathered using a 16 KHz sampling frequency and 12 distinct vowel words per sample. Two techniques for classification are developed: discriminative analysis (DA) and artificial neural networks (ANN). The retrieved features are employed by the constructed algorithm. Both feature extractions performed well in the categorization model. However, MFCC performs better than LPC in both DA and ANN models. It has been observed that the MFCC's accuracy for classifying gender in DA and ANN is 95.16% and 97.07%, respectively.

ResNet 34 and ResNet 50 are pre-trained algorithms, while Deep Neural Network (DNN) is a recommended deep learning technique (Alnuaim Abeer Ali et al., 2022). The Mozilla dataset was subjected to feature extraction techniques such as MFCC, Mel spectrogram, Chroma STFT, Tonnetz, and special contrast. To extract the gender attributes that are most pertinent, the dataset is filtered. Machine learning and DNN algorithms are trained using the hand-crafted voice characteristics. In comparison to other machine learning techniques, the DNN classification obtained 95.97% accuracy based on the model's result. ResNet 34 and ResNet 50 are trained using spectrogram pictures from audio data. ResNet34 and ResNet50 obtained 97.94% and 98.57% accuracy, respectively, using spectrogram images. SVD yielded a performance evaluation of 72.74% while RAVDESS yielded a 91.5% for ResNet50.

Using gathered speech samples, Singhal et al.'s (2023) deep learning technique uses RNN-BiLSTM to classify speakers' genders. Three genders are represented in the speech sample dataset: male, female, and transgender. The most common use of MFCC is the extraction of important features from voice signals. To identify three genders, MFCC characteristics are retrieved, and RNN-BiLSTM is used for classification. The BiLSTM algorithm uses voice data to gather and store input features from extracted features at a certain time period in the past and future. The proposed model is optimized using the Adam optimization technique, which also raises the algorithm's learning rate. Based on the classification algorithm, the accuracy attained is 95.52%, the precision is 95.35%, and the error factor is 0.045%.

A more sophisticated LSTM algorithm was created by Ertam et al. (2019) for the purpose of classifying and identifying gender in speech samples. Acoustic properties are collected from speech samples and the public voice dataset is sourced from Kaggle. By determining the weight values of the retrieved features, the Relieff-based approach chooses only the most useful features to feed into the deeper LSTM algorithm. The algorithm's performance is improved by using a two-layer LSTM architecture, putting the final LSTM layer in last place, and using softmax as the activation function. The previous LSTM layer's output mode is set to sequence. When compared to machine learning techniques (KNN, SVM with different activation functions, linear regression, fine tree, and linear discriminant), the suggested classification method produces 98.4% more superior results in determining the gender.

Das Manmath Nath et al. (2022) successfully classified speaker gender using a Deep Learning Convolutional Neural Network (DLCNN). Spectral subtraction is a preprocessing technique used to remove noise from the RAVDESS dataset. The developed algorithm is trained and tested by extracting MFCC features from target audio recordings. The neuron weights of the algorithm are determined by the MFCC features. The algorithm makes use of the ReLU activation layer and the cross-channel normalization layer. 98.33% accuracy in gender identification was attained by the DLCNN.

Machine learning and deep learning (CNN) approaches are proposed by Jaleel et al. (2022). Voice samples are used to extract the following four features: The CMU ARCTIC dataset comprises wave files at a sampling rate of 16 KHz. Mean, Standard Deviation, Zero-Crossing Rate, and Amplitude are merged with 12 extracted characteristics by applying MFCC from speech samples. Single feature vectors are created by combining the extracted features. Machine learning techniques are outperformed by the CNN classifier in terms of precision, recall, and F1-measure metrics. The CNN classifier performs better than

machine learning methods in terms of F1-measure parameters, recall, and accuracy.

III. MATERIALS AND METHODS

In order to extract spatial and temporal information from voice samples, deep learning algorithms are built. This study uses ResNet18, ResNet50 and CNN to classify gender (male and female) based on speech recordings. The collected audio files are converted into the spectrogram images by undergoing the pre-processing. As a further step, ResNet18, ResNet50 and CNN algorithms are trained and tested on the extracted features of both genders to recommend a more fine-tuned method of feature extraction in order to provide an effective gender identification.



Fig. 1 Block Diagram of Proposed Method

The proposed method focuses on collecting speech samples of male and female. The speech samples are pre-processed using window hamming, Nfft to obtain spectrogram images. Then modeling deep learning algorithms to classify the genders based on the given spectrogram images.

A. DATABASE

For speaker recognition systems, the Voxforge voice dataset is an invaluable tool. Researchers examining the characteristics of human speech can also benefit from it. Voxforge is an open-source collection of both male and female voice samples. The dataset was acquired from a repository database. English voice samples of speakers can be retrieved in the Voxforge collection. For this research, voice samples of 200 males and 200 females at a 16 KHz sampling rate are collected for gender classification.

B. ALGORITHM

ResNet 18 and ResNet 50

ResNet 18 and ResNet 50 algorithms are designed to automatically recognize the speaker's gender from spectrogram images. To overcome the vanishing gradient problem and create networks with thousands of convolutional layers that perform better than shallower networks, the Residual Network (ResNet) architecture was developed. The fundamental units of ResNet networks are residual blocks. ResNet adds intermediate inputs to the output of a collection of convolution blocks to enable the creation of very deep convolutional structures. Skip connections reduce the number of layers in the network, which speeds up initial training. The purpose of skip connections is to ensure that significant features in the spectrogram images are retained until the last layers. As a result, they do not increase the network's computational load. Computer vision applications like object identification and image classification require extensive use of these networks. Their effectiveness in identifying intricate patterns in images. Convolutional layers with 3x3 filter size, batch normalization, ReLU activation functions, and Four residual blocks with two convolutional layers activated by ReLU and batch normalization in each that comprise the ResNet18 algorithm. Whereas ResNet-50 is made up of 50 layers and it consists of multiple residual blocks with varying depths. Each residual blocks typically contain multiple convolutional layers with 1x1, 3x3, and 1x1 kernel sizes. Global Average Pooling Layer reduces the feature maps' spatial dimensionality to 1x1 and calculates the average of each feature map to aggregate spatial data. Finally, the fully connected layer classifies the data using the features extracted by the previous layers to classify the gender of a speaker.

CNN

To classify the speaker's gender, a Convolutional Neural Network (CNN) effectively extracts features from spectrogram images. CNN utilize several layers, each layer extracts unique characteristics from an input image. The spectrogram images are fed as input data to the Convolutional 2D with 32 filters and 3X3 filter size along with ReLu as an activation layer. By using batch normalization, each layer of the network can learn independently. It is utilized to normalize the output from the previous layers and it may also be used as regularization to prevent overfitting of the model. In addition to helping the neural network extract important features from the input, max pooling with 1x1 stride and 5x5 pooling size layer reduces the data's dimensions. The classification is carried out by the fully connected layer using the characteristics that are retrieved from the previous layers is shown in Fig.2. Softmax tends to be used as the network's last layer. It produces a classification prediction after obtaining as input the final representation of the data.

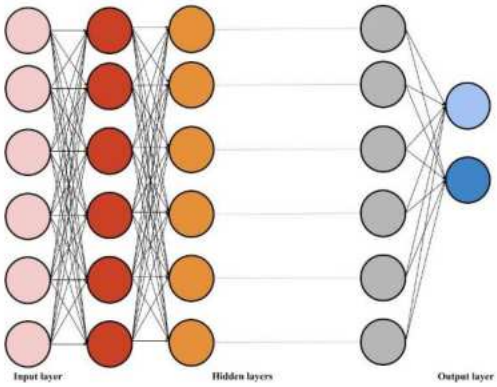


Fig. 2 CNN Architecture

IV. RESULT AND DISCUSSION

Automatically classifying a speaker's gender from their voice signal is essential for many applications, including call routing optimization based on gender, personalizing services and responses based on the caller's gender, advertising through voice assistants, gender analysis of population statistics, and indexing multimedia content. Both male and female audio files are converted into spectrogram image. The speaker gender categorization is shown in Fig. 3, 4 & 5 for ResNet18, ResNet50 & CNN demonstrates the ResNet50 algorithms. The proposed algorithms are trained by normalizing the retrieved characteristics using the mean and standard deviation. The algorithm is trained up to 30 epochs. ResNet18 obtained 90 % whereas ResNet50 obtained 92% and CNN obtained 87% of accuracy in gender classification, respectively.

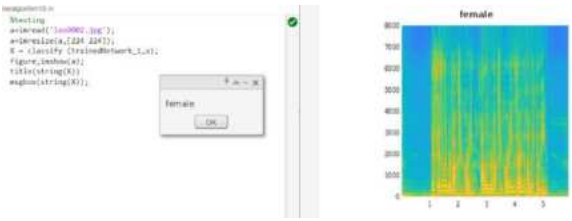


Fig. 3 Gender Classification using ResNet18



Fig. 4 Gender Classification using ResNet50

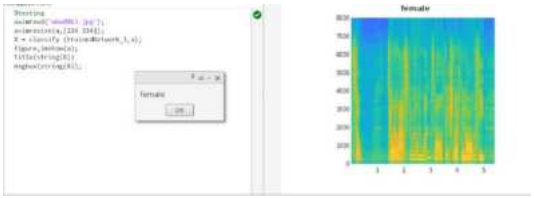


Fig. 5 Gender Classification using CNN

V. CONCLUSION

Thus, the model produced demonstrates that it is possible to identify the gender of a voice using the acoustic characteristics of speech and voices. We have considered the accuracy of the various algorithms utilized by different surveyors based on our review of the literature. After looking over the algorithm's architecture, we made the decision to create a more accurate voice gender model ourselves. Our main goal is to create a model that is more accurate than the one that was created earlier. One of the main issues in the field of signal processing is gender identification. The technology uses vocal traits to determine an individual's gender. Certain aspects of human voice indicate that identifying a person's gender is based on more than just their frequency and pitch. The hardest issue to solve is choosing features from a large variety of characteristics, which serves as a discriminating element in determining an individual's gender. The suggested approach uses deep learning techniques to identify gender from speech. Hence we decided to use three algorithms ResNet18, ResNet50 and CNN. In the further preceding will implement the steps to build a model and check the accuracy on gender recognition by voice utilizing a new ensemble semi-supervised convolution neural network algorithm. Our preliminary numerical experiments demonstrate the classification efficiency of the proposed algorithm in terms of accuracy.

VI. REFERENCES

1. Alnuaim, Abeer Ali, et al. "Speaker gender recognition based on deep neural networks and ResNet50." Wireless Communications and Mobile Computing 2022 (2022): 1-13.

2. Majkowski, Andrzej, et al. "Identification of gender based on speech signal." 2019 IEEE 20th International conference on computational problems of electrical engineering (CPEE). IEEE, 2019

3. Zhang, Li-Min, et al. "A Deep Learning Method Using Gender-Specific Features for Emotion Recognition." Sensors 23.3 (2023): 1355.

4. Jayne, Chrisina, et al. "Automatic Accent and Gender Recognition of Regional UK Speakers." International Conference on Engineering Applications of Neural Networks. Cham: Springer International Publishing, 2022.

5. Buyukyilmaz, Mucahit, and Ali Osman Cibikdiken. "Voice gender recognition using deep learning." 2016 International Conference on Modeling, Simulation and Optimization Technologies and Applications (MSOTA2016). Atlantis Press, 2016.
6. Alamsyah, Rangga Dwi, and Suyanto Suyanto. "Speech gender classification using bidirectional long short term memory." 2020 3rd International Seminar on Research of Information Technology and Intelligent Systems (ISRITI). IEEE, 2020
7. Ertam, Fatih. "An effective gender recognition approach using voice data via deeper LSTM networks." Applied Acoustics 156 (2019): 351-358.
8. Alnuaim, Abeer Ali, et al. "Speaker gender recognition based on deep neural networks and ResNet50." Wireless Communications and Mobile Computing 2022 (2022): 1-13.
9. Alkhawaldeh, Rami S. "DGR: gender recognition of human speech using one-dimensional conventional neural network." Scientific Programming 2019 (2019).

10. Chaudhary, Shivam, and Davendra Kumar Sharma. "Gender identification based on voice signal characteristics." 2018 International conference on advances in computing, communication control and networking (ICACCCN). IEEE, 2018

HEALTH CARE HUMANOID CHATBOT IN FORENSIC INVESTIGATION

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Abstract - Healthcare humanoid chatbots are a cutting-edge approach to solving problems in forensic investigations, particularly when it comes to the necessity for effective medical knowledge and documentation of evidence. Healthcare humanoid chatbots present a viable way to enhance the forensic investigation process, given the increase in forensic cases and a shortage of forensic specialists. These chatbots, which use artificial intelligence and natural language processing, offer medical advice, triage services, documentation of evidence, and decision assistance to patients and investigators. These chatbots improve patient engagement and assistance by combining humanoid traits with sympathetic communication skills. This allows patients, criminals, investigators, and forensic professionals to collaborate and communicate effectively. This paper discusses the idea on investigating how healthcare humanoid chatbots function in forensic investigations, emphasizing how they might improve workflow, increase efficiency, and improve outcomes in forensic healthcare settings.

Keywords: Artificial intelligence, Healthcare chatbot, DCNN, forensic investigations

I. INTRODUCTION

Chatbots facilitate communication using a text or voice interface and obtain information from artificial intelligence without any face interaction[1]. Chatbots are often used in ecommerce customer service, call centers, and online gaming. Chat bots are computer programs that respond to messages automatically. We use machine learning to adapt their responses to fit the situation as well as respond differently each time for messages containing specific keywords. Online Chat bots are used by an increasing number of hospitals, nursing homes, and even private centers to provide human services on their online sites. Creation of chatbot is practical way in this modern era with lot of new possibilities and innovations [2]. These bots communicate with users on the site, assisting them in finding specialists and securing the appropriate solution. We ought to create a machine learning model which can accept any text input and analyse the symptoms based on the training data. To train the model with data sets containing various diseases, medical conditions, case studies on crimes in CSV files, a Supervised DCNN machine learning algorithm could be used. The dataset comprises a CSV file which already includes a list of all diseases. The DCNN algorithm in Machine Learning allows us to process information easily even synchronous speechs making criminal emotions to bring the answers out esily [3-4]. The goal is to model the data's underlying structure or utilisation in order to get information out of the training set. In any case, the use of artificial intelligence in a sector where people's lives are at stake raises concerns. It raises the question of whether the above-mentioned task should be delegated to humans. This healthcare chatbot system will assist hospitals and CB-CID in providing online healthcare support 24/7 a week. It answers both complex and basic questions. It also assists in the generation of leads and the automatic delivery of lead information to sales. By asking questionnaires in order, it guides the patient in evaluating what he or she is looking for.

II. LITERATURE SURVEY

Here we considered the study summery on number of proceedings based on chatbot interface, NLU Engine, review on word segment, POS Tagging, dependency parsing, synonym and pattern recognition, decision and machine learning of chatbot.

The paper suggested to replace usual human machine interaction mechanism with an approach that leverage a chatbot program, design and trained in order to act and interact as a human begin [5]. Chatbot have limited response so they are not often able to answer multiple part questions. In this paper the sentence that is the most similar to the user sentence is chosen. The informationgain is then calculated using the extracted synonym sets for that clause of characteristics [6]. The strongest synonym extracted is the one that yielded the most information. This method takes longer and involves greater storage and complexity. A Chatbot uses natural language to get vast information available in the system, it detects the human message pattern using AIML (Artificial Intelligence Mark-up Languages) based on XML to built with AI Application. Machine learning features transform a static and simple FAQ system into a smarter and more individualized communication experience [7]. The machine learning layer extends the capabilities of chatbots that deliver services across multiple domains. This study explores the effectiveness of a chatbot called AICI, which uses AI and cognitive interview to record statements after an incident. The AI CI elicited more accurate information than other tools, including Free Recall, CI Questionnaire, and CI Basic Chatbot [8]. This suggests that AI CI offers an alternative method for efficiently recording high-quality evidentiary statements from victims and witnesses. This document discusses the planning and implementation of a chatbot, which is used in various sectors. The main goal is to efficiently register an F.I.R. through an Android-based bot, providing a user-friendly interface for crime information and reporting [9]. The system handles all operations, generates reports, and allows police to access them through a separate portal for action. The study explores the use of text-based healthcare chatbots (THCB) to support patients and health professionals in therapeutic settings beyond on-site consultations [10]. An open-source THCB system was designed for a childhood obesity intervention, showing promising results in intervention adherence, scalability, and perceived enjoyment and attachment bond between patients and THCB.

III. PURPOSE

This paper discusses a prototype chatbot idea training with symptoms to predict the condition of the patient. Let see the bot in detail.

A. *Scope*

The "Healthcare Humanoid Chatbot in Forensic Investigation" project aims to create a chatbot system for forensic healthcare, providing medical advice, triage services, evidence documentation, and decision support. The system will integrate with existing systems, undergo rigorous evaluation, and comply with regulations, enhancing patient care and forensic healthcare. Chatbots, which are essentially virtual robots, never get tired of following your commands. Chatbots, which are essentially virtual robots, never get tired of following your commands.

B. *Expected Scheme*

The DCNN algorithm in Machine Learning helps us to process data quickly. The aim is to model the data's underlying structure or distribution in order to gain more insight from the training collection. In either case, the use of artificial intelligence in a field where people's lives are at risk raises concerns. It raises the question of whether the above-mentioned duty should be delegated to humans.

IV. PROJECT ANALYSIS

A. *Review of literature*

The scheme's main goal is to train the prototype with symptoms and diseases to identify the conditions for the person during investigation and provide medical conditions and to record the investigation session both video and script. Investigator finds free to deal with the criminal cases without the help of doctor at particular time of requirement.

B. *Dataset Details*

The dataset includes explanations of various diseases, medical condition, case study and prediction-based analysis. These collections should contain explanations of a particular disease from various physicians, hospitals, and other sources. A Sequence from over 133 illnesses, physicians, and hospitals were documented to establish the dataset.

C. *Methodology Used:*

The Healthcare Chatbot System should be written in Python and provide GUI links as well as a basic network API. The device must be scalable in terms of the number of surface processors, tablets, or displays connected at any given time. Individual computer failure can also be handled seamlessly by the end system, with no data loss. All machine operations must be logged as part of a strong audit chain. Although interfaces are essential, this system is likely to adhere to the available options. With that in mind, the most adaptable and compact technologies for implementation should be used. Since it is a live machine, the system has criticality. Customers must not know if the system is down, or must notice if the system recovers quickly (seconds). The system must be consistent enough to run, crash, and glitch-free for an extended period of time, or provide good error recovery so that errors are never exposed to end-users.

D. *Block diagram*

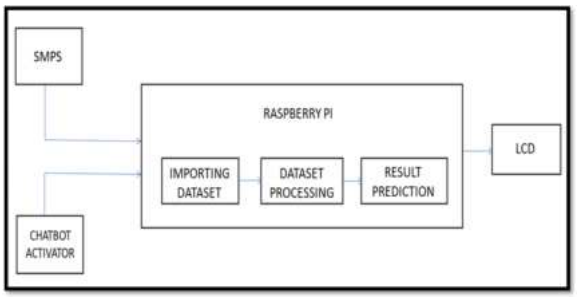


Figure 1: Block diagram

E. *Explanation*

The Raspberry Pi is interfaced with a chatbot activator button and once the button gets activated and the chatbot starts asking the question. Once we start replying to the question the Raspberry Pi performs Machine learning and compares the answers with the symptom database. If any of the symptoms matches the respective symptom is shown through LCD and the chatbot also suggests the Respective doctor to visit.

F. *Hardware and Software Requirements*

- ✓ Raspberry Pi
- ✓ Button
- ✓ SMPS
- ✓ LCD Display
- ✓ Python IDE

G. *Experimental Setup:*

The overall purpose is to bridge the gap between investigator and healthcare professionals by providing timely responses to questions raised by investigator. People nowadays are more likely to just be addicted to the internet, but they are indifferent about their own health. People avoid going to the hospital for minor issues which might turn into a major disease in the future. Rather than surfing the internet through a list of potentially relevant documents from the site, developing question-and-answer forums is becoming a simple way to answer those requests. Many existing systems have failings, such as the patients don't really receive an immediate response and should wait a long time for experts to acknowledge their concerns. Some of the processes may require payment to communicate with doctors online via live chat or telephony. The goal of this system is to mimic a person's conversation.

V. RESULT

Without a well-thought-out testing effort, the project will almost likely succeed and have an adverse influence on the solution's cumulative performance outcomes. Support and maintenance costs will shoot

through the roof if a solution isn't thoroughly tested, and the solution's reliability will endure. As a consequence, it's important to keep in mind that testing is a prerequisite, not just a last-minute task.

The python script for the chatbot system is executed in Raspberry Pi. First all the testing and Training data is imported. Once the Program gets executed, the chatbot asks questions. Once the question and answer is done it prints the possibilities and also suggests the recommended for the problem.

VI. REFERENCES

[1] Chin-Yuan Huang, Ming-Chin Yang, Chin-Yu Huang, "A Chatbot-supported Smart Wireless Interactive Healthcare System for Weight Control and Health Promotion", proceeding of the IEEE, April-2018.

[2] He, J, Baxter, SL, Xu, J, et al. The practical implementation of artificial intelligence technologies in medicine. Nat Med 2019; 25(1): 30–36.

[3] Hoermann, S, McCabe, KL, Milne, DN, et al. Application of synchronous text-based dialogue systems in mental health interventions: Systematic review. J Med Internet Res 2017; 19(8): e267.

[4] Oh, KJ, Lee, D, Ko, B, et al. A chatbot for psychiatric counseling in mental healthcare service based on emotional dialogue analysis and sentence generation. In *18th IEEE International Conference on Mobile Data Management (MDM), 2017*. IEEE, 2017, pp.371–375.

[5] Flora Amato, Stefano Marrone, "Chatbots meet eHealth: automat zing healthcare", proceeding of diet, May-2018.

[6] BenildaEleonor V. Comendador, "Pharmabot: A pediatric generic Medicine consultant Chatbot", proceeding of the JACE, April 2015.

[7] Divya, Indumathi, Ishwarya, Priyasankari, "A SelfDiagnosis Medical Chatbot Using Artificial Intelligence", proceeding MAT Journal, October-2017.

[8] Minhas, R., Elphick, C., & Shaw, J. (2022). Protecting victim and witness statement: examining the effectiveness of a chatbot that uses artificial intelligence and a cognitive interview. *AI & SOCIETY*, 1-17.

[9] Singh, D., Jariwala, H., Kamli, N., Mehta, V., & Patel, J. (2022). FIR Registration Using Chatbot. *International Journal of Innovative Research in Engineering & Management*, *9*(2), 331-337.

[10] Tobias Kowatsch," Text-based Healthcare Chatbots Supporting Patient and Health", 01 October 2017.

Detection of Blood Group using Saliva

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***Abstract*— Blood group is the fundamental aspect used in various diagnosis of abnormalities and organ compatibility. The conventional method of blood group detection involves uncomfortable process of collecting the blood using needle inducing pain and might lead to infections or other needle borne diseases. To replace this usual method, detection of blood group using saliva is deployed where fresh samples of saliva is collected from the patient to detect their blood group. This is possible as, the antigens that mark the group of blood is observed to exist in 80% of the population's saliva. The presence of antigens in the saliva helps to determine the group of blood.**

Keywords— ***pH electrode, Electrical Conductivity electrode, Saliva, Blood Group.***

I. INTRODUCTION

Biological antigens and saliva are closely related and have great potential in the world of medical and forensic investigations. Saliva, often overlooked, provides valuable insights into an individual's blood group, offering a non-invasive and convenient alternative to traditional blood sampling. This study aims to demonstrate the reliability of ABO blood group determination and Rh typing from salivary samples, paving the way for more comfortable and efficient blood examinations, particularly in children who experience needle phobia.

The implications of this research extend to both medical diagnostics and forensic science, where saliva plays a pivotal role in revealing critical information about an individual's blood group, thereby enhancing the accessibility and effectiveness of such investigations.

Blood groups vary from A, B, O, and AB with positive and negative rhesus for the respective types. These blood groups are usually identified with the help of performing chemical procedures such as the absorption inhibition method. This same procedure is applied to saliva samples and observes an 80% success rate in blood type detection.

Using a saliva sample, around 80% of people can determine their blood type due to the presence of relevant antigens, according to 2018 research.

However, it's important to note that not everyone secretes these antigens, and the method may not indicate the presence or absence of the Rh factor.

I. SAMPLE COLLECTION

A. Collection of saliva sample

To acquire accuracy and reliability, meticulous procedures are employed to collect fresh saliva samples from individuals.

Before collecting saliva, the person from whom the saliva is collected is asked to rinse their mouth and the first saliva collected is washed off. And the second collected saliva is collected for testing.

II. METHODOLOGY

These samples are carefully gathered in sterilized petri dishes, a critical measure taken to prevent errors and contamination that could compromise the integrity of the research. The utilization of sterilized equipment ensures that the collected saliva remains free from external influences, allowing for precise analysis and interpretation of the data obtained.

A significant aspect of this project revolves around the observation of variations in pH among different blood types. pH, a measure of the acidity or alkalinity of a solution, emerges as the primary variable under scrutiny due to its fundamental role in physiological processes. Notably, subtle differences in pH levels have been observed across various blood types, prompting further investigation into their implications and underlying mechanisms. Understanding these variations holds potential insights into individual health profiles and predispositions to certain conditions.

To accurately assess the pH levels of fresh saliva samples, a pH probe is employed as the primary instrument of measurement. This specialized device offers the capability to obtain magnified raw pH data with precision and clarity. By interfacing directly with the saliva samples, the pH probe generates real-time readings that capture the nuanced pH variations present within each sample. This granular level of detail enables researchers to discern even the slightest shifts in acidity or alkalinity, facilitating comprehensive analysis and interpretation of the data.

The utilization of a pH probe represents a crucial component of the experimental methodology, providing researchers with a reliable means to investigate the pH

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dynamics of fresh saliva samples. Through meticulous observation and analysis, the project aims to elucidate the intricate relationship between blood types and pH levels, shedding light on the physiological nuances that contribute to individual variability. Ultimately, the insights gleaned from this research endeavor have the potential to inform future studies in fields ranging from personalized medicine to preventive healthcare strategies, paving the way for advancements in our understanding of human physiology and health.

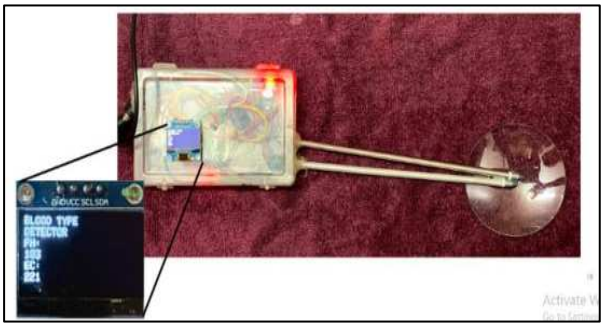


Fig. 1: Electrode placement in saliva sample

Electrical conductivity measurements can provide valuable insights into the detection of blood groups using saliva due to the distinct electrolyte compositions associated with different blood types. Saliva, like blood, contains various electrolytes such as sodium, potassium, chloride, and bicarbonate ions, which contribute to its conductivity. These electrolytes play a crucial role in maintaining the pH balance and overall electrolyte concentration within the body.

Each blood type has a characteristic electrolyte composition, which may result in subtle differences in electrical conductivity between saliva samples from individuals with different blood groups. By measuring the conductivity of saliva samples, it may be possible to identify patterns or correlations between conductivity values and specific blood types.

The detection process could involve collecting saliva samples from individuals with known blood types and measuring their electrical conductivity using specialized equipment. Through careful analysis and comparison of conductivity measurements across different blood groups, researchers may identify unique conductivity signatures associated with each blood type.

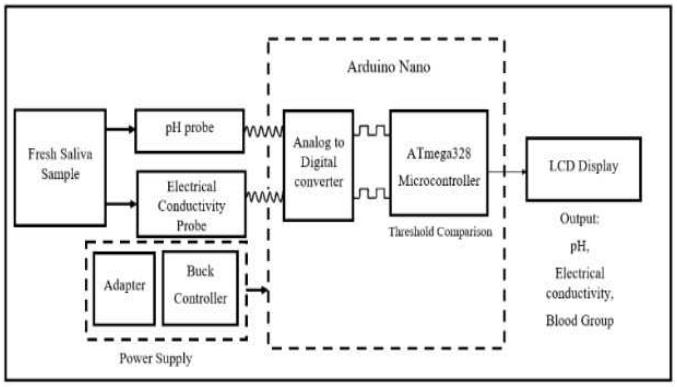


Fig. 2: Block Diagram

Additionally, advancements in technology, such as microfluidic devices or biosensors, could potentially enable rapid and non-invasive detection of blood groups using saliva. These devices could be designed to analyze conductivity levels in saliva samples and provide real-time feedback on the individual's blood group, offering a convenient and efficient alternative to traditional blood testing methods.

Overall, leveraging electrical conductivity measurements in saliva for blood group detection holds promise for facilitating non-invasive and potentially point-of-care diagnostic applications. Further research and development in this area could lead to the development of innovative technologies for rapid and reliable blood typing, ultimately benefiting clinical practice and healthcare delivery. organized into a tabulated format to facilitate in-depth analysis. Through careful observation and categorization, pertinent conclusions were drawn regarding the samples, likely relating to blood group determination. These conclusions serve as crucial inputs for an Arduino Nano system, employing comparator functions. When pH and electrical conductivity values are input into the system, it promptly processes this information to display the corresponding blood group. This innovative integration of biological data analysis with Arduino technology offers a streamlined and efficient method for determining blood groups.

Blood Group	***pH (Analog probe values)***	**Electrical Conductivity(mV)**	
		Rhesus (+)	***Rhesus (-)***
A	160-190	106-189	190-210
B	100-140		

Blood Group	*pH (Analog probe values)*	Electrical Conductivity(mV)	
		Rhesus (+)	*Rhesus (-)*
O	141-159		
AB	191-270		

Fig 3: Result Table

IV. ADVANTAGES

The project's primary advantage is its innovative use of saliva samples for blood group determination and Rh typing, eliminating the need for invasive blood draws. By offering a non-invasive and convenient alternative, it reduces patient discomfort, streamlines sample collection, and opens opportunities for population-wide studies. Additionally, the approach has implications in forensic science, aiding criminal investigations. Overall, this advancement enhances patient experiences, improves healthcare efficiency, and facilitates broader scientific research across medical and forensic fields.

V. CONCLUSION AND FUTURE WORK

In conclusion, this project highlights the significant potential of utilizing saliva samples for blood group determination and Rh typing. By offering a non-invasive alternative to traditional blood sampling methods, it enhances patient comfort and accessibility while maintaining reliability. Moving forward, future work could focus on refining detection methods to improve accuracy and reliability, expanding the scope of antigens analyzed, and exploring correlations between saliva composition and various health conditions. Additionally, further research could investigate the feasibility of implementing saliva-based diagnostics in clinical settings on a larger scale, ultimately advancing medical diagnostics and forensic investigation.

VI. REFERENCE

[1] Rajawat G, Ramalingam K, Pareek R, Singh G, Narula H, Aggarwal A. Assessment of Salivary ABO Blood Group Antigens and Secretor Status in Sriganganagar, Rajasthan: A Correlational Analysis of 300 Samples. Cureus. 2023 Apr 11;15(4):e37415.doi: 10.7759/cureus.37415. PMID: 37182010; PMCID: PMC10172881.

[2] Al-Mahmood, Sumayah A Al-Kaisy, Aedah Z., A Mahmood, Maha A., A Aldhaher, Zainab A., A Sabri, Abbas, The Prevalence of Streptococcus Mutans with Different ABO Blood Groups Among Healthy College Students, D 2020/02/18, *The Open Dentistry Journal.*

[3] Gilmiyarova, F., Kuzmicheva, V., Ryskina, E. A., Kolotyeva, N., Gusyakova, O., Baisheva, G., & Gilmiyarov, E. (2020). Saliva as a diagnostic tool for AB0 blood group determination. *Biomedical Journal of Scientific and Technical Research*,26(5), 20336-20339.

[4] Velani PR, Shah P, Lakade L. Determination of ABO Blood Groups and Rh Typing from Dry Salivary Samples. Int J Clin Pediatr Dent. 2018 Mar-Apr;11(2):100-104.doi:10.5005/jp-journals-10005-1493. Epub 2018 Apr

[5] Pawan Motghare, Lata Kale, Aarti Bedia, Sonal Charde PY - 2011/07/01 Efficacy and Accuracy of ABO Blood Group Determination from Saliva *Journal of Indian Academy of Oral Medicine and Radiology.*

[6] W Kim, Y.K Kim, S.C Chung, S.W Lee, H.S Kho, Detection of ABH blood group antigens in the saliva of Koreans and their stability according to storage of saliva samples, *Forensic Science International*, Volume 129, Issue 1, 2002.

[7] Kang, Jeong-Hyun, and Hong-Seop Kho. "Blood contamination in salivary diagnostics: current methods and their limitations." *Clinical Chemistry and Laboratory Medicine* (CCLM) 57.8 (2019): 1115-1124.

[8] Tejasvi, ML Avinash, et al. "Evaluation of the secretor status of ABO blood group antigens in saliva using absorption inhibition method." *Global Medical Genetics* 8.01 (2021): 019-023.

Facial Recognition System for Suspect Identification Using Surveillance Camera

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ABSTRACT: **The burgeoning field of law enforcement necessitates innovative solutions for managing the ever-increasing volume of criminal records. Traditional methods, often reliant on manual data entry and verification, struggle to keep pace with the growing demands. This project proposes a revolutionary approach that leverages the power of face recognition technology to streamline this critical process. By integrating a modified CNN DenseNet model within the Dlib library framework, the system facilitates the accurate identification of individuals with criminal records from a comprehensive database. Upon successful recognition, a seamless interface with a secure web application connected to the police portal enables real-time updates of criminal records. This integration fosters enhanced efficiency, improved accuracy, and streamlined collaboration between law enforcement agencies. The project's significance lies in its potential to revolutionize criminal record management, leading to faster investigations, improved public safety, and a more robust law enforcement infrastructure.**

Keywords: ***Face Recognition, Criminal Record Management System (CRMS), Dlib, CNN DenseNet, Law Enforcement, Real-Time Updates***

1. INTRODUCTION

Facial Recognition plays an important role in finding a specific person from multiple sources of the camera, which employs multiple subtasks like recognizing a human from an image, extracting the face from it, processing the face to identify the unique features of the face, and training the system to recognize similar faces to identify the same person. Therefore, the person to be searched can be identified and isolated to a specific region for further monitoring the persons to know about his/her activities and also whereabouts to pinpoint and track them. The various applications for facial recognition are searching for people lost in the crowd, looking out for terrorists and other criminal suspects who are in search by the police, monitoring little children by parents remotely, and so on. Effective criminal record management underpins efficient law enforcement operations. It provides a centralized repository of information on individuals involved in criminal activity, enabling background checks, investigation support, and informed decision-making by law enforcement personnel. However, traditional CRMS often struggle with the following challenges:

Manual Data Entry and Verification: Manual processes are time-consuming, prone to human error, and can lead to delays in data processing and retrieval.

Scalability Issues: Traditional systems often lack the scalability to accommodate the ever-growing volume of criminal records.

Data Accuracy: Inconsistent data entry practices and limited verification mechanisms can compromise the accuracy of information within the CRMS.

These challenges can significantly impede law enforcement investigations and response times. This paper introduces a novel approach that integrates face recognition technology for a paradigm shift in criminal record management. By leveraging facial recognition algorithms, the proposed system offers a robust and efficient solution, fostering significant improvements in law enforcement capabilities.

II. LITERATURE SURVEY

A comprehensive understanding of existing research is crucial for positioning the proposed system within the broader technological landscape. The literature survey will delve into three key areas:

Face Recognition Techniques: Facial recognition is a branch of artificial intelligence (AI) that deals with identifying or verifying an individual from a digital image or video frame. Over the past few decades, significant advancements have been made in this field. Deep learning algorithms, particularly Convolutional Neural Networks (CNNs), have demonstrated remarkable performance in facial recognition tasks. The survey will explore the strengths and limitations of CNN architectures, with a specific focus on the DenseNet model chosen for this project.

Criminal Record Management Systems: A review of existing CRMS will be conducted, analyzing their functionalities, limitations, and potential areas for improvement. The survey will focus on identifying shortcomings concerning efficiency, accuracy, and scalability in traditional systems.

Integration of Facial Recognition with Law Enforcement: Facial recognition technology has garnered increasing interest within the law enforcement domain. The literature survey will examine existing attempts at integrating facial recognition into the law enforcement framework, highlighting the successes achieved and the challenges encountered.

Facial Recognition Technology for Law Enforcement: URL facial recognition technology for law enforcement by the National Institute of Justice (NIJ)

III. METHODOLOGY

This section will delve into the technical details of the proposed system, outlining the system design, data acquisition, and preprocessing techniques, the modified CNN DenseNet model, and the real-time update mechanism.

System Design:

The system can be broadly divided into three modules:

A.Face Recognition Module: This module utilizes the Dlib library and a modified CNN DenseNet model to perform facial recognition on captured images or video feeds. Upon successful recognition, the system retrieves the corresponding criminal record from the database.

B.Criminal Record Database: This is a secure and centralized database that stores the facial images and corresponding criminal records of individuals. The database design should consider factors like scalability, security, and efficient data retrieval.

C. Web Application Interface and Secure Communication: A secure web application acts as an interface between the face recognition module and the police portal's CRMS. Upon successful facial recognition, the web application securely transmits the identified individual's information to the CRMS for real-time record updates. This communication utilizes secure protocols like HTTPS to ensure data integrity and confidentiality.

D. Data Acquisition and Preprocessing:

Building a comprehensive criminal record database is crucial for the system's effectiveness. Data acquisition methods may involve:

- Collaboration with law enforcement agencies to obtain mugshots and criminal information.
- Uploading existing data from legacy CRMS.
- Implementing a secure mechanism for authorized personnel to add new entries to the database.
- Data preprocessing techniques, such as facial landmark detection, normalization, and image enhancement, are essential for optimal performance of the face recognition model. These techniques ensure consistency in the data fed into the model, improving recognition accuracy.

E. Modified CNN DenseNet Model:

The project proposes a modified version of the DenseNet CNN architecture for facial recognition. DenseNets offer advantages like improved feature extraction and reduced vanishing gradients compared to traditional CNN architectures. The modifications will be tailored to the specific requirements of criminal record management, potentially focusing on:

Network Optimization: Optimizing the network structure (number of layers, filter sizes) for efficient processing and memory usage.

Loss Function Selection: Choosing an appropriate loss function (e.g., triplet loss) to train the model for accurate facial recognition under varying conditions.

Data Augmentation: Artificially expanding the training data by applying random transformations (e.g., rotations, scaling) to existing images to improve the model's generalization capabilities.

F.Real-Time Updates:

The secure web application interface facilitates real-time updates to criminal records upon successful facial recognition. This involves:

Secure transmission of the identified individual's information to the authorized CRMS access point.

Implementing access control mechanisms to ensure only authorized personnel can modify records.

Utilizing database update protocols that maintain data integrity and minimize downtime.

G. Evaluation and Results:

A thorough evaluation of the system's performance is essential to assess its effectiveness and identify areas for improvement

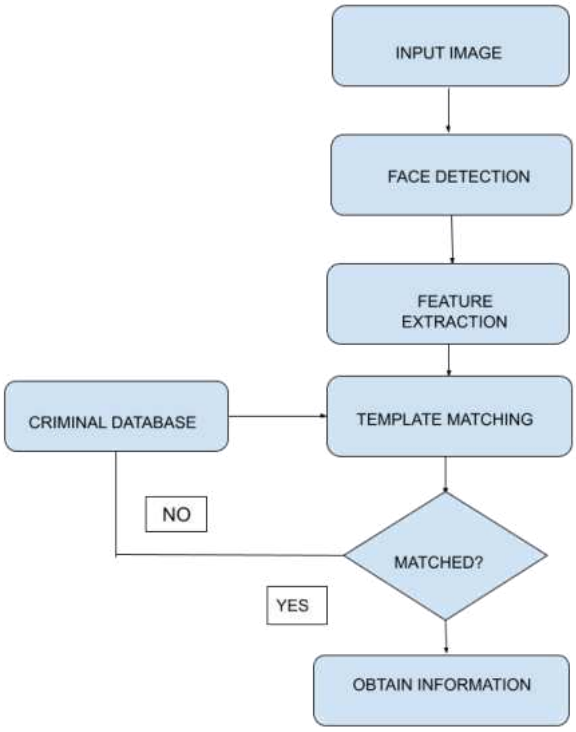


Fig 1: Block diagram

The evaluation will focus on the following metrics:

Accuracy: This refers to the system's ability to correctly identify individuals with criminal records from the database. Metrics like True Positive Rate (TPR) and False Positive Rate (FPR) will be used to measure recognition accuracy.

Efficiency: This metric evaluates the speed and processing time required for facial recognition and subsequent database updates.

Scalability: The system's ability to handle a growing database size and increasing number of concurrent users will be assessed.

The evaluation will involve testing the system on a representative dataset of facial images and criminal records. The obtained results will be presented clearly and concisely, highlighting the system's strengths and limitations.

IV. CONCLUSION

The proposed system presents a revolutionary approach to criminal record management by integrating face recognition technology. By leveraging the power of facial recognition algorithms, the system offers significant improvements in efficiency, accuracy, and real-time data management capabilities. This can lead to faster investigations, enhanced public safety, and a more robust law enforcement infrastructure.

V. FUTURE SCOPE

The potential for further development and refinement of the system is vast. Here are some key areas for future exploration:

Enhancing Facial Recognition Accuracy: Research on improving facial recognition accuracy under challenging conditions (e.g., poor lighting, facial coverings) will be crucial for broader real-world applications. Techniques like multi-modal recognition (combining facial recognition with other biometrics) can be explored.

Expanding Functionality: Integrating other biometric modalities like fingerprints or iris scans can further strengthen the system's identification capabilities.

Ethical Considerations: The ethical implications of using facial recognition technology in law enforcement require careful consideration. Developing and implementing robust policies for data privacy, accountability, and responsible use will be paramount.

REFERENCE

[1]. V. D . A mbeth Kumara,*, V. D. Ashok Kumar, S. Malathia, K. Vengatesanc, and M. F.A. (2018). Facial Recognition System for Suspect Identification Using a Surveillance Camera ResearchGate Access, 28(3):410-420

[2]. Kortli, Yassin, et al. "Face recognition systems: A survey." Sensors 20.2 (2020): 342.Access: Google Scholar

[3]. Sukhavasi, Susrutha Babu, et al. "Deep neural network approach for pose, illumination, and occlusion invariant driveremotion detection.Access:" International Journal of Environmental Research and Public Health 19.4 (2022)

[4]. Syed Ibrahim, Syed Nahid Suleman, Manikanta Suthapalli, Abhishek Sharma, Shilpa K S Design of Intelligent Facial Recognition System using AI for surveillance Application Access, Academic Edu 6 (3): 346-356

[5]. Somani, Atharv, et al. "A Survey paper on live criminal detection using facial recognition and tracking".Access Google scholar,(2023)

[6]. Sourav Patil, Aman Prakash, Ujjawal Kant, Atif Hussain, Abhishek Kumar D. Y. Patil Facial Recognition System for Suspect Identification using a Surveillance Camera Access, Journal of Emerging Technologies and Innovative Research(JETIR) (2021), 8(6)

[7] .Ms. Bhagyshree Tingare1 and Mr. Suraj Kurde2 Assistant Professor, Department of Computer Engineering1,2 D. Y. Patil College of Engineering, Pune, Maharashtra Facial Recognition System for Suspect Identification using a Surveillance Camera Access, Journal of Advanced Research in Science, Communication and Technology (IJARSCT) (2020), 10(2)

[8] . V. D. Ambeth Kumar, V. D. Ashok Kumar, S. Malathi K. Vengatesan and M. Ramakrishnan Facial Recognition System for Suspect IdentificationUsing a Surveillance Camera Access, Academic edu,(2020)

[9]. A. V. Deorankar, Neha S. Tadam A Study on Video-Based Face Recognition for Real-Time Surveillance Access, International Journal of Scientific Research in Science, Engineering and Technology,(2019),6(3)

[10]. Teoh, K. H., et al. "Face recognition and identification using deep learning approach." Journal of Physics: Conference Series. Vol. 1755. No. 1. IOP Publishing, 2021 Access: Research gate

Firearms Detection System using Deep Learning

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Abstract—**Gunshot detection technology is vital for urban safety, requiring advanced systems to swiftly identify gunfire amidst city noise. This project utilizes deep learning on audio data to develop a firearm detection system tailored for urban environments. A dataset of 851 audio files representing 8 gun models is sourced from Kaggle, ensuring data integrity through format conversion and noise removal. Preprocessing techniques handle missing values and normalize features for robust analysis. Feature extraction methods like MFCCs and spectral features aid model training. The Support Vector Machine (SVM) classifier, optimized with GridSearchCV, effectively handles high-dimensional data and nonlinear boundaries. Evaluation metrics, including accuracy and ROC AUC score, validate the model's performance. This project showcases machine learning's potential in enhancing urban security and surveillance systems, offering insights for future firearm detection technology**

Keywords—Gunshot detection, Deep learning, Audio analysis, Machine learning, Exploratory Data Analysis (EDA), Feature extraction, MFCCs (Mel-Frequency Cepstral Coefficients), Spectral features, Support Vector Machine (SVM), GridSearchCV, Evaluation metrics, ROC AUC score, Firearm detection technology.

I. INTRODUCTION

Gun detection systems are pivotal in ensuring public safety and security, particularly in urban areas where firearm-related incidents are prevalent[3][5]. Our project addresses this critical need by developing a sophisticated firearm detection system tailored specifically for urban settings. Leveraging advanced machine learning algorithms and cutting-edge audio processing techniques, our system aims to accurately detect and classify gunshot sounds in real-time. By analyzing audio data captured from surveillance cameras, acoustic sensors, and social media platforms, this project will enable swift response from law enforcement agencies, minimizing the risk to public safety and enhancing community well-being.

The escalating rates of gun-related crimes, including shootings, armed robberies, and acts of terrorism, highlight the urgent need for effective firearm detection technologies. Prompt detection of gunfire plays a crucial role in preventing the escalation of violence, minimizing casualties, and apprehending perpetrators swiftly. Our project aims to address these challenges by developing a robust firearm detection system capable of identifying and localizing gunshot sounds amidst urban noise. By enhancing situational awareness for law enforcement personnel, our system will empower them to respond effectively to active shooter situations and mitigate the impact of firearm-related incidents on communities.

Conventional gunshot detection systems often struggle to differentiate between gunfire and other ambient urban sounds, leading to false alarms or missed detections. Overcoming this challenge requires advanced methodologies and technologies that can accurately identify and classify gunshot sounds in complex acoustic environments. Through the development of a deep learning-based solution, our project seeks to provide a reliable firearm detection system that can operate seamlessly in urban settings. By integrating state-of-the-art algorithms and techniques, this project aims to enhance situational awareness and response capabilities, ultimately contributing to the creation of safer urban environments.

Altogether our project endeavors to develop a cutting-edge firearm detection system that addresses the pressing need for effective public safety measures in urban areas. By leveraging advanced machine learning algorithms and audio processing techniques, we aim to create a system capable of swiftly detecting and responding to firearm-related incidents. Through collaboration with law enforcement agencies and community stakeholders, we seek to deploy our system to enhance security infrastructure and safeguard public welfare in urban environments.

II. LITERATURE REVIEW

A. *Scream and gunshot detection and localisation for audio-surveillance systems.*

Valenzise et al. (2007) present a method for detecting and localizing anomalous audio events in public squares. Their approach utilizes parallel Gaussian Mixture Model (GMM) classifiers to discriminate screams and gunshots from background noise, enabling effective surveillance and threat detection in urban environments.

B. *Gun type recognition from gunshot audio recordings*

The template Kiktova et al. (2015) focus on gun type recognition based on audio recordings, aiming to detect and identify various firearms. Their system employs audio analysis techniques to recognize gunshot sounds, contributing to urban environment monitoring and enhancing security measures against potential threats.

C. *Low Cost Gunshot Detection using Deep Learning on the Raspberry Pi.*

Morehead et al. (2019) introduced an affordable gunshot detection system utilizing deep learning on the Raspberry Pi platform. Achieving over 99% accuracy on validation data, their solution is ideal for real-time surveillance and security in urban areas. By leveraging minimal hardware, it offers cost-effective deployment, enhancing accessibility across various applications. The system's efficiency on the Raspberry Pi platform highlights its scalability and versatility, providing a practical solution to enhance public safety measures. This innovative approach meets the increasing demand for effective gunshot detection systems in

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urban settings, offering a reliable means to address potential threats and strengthen security infrastructure.

D. Acoustical Detection of gunshots.

Hrabina and Sigmund (2015) developed a binary gunshot detector focusing on identifying gunfire occurrences without categorizing firearm types. Their method analyzes linear predictive coefficients and compares spectral energy across sub-bands, ensuring low power consumption. This approach is well-suited for specialized applications like counter-poaching devices, enhancing security measures while minimizing power usage for prolonged surveillance against illegal activities such as poaching.

E. Gun identifcation from gunshot audios for secure public places using transformer learning:

The study responds to the urgent need for real-time, cost-effective weapon detection systems amid rising mass shootings and terrorist threats. Unlike visual analysis approaches, it focuses on audio-based gun-type detection using Mel-frequency-based features. By comparing convolution-based and transformer architectures, the research shows that transformers achieve superior performance, with a classification accuracy of 93.87%. These findings highlight the potential of the proposed model to enhance security measures effectively.

F. Sound of Guns:Digital Forensics of Gun Audio Samples meets Artificial Intelligence:

The task of classifying weapons based on muzzle blast poses challenges with broad security and military applications. Prior approaches rely on microphone arrays for accurate detection but are impractical in real-world scenarios. The proposed technique achieves over 90% accuracy in identifying gun category, caliber, and model without prior setup knowledge. Leveraging Convolutional Neural Network (CNN), it enhances classification performance without ad-hoc setups, offering efficiency in diverse operational contexts.

III. SYSTEM DESIGN

The Firearms Detection System using Deep Learning aims to improve public safety by detecting firearm-related incidents effectively. This requires careful consideration of hardware and software components. Specific hardware specifications, including processor, RAM, and storage capacity, are crucial for optimal performance. Additionally, the selection and installation of software components such as Jupyter Notebook and Python are essential for developing and executing machine learning algorithms. In this introduction, we will explore the necessary hardware and software requirements for implementing the Firearms Detection System [3].

A. Hardware Requirements:

To ensure smooth operation, the system requires a processor of at least Intel Pentium Dual Core i5 or above, with a minimum clock speed of 2.2GHz. Additionally, a minimum of 8GB of RAM is essential for handling the computational load, along with a hard disk with a storage capacity of at least 200 GB [3].

B. Software Requirements:

Several software components are indispensable for the successful implementation of the Firearms Detection System. Jupyter Notebook, an open-source web application, plays a crucial role in creating and sharing documents containing live code, visualizations, and narrative text.[3] Python programming language serves as the backbone, providing the necessary environment for developing and executing machine learning algorithms.

C. Installation Procedures:

Jupyter Notebook can be installed using either Anaconda Distribution or PIP, the package manager for Python. Anaconda Distribution offers a comprehensive package that includes Python, Jupyter Notebook, and other essential libraries for scientific computing. Alternatively, PIP allows for a more customizable installation process, enabling users to install specific packages as needed.

D. Software Description:

Python is an interpreted language renowned for its simplicity and readability. It boasts a vast ecosystem of libraries and frameworks, making it well-suited for a wide range of applications, including machine learning. Its versatility and ease of use make it an ideal choice for developing and executing algorithms within the Firearms Detection System.

IV. METHODOLOGY

The methodology for developing the Firearms Detection System using Deep Learning involves a systematic approach to data collection, preprocessing, model building, and evaluation. This methodology aims to outline the step-by-step process for implementing the system, ensuring its effectiveness and reliability in detecting firearm-related incidents. By following this methodology, researchers and developers can create a robust detection system capable of accurately identifying and responding to gunshot audio signals. In this introduction, we will provide an overview of the methodology, highlighting key steps and considerations involved in each stage of the development process.

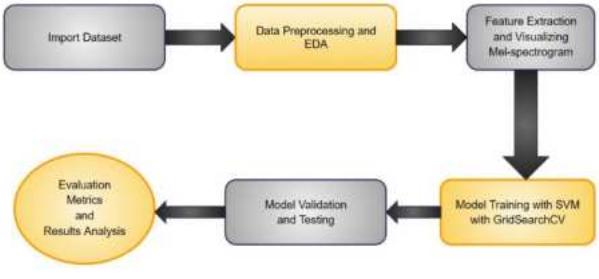


Fig. 1. Block diagram

A. Importing Dataset:

The process begins with the acquisition of necessary libraries and sourcing gunshot audio from publicly available Kaggle datasets [3]. The dataset comprises 851 audio files, each containing 2-second segments of 8 different gun models. Quality assurance procedures are implemented, including WAV format conversion and noise removal, to ensure the integrity of the dataset [3].

B. *Data Preprocessing and EDA:*

Following dataset acquisition, the data undergo preprocessing steps to clean, handle missing values, and normalize features [1]. Exploratory Data Analysis (EDA) is then conducted to gain insights into the characteristics of the audio data. This involves visualizing waveform plots and logmel-spectrograms to understand the frequency content of the audio signals [3]

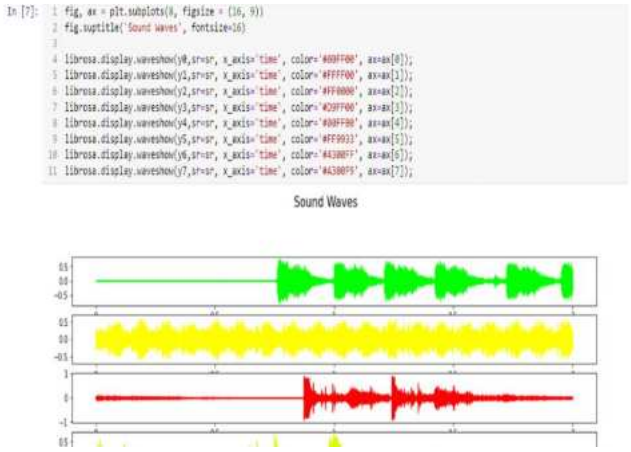


Fig. 2. Data preprocessing and EDA

C. *Feature Extraction And Visualizing Logmael Spectrogram:*

Feature extraction is a crucial step in preparing the data for model training. Various features such as MFCCs, chroma features, and spectral contrast are extracted from the audio signals [3]. Additionally, logmel-spectrograms are generated to provide a visual representation of the frequency content. This process aids in capturing relevant information from the audio data, which is essential for building an effective detection model.

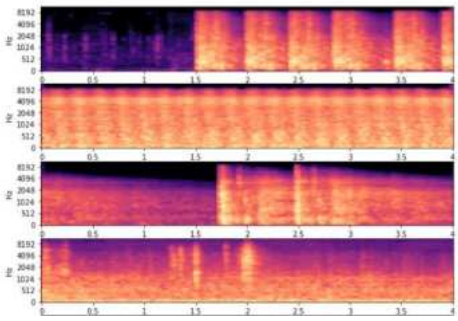


Fig. 3. Feature Extraction

D. *Building and Training The Model with Algorithms:*

The next phase involves building and training the detection model using machine learning algorithms[4][5]. Support Vector Machine (SVM) with GridSearchCV is chosen for its effectiveness in handling high-dimensional data and optimizing hyperparameters[1][4]. The pre-processed and feature-extracted dataset is utilized for model training, with feature vectors standardized to ensure equal contribution during training[3].

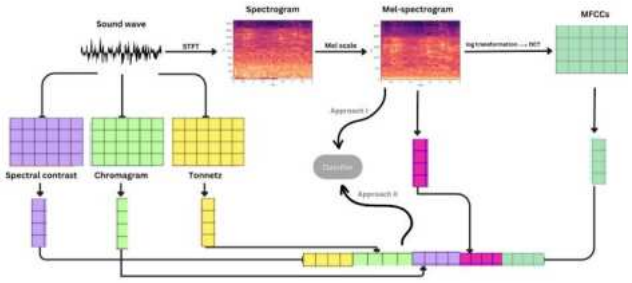


Fig. 4. Model Training

E. *Testing the Model:*

Once the model is trained, it is evaluated using a dedicated testing dataset that was not used during training or validation. [1] The trained SVM classifier is employed to make predictions on the standardized test data, and performance metrics such as accuracy, confusion matrix, and ROC AUC score are calculated. This evaluation process aims to assess the model's ability to accurately classify gunshot audio samples.

```
y_pred = svc.predict(x_test_scaled)

from sklearn.metrics import accuracy_score
print(f"testing Model accuracy score: {accuracy_score(y_test, y_pred):0.4f}")
```

```
testing Model accuracy score: 0.9532
```

Fig. 5. Testing Accuracy

V. GENERATION AND CALCULATION OF EVALUATION METRICS

Model performance is assessed through several key metrics, including accuracy, confusion matrix, classification report, and ROC AUC score [1]. These metrics collectively provide insights into the classifier's ability to accurately classify audio samples across different classes and thresholds. The accuracy metric quantifies the proportion of correctly classified samples out of the total samples evaluated, offering a fundamental measure of overall performance. Additionally, the confusion matrix offers a detailed breakdown of the classifier's performance by displaying the counts of true positive, false positive, true negative, and false negative predictions for each class. This matrix provides valuable information on the classifier's ability to discriminate between different classes and identify any misclassifications.

```
In [24]: from sklearn.metrics import confusion_matrix
         cm = confusion_matrix(y_test, y_pred)
         print("Confusion Matrix:")
         print(cm)
```

```
Confusion Matrix:
[[14  0  0  0  0  0  0  0]
 [ 0 20  0  0  0  0  0  0]
 [ 0  0 20  0  0  0  0  0]
 [ 0  2  0 38  0  0  0  0]
 [ 0  0  0  3 17  0  0  0]
 [ 0  1  0  0  0 19  0  0]
 [ 1  0  0  2  0  0 17  0]
 [ 0  0  0  0  0  0  0 17]]
```

Fig. 6. Confusion Matrix

Furthermore, the classification report presents a summary of key classification metrics, including precision, recall, and F1-score, for each class [2]. Precision measures the proportion of true positive predictions out of all positive predictions made, while recall quantifies the proportion of true positive predictions out of all actual positive instances. The F1-score represents the harmonic mean of precision and recall, providing a balanced measure of the classifier's performance. Moreover, ROC curves are plotted for each class to visualize the classifier's performance across different thresholds. These curves depict the trade-off between the true positive rate and false positive rate at various decision thresholds. Additionally, the ROC AUC score, calculated for multi-class classification, provides a comprehensive measure of the classifier's ability to discriminate between different classes, with higher values indicating better performance. Overall, these evaluation metrics offer a holistic view of the classifier's performance and aid in assessing its effectiveness in accurately detecting firearm-related incidents.

```
ROC AUC for multi-class is 0.9953879051620648
```

```
num_classes = y_pred_prob.shape[1]
for i in range(num_classes):

    y_true_class_i = (y_true == i).astype(int)


    roc_auc = roc_auc_score(y_true_class_i, y_pred_prob[:, i])
    print(f"ROC AUC for class {i} : {roc_auc.round(3)}")
```

```
ROC AUC for class 0 : 1.0
ROC AUC for class 1 : 0.997
ROC AUC for class 2 : 1.0
ROC AUC for class 3 : 0.977
ROC AUC for class 4 : 0.996
ROC AUC for class 5 : 0.998
ROC AUC for class 6 : 0.993
ROC AUC for class 7 : 1.0
```

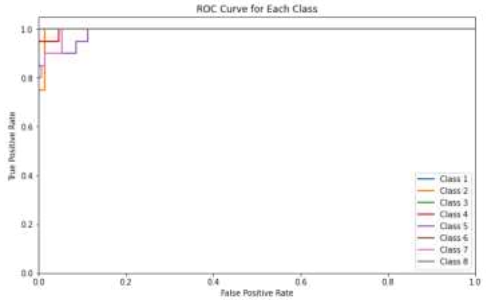


Fig. 7. ROC curve for each class

VI. RESULT

In this project, we developed a robust and accurate system for detecting firearms from audio signals. The Support Vector Machine (SVM) classifier is selected for its effectiveness in handling high-dimensional data and its capability to handle non-linear decision boundaries. Parameters for the SVM classifier are optimized through hyperparameter tuning using GridSearchCV, ensuring optimal performance of the model. Additionally, ROC curves are plotted for each class to visualize the classifier's performance across various thresholds. The ROC AUC for multi-class classification is found to be 0.995, indicating excellent discrimination ability between different classes of firearm audio signals.

REFERENCES

[1] G. Valenzise, L. Gerosa, M. Tagliasacchi, F. Antonacci and A. Sarti, "Scream and gunshot detection and localization for audio-surveillance systems," 2007 IEEE Conference on Advanced Video and Signal Based Surveillance, London, UK, 2007, pp. 21-26, doi: 10.1109/AVSS.2007.4425280.

[2] E. Kiktova, M. Lojka, M. Pleva, J. Juhar and A. Cizmar, "Gun type recognition from gunshot audio recordings," *3rd International Workshop on Biometrics and Forensics (IWBF 2015)*, Gjovik, Norway, 2015, pp. 1-6, doi: 10.1109/IWBF.2015.7110240.

[3] A. Morehead, L. Ogden, G. Magee, R. Hosler, B. White and G. Mohler, "Low Cost Gunshot Detection using Deep Learning on the Raspberry Pi," 2019 IEEE International Conference on Big Data (Big Data), Los Angeles, CA, USA, 2019, pp. 3038-3044, doi: 10.1109/BigData47090.2019.9006456.

[4] M. Hrabina and M. Sigmund, "Acoustical detection of gunshots," 2015 25th International Conference Radioelektronika (RADIOELEKTRONIKA), Pardubice, Czech Republic, 2015, pp. 150-153, doi: 10.1109/RADIOELEK.2015.7128993.

[5] Nijhawan, R., Ansari, S.A., Kumar, S. *et al.* Gun identification from gunshot audios for secure public places using transformer learning. *Sci Rep* **12**, 13300 (2022). https://doi.org/10.1038/s41598-022-17497-1

[6] Raponi, S., Oligeri, G. & Ali, I.M. Sound of guns: digital forensics of gun audio samples meets artificial intelligence. *Multimed Tools Appl* **81**, 30387–30412 (2022). https://doi.org/10.1007/s11042-022-12612-w

Python-Based Automated Chain of Custody System for Digital Forensics

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***Abstract*—— Chain of custody is Python is often preferred in digital forensics for its simplicity, extensive libraries, and community support. This documentation process protects evidence from contamination and tampering. It is also sometimes called the chain of evidence. Python, you can create a chain of custody system using data structures and possibly databases to record and track these actions Using Python, forensic investigators can create scripts to automate the documentation of evidence acquisition, storage, and transfer processes. This includes logging details such as the time of acquisition, location, custodian information, and any alterations made to the evidence. Python's libraries like hashlib can be utilized to generate cryptographic hashes of digital evidence, providing a unique fingerprint that can be used to verify its integrity throughout the chain of custody. Additionally, metadata extraction libraries like ExifTool enable the extraction of relevant information from digital files, aiding in the documentation process.Furthermore, Python allows for the integration of secure communication protocols to transfer evidence between parties while maintaining its integrity. This can include encryption and digital signatures to ensure data confidentiality and authenticity.**

Keywords—Chain of custody, Hashlib, digital forensic, metadata, ExifTool.

INTRODUCTION

Digital forensics, a critical aspect of forensic science, focuses on investigating, collecting, preserving, analyzing, and presenting digital evidence found on electronic devices and systems. This field plays a pivotal role in uncovering various digital crimes such as cyberattacks, data breaches, intellectual property theft, fraud, and more. At the core of digital forensics lies the importance of a chain of custody system. This system acts as a meticulously documented trail that meticulously tracks the possession, handling, and whereabouts of digital evidence from its initial collection to its eventual presentation in a legal context. One of the primary reasons for emphasizing a chain of custody system is its role in preserving the integrity of evidence. By preventing tampering, contamination, or unauthorized access, it ensures that digital evidence remains unaltered and maintains its admissibility in court. Furthermore, a properly documented chain of custody establishes a legal foundation, ensuring the authenticity and reliability of digital evidence, which is crucial for its acceptance and credibility in legal proceedings. Additionally, the chain of custody system brings accountability and transparency to the investigative process by assigning responsibility to individuals involved in handling evidence and documenting every access and action taken. This accountability and transparency not only enhance the credibility of investigative findings but also protect against challenges regarding the authenticity or handling of digital evidence. In essence, a robust chain of custody system is fundamental in digital forensics, upholding the reliability, admissibility, and credibility of digital evidence, and ultimately supporting the pursuit of justice and adherence to the rule of law in digital environments. Python's suitability for implementing a chain of custody system in digital forensics stems from its versatility, robust libraries, and developer-friendly characteristics. Its simplicity and readability accelerate system development, allowing forensic investigators to focus on logic rather than intricate syntax. Python's extensive libraries such as hashlib for cryptographic hashing and ExifTool for metadata extraction provide essential functionalities directly applicable to digital forensic workflows. Moreover, Python's active community ensures continuous support, knowledge sharing, and updates, enhancing the system's reliability and adaptability. Its cross-platform compatibility enables seamless operation across diverse environments, crucial in digital forensics where evidence may originate from various sources. Python's scripting capabilities facilitate automation, reducing human error and enhancing efficiency in documenting evidence handling processes. Additionally, Python's integration with secure protocols like encryption and digital signatures ensures the secure transfer and preservation of digital evidence, maintaining data integrity and authenticity throughout the chain of custody. In essence, Python's comprehensive features make it an ideal language for implementing a robust and effective chain of custody system in digital forensics, offering both technical prowess and practical usability.

BACKGROUND AND RELATED WORK

The review of existing chain of custody methods and technologies in digital forensics showcases a transition from traditional manual documentation to modern, technology-driven approaches. Historically, manual methods using paper-based logs were prevalent but faced challenges in accuracy, security, and scalability. Digital chain of custody software has emerged as a solution, offering automated tracking, timestamping, user authentication, and audit trail capabilities. This shift improves reliability, accountability, and efficiency in evidence handling. Additionally, blockchain technology has gained attention for its tamper-resistant and transparent record-keeping capabilities, enhancing data integrity and trustworthiness in custody transfers. Digital signatures and encryption methods bolster security by authenticating evidence and ensuring confidentiality. Forensic tools and metadata analysis play a vital role in verifying evidence authenticity and providing contextual insights. Compliance frameworks such as ISO/IEC 27037 provide guidelines for adhering to legal and regulatory requirements, emphasizing best practices in evidence management. While these advancements address many challenges, ongoing efforts are needed to address interoperability, standardization, and evolving digital threats in the dynamic landscape of digital forensics. Python and its extensive range of libraries play a

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pivotal role in digital forensics, offering a versatile toolkit for forensic investigators. One of Python's key strengths lies in its automation and scripting capabilities, allowing for the creation of scripts to automate repetitive tasks involved in evidence analysis and reporting. This automation not only enhances efficiency but also ensures consistency and accuracy in investigative processes. Python's libraries for data parsing and extraction, such as BeautifulSoup and lxml, enable investigators to extract valuable information from various file formats, including documents, emails, databases, and web pages, streamlining the collection and analysis of digital evidence. Moreover, Python's hashlib library is instrumental in cryptographic hashing, providing a means to verify the integrity of digital evidence through unique fingerprints generated by hashing algorithms like MD5 and SHA-256. Metadata analysis, facilitated by libraries like ExifTool and pyexif, further aids investigators in extracting and analyzing metadata from digital files, uncovering crucial details such as file origins, timestamps, and user activities. Additionally, Python libraries for network forensics, such as Scapy and dpkt, empower analysts to analyze network traffic, detect anomalies, and reconstruct communication patterns, essential for investigating cyberattacks and network intrusions. Furthermore, Python's machine learning libraries, such as scikit-learn and TensorFlow, enable advanced pattern recognition, anomaly detection, and predictive analysis in digital forensics. The collaborative nature of Python's community also fosters knowledge sharing, tool development, and continuous improvement in forensic methodologies, making Python an indispensable tool in the arsenal of digital forensic investigators.

DESIGNING SYSTEM

In designing a Python-based chain of custody system for digital forensics, it is crucial to implement robust security measures to ensure the integrity, confidentiality, and availability of the digital evidence. Here are detailed security measures that should be integrated into the system. Data Integrity with Cryptographic Hashing:Use Python’s `hashlib` library to compute cryptographic hashes of digital evidence as soon as it is collected. This hash serves as a digital fingerprint. Every time the evidence is accessed, the hash should be recomputed and compared against the stored hash to ensure that the evidence has not been altered. The hash algorithms chosen (e.g., SHA-256) should be resistant to collisions to enhance security.

Secure Storage: The evidence and its associated data should be stored in an encrypted format to prevent unauthorized access. Using Python’s `cryptography` library, files can be encrypted before being stored. Additionally, the database where evidence metadata and logs are stored should also be encrypted using database-level encryption or file-system-level encryption.

Access Control: Implement strict access controls to ensure that only authorized personnel can access the evidence and its corresponding logs. This can be managed through user authentication mechanisms integrated within a web framework like Flask, using extensions such as Flask-Login. Role-based access control (RBAC) should be configured to limit the operations that users can perform based on their roles.

Audit Trails: Maintain comprehensive audit trails for all operations performed on the evidence, including access, modification, and transfer. Python’s `logging` module can be configured to log every action, along with timestamp and user information, into an immutable log store. Ensure logs themselves are protected against tampering and unauthorized access.

Secure Transmission: When evidence needs to be transferred between parties, secure transmission protocols such as HTTPS, SFTP, or encrypted VPN tunnels should be used. Employ Python’s libraries like `paramiko` for SFTP or `requests` for HTTPS. Digital signatures, managed through the `cryptography` library, should also be implemented to verify the authenticity of the transferred data and the identities of the communicating parties.

Regular Security Audits and Penetration Testing: Conduct regular security audits and penetration testing to identify and mitigate vulnerabilities. This includes checking for SQL injection, cross-site scripting (XSS), and other common vulnerabilities in web applications when Flask or another framework is used for the user interface.

Patch Management: Keep all software, including Python and its libraries, up to date with the latest security patches. Automate this process where possible to avoid human error, ensuring that security patches are applied promptly.

Data Backup and Disaster Recovery: Implement regular backups of both the evidence data and the log data to secure, offsite locations. Test recovery procedures to ensure that data can be accurately and completely restored in the event of a disaster.

Training and Awareness: Conduct regular training sessions for all users of the system to ensure they are aware of the security features and their responsibilities in maintaining the integrity of the chain of custody. This helps in minimizing human errors and improving compliance with security protocols.

Use of Secure Coding Practices: When developing the system, follow secure coding practices to minimize vulnerabilities from the outset. Utilize tools for static and dynamic code analysis to detect and resolve potential security issues in the codebase.

By implementing these security measures, the chain of custody system can robustly protect digital evidence against unauthorized access, tampering, and other security threats, thereby maintaining its integrity throughout the forensic investigation process.be the use of English units as identifiers in trade, such as “3.5-inch disk drive”.

IMPLEMENTATION DETAILS

To implement a Python-based chain of custody system for digital forensics, we first establish a structured environment covering evidence acquisition, secure storage, integrity verification, metadata extraction, secure transmission, access controls, user interface, backup, recovery, testing, and security audits. Python libraries such as `os`, `subprocess`, `sqlite3`, `hashlib`, `pyexiftool`, `logging`, `paramiko`, `cryptography`, and web frameworks like Flask are utilized throughout the process.

The system starts by automating evidence collection using Python scripts, tagging each piece with metadata including time, location, and device information. Data is then stored securely in a lightweight database like SQLite, with each record containing essential details such as evidence ID, acquisition information, and cryptographic hashes to ensure integrity. Metadata extraction from files is facilitated by integrating ExifTool, enriching database entries for analysis.

To maintain a comprehensive audit trail, Python's logging library captures every action performed on evidence, ensuring logs are tamper-proof. Secure transmission protocols such as SSH, SFTP, or HTTPS are employed for transferring evidence between parties, with data encryption and digital signatures managed by Python's cryptography library.Access controls are implemented using Flask and Flask-Login, enabling role-based authentication and user-friendly interfaces.

Regular backups of databases and logs are automated using Python scripts, with offsite storage strategies for disaster recovery. Rigorous testing and security audits, leveraging Python's unit testing frameworks, ensure system robustness against vulnerabilities and functional integrity.

CASE STUDY

Case Study: Law Enforcement Investigation

In a cybercrime investigation conducted by law enforcement agencies, Python scripts were used to automate the chain of custody documentation process. Scripts were developed to log evidence acquisition details, including timestamps, acquisition locations, and custodian information. This automation significantly reduced the time and effort required for manual documentation, ensuring accuracy and consistency in recording evidence handling actions. Insight: Python's scripting capabilities enabled efficient and standardized evidence documentation, improving the overall investigative process and facilitating compliance with legal requirements.

Case Study: Corporate Data Breach Response

In response to a corporate data breach incident, forensic analysts utilized Python libraries such as hashlib for generating cryptographic hashes of digital evidence. These hashes were compared at different stages of the investigation to verify the integrity of evidence and detect any unauthorized alterations. Python's hashlib library provided a reliable method for ensuring the authenticity and reliability of digital evidence throughout the chain of custody.Insight: Python's libraries, such as hashlib, offer essential functionalities for maintaining evidence integrity and supporting forensic analysis in response to cybersecurity incidents.

DISCUSSION AND FUTURE WORK

The implementation of a Python-based chain of custody system in digital forensics offers numerous benefits, including simplicity, extensive library support, and community backing. This system facilitates the documentation and tracking of evidence acquisition, storage, and transfer processes, crucial for maintaining the integrity of digital evidence and safeguarding against contamination and tampering. By leveraging Python's hashlib library, cryptographic hashes can be generated for digital evidence, providing unique fingerprints that ensure the evidence's integrity throughout the chain of custody. Additionally, metadata extraction libraries like ExifTool enable the extraction of relevant information from digital files, aiding in documentation.

One potential area for future work in enhancing the Python-based chain of custody system is the integration of machine learning algorithms for automated analysis of digital evidence. Machine learning techniques can assist forensic investigators in identifying patterns, anomalies, and correlations within large datasets, thereby expediting the analysis process and potentially uncovering insights that may have been overlooked manually. Moreover, advancements in natural language processing (NLP) could be leveraged to extract and analyze text-based evidence, such as chat logs or documents, further enhancing the system's capabilities.

CONCLUSION

In conclusion, the utilization of Python in digital forensics for establishing a chain of custody system offers unparalleled advantages, including simplicity, extensive library support, and a thriving community. By harnessing Python's capabilities, forensic investigators can automate the documentation of evidence acquisition, storage, and transfer processes, thereby safeguarding against contamination and tampering. Through the utilization of libraries like hashlib, cryptographic hashes can be generated to provide a unique fingerprint, ensuring the integrity of digital evidence throughout its lifecycle. Additionally, metadata extraction tools such as ExifTool aid in extracting relevant information from digital files, enhancing the documentation process. Moreover, Python facilitates the integration of secure communication protocols, enabling the transfer of evidence between parties while maintaining confidentiality and authenticity through encryption and digital signatures. Overall, Python serves as a powerful tool in digital forensics, empowering investigators to efficiently manage and protect digital evidence, ultimately bolstering the integrity and credibility of forensic investigations.

REFERENCES

[1] Dosisa, S.; Homema, I.; Popova, O. Semantic representation and integration of digital evidence. Procedia Comput. Sci. 2013, 22, 1266–1275.

[2] Prayudi, Y.; Azhari, S. Digital chain of custody: State of the art. Int. J. Comput. Appl. 2015, 114, 1–9.

[3] Campbell, N.; Goodyear, T.; Messer, W.; Stuart, E.; Fairbanks, J. Digital witness: Remote method for volunteering digital evidence on mobile devices. In Proceedings of the IEEE International Conference on Technologies for Homeland Security, Woburn, MA, USA, 23–24 October 2018; pp. 1–5.

[4] Patel, J.; Bhatt, N. Review of digital image forgery detection. Int. J. Recent Innov. Trends Comput. Commun. 2017, 5, 152–155.

[5] Varkey, A.; Nair, L. Robust image forgery detection and classification in copy-move using SVM. Int. J. Adv. Res. Trends Eng. Technol. 2018, 5, 89–93.

[6] Hamid, A.; Naaz, R. Forensic-chain: Blockchain based digital forensics chain of custody with POC in hyperledger composer. Int. J. Digit. Investig. 2019, 28, 44–55.

[7] Tian, Z.; Li, M.; Qiu, M.; Sun, Y.; Su, S. Block-DEF: A secure digital evidence framework using blockchain. Int. J. Inf. Sci. 2019, 491, 151–165.

[8] Yunianto, E.; Prayudi, Y.; Sugiantoro, B. B-DEC: Digital evidence cabinet based on blockchain for evidence management. Int. J. Comput. Appl. 2019, 181, 22–29.

Security Enhancing System Using Elliptic Curve Cryptography

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***Abstract*— In today's digital era, where vast amounts of data are transmitted daily over the Internet, ensuring the confidentiality and integrity of this data is paramount. This paper explores the use of cryptographic and stenographic techniques to bolster data security during transmission. Specifically, our focus lies on Elliptic Curve Cryptography (ECC), a robust cryptographic method utilized in our project. Extensive studies on ECC have demonstrated its efficacy in safeguarding data, particularly due to the exponential complexity of solving the Elliptic Curve Discrete Logarithmic Problem relative to the key size employed. This property sets ECC apart as a superior choice for encryption and decryption processes, surpassing other cryptographic methods that exhibit linear or sub-exponential difficulty levels. By integrating ECC and steganography into our data transfer protocols, we aim to enhance data security standards and contribute to the ongoing discourse on safeguarding digital communications. With the advent of the Internet and associated technologies, millions of data in the form of text and images are transferred every day across the network. It is essential to ensure the confidentiality and integrity of the data being transferred. Security of data can be enhanced by using techniques like cryptography, and steganography on data to be transferred. The cryptographic technique which we have used in our project is Elliptic Curve Cryptography (ECC). Various study on ECC has concluded that the difficulty to solve an Elliptic Curve Discrete Logarithmic Problem is exponentially hard with respect to the key size used. This property makes ECC a very good choice for the encryption/decryption process compared to other cryptographic techniques which are linearly difficult or sub exponential difficult.**

Keywords—Cryptography, steganography, Elliptic Curve Cryptography, Data Security, Data Transfer, Protocols and Confidentiality, Integrity, Exponential Complexity.

I. OVERVIEW

Authentication and key establishment are fundamental steps in setting up secure communications. Authentication is concerned with knowing that the correct parties are communicating; key establishment is concerned with obtaining good cryptographic keys to protect the communications, particularly to provide confidentiality and integrity of the data communicated. Because the modern world increasingly relies on digital networks, the security of communications is a critical element in the functioning of society today, and will become only more important in the future. Authentication and key establishment typically occur at the start of a communications session, which we often call simply a session. Authentication allows those parties active in the session to learn the identity of other parties in the session. Key establishment is used to set up a session key, used to subsequently protect the data communicated during the session with the help of whatever cryptographic mechanisms are chosen.

The proposed method of this project is : Independent of the development of cluster and high performance computing, emergence of clouds and the map reduce programming model has resulted in file systems such as Hadoop Distributed File system (HDFS) Amazon S3 file system and cloud store.

But there is a drawback on this method. The current focuses on interopibility, instead of efficiency and scalability, of various mechanisms to provide basic security. Moreover, key establishment between client and multiple storage devices. So, This project neglect this drawback by investigate the problem of secure many to many communications in large scale network file system that supports parallel access to multiple storage devices.

II. SYSTEM SPECIFICATION

A. HARDWARE REQUIREMENTS

- System : DUAL CORE
- Hard Disk : 160 GB.
- Monitor resolution : 1024 x 768 or higher
- Keyboard : 108 keys
- Mouse : Logitech.
- Ram : 1 GB.

B. SOFTWARE REQUIREMENTS:

- Operating system : Windows XP.
- Frontend : PHP

III. DESCRIPTION OF THE MODULES

A. MODULES

- Image Security exchange
- Forward secrecy
- User Login
- Offer Data
- Transfer Data
- Download File
- Server Authentication
- Acknowledge client
- Permit Client Document

B. AUTHENTICATION

Authentication module contains all the information about the authenticated Person. Administrator without his username and password can't enter into the login if he is only the authenticated Person then he can enter to his login. Authentication is the process of verifying the identity of a

Person by obtaining some sort of credentials and using those credentials to verify the Users identity. If the credentials are valid, the authorization process starts. Authentication process always proceeds to Authorization process.

C.CLOUD NETWORK FORMATION

Parallel secure sessions between the customers and the capacity gadgets in the parallel Network File System (pNFS) The present Internet standard—in a productive and versatile way. This is like the circumstance that once the foe bargains the long-haul mystery key, it can take in all the subsequence sessions. In the event that a legitimate customer and a genuine stockpiling gadget finish coordinating sessions, they register a similar session key. Second, two our conventions give forward mystery: one is somewhat forward secure regarding various sessions inside a day and age.

D.AUTHENTICATED KEY EXCHANGE

Our essential objective in this work is to plan proficient and secure validated key trade conventions that meet particular necessities of pNFS. The principle aftereffects of this paper are three new provably secure confirmed key trade conventions. Portray our outline objectives and give some instinct of an assortment of pNFS verified key exchange6 (pNFS-AKE) conventions that we consider in this work.

E. FORWARD SECRECY

The convention should ensure the security of past session keys when the long haul mystery key of a customer or a capacity gadget is bargained. Be that as it may, the convention does not give any forward mystery. To address key escrow while accomplishing forward mystery at the same time, we fuse a Diffie-Hellman enter understanding strategy into Kerberos-like pNFS-AKE-I.

F. USER LOGIN:

User Registration / Login

After the registration, he will be issued with valid user id and password by the Administrator. The user can log into the system with this user Id and Password. After successfully login into the system, the user moves to the instruction web page where he w A user's account allows a user to authenticate to a system and to be granted authorization to access resources provided by or connected to that system; however, authentication does not imply authorization. To log into an account, a user is typically required to authenticate oneself with a password or other credentials for the purposes of accounting, security, logging, and resource management. Once the user has logged on, the operating system will often use an identifier such as an integer to refer to them, rather than their username, through a process known as identity correlation.

G.USER PRIVILEGES

Offer Data

The client can share their information with another client in the same gathering the information will decipher by way setting information.

Transfer Data

The client can transfer the document to the cloud. What's more, the Admin can enable the information to store the cloud.

Download File

The client likewise downloads the cloud record by the conditions.

H. SERVER AUTHENTICATION:

Acknowledge client

The administrator can acknowledge the new client ask for and furthermore dark the clients.

Permit client document

The clients can transfer the document to the cloud. Furthermore, the administrator can enable the documents to the cloud then just the record can store the cloud.

IV. FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

- Economical Feasibility
- Technical Feasibility
- Social Feasibility

A. ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

B. TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

C. SOCIAL FEASIBILITY

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

V. SOFTWARE DESCRIPTION

A.WEB SERVER

The Web server accepts the request and sends the HTML to the Client browser that requests it. Web browser and web

server communicate through a common protocol (HTTP). The examples for web server are XAMPP(any of four different operating systems, Apache, MySQL,Php,Perl),WAMP(Windows,Apache,MySQL,Php), MAMP(Macintosh, Apache, MySQL, PHP).

B. PHP:

PHP stands for Hypertext Preprocessor. PHP scripts run inside Apache server or Microsoft IIS. PHP and Apache server are free. PHP code is very easy. PHP is the most used server side scripting language. PHP files contain PHP scripts and HTML. PHP files have the extension "php", "php3", "php4", or "phtml".

Using PHP

Generate dynamic web pages. PHP can display different content to different user or display different content at different times of the day Process the contents of HTML forms. We can use a PHP to retrieve and respond to the data entered into an HTML form. Can create database-driven web pages. A PHP can insert new data or retrieve existing data from a database such a MySQL.

Working of PHP

PHP is a standard HTML file that is extended with additional features. Like a standard HTML file, PHP contains HTML tag that can be interpreted and displayed by a web browser. Anything we could normally place in an HTML file Java applets, Blinking text, server side scripts .we can place in PHP. However, PHP has three important features that make it unique. PHP contains server side scripts. PHP provides several built-in objects.

C. HYPER TEXT MARKUP LANGUAGE (HTML)

HTML is an application of the Standard Generalized Markup Language (SGML), which was approved as an international standard in the year 1986. SGML provides a way to encode hyper documents so they can be interchanged SGML is also a Meta language for formally describing document markup system. Infact, HTML uses SGML to define a language that describes a WWW hyper document's structure and inter connectivity. Following the rigors of SGML, TBL bore HTML to the world in 1990. Since then, many of us have it to be easy to use but sometimes quite limiting. These limiting factors are being addressed but the World Wide Web Consortium (aka W3c) at MIT. But HTML had to start somewhere, and its success argues that it didn't start out too badly.

D. BENEFIT OF PHP

Because the server does processing, the output of PHP files changes when its input changes. For example, most of the pages on the Horticulture site have only two (2) PHP commands:

1. Include the header file that defines the links on the left, the banner, and the quick links at the top.
2. Include the footer file that displays the mission statement and Horticulture contact information.

Because including the files is performed everytime the PHP file is accessed, when the header/footer files change, the new content will be immediately updated. In other words, if

you add a new link, every page that includes the header will immediately display the new lin

- PHP stands for PHP: Hypertext Preprocessor
- PHP is a server-side scripting language, like ASP
- PHP scripts are executed on the server
- PHP supports many databases (MySQL, Informix, Oracle, Sybase, Solid, PostgreSQL, Generic ODBC, etc.)
- PHP is an open source software
- PHP is free to download and use
- PHP files can contain text, HTML tags and scripts
- PHP files are returned to the browser as plain HTML
- PHP files have a file extension of ".php", ".php3", or ".phtml"
- PHP runs on different platforms (Windows, Linux, Unix, etc.)
- PHP is compatible with almost all servers used today (Apache, IIS, etc.)
- PHP is FREE to download from the official PHP resource: www.php.net
- PHP is easy to learn and runs efficiently on the server side

To get access to a web server with PHP support, you can:

- Install Apache (or IIS) on your own server, install PHP, and MySQL
- Or find a web hosting plan with PHP and MySQL support

E. BASIC PHP SYNTAX

A PHP scripting block always starts with <?php and ends with ?>. A PHP scripting block can be placed anywhere in the document. On servers with shorthand support enabled you can start a scripting block with <? And end with ?>. For maximum compatibility, we recommend that you use the standard form (<?php) rather than the shorthand form. A PHP file normally contains HTML tags, just like an HTML file, and some PHP scripting code.

Each code line in PHP must end with a semicolon. The semicolon is a separator and is used to distinguish one set of instructions from another

BACK END MYSQL SERVER

Database

A database is simply a collection of used data just like phone book. MySQL database include such objects as tables, queries, forms, and more.

Tables

In MySQL tables are collection of similar data. With all tables can be organized differently, and contain mostly different information- but they should all be in the same database file. For instance we may have a database file called video store. Containing tables named members, tapes, reservations and so on. These tables are stored in the same database file because they are often used together to create reports to help to fill out on screen forms.

Relational database

MySQL is a relational database. Relational databases tools like access can help us manage information in three important ways.

- Reduce redundancy
- Facilitate the sharing of information
- Keep data accurate

Fields

Fields are places in a table where we store individual chunks of information.

Primary key and other indexed fields

MySQL use key fields and indexing to help speed many database operations. We can tell MySQL, which should be key fields, or MySQL can assign them automatically.

Controls and objects
Queries are access objects us display, print and use our data. They can be things like field labels that we drag around when designing reports. Or they can be pictures, or titles for reports, or boxes containing the results of calculations.
Queries and dynasts
Queries are request to information. When access responds with its list of data, that response constitutes a dynast. A dynamic set of data meeting our query criteria. Because of the way access is designed, dynasts are updated even after we have made our query.
Forms
Forms are on screen arrangement that make it easy to enter and read data. we can also print the forms if we want to. We can design form our self, or let the access auto form feature.
Reports
Reports are paper copies of dynasets. We can also print reports to disk, if we like. Access helps us to create the reports. There are even wizards for complex printouts.
Properties
Properties are the specification we assigned to parts of our database design. We can define properties for fields, forms, controls and most other access objects.

VI. FEATURES OF MYSQL

MYSQL is a relational database system. If you can believe many diehard MYSQL fans, MYSQL is faster, more reliable, and cheaper -- or, simply put, better -- than any other database system (including commercial systems such as Oracle and DB2). Many MYSQL opponents continue to challenge this viewpoint, going even so far as to assert that MYSQL is not even a relational database system. We can safely say that there is a large bandwidth of opinion.

- The fact is that there is an ever increasing number of MYSQL users, and the overwhelming majority of them are quite satisfied with MYSQL. Thus for these users we may say that MYSQL is good enough.
- It is also the fact, however, that MYSQL still lacks a number of features that are taken for granted with other database systems. If you require such features, then MYSQL is (at least for the present) not the database system for you. MYSQL is not a panacea.

The following list shows the most important properties of MYSQL. This section is directed to the reader who already has some knowledge of relational databases. We will use some terminology from the relational database world without defining our terms exactly. On the other hand, the explanations should make it possible for database novices to understand to some extent what we are talking about.
Relational Database System: Like almost all other database systems on the market, MYSQL is a relational database system.
Client/Server Architecture: MYSQL is a client/server system. There is a database server (MYSQL) and arbitrarily many clients (application programs), which communicate with the server; that is, they query data, save changes, etc. The clients can run on the same computer as the server or on another computer (communication via a local network or the Internet).
Almost all of the familiar large database systems (Oracle,Microsoft SQL Server, etc.) are client/server systems. These are in contrast to the file-server systems, which include Microsoft Access, dBase and FoxPro. The decisive drawback to file-server systems is that when run over a network, they become extremely inefficient as the number of users grows.
MySQL server overview
The MySQL server provides a database management system with querying and connectivity capabilities, as well as the ability to have excellent data structure and integration with many different platforms. It can handle large databases reliably and quickly in high-demanding production environments. The MySQL server also provides rich function such as its connectivity, speed, and security that make it suitable for accessing databases.
The MySQL server works in a client and server system. This system includes a multiple-threaded SQL server that supports varied backend, different client programs and libraries, administrative tools, and many application programming interfaces (API)s.
To get started, you must do the following:

1. Download MySQL Version 5.0.27.
2. Build and load the MySQL server.
3. Initialize the MySQLdatabase.
4. Start the MySQL server.

MySQL directory structure
On the z/TPF system, the MySQL server uses the directory tree setup when you enter ZMSQL BOOTSTRAP PATH-/pathname, where /pathname specifies the base directory in which MySQL is installed. This means that all MySQL files can be found in this directory (/pathname). When you are configuring MySQL, ensure that the MySQL files reside in a file system that is thread-safe, such as a pool file system (PFS), memory file system (MFS), or fixed file system (FFS). MySQL uses the following directories by default, assuming /pathname is specified for the PATH parameter:

/pathname/mysql/data

The MySQL data directory, which is the default directory where log files are saved. Subdirectories in the MySQL data directory correspond to databases in MySQL. Files in the subdirectories correspond to tables in those databases.

/pathname/mysql/data/mysql

The MySQL database directory. This is a special database that contains the administrative databases for MySQL.

/pathname/share/mysql/charset

This directory contains the character set support files.

/pathname/share/mysql/english/

This directory contains the English language error messages.

/pathname/share/mysql/

This directory contains other language support.

Database administration
Database administration is the process of establishing computerized databases and preparing for the environmental aspects of a database. In general, these include database setup, database backup, and database logging. Additionally, database administration involves monitoring the performance of databases and enforcing standards for database use and security.

Database setup: MySQL supports several types of databases and storage engines.

Database backup and restore

In information technology, backup refers to the copying of data so that the additional copies may be restored after a data loss. Backups are useful for restoring a computer to an operational state following a disaster (disaster recovery) and to restore small numbers of files after they have been accidentally deleted or corrupted. Backups differ from archives in the sense that archives are the primary copy of data and backups are a secondary copy of data.

Stored procedures

A stored procedure is a set of SQL statements that can be stored on the MySQL server. By using stored procedures, it is not necessary for client applications to continually issue individual SQL statements because they can refer to the stored procedure instead.

Stored procedures are useful in these situations:

- When multiple client applications are written in different programming languages or operate on different platforms, but must perform the same database operations
- When security is important. Banks, for example, use stored procedures and functions for all common operations. Doing so provides a consistent and secure environment, and routines can ensure that each operation is logged properly. With such a setup, client applications and users cannot access the database tables directly, but do have the ability to process specific stored routines.

Stored procedures can provide improved performance because less information needs to be sent between the MySQL server and the client application, but they can also increase the load on the database server because more of the work is performed on the server side and less work is performed on the client application side.

Error and crash recovery from data corruption

Crash recovery is the recovery of a database and the ability to automatically correct a hardware, software, or line failure through a set of concepts, procedures, and strategies that protect databases against data loss due to media failure or user errors. Ordinarily you can protect against most common system failures, including power outages and hardware and software problems. However, there are times when the portion of the system that is running on an individual computer may crash, and then be restarted by a crash recovery procedure. This may result in the loss of some information that was present just before the crash. The loss of the information may lead to an inconsistent state for the information permanently stored in the system.

VII. TESTING

It is the process of exercising software with the intent of finding and ultimately correcting errors. This fundamental philosophy does not change for web applications, because web based system and applications reside on network and inter-operate with many different operating systems, browsers, hardware platforms and communication protocols. Thus searching for errors is significant challenge for web applications.

Testing issues:

- Client GUI should be considered.
- Target environment and platform considerations
- Distributed database considerations
- Distributed processing consideration
- Testing and Methodologies

System testing is the state of implementation, which is aimed at ensuring that the system works accurately and efficiently as expect before live operation, commences. It certifies that the whole set of programs hang together System testing requires a test plan, that consists of several key activities and steps for run program, string, system and user acceptance testing. The implementation of newly design package is important in adopting a successful new system

Testing is important stage in software development. System test is implementation should be a confirmation that all is correct and an opportunity to show the users that the system works as they expected It accounts the largest percentage of technical effort in software development process.

Testing phase is the development phase that validates the code against the functional specifications. Testing is a vital to the achievement of the system goals. The objective of testing is to discover errors. To fulfill this objective a series of test step such as the unit test, integration test, validation and system test where planned and executed.

UNIT TESTING

Here each program is tested individually so any error apply unit is debugged. The sample data are given for the unit testing. The unit test results are recorded for further references. During unit testing the functions of the program unit validation and the limitations are tested.

Unit testing is testing changes made in a existing or new program this test is carried out during the programming and each module is found to be working satisfactorily. For example in the registration form after entering all the fields we click the submit button. When submit button is clicked, all the data in form are validated. Only after validation entries will be added to the database.

Unit testing comprises the set of tests performed by an individual prior to integration of the unit into large system. The situation is illustrated in as follows

Coding-> Debugging ->Unit testing -> Integration testing

The four categories of test that a programmer will typically perform on a program unit

- Functional test
- Performance test
- Stress Test
- Structure test

Functional test involve exercising the code with nominal input values for which the expected results are known as well as boundary values and special values.

Performance testing determines the amount of execution time spent in various parts of unit program through put and response time and device utilization by the program.

A variation of stress testing called sensitivity testing in same situations a very small range of data contained in a bound of valid data may cause extreme and even erroneous processing or profound performance degradation.

Structured testing is concerned with a exercising the internal logic of a program and traversing paths. Functional testing, stress testing performance testing are referred as “black box” testing and structure testing is referred as “white box” testing

VALIDATION TESTING

Software validation is achieved through a serious of testes that demonstrate conformity with requirements. Thus the proposed system under consideration has been tested by validation & found to be working satisfactory.

OUTPUT TESTING

Asking the user about the format required by them tests the output generated by the system under consideration .It can be done in two ways, one on screen and other on printer format. The output format on the screen is found to be correct as the format designed n system test.

SYSTEM TESTING

In the system testing the whole system is tested for interface between each modules and program units are tested and recorded. This testing is done with sample data. The securities, communication between interfaces are tested

System testing is actually a series of different tests whose primary purpose is to fully exercise the computer based system although each test has a different purpose all work to verify that all system elements properly integrated and perform allocate function. It involves two kinds of activities namely

1. Integrated testing
2. Acceptance testing
3. Integrated testing

Integrated testing is a systematic technique for constructing tests to uncover errors associated with interface.

Objective is to take unit tested modules and build a program structure that has been dictated by design

Acceptance testing

Acceptance testing involves planning an execution of a functional test, performance test and stress test to verify that the implemented system satisfies the requirement.

The acceptance testing is the final stage of the user the various possibilities of the data are entered and the results are tested.

Validation testing

Software validation is achieved through a series of test that demonstrates the conformity and requirements. Thus the proposed system under consideration has to be tested by validation and found to be working satisfactorily. For example in customer enters phone number field should contain number otherwise it produces an error message similarly in all the forms the fields are validated

Testing results

All the tests should be traceable to customer requirements the focus of testing will shift progressively from programs Exhaustive testing is not possible To be more effective testing should be which has probability of finding errors

The following are the attributes of good test

1. A good test has a probability of finding an errors
2. A good test should be “best of breeds”
3. A good test to neither simple nor too complex

VIII. INPUT DESIGN

Input design is one of the most expensive phases of the operation of computerized system and is often the major problem of a system. A large number of problems with the system can usually be traced back to fault input design and method. Needless to say, therefore that the input data is the life block of a system and has to be analyzed and designed with the most consideration.

The decisions made during the input design are:

- To provide cost effective method of input.
- To achieve the highest possible level of accuracy.
- To ensure that input is understood by the user.

System analysts decide the following input design details like, what data item to input, what medium to use, how the data should be arranged or coded data items and transaction needing validations to detect errors and at last the dialogue to guide users in providing input. Input data of a system may not be necessarily a raw data captured in the system from scratch. These can also be the output of another system or sub-system. The design of input covers all phases of input from the certain of initial data to actual entering the data to the system for processing.

OUTPUT DESIGN

Output design generally refers to the results and information that are generated by the system. For many end-users, output is the main reason for developing the system and the basis on which they evaluate the usefulness of the application.

The objective of a system finds its shape in terms of output. The analysis of the objective of a system leads to determination of outputs. Outputs of a system can take various forms. The most common are reports, screens displays printed form, graphical drawing etc. the outputs vary in terms of their contents, frequency, timing and format. The users of the output, its purpose and sequence of details to be printed are all considered.

When designing output, the system analyst must accomplish things like, to determine what information to be present, to decide whether to display or print the information and select the output medium to distribute the output to intended recipients.

External outputs are those, whose destination will be outside the organization and which require special attention as the project image of the organization.

Internal outputs are those, whose destination is within the organization. It is to be carefully designed, as they are the user’s main interface with the system. Interactive outputs are those, which the user uses in communication directly with the computer.

IX. CONCLUSION

The “Security Enhancing System Using Elliptic Curve Cryptography” has been developed to satisfy all proposed requirements. The process is maintained more simple and easy. The system is highly scalable and user friendly. Almost all the system objectives have been met. The system has been tested under all criteria. The system minimizes the problem arising in the existing manual system and it eliminates the human errors to zero level. The design of the database is flexible ensuring that the system can be implemented. It is implemented and gone through all validation. All phases of development were conceived using methodologies. User with little training can get the required report. The software executes successfully by fulfilling the objectives of the project. Further extensions to this system can be made required with minor modifications.

X. REFERENCES

Book Reference

[1]Professional PHP6, By Ed Lecky-Thompson, Steven D. Nowicki, and Thomas Myer
[2]Learning PHP, MySQL, and JavaScript: A Step-by-Step Guide to Creating Dynamic Websites, By Robin Nixon
[3]PHP Solutions: Dynamic Web Design Made Easy, By David Powers
[4]Beginning PHP and MySQL: From Novice To Professional, By W. Jason Gilmore
[5]Head First PHP & MySQL, By Lynn Beighley and Michael Morrison
[6]Core PHP programming By Leon Atkinson, Zeev Suraski.
[7]PHP Object-Oriented Solutions By David Powers
Web Reference
[8]www.w3schools.com
[9]www.php.net/manual/en/tutorial.php
[10]www.tutorialspoint.com
[11]www.tizag.com/php
[12]www.codecademy.com/tracks/php

Anti-Spoofing Method for Fingerprint Recognition Using ML in Cyber Security

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Abstract: Fingerprint recognition is a widely utilized biometric authentication method due to its uniqueness and reliability. However, conventional fingerprint recognition systems are vulnerable to spoofing attacks, where an attacker fabricates artificial fingerprints to deceive the system. In cybersecurity, these vulnerabilities pose significant threats to the integrity of sensitive data and systems. To address this challenge, we proposed an anti-spoofing method for fingerprint recognition leveraging Machine Learning (ML) techniques. This method aims to enhance the security of fingerprint recognition systems against spoofing attacks. Subsequently, a machine learning model, such as a Convolutional Neural Network (CNN), is trained on the extracted features to distinguish between genuine and spoofed fingerprints.

Keywords: *Anti-spoofing, Cybersecurity, Machine Learning, Convolutional Neural Network*

I. INTRODUCTION

In our modern world, there is an ever-growing need to identify individuals, especially for personal authentication, e.g., to unlock a smartphone, authorize a banking transaction, or withdraw money from ATM. Biometric recognition systems provide a convenient way to perform this necessary authentication step without having to hassle with keys, smart cards, or having to remember complicated passwords and, thus, have the potential to provide some extra security as well. Many spoof fingerprint detection techniques have been developed. Thus, misrepresentation of fingerprints and the detection of forged fingerprints are still an open issue. So, we use the Convolution Neural Network algorithm to overcome this problem with the help of Machine Learning.

Anti-spoofing identification can be performed by classifying the collected images into bonafide fingerprints, artificial fingerprints, and background information. Behavioral biometrics, which focuses on individuals' unique behavioral traits, presents a promising avenue for addressing the complexities of forensic authentication [5],[6]. Specifically, analyzing fingerprint images using advanced machine learning algorithms offers a potent solution for detecting alterations and determining the originality of fingerprints. In this context, CNN emerge as a powerful tool for automating the analysis of fingerprint patterns and identifying subtle deviations indicative of tampering [8],[7].

This project endeavours to leverage the capabilities of behavioral biometrics, particularly in the context of fingerprint authentication within forensic investigations. The aim is to create a reliable system that can classify changes as mild, moderate, or severe by employing CNN algorithms trained on diverse datasets encompassing varying fingerprint alterations. Such a system holds the potential to revolutionize forensic authentication practices, providing forensic analysts with automated tools to assess the integrity of fingerprint evidence efficiently and effectively [1],[5],[4].

In this introduction, we provide an overview of the challenges inherent in forensic authentication, the significance of behavioral biometrics in addressing these challenges, and the specific focus of our project on utilizing CNN algorithms for analyzing fingerprint alterations.

II. LITERATURE SURVEY

Qing Bao, et.al., (2023), proposed a combined method to rectify the latent fingerprints extracted at a crime scene. The technique is a coarse-to-fine approach, combining the robustness of traditional pattern recognition and the accuracy of deep learning networks. They conducted several experiments to compare our approach with other techniques, including the nearest-neighbour search and network methods. The results show a remarkable improvement in fingerprint matching, especially in low-quality latent fingerprints [1].

Khan A.I., et.al., (2018), A patch-based method uses a CNN to identify patches to segment latent fingerprint pictures. We decided to employ CNN for this challenging challenge because of its recent remarkable performance in object detection, classification, and pattern recognition. They used SGD to train the CNN model to classify picture patches into fingerprint and non-fingerprint classes. The isolated and incorrectly classified patches are then removed using the suggested false patch removal strategy, which uses the "majority of neighbours." Lastly, an ROI is created to distinguish latent fingerprint picture foreground separated from the background based on the last class of patches. The IIIT-D latent fingerprint database was used to evaluate the model, and the experimental findings indicate increases in overall accuracy over previous approaches [2].

Cao K., et.al., (2018), proposed an automated latent fingerprint recognition algorithm in this paper that uses Convolutional Neural Networks (ConvNets) for ridge flow estimation and minutiae descriptor extraction. Two minutiae templates and one texture template are extracted as complementary templates. The comparison scores between the latent and a reference print based on the three templates are fused to obtain a brief candidate list from the reference database [3].

A B. Spanier., et.al., (2023), This study contributes insights into practical gender classification from fingerprints, emphasizing the significance of the fingerprint periphery. It employed supervised learning and CNN methods for model training, particularly networks such as VGG and ResNet, which have maintained their importance within deep learning for image classification. The architectures emphasize depth through the recurrent use of small receptive field convolutions and pooling layers, simplifying implementation and comprehension. Our approach involves fine-tuning CNN architectures tailored to the specific image classification objectives. We employed standard training techniques to train

our CNN models, including data augmentation, normalization, a method for class imbalance, stochastic AdaGrad optimization, and others [4].

F. Liu., et.al., (2021), proposes a novel fingerprint PA detection technique based on optical coherence technology (OCT) pictures using the One-Class PAD (OCPAD) method. The training set for the suggested OCPAD model only contains Bonafide or actual fingerprints. The following computation of the spoofed score is based on the reconstruction error and latent code acquired from the trained auto-encoder network in the suggested model. We recommend utilizing an activation map-based weighting technique to enhance the precision of reconstruction error estimates. Various statistics and distance metrics are tested, and a decision-level fusion makes the ultimate prediction. A dataset of 48400 PA scans and 93200 genuine scans is used in our investigations. A feature-based approach and a supervised learning-based model that requires PAs for training were significantly outperformed by the suggested OCPAD, which can obtain a True Positive Rate (TPR) of 99.43% when the False Positive Rate (FPR) equals 10% and a TPR of 96.59% when FPR=5%, according to the results [5].

D.M. Uliyan., et.al., (2020), proposed a novel deep learning model for examining fingerprints based on DRBM and Deep Boltzmann Machine, which robustly deals with complex texture patterns due to its probabilistic multilayer architecture. In the proposed method, after training a DBM, such a structure has been employed to extract deep features of the grayscale fingerprints. KNN classifier is applied with the feature vectors of the ROIs removed by the DBM to examine spoof forgeries. The experiment results demonstrate that the Deep learning model is robust against different spoof forgeries such as wood glue, Gelatin and Play-Doh. Deep features are extracted from the actual image of grayscale and Depth visual structures such as scaled and rotated patch ROIs. The performance evaluation of the DRBM + DBM method achieved state-of-the-art results in three public fingerprint recognition benchmarks [6].

F. Liu., et.al., (2019), proposed to avoid the fabrication of identification. The model used the multi-scale LPQ to extract the features. Considering how highly dimensional the derived features are, which increases the complexity and requires more memory capacity, they used PCA to mitigate these drawbacks. After reducing the extracted features vector, they trained the model using the SVM classifier; then, they tested it to measure the performance; the results demonstrated an improvement in terms of accuracy [7].

Joshua J., et.al., (2019), proposed one such spoof detection method by modifying RaspiReader with two cameras for fingerprint picture capture. One camera captures direct photographs of the finger in contact with the platen, while the other captures high contrast, frustrated total internal reflection (FTIR) fingerprint images. By utilizing the two picture streams, we can extract complementary information that, when combined and applied to spoof detection, yields a significant boost in performance compared to earlier techniques that just relied on grayscale FTIR images from COTS optical readers. Lastly, fingerprint matching tests between images obtained from the RaspiReader's FTIR output and images obtained from a COTS reader confirm that the RaspiReader is compatible with currently available COTS optical readers [8].

C. Yuan., et.al., (2019), proposed an improved DCNN with image scale equalization and a fingerprint liveness detection technique. They applied the confusion matrix to fingerprint liveness detection for performance indication. The databases used were LivDet 2011 and 2013. Their results show an increase in performance compared to existing methods [9].

Table 1: Advancements in Fingerprint Recognition and Anti-Spoofing Technologies

S.NO	PAPER	METHODOLOGY USED	ACCURACY
1.	A Coarse-to-Fine Approach for Rectifying Distorted Latent Fingerprints from Crime Scenes [1]	Coarse-to-fine algorithm	67%
2.	Patch-based Segmentation of Latent Fingerprint Images Using Convolutional Neural Network [2]	patch-based technique for segmentation & CNN to classify patches	78%
3.	Automated latent fingerprint recognition [3]	Fully Convolutional Network is used to highlight the use of full image for image segmentation.	76%
4	Enhancing Fingerprint Forensics: A Gender Classification Based on Advanced Data-Centric AI Approaches and Multi-Database Analysis [4]	Convolutional Neural Network is used for fingerprint image gender classification.	80%
5	One-class fingerprint presentation attack detection using auto-encoder network [5]	One-Class PAD (OCPAD) is used for Optical Coherence Technology (OCT) images-based fingerprint PA detection.	85%
6	Anti-spoofing method for fingerprint recognition using patch based deep learning machine [6]	This paper uses Discriminative Restricted Boltzmann Machines (DRBM) and Deep Boltzmann	87%

		Machine (DBM) to recognize fingerprints accurately against fabricated materials used for spoofing using Deep Learning model.	
7	High-accurate and robust fingerprint anti-spoofing system using Optical Coherence Tomography [7]	This paper proposed an efficient fingerprint anti-spoofing system with high accuracy and robustness using OCT.	92%

P. Mishra., et.al., (2019), proposed a detailed investigation and analyzed various machine learning techniques. It provides a detailed survey of attack detection. Data mining tools for machine learning were introduced as well [10].

L. Almajmaie., et.al., (2019), proposed a new technique for fingerprint recognition based on associative memory. The experiments were carried out on databases like FVC (2004), international NIST databases and an internal database. The proposed system produced results with an accuracy of 99.5% [11].

R. P. Krish., et.al., (2019), proposed a linear binary pattern was used by resizing the fingerprint image to the size 60*60. The resized images were binarized using a threshold value and then divided into nine equal segments. For each block, the linear binary pattern is found. The second step is the classification; in this step, two machine learning algorithms are applied: the neural network and the nearest neighbour classifiers. They used two datasets to train and test the model, including FVC200214 and FVC200415. The results demonstrated that the neural network outperformed the nearest neighbour classifier regarding accuracy [12].

J. B. Kho., et.al., (2019), proposed to overcome the weakness in the traditional systems, which is a leak in resolution and cannot extract deep information from the captured image. Their system had two novel techniques for feature extraction. The first feature, called depth-double-peak, indicates that there should be only two peaks in the 1D depth signal, reflecting the double-peak structure of natural fingertip skin. The second one called sub-single-peak, which refers that there should be a peak in the 1D depth signal intercepted before the maximum peak, which distinguishes the extra layer covered on a real finger. They validate their system using four datasets. The experiment's outcomes show how accurate and efficient their method [13].

S.S. Ali., et.al., (2020), proposed a technique to secure a fingerprint-based user template. In the method, fingerprint features of a user template are transformed with the help of a transformation function and a unique user key-set to get a secure user template. If the user template is compromised, the user key set can easily be changed to produce a very different new fast template in the technique [14].

Z. Yu., et.al., (2020), proposed a unique frame-level FAS technique based on Central Difference Convolution (CDC) that aggregates both intensity and gradient data to capture intrinsic detailed patterns. The Central Difference Convolution Network (CDCN), constructed using CDC, has a more robust modelling capacity than its equivalent created using vanilla convolution. Moreover, Neural Architecture Search (NAS) is employed to find a more robust network structure (CDCN++) over a specially-designed CDC search space, which can be coupled with a Multiscale Attention Fusion Module (MAFM) to improve performance further. On six benchmark datasets, extensive tests are carried out to show that 1) the proposed method achieves superior performance on cross-dataset testing (specifically, 6.5% HTER from CASIA-MFSD to Replay-Attack datasets), and 2) it also performs well on intra-dataset testing (particularly 0.2% ACER in Protocol-1 of OULU-NPU dataset [15].

D.M. Uliyan., et.al, (2020), proposed a unique technique for identifying phoney fingerprints about spoof forgeries utilized in authentication-based systems. We adapt several deep characteristics retrieved from images, including the Deep Boltzmann Machine (DBM). The primary advantage of DMB is its tiered architecture, which facilitates deep learning of highly detailed data features and aids in investigating intricate feature relationships. Deep Neural Network-based feature extraction from the input image facilitates in-depth data understanding. By extracting excellent information from the image, probabilistic deep learning models, or DBMs, can easily handle intricate patterns. It works well for tasks where patterns could be difficult to identify or falsify. Results on the Cross Match dataset demonstrate that our strategy performs well compared to handcrafted-based approaches and has a high detection rate for spoofing attacks [16].

III. METHODOLOGY

3.1 Data Collection:

Acquire a dataset consisting of genuine and altered fingerprint images. Ensure the dataset contains sufficient samples for each class (actual fingerprints, hard-altered, medium-altered, and easy-altered fingerprints). Preprocess the fingerprint images to enhance their quality and standardize their format. Apply techniques such as normalization, denoising, and enhancement to ensure consistency and suitability for analysis by the CNN.

The dataset used is publicly available on the Kaggle website, from the source of FVC (FVC2000 DB1, FVC2002 DB1, FCV2004), NISC (NISC27, NIST SD4), and LivDet (LivDet 2011,2017,2019), which consists of real time crime scene fingerprints. FVC dataset contains 10,000 fingerprint images (both spoofing and genuine fingerprint images), NISC contains 15,450 fingerprint images and LivDet contains 5,200 fingerprint images (live and spoofed fingerprint images). All the images are combined into a single file as 30,650 images for the purpose of training and testing. These datasets serve as standardized benchmarks for evaluating fingerprint recognition systems and anti-spoofing algorithms.

3.2 Data Augmentation:

Augment the dataset using rotation, scaling, and translation techniques to increase the diversity of training samples. This helps CNN learn robust representations of fingerprint patterns and improves generalization performance. Data augmentation techniques can also be applied in the field of forensic fingerprint analysis to enhance

the robustness of fingerprint recognition systems. It improves the accuracy and robustness of fingerprint recognition systems.

3.3 CNN Architecture Design:

Design a CNN architecture (Fig 1) suitable for fingerprint classification. Consider architectures commonly used in image recognition tasks, such as convolutional layers for feature extraction and pooling layers for dimensionality reduction. Experiment with different architectures and hyperparameters to optimize performance, considering factors such as model complexity, training time, and classification accuracy.

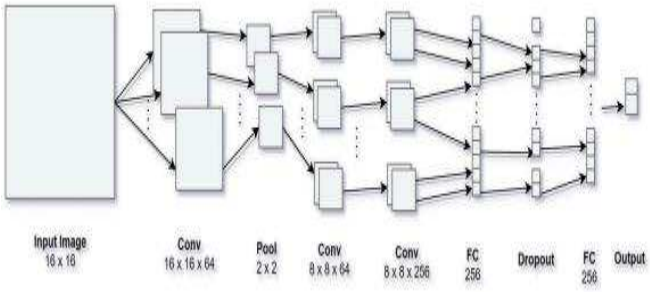


Fig 1: Architecture of CNN Model

3.4 Model Training:

Split the augmented dataset into training, validation, and testing sets. Ensure each set contains a representative distribution of genuine and altered fingerprint images. Train the CNN using a supervised learning approach, where it learns to classify fingerprint images into one of the four classes: actual fingerprints, hard-altered, medium-altered, or easy-altered fingerprints. Utilize a suitable loss function (e.g., categorical cross-entropy) and an optimization algorithm (e.g., stochastic gradient descent) to optimize the network parameters during training. Monitor the training process using accuracy, loss, and validation performance metrics to prevent overfitting and ensure convergence.

3.5 Model Evaluation:

Evaluate the trained CNN model using the testing set to assess its performance in classifying fingerprint images. Calculate accuracy, precision, recall, and F1-score metrics to measure the model's effectiveness in distinguishing between genuine and altered fingerprints. Perform additional analyses, such as confusion matrix visualization, to gain insights into the model's behavior and identify areas for improvement.

3.6 Deployment and Integration:

Deploy the trained CNN model into a real-time application environment, such as access control systems or authentication platforms. Integrate the model with existing security protocols to enhance authentication mechanisms and detect altered fingerprints in real-time scenarios. Keep an eye on the deployed model's performance and update it as necessary to keep up with changing environmental conditions and growing security threats. Deployment and integration of CNN involve several crucial steps to transition from trained models to real-world applications.

The Flowchart explains that the datasets are been divided into two forms for training and testing datasets, the 19,650 datasets are used for the training process and further datasets of 11,000 datasets ae used for the testing purpose. The CNN Algorithm is been used for training the datasets and it is been given for the classification. The testing datasets are classified according to the CNN classification, and the output is bee predicted as Real or Fake fingerprint Image.

FLOW CHART:

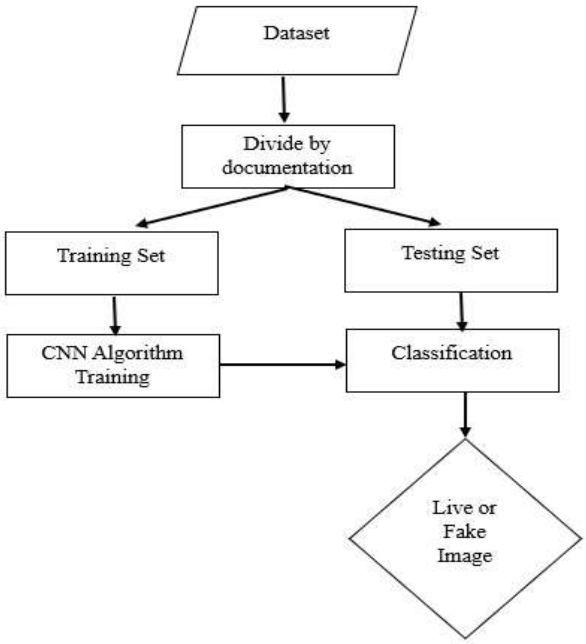


Fig 2: Workflow of CNN

IV. RESULTS

4.1 Datasets:

Publicly available fingerprint anti-spoofing databases:

Implementing fingerprint liveness detection techniques requires datasets for the training and testing phases. There are various databases publicly available. Some of these databases have become outdated with the introduction of Artificial intelligence in the field of liveness detection, as they are small in size and need more data. The well-known databases used in this experiment are listed below (Table 2).

Table 2: Anti-spoofing Datasets

S.No	Datasets	Datasets Available	No of Datasets Taken
1.	FVC	FVC2000 DB1, FVC2002 DB1, FCV2004	10,000
2.	LivDet	LivDet 2011,2017,2019	5,200
3.	NIST	NISC27, NIST SD4	15,450

Fingerprint Images taken for the experiment is 36,500 Fingerprints, the training is given to the software and it is tested by the fingerprint images, the images are been categorized as Real Fingerprint Images, Easy altered spoofed Fingerprint Images, Medium altered spoofed Fingerprint Images and Hard altered spoofed Fingerprint Images.

4.2 Evaluation Methods:

For fingerprint evaluation, comparing the original image, the de-noised image, and the residual image can provide insights into the effectiveness of denoising techniques. Evaluation of these images typically involves both qualitative and quantitative analysis:

4.2.1 Qualitative Analysis:

Visual inspection of the original, de-noised, and residual images allows for a subjective assessment of denoising effectiveness. Analysts look for improvements in clarity and noise reduction in the de-noised image while preserving essential fingerprint features.

4.2.2 Quantitative Analysis:

Objective measurements like the structural similarity index (SSIM) and peak signal-to-noise ratio (PSNR), or mean squared error (MSE) can quantify the degree of similarity between the original and de-noised images. Additionally, specific fingerprint recognition algorithms may be used to evaluate the impact of denoising on identification or verification performance.

4.3 Experimental Outputs:

4.3.1 Training Set:

Training the dataset of fingerprint images in ML involves preparing the data, selecting suitable algorithms, and optimizing the model to recognize and distinguish between genuine and spoof fingerprints (Fig 3). Initially, a diverse dataset comprising authentic and fraudulent fingerprint samples is collected. These images undergo preprocessing steps to enhance quality and standardize features. Data augmentation methods may be employed to increase dataset size and variability. The ML model used is CNN. During training, the model learns from the labelled dataset, adjusting its parameters to minimize errors.

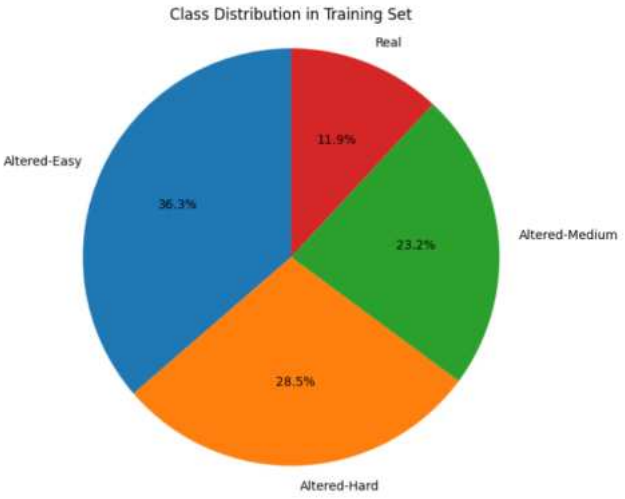


Fig 3: Pie chart of Training the datasets

4.3.2 Validation Set:

Validating the dataset of fingerprint images in ML involves assessing the quality and suitability of the data for training ML models (Fig 4). This process ensures the dataset accurately represents the problem domain and provides reliable results during model training and evaluation. Initially, the dataset is split into training and validation sets. The training set is used to train the ML model, while the validation set is held out for assessing the model's performance and tuning hyperparameters.

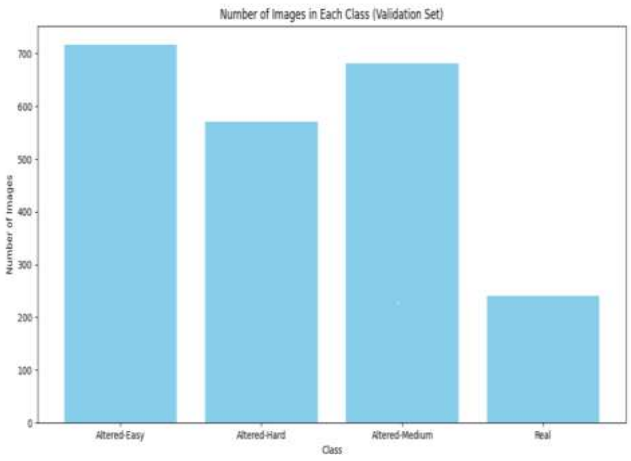


Fig 4: Bar chart Representation of Validation set

4.3.3 Testing Set:

In ML, testing the fingerprint image dataset refers to evaluating a trained model's performance on a separate data collection that was not used for training or validation. During testing, the trained ML model is applied to the testing dataset, and its predictions are compared against the ground truth labels.

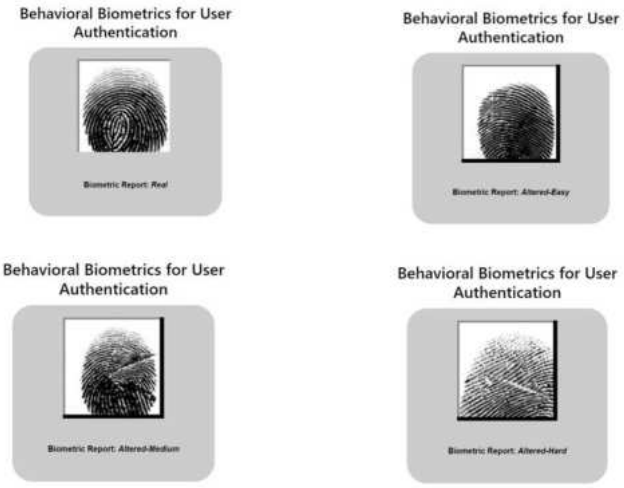


Fig 5: Results

The out of the tested dataset is given as four forms such as Real Fingerprint Images, Easy altered spoofed Fingerprint Images, Medium altered spoofed Fingerprint Images and Hard altered spoofed Fingerprint Images (Fig 5).

4.4 Accuracy

The primary goal of our research, is to improve the accuracy of fingerprint recognition systems. In the context of cybersecurity, accurate fingerprint recognition is crucial for authentication and identity verification, making it essential to develop methods that can reliably distinguish between genuine and spoofed fingerprints (Fig 6).

True Positives (TP): These are the samples that are correctly predicted as positive by the model.

True Negatives (TN): These are the samples that are correctly predicted as negative by the model.

False Positives (FP): These are the samples that are incorrectly predicted as positive by the model when they are actually negative.

False Negatives (FN): These are the samples that are incorrectly predicted as negative by the model when they are actually positive.

With these definitions, we calculated accuracy using the formula:

Accuracy = (TP+TN) / (TP+TN+FP+FN)

Thus, the accuracy was found to be **98%**.

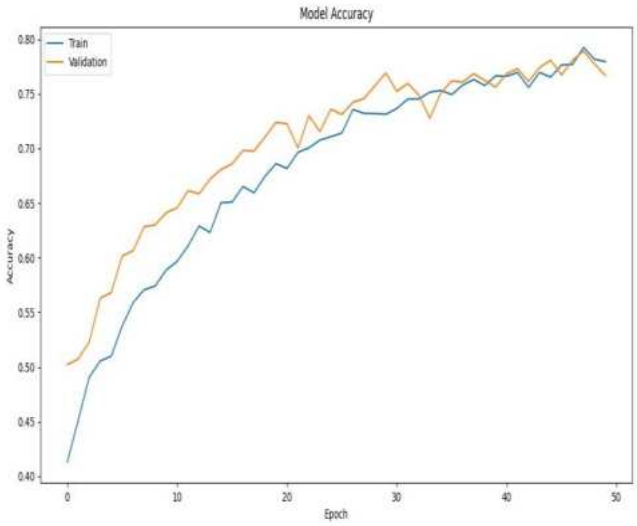


Fig 6: Accuracy level of fingerprint recognition

V. CONCLUSION

In conclusion, the anti-spoofing technique suggested for fingerprint recognition is a significant step toward improving the security and dependability of biometric authentication systems. We aim to strengthen these systems against increasingly complex spoofing assaults using machine learning techniques, including CNN.

With the support of extracted information, we want to create a reliable model that can distinguish between real and fake fingerprints. This approach fixes present vulnerabilities and lays the groundwork for future threat adaptation via frequent upgrades and retraining. Ultimately, our initiative is a proactive move to improve the security posture of fingerprint recognition systems, which will raise the confidence and dependability associated with biometric identification technologies.

VI. REFERENCE

[1] Qing Bao, Ya-Gang Wang, Chang Gao, Liangxiao Sha, and Feifie Lee, "A Coarse-to-Fine Approach for Rectifying Distorted Latent Fingerprints From Crime Scenes", IEEE Artificial International System, 18th December 2023, Vol: 11

[2] Khan A.I., & Wani M.A., "Patch-based Segmentation of Latent Fingerprint Images Using Convolutional Neural Network.", Applied Artificial Intelligence, 1–15(2018)

[3] Cao K., Jain A.K., "Automated latent fingerprint recognition.", IEEE Transactions on Pattern Analysis and Machine Intelligence, (2018).

[4] Assaf B. Spanier, Dor Steiner, Navon Sahalo, Yoel Abecassis, Dan Ziv, Ido Hefetz and Shimon Kimchi, "Enhancing Fingerprint Forensics: A Gender Classification Based on Advanced Data-Centric AI Approaches and Multi-Database Analysis", Multidisciplinary Digital Publishing Institute, applied sciences, (2023), vol: 14

[5] F. Liu, H. Liu, W. Zhang, G. Liu, L. Shen, "One-class fingerprint presentation attack detection using auto-encoder network", IEEE Trans. Image Process. 30 (2021) 2394–2407.

[6] D.M. Uliyan, S. Sadeghi, H.A. Jalab, "Anti-spoofing method for fingerprint recognition using patch based deep learning machine", Eng. Sci. Technol. Int. J. 23 (2020) 264–273.

[7] F. Liu, G. Liu, and X. Wang, "High-accurate and robust fingerprint anti- spoofing system using Optical Coherence Tomography", Expe. Sys. Appl., Vol.130, pp.31-44, 2019.

[8] Joshua J. Engelsma, Kai Cao, Anil K.Jain, "RaspiReader: Open Source Fingerprint Reader", IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 41, No. 10, pp. 2511–2524, Oct. 2019.

[9] C. Yuan, Z. Xia, and L. Jiang, "Fingerprint Liveness Detection Using an Improved CNN With Image Scale Equalization", IEEE Access, vol. 7, pp. 26953–26966, 2019.

[10] P. Mishra, V. Varadharajan, S. Member, U. Tupakula, E. S. Pilli, and S. Member, "A Detailed Investigation and Analysis of Using Machine Learning Techniques for Intrusion Detection," IEEE Commun. Surv. Tutorials, vol. 21, no. 1, pp. 686–728, 2019.

[11] L. Almajmaie, O. N. Ucan, and O. Bayat, "Fingerprint recognition system based on modified multi-connect architecture (MMCA) Action editor: Peter Erdi," ScienceDirect Cogn. Syst. Res., vol. 58, pp. 107–113, 2019.

[12] R. P. Krish, Julian Fierrez, Danial Ramos, Fernando Alonso Fernandez, Josef Bigun, "Improving automated latent fingerprint identification using extended minutia types", Information Fusion, Vol.50, pp.9-19, 2019.

[13] J. B. Kho, Wonjune Lee, Heeseung Choi, Jaihie Kim, "An incremental learning method for spoof fingerprint detection", Expe. Sys. Appl., Vol.116, pp.52-64, 2019.

[14] S.S. Ali, V.S. Baghel, I.I. Ganapathi, S. Prakash, "Robust biometric authentication system with a secure user template", Image Vis Comput. 104 (2020), 104004.

[15] Z. Yu, C. Zhao, Z. Wang, Y. Qin, Z. Su, X. Li, F. Zhou, G. Zhao, "Searching central difference convolutional networks for face anti-spoofing", CVPR (2020) 5295–5305.

[16] D.M. Uliyan, S. Sadeghi, H.A. Jalab, "Anti-spoofing method for fingerprint recognition using patch based deep learning machine", Eng. Sci. Technol. Int. J. 23 (2020) 264–273.

Robust Fingerprint Matching System with Convolutional Neural Networks in Forensic Investigations

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Abstract: **Fingerprint identification is crucial in forensic investigations, determining suspects, and solving crimes. This study presents a robust fingerprint-matching system utilising Convolutional Neural Networks (CNNs) for enhanced accuracy and efficiency in suspect identification. The system inputs crime scene fingerprints and employs CNN algorithms to match them with a trained model, ultimately revealing the suspect's identity. The suggested system tackles the issues linked to conventional fingerprint-matching approaches by harnessing the capabilities of deep learning and Convolutional Neural Networks (CNNs). Through extensive training on large-scale fingerprint datasets, the CNN model learns intricate patterns and features crucial for accurate matching, thus improving overall reliability and precision in forensic analyses. Key features of the system include its adaptability to diverse fingerprint variations, robustness against noise and distortion, and scalability to handle large volumes of fingerprint data efficiently. Additionally, the system offers real-time performance, facilitating swift decision-making in forensic investigations. Empirical findings illustrate the efficacy of the suggested method, highlighting its superior performance compared to traditional fingerprint-matching methods.**

Keywords: *Latent fingerprints, Minutiae extraction, Matching, Deep Learning.*

I. INTRODUCTION

The fingerprints play a vital role in the investigation of a crime scene. The fingerprints are impressions made by the friction edges on the human finger. The results of forensic fingerprint analysis to solve crimes have been used by investigators for more than a century. Unique physical characteristics like fingerprints, palm prints, iris, facial recognition, etc., are widely used for solving criminal cases in today's digital society (Singla et al., 2020). The fingerprints collected at a crime scene (latent fingerprints) are compared with the known samples for their resemblance. This is carried out by a trained examiner using the comparison method. The details, such as the shapes, the ridge lines form, and the end or split of the lines, are compared. The deposited FPs at the crime scene are categorised into three parts: (i) the visible (positive/negative), (ii) indented (moulded/plastic), and (iii) the latent/invisible prints. The difficulties in the contrast of the surface, impurities deposition on the finger ridges, or the secretions in the examination of latent prints become challenging for the investigators. Several approaches exist for collecting, enhancing, and extracting features from latent fingerprints. This includes nanomaterials, image enhancement techniques, modern deep learning, and machine learning algorithms. Exemplar prints or known prints are deliberately collected from a person for enrollment or from a suspected criminal of that scenario. This includes one print taken from each finger by rolling from one edge of the nail to the other by using live scan or ink on paper. In forensic science, the fingerprints gathered from partial prints, known as latent fingerprints, are not visible, so they require chemical development through powder dusting, iodine fuming, or silver nitrate soaking. These fingerprints can be subjected to drug detection by employing chemical approaches such as gold nanoparticles with attached cotinine antibodies in tobacco smokers' fingerprints.

The latent fingerprints have a smudgy and unclear finger zone compared to the fingerprint obtained from the inked finger during enrollment. Therefore, the latent fingerprints have to be scrutinised by the forensic investigators. To make these unclear prints more noticeable, it is crucial to determine the technique that needs to be applied to recognise the high-resolution images. This is done by employing the improvement techniques for image enhancement, thus creating a new image that is better than the original image. In recent years, the

advent of deep learning and neural network technologies has revolutionised the field of biometric identification, offering novel approaches for enhancing the accuracy and efficiency of fingerprint-matching systems. Convolutional Neural Networks (CNNs), in particular, have emerged as powerful tools for pattern recognition tasks, exhibiting remarkable image analysis and classification capabilities.

The proposed approach introduces a robust fingerprint-matching system that leverages CNNs to automate and improve the suspect identification process in forensic investigations. The objective of the system is to overcome the constraints of traditional fingerprint analysis techniques by utilising the computational capabilities of deep learning algorithms. These algorithms are employed to analyse and compare fingerprints from crime scenes with a trained model. Moreover, integrating CNNs into the forensic workflow facilitates real-time analysis and decision-making, empowering investigators to expedite identification and swiftly apprehend suspects. The system's ability to handle large volumes of fingerprint data efficiently further enhances its utility in forensic applications, enabling forensic experts to analyse evidence more effectively and expedite criminal investigations.

This research marks a notable progression in forensic science, showcasing the capacity of deep learning technologies to transform fingerprint identification and play a role in the pursuit of justice within society. The subsequent sections will delve into the methodology, experimental results, and implications of the proposed fingerprint-matching system, highlighting its contributions to the field and potential avenues for future research.

II. LITERATURE REVIEW

Assaf B. Spanier et al. (2024) proposed a method to extract additional demographic information from the latent fingerprints collected from crime scenes. This method provides a pioneering comparison of gender classification across datasets, considering fingerprint variations. The databases are gathered from both public and private sources. This research uses cross-dataset gender classification evaluation across various datasets, including three public databases (NIST-DB4, SOCOfing, and NIST-302) and one proprietary internal database (IsrPoliceDB). These are examined using Data-Centric AI (DCAI) approaches for enhanced classification. This data-centric approach shows a paradigm shift in AI applications. The observations showed that Convolutional Neural Network (CNN), specifically VGG, proves effective with an accuracy of 70% - 95%. This is a critical determinant of gender classification, notably for partial and low-quality fingerprints.

Qing Bao et al. (2023) proposed an approach for rectifying distorted latent fingerprints from crime scenes. This approach combines the robustness of traditional pattern recognition and deep learning networks. This research also compared the match rate with other approaches, including nearest neighbour search and network methods. The database was fetched from the Shanghai Public Security Bureau fingerprint (SPSB), which contains over 20,000,000 fingerprints. The methodology includes primarily three steps: (1) Estimation using two standard scales of nonlinear deformation caused by curved surfaces in crime scenes, (2) Estimation of the distortion field of the input image using the DCNN (Deep Convolutional Neural Network) model, and (3) Combining the advantages of both. The outcome shows a prominent improvement in fingerprint matching, especially in low-quality fingerprints. The accuracy level improved from the original accuracy-0.65 to the proposed level-1 and showed better improvement than the other approaches.

Ke Han et al. (2021) proposed a method for enhancing the fingerprint images interfered with by Gaussian noise. This is done by applying the partial differential equation method based on the total variation in processing Gaussian noise. The PDE method for fingerprint denoising uses the split Bregman isotropic Total Variation (TV) optimisation model. The performance of this method is evaluated by adding two different latent fingerprint images to Gaussian noise at various intensities. The results are compared with the traditional neighbourhood averaging method by structural similarity. It is concluded that the effects are the same in both methods when the Gaussian noise is low. Nevertheless, while increasing the Gaussian noise intensity, the PDE method shows better results, which states that the effect of processing Gaussian noise is greatly influenced by weight in the PDE method. The optimal weight depends on the intensity of Gaussian noise and the fingerprint image, which is not fixed in this method.

HajerWalhazi et al. (2020) proposed a technique for extracting latent fingerprint regions from the background as it would have poor ridge quality, complex background noise, and overlapped structure noise. This technique is a novel procedure for fingerprint segmentation comprised of two ideas: (1) for pre-processing by applying the RGB conversion to the YCBCR colour model and the Gaussian blur technique, and (2) defining the fingerprint region based on an evolving contour

using morphologic active contours without edges (MACWE). The databases were obtained from FVC2004 and NIST SD27. The experimental results were found to have a high accuracy of 97.54% for the FVC2004 database and 95.5% for the NIST SD27 database and evaluate the miss-classified pixels.

Samy Bakheet et al. (2022) proposed a technique for fingerprint enhancement, feature extraction, and matching. To improve the contrast, a variation of adaptive histogram equalisation known as contrast limited adaptive histogram equalisation and a combination of Gabor filters and the fast Fourier transform (FFT) are first applied to enhance the fingerprint images. Subsequently, the fingerprint is verified by selecting a tiny subset of data from minutiae point features, which are local places of interest. These features are recovered from the thinned binary fingerprint image using a hybrid combination of Harris and SURF feature detectors to get noticeably better detection results. The feature matching similarity measure of two fingerprint images for fingerprint matching is the Euclidean distance between the associated Harris-SURF feature vectors of two feature points. Additionally, RANSAC (RANdomSAmple Consensus), an iterative technique, is used for fine matching and automatically removing inaccurate match points and false matches. The suggested framework performs well and is feasible, as evidenced by quantitative experimental results obtained on the public domain fingerprint databases FVC2002 DB1 and FVC2000 DB1, which show average recognition rates of 95% and 92.5% for the two databases, respectively.

Yonghong Liu et al. (2019) proposed a method for aligned fingerprint matching based on deep learning. Finger ConvNet, a convolutional network, is created based on the properties of fingerprint photographs. Furthermore, Finger ConvNet is trained with a novel joint supervision signal to extract deep features. The experimental investigations used the public subjects' fingerprint datasets, the Ten-Finger Fingerprint Card fingerprint, and the ID Card fingerprint datasets. Additionally, measurements are made for four performance indicators: the receiver operating characteristic (ROC) curve, equal error rate (EER), false non-matching rate (FNMR), and false matching rate (FMR). The experimental findings show how practical the suggested approach is; fingerprint verification tasks utilising the FVC2000, FVC2002, and FVC2004 datasets produced a competitive effect compared to traditional fingerprint-matching methods. Furthermore, the proposed method's matching speed was nearly five times quicker than the quickest traditional fingerprint-matching methods. Likewise, it can be applied as a quick matching technique to eliminate numerous templates with poor scores by establishing a threshold based on the matching scores, which will quicken the identification task procedure.

VedatDelican et al. (2023) proposed a method for fingerprint matching using direct pore-based identification. This method is distinct from traditional fingerprint identification techniques. A direct pore-based identification system for fingerprint matching is proposed using data from the DocucenterNirvis device and Projectina Image Acquisition-7000 software as a hyperspectral imaging system where pores are more clearly visualised. The pores in the 800 fingerprints in the database were manually annotated for correctness, even though this presented challenges from an operational standpoint. Latent fingerprints were then discovered using scoring based on an iterative nearest-point approach. Ten fingerprints were randomly chosen from 1050 fingerprint datasets to validate the fingerprints utilised in the database. The findings indicate that the greater the hit score, the more pores were inspected and the more precisely the pores were noted.

Table 1. Shows the different techniques implemented for fingerprint recognition in forensic scenarios

Author Year of Publication	Dataset used	Techniques	Observation	Accuracy
Assaf B. Spanier et al. (2024)	NIST-DB4, SOCOfing, and NIST-302	Data-Centric AI (DCAI)	Comparison of gender classification across datasets, considering fingerprint variations. This data-centric approach shows a paradigm shift in AI applications. The observations showed that Convolutional Neural Network (CNN), specifically VGG, proves effective	70% - 95%

Qing Bao et al. (2023)	Shanghai Public Security Bureau fingerprint (SPSB)	DCNN (Deep Convolutional Neural Network) model.	The methodology includes primarily three steps: (1) Estimation using two standard scales of nonlinear deformation caused by curved surfaces in crime scenes, (2) Estimation of the distortion field of the input image using the DCNN, and (3) Combining the advantages of both. The outcome shows a prominent improvement in fingerprint matching, especially in low-quality fingerprints.	Improved from 0.65 to 1
Samy Bakheet et al. (2022)	FVC2002DB1 FVC2000DB1	Harris and SURF feature detectors RANSAC (RANdomSAmple Consensus),	To improve the contrast, contrast-limited adaptive histogram equalisation, a combination of Gabor filters, and the fast Fourier transform (FFT) are first applied to enhance the fingerprint images. A hybrid combination of Harris and SURF feature detectors is used to get noticeably better detection results.	FVC2002-95% FVC2000-92.5%
HajerWalhazi et al. (2020)	FVC2004 NIST SD27	MACWE (morphologic active contours without edges)	This technique is a novel procedure for fingerprint segmentation comprised of two ideas: (1) for pre-processing by applying the RGB conversion to the YCBCR colour model and the Gaussian blur technique, and (2) defining the fingerprint region based on an evolving contour using MACWE.	FVC2004-97.54% NIST SD27-95.5%
Ravinder Kumar (2020)	FVC 2002 FVC 2004 FVC 2006	OLBP (orientation local binary patterns) LSSVM (least square support vector machine)	This technique introduces a novel approach to fingerprint matching based on the orientation analysis of fingerprints utilising LBP, which is calculated from the orientation field of the fingerprint ridge. The matching performance using the OLBP descriptor has been assessed using the Euclidean distance, the Chi-square test, and the LSSVM.	FVC 2002-99.25% FVC 2004-99% FVC 2006-98.60%

III. PROPOSED METHODOLOGY

The proposed system aims to revolutionise forensic analysis by leveraging the power of deep learning (DL) to enhance both efficiency and accuracy. At its core, the system utilises a comprehensive dataset comprising fingerprints from four distinct classes, each representing a different criminal. By harnessing advanced ML algorithms, the system can analyse uploaded fingerprint images and accurately identify the associated criminal. This process not only expedites the investigation process but also minimises the margin for error, thereby optimising the overall efficacy of forensic analysis.

The system's architecture revolves around a sophisticated ML model trained on the dataset. This model can recognise subtle patterns and features within fingerprint images, enabling it to distinguish between individuals with a high degree of precision. The system integrates with a user-friendly frontend developed using Flask to facilitate seamless interaction with users. This interface allows users to easily upload fingerprint images and receive instantaneous feedback regarding the identified criminal. Additionally, the front end provides supplementary information, such as the confidence level of the identification and any relevant case details. To ensure the reliability and robustness of the system, rigorous testing and validation procedures are conducted at various

stages of development. This includes evaluating the ML model's performance on diverse fingerprint data sets to assess its generalisation capabilities and resilience to variability. Moreover, the system undergoes extensive real-world testing in collaboration with forensic experts to validate its effectiveness in practical scenarios. Continuous refinement and optimisation based on feedback and new data enhance the system's accuracy and reliability.

The proposed system represents a groundbreaking advancement in forensic analysis, offering a potent combination of efficiency and accuracy through the integration of ML technology. The system streamlines investigations and empowers law enforcement agencies with timely and reliable insights by automating the criminal identification process based on fingerprint evidence. With its user-friendly interface and robust performance, the system has the potential to revolutionise forensic practices and significantly contribute to the pursuit of justice.

3.1. TRAINING AND TESTING THE MODEL:

3.1.1. Data Collection:

The fingerprint datasets are obtained from an open source namely FVC2000DB4, FVC2002DB4, FVC2004DB4, and FVC2006DB4 databases where each of them consists of a total number of 80 finger-print images with a resolution of 300 × 300 pixels for FVC2000DB4 & FVC2002DB4 and 388 × 374 pixels for FVC2004DB4 & FVC2006DB6. This comprehensive dataset contains fingerprint images categorised into four classes, eight acquisitions for each person of the same finger, and each representing a different criminal suspect. Then, the dataset is labelled correctly and annotated with the corresponding criminal class for supervised learning.



Fig.1.1. Testing Datasets Sample



Fig.1.2. Training Datasets Sample

3.1.2. Data Preprocessing:

Preprocessing steps are performed on the fingerprint images to standardise them for model training. This may include resizing, normalisation, and augmentation techniques to increase the variability of the dataset. Then, the dataset will be split into training, validation, and test sets to effectively evaluate the model's performance.

3.1.3. Model Selection:

An appropriate Convolutional Neural Network (CNN) architecture is chosen for fingerprint identification. CNNs are well-suited for image recognition tasks due to their ability to capture spatial hierarchies of features. Experiment with different CNN architectures such as VGG, ResNet, or custom-designed networks tailored to the specific requirements of fingerprint recognition.

3.1.4. Model Training:

Initialising the chosen CNN architecture VGG with random weights and training it on the preprocessed fingerprint dataset. Utilising the transfer learning techniques, if applicable, leveraging pre-trained models on large image datasets like ImageNet to expedite training and improve generalisation. Fine-tuning the model parameters using stochastic gradient descent (SGD) optimisation algorithm to minimise classification loss.

3.1.5. Model Evaluation:

Evaluating the trained model's performance on the validation set using accuracy, precision, recall, and F1-score to assess its efficacy in identifying criminals from fingerprint images. Then, cross-validation is done to ensure the model's robustness and generalisation ability across different subsets of the dataset.

3.1.6. Deployment:

A user-friendly Flask frontend interface was developed to facilitate interaction with the trained model. This frontend will allow users to upload fingerprint images and receive immediate feedback on the identified criminal. Ensuring that the deployed system is scalable, robust, and capable of handling concurrent user requests efficiently.

3.1.7. Testing and Validation:

Conducting rigorous testing of the deployed system under various scenarios to validate its performance and reliability. Collaboration with forensic experts to evaluate the system's effectiveness in practical forensic analysis tasks and gather feedback for further refinement.



Fig.1.3. Pie-chart representation of training set

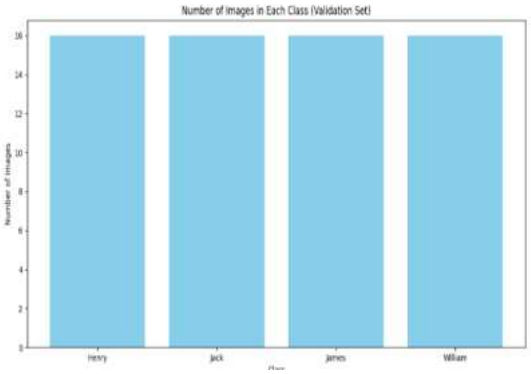
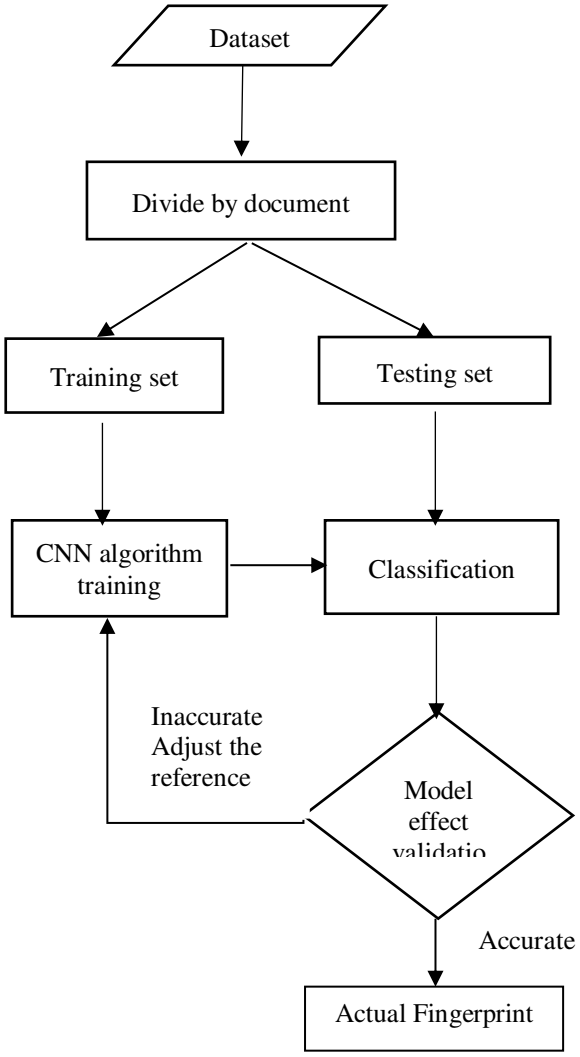


Fig.1.4. Bar representation of validation set

3.1.8. Continuous Improvement:

Incorporating feedback from users and stakeholders to iteratively improve the system's accuracy, usability, and functionality. By staying abreast of machine learning and computer vision research advancements, we can incorporate state-of-the-art techniques and enhance the system's capabilities over time. By following these steps, we developed an automated forensic analysis system for fingerprint identification that leverages the power of machine learning to expedite investigations and improve outcomes in criminal cases.

3.2. WORKFLOW:



IV. RESULTS AND DISCUSSION

Initialising the Python environment in the anaconda prompt can obtain a URL for the webpage. The webpage navigates as a user interface where we upload our fingerprint image for matching.



Fig.1.5. Webpage for uploading latent fingerprint image



Fig.1.6. Webpage after uploading the fingerprint image

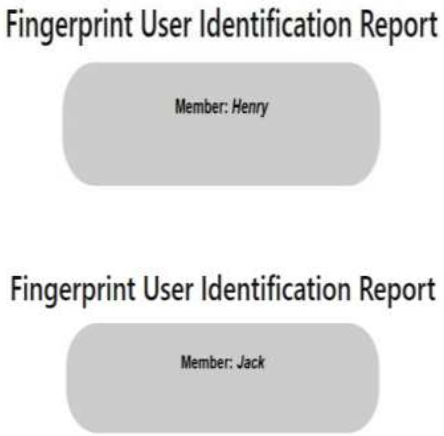


Fig.1.7. Identification of the suspect name

Thus, the input image is identified as the suspect's image that the model has trained. The user interface displays the suspect's name as a fingerprint identification report.

The training model's accuracy was 98%, with a two-percent loss during the testing and validation process, which was plotted against 50 epochs. Accuracy is one of the most common metrics used to evaluate classification models. It represents the proportion of correctly classified samples out of the total number of samples.

True Positives (TP): These are the samples correctly predicted as positive by the model.

True Negatives (TN): These are the samples correctly predicted as negative by the model.

False Positives (FP): The model incorrectly predicts these samples as positive when they are negative.

False Negatives (FN): These are the samples incorrectly predicted as negative by the model when, they are positive.

With these definitions, we calculated accuracy using the formula:

$$\text{Accuracy} = (TP+TN)/(TP+TN+FP+FN)$$

Thus, the accuracy was found to be 98%.

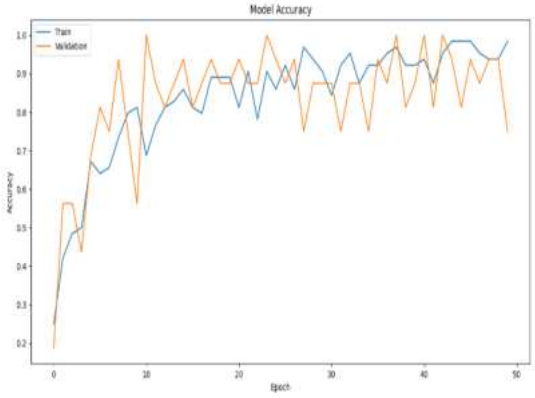


Fig.1.8. Plotting of the model accuracy

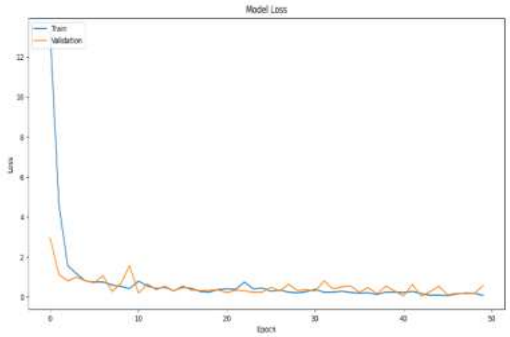


Fig.1.9. Plotting of the loss

V. CONCLUSION

In conclusion, the proposed automated forensic analysis system significantly advances criminal investigation and law enforcement. By harnessing the capabilities of machine learning, the system offers a reliable and efficient means of identifying criminals based on fingerprint evidence. By integrating image processing techniques and classification algorithms, the system achieves remarkable accuracy in determining the criminal associated with a given fingerprint image. Using Flask for front-end display ensures a user-friendly experience, allowing investigators to upload and analyse fingerprint images seamlessly.

Moreover, the continuous refinement of the ML model through techniques such as data augmentation and cross-validation further enhances its performance and reliability. By streamlining the

forensic analysis process, our system enables law enforcement agencies to expedite investigations, apprehend criminals more swiftly, and deliver justice to victims and communities. Overall, the proposed system represents a promising step towards leveraging technology to combat crime and uphold society's justice and security principles.

VI. REFERENCES

[1] Delican, V., Töreyin, B. U., Çetin, E., & Saribey, A. Y. (2023). Direct pore-based identification for fingerprint matching process. Turkish Journal of Electrical Engineering & Computer Sciences, 31(5), 814–827. doi:10.55730/1300-0632.4019.

[2] Bao, Q., Wang, Y.-G., Gao, C., Sha, L., & Lee, F. (2023). A coarse-to-fine approach for rectifying distorted latent fingerprints from crime scenes. IEEE Access: Practical Innovations, Open Solutions,11,144150144167.doi:10.1109/access.2023.3344465.

[3] Surajkanta, Y., & Pal, S. (2021). A digital geometry-based fingerprint matching technique. Arabian Journal for Science and Engineering, 46(4),4073–4086.doi:10.1007/s13369-021-053904.

[4] Socheat, S., & Wang, T. (2020). Fingerprint enhancement, minutiae extraction, and matching techniques. Journal of Computer and Communications, 08(05), 55–74. doi:10.4236/jcc.2020.85003.

[5] Liu, Y., Zhou, B., Han, C., Guo, T., & Qin, J. (2020). A novel method based on deep learning for aligned fingerprint matching. Applied Intelligence, 50(2), 397–416.doi:10.1007/s10489-019-015304.

[6] Han, K., & Li, X. (2021). Application of partial differential equation method in fingerprint image enhancement. IEEE/ACIS 19th International Conference on Software Engineering Research, Management and Applications (SERA). doi:10.1109/sera51205.2021.9509273.

[7] Spanier, A. B., Steiner, D., Sahalo, N., Abecassis, Y., Ziv, D., Hefetz, I., & Kimchi, S. (2024). Enhancing fingerprint forensics: A comprehensive study of gender classification based on advanced Data-Centric AI approaches and multi-database analysis. Applied Sciences (Basel, Switzerland),14(1), 417.doi:10.3390/app14010417.

[8] Bakheet, S., Al-Hamadi, A., & Youssef, R. (2022). A fingerprint-based verification framework using Harris and SURF feature detection algorithms. Applied Sciences (Basel, Switzerland), 12(4), 2028.doi:10.3390/app12042028.

[9] Kumar, R. (2020). Orientation local binary pattern-based fingerprint matching. SN ComputerScience,1(2).doi:10.1007/s42979-020-0068-y.

[10] Walhazi, H., Haddada, L. R., Maalej, A., & Amara, N. E. B. (2020). Preprocessing latent-fingerprint images for improving segmentation using morphological snakes. 2020 5th International Conference on Advanced Technologies for Signal and Image Processing (ATSIP).doi:10.1109/atsip49331.2020.9231908.

[11] Latent fingerprint enhancement techniques: A review. (2020). Journal of Chemical Reviews, 2(1), 40–56. doi:10.33945/sami/jcr.2020.1.3.

[12] Martins, N., Silva, J. S., & Bernardino, A. (2024). Fingerprint recognition in forensic scenarios. Sensors, 24(2), 664. https://doi.org/10.3390/s24020664.

[13] Krish, R. P., Fierrez, J., Ramos, D., Alonso-Fernandez, F., & Bigun, J. (2019, October). Improving automated latent fingerprint identification using extended minutia types. Information Fusion, 50, 9–19.https://doi.org/10.1016/j.inffus.2018.10.001.

[14] Pinna, A., Rocca, S., Porcu, S., Cardia, R., Chiriu, D., Carbonaro, C. M., Corpino, R., Tuveri, E., Coli, P., & Ricci, P. C. (2023, December). Unveiling Hidden Prints: Optically stimulated luminescence for latent fingerprint detection. Heliyon,9(12),e22794.https://doi.org/10.1016/j.heliyon.2023.e22794.

[15] Nachar, R., Inaty, E., Bonnin, P. J., & Alayli, Y. (2019, January 16). Hybrid minutiae and edge corners feature points for increased fingerprint recognition performance. Pattern Analysis and Applications,23(1),213–224. https://doi.org/10.1007/s10044-018-0076-z.

A Smart Pillow For Health Sensing System

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***Abstract* - A smart pillow is a cutting-edge sleep aid device designed to revolutionize sleep quality and monitoring capabilities. Equipped with advanced technologies, it offers personalized comfort while simultaneously tracking vital parameters essential for optimal rest. These parameters include the user's position, SpO2 levels, systolic pressure, temperature, BPM (heart rate), and overall sleep status. By integrating sensors directly into the pillow, users can gain valuable insights into their sleep patterns and health metrics without the need for bulky external devices. Additionally, smart pillows seamlessly connect with mobile apps, allowing for convenient monitoring and analysis of vital parameters over time. In essence, a smart pillow represents the fusion of comfort and innovation, aiming to enhance sleep quality and overall well-being through the power of technology-driven solutions.**

Keywords—SPO₂ (blood oxygen saturation), BPM, Thinkspeak, Smart Pillow.

I. INTRODUCTION

The quality of sleep during the night plays a pivotal role in determining one's productivity throughout the day. When we aim to maximize our daily performance, it becomes imperative to comprehend the various factors that can hinder the quality of our sleep, with stress being a prominent culprit. This innovative system relies on a range of physiological parameters, including body temperature, blood pressure, respiration rate, and heart rate. At its core, the Smart Pillow stands as a cutting-edge sleep companion that seamlessly blends comfort, convenience, and state-of-the-art technology to redefine your nightly rest and overall body health. The Smart Pillow goes further by keeping a vigilant eye on the individual's breathing rate. In the cases where insufficient oxygen levels are detected, the system can autonomously administer supplemental oxygen to the patient. Moreover, the system excels in detecting stress level, analyzing stress levels and sleeping patterns on a regular basis. By collecting and analyzing data over time, it offers valuable insights into how external factors, lifestyle choices, and stressors impact the quality of one's sleep. The advantages of this system is to reduce the burden on hospital bed services, as it allows for remote monitoring from the comfort of one's home.

II. METHODOLOGY

The integration of IoT (Internet of Things) technology into health and wellness has led to the development of smart pillows, which represent a notable application in this domain. These innovative pillows are designed to do more than just provide comfort during sleep; they actively collect and analyze data related to various vital parameters, contributing to better sleep health and overall well-being. Smart pillows are equipped with embedded sensors that monitor a range of vital parameters such as SpO2 levels (blood oxygen saturation), systolic pressure, temperature, heart rate (BPM), and the position of the person during sleep. These sensors continuously gather data throughout the night, offering a comprehensive picture of the user's sleep patterns and health metrics. The collected data is then transmitted wirelessly to a mobile app via IoT connectivity for in-depth analysis. This mobile app provides users with detailed insights into their sleep health, including metrics such as sleep quality, duration, and any potential disturbances or anomalies detected during the night. By having access to this information, users can gain a better understanding of their sleep habits and make informed decisions to improve their overall sleep quality and well-being.

One of the key features of IoT-enabled smart pillows is their ability to offer a high level of customization. Users can adjust the pillow's surface temperature according to their preferences, creating a comfortable sleep environment tailored to their needs. This temperature control feature not only enhances comfort but also contributes to promoting better sleep quality. Through the dedicated mobile app, users can conveniently monitor their sleep data in real-time, set personal preferences, and receive actionable feedback and recommendations for optimizing their sleep habits. The app may also provide personalized sleep coaching or suggest lifestyle changes based on the analysed data to further enhance sleep quality and overall health. Furthermore, the data collected by the sensors in the smart pillows is securely transmitted to a cloud-based health sensing system, such as ThingSpeak, for storage and analysis. Using the master and slave method, this system processes the incoming data, identifies patterns, and generates valuable insights that can be used by healthcare professionals or individuals to track progress and make informed decisions about their sleep health. In summary, smart pillows powered by IoT technology offer a holistic approach to sleep health management. By leveraging embedded sensors, mobile apps, and cloud-based analytics, these pillows empower users to take control of their sleep habits, improve sleep quality, and ultimately enhance their overall well-being. dimensionally. If you must use mixed units, clearly state the units for each quantity that you use in an equation.

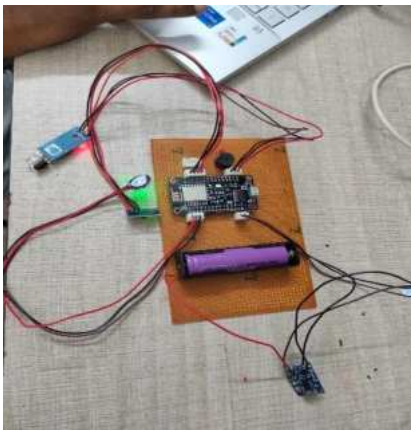


Fig. 1: Hardware setup of Smart Pillow.

III. SYSTEM DESIGN AND IMPLEMENTATION

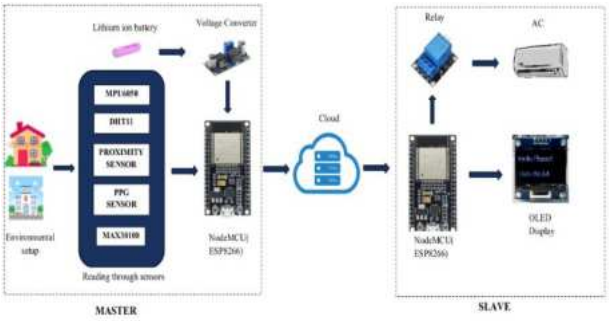


Fig. 2: Block Diagram

The IoT enabled pillow contains MPU 6050 (Gyroscope and Accelerometer), Temperature sensor (DHT 11), Proximity sensor (IR sensor), PPG sensor (Photo plethysmography) and SpO2 sensors (Max 30100) are intentionally placed inside it to access sleep conditions without any interruption and gives comfort to the patient.

It continuously monitors the patient's vital parameters and based on the output from the patient's body temperature value while sleeping, it adjusts the surrounding temperature (AC temperature). The patient data will be collected using the aforementioned sensors, and a cloud-based health sensing system (ThingSpeak) will collect and analyze the data using the Master and Slave method.

IV. SOFTWARE IMPLEMENTATION

1. ThingSpeak

ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak. With the ability to execute MATLAB code in ThingSpeak you can perform online analysis and processing of the data as it comes in. ThingSpeak is often used for prototyping and proof of concept IoT systems that require analytics.

2. Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. The Arduino IDE (Integrated Development Environment) is used to write the computer code and upload this code to the physical board.

V. HARDWARE IMPLEMEMTATION

The smart pillow represents a remarkable fusion of cutting-edge technology and sleep science, incorporating an array of embedded sensors and microcontrollers to revolutionize the sleep experience. By integrating accelerometers, heart rate sensors, temperature sensors, SpO2 sensors, and proximity sensors with microcontrollers like Arduino UNO and Node MCU, the pillow becomes a sophisticated sleep monitoring system. These sensors work in concert to capture a wealth of data, including movement, heart rate variability, temperature fluctuations, blood oxygen levels, and user proximity, enabling detailed analysis of sleep patterns and vital signs. Through continuous monitoring and analysis, the smart pillow provides valuable insights into sleep quality, duration, and disturbances, empowering users to make informed decisions about their sleep habits. Real-time feedback mechanisms, such as gentle vibrations or temperature adjustments, offer immediate responses to address sleep disruptions and enhance overall sleep quality. Furthermore, the smart pillow serves as a proactive health monitoring tool, capable of detecting early signs of sleep disorders or other health issues, thereby promoting preventive healthcare. Accessible through a user-friendly mobile app or web dashboard, detailed sleep reports and personalized recommendations empower users to take control of their sleep health, fostering a holistic approach to well-being.



VI. RESULT AND DISCUSSION

Smart pillows are high-tech sleep aids that use advanced sensors to monitor vital parameters like position, SpO2 levels, blood pressure, temperature, and heart rate. They offer personalized comfort and connect seamlessly with mobile apps for convenient tracking and analysis of sleep data. By eliminating the need for bulky external devices, smart pillows aim to revolutionize sleep quality and overall well-being through technology-driven solutions.

Temperature	Pressure	BPM	SPO_2	Angle
36.000	103.000	75.97063	94.00	3.62722

VII. CONCLUSION AND FUTURE WORK

In conclusion, the integration of IoT technology into smart pillows represents a transformative leap in the landscape of sleep health and monitoring. By seamlessly combining embedded sensors such as accelerometers, heart rate sensors, temperature sensor, spo2 sensors and proximity sensors with microcontrollers like Arduino UNO and Node MCU, these devices evolve beyond more comfort to providers into intelligent systems that actively track and analyze sleep patterns and vital signs. The IoT framework facilitates real-time data transmission to cloud servers, empowering users with personalized insights and feedback through mobile apps. The ability to adjust pillow surface temperature and autonomously administer supplemental oxygen showcases the adaptability and potential health interventions these pillows can offer. In essence, IoT-enabled smart pillows redefine the sleep experience, becoming integral components of proactive, connected, and user-centric approaches to sleep health and well-being.

VIII. REFERENCES

[1]Yamada, Shuori. Orthopaedic Pillow: Theory and Practice. Springer Nature, 2023.

[2]Dong, Kai. "Triboelectric Nanogenerators as Sensing for Smart Home." Handbook of Triboelectric Nanogenerators. Cham: Springer International Publishing, 2023. 1621-1657.

[3]Wang, Heng, et al. "SleepSense: Smart Pillow with Pressure-Sensitive FBG-Embedded Silicone Buttons." IEEE Sensors Journal (2023).

[4]Kau, Lih-Jen, Mao-Yin Wang, and Houcheng Zhou. "Pressure-Sensor-Based Sleep Status and Quality Evaluation System." IEEE Sensors Journal 23.9 (2023): 9739-9754.

[5]Moshayedi, Ata Jahangir, et al. "Recognition System for Ergonomic Mattress and Pillow: Design and Fabrication." IETE Journal of Research (2023): 1-19.

[6]Gourlay, Banu. "Multidisciplinary development of electroencephalogram (EEG)-based smart head piece prototype for everyday environments monitoring." (2023).

[7]Mekid, S., and K. Chenaoua. "IoT-Enabled Smart Mask for Monitoring Body Parameters and Location through Cloud." Internet of Things (2023): 100794.

[8]Chen, Yanyan, et al. "The past, present, and future of sleep quality assessment and monitoring." Brain Research 1810 (2023): 148333.

[9]Jeon, Yeong Jun, Sung Ho Park, and Soon Ju Kang. "Self-x based closed loop wearable IoT for real-time detection and resolution of sleep apnea." Internet of Things 22 (2023): 100767.

[10]Wang, Heng, et al. "SleepSense: Smart Pillow with Pressure-Sensitive FBG-Embedded Silicone Buttons." IEEE Sensors Journal (2023).

[11]MB, Nirmala, et al. "Detection of Stress through Sleeping Habits." Grenze International Journal of Engineering & Technology (GIJET) 9.1 (2023).

[12]Baig, Mirza Mansoor, and Hamid Gholamhosseini. "Smart health monitoring systems: an overview of design and modeling." Journal of medical systems 37 (2013): 1-14.

[13]Kou, Haiying, et al. "Smart pillow based on flexible and breathable triboelectric nanogenerator arrays for head movement monitoring during sleep." ACS Applied Materials & Interfaces 14.20 (2022): 23998-24007.

[14]Xing, Huan, et al. "MXene/MWCNT electronic fabric with enhanced mechanical robustness on humidity sensing for real-time respiration monitoring." Sensors and Actuators B: Chemical 361 (2022): 131704.

[15]Sangeetha, T., et al. "Smart mattress integrated with pressure sensor and IoT functions for sleep apnea detection." Measurement: Sensors 24 (2022): 100450.

[16]Zhu, Zhiyuan, Maoqiu Pu, and Zisheng Xu. "Sleep monitoring based on triboelectric nanogenerator: wearable and washable approach." Frontiers in Psychiatry 14 (2023): 1163003.

[17]Cao, Ting, et al. "Parametric study on the sleep thermal environment." Building Simulation. Tsinghua University Press, 2022.

[18]He, Chunhua, et al. "A smart flexible vital signs and sleep monitoring belt based on MEMS triaxial accelerometer and pressure sensor." IEEE Internet of Things Journal 9.15 (2022): 14126-14136.

CHAPTER 3

IoT Covid Patient Health Monitoring System

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Abstract: Lack of healthcare or inaccessibility of doctors and caregivers is a major concern. The increase in COVID-19 patients is putting tremendous pressure on hospital management in urban areas. Therefore, the development of IoT (Internet of Things) based patient monitoring systems allows doctors to obtain patient data from remote locations. The Internet of Things is an evolving technology that takes healthcare to the next level by providing affordable, reliable, and convenient devices that can be carried or embedded with patients. There is a growing interest in wearable sensors and medical devices. Therefore, wearable monitoring systems will take patient monitoring to a new level. The IoT allows various devices to be connected over the Internet. Data is collected using sensors and sent to the cloud *via* IoT channels, where both patients and doctors can access the data (real-time and historical) through a variety of devices. Any deviations from the norm will result in alerts being sent to both doctors and patients. This enables doctors to monitor a large number of patients at once.

Keywords: IoT healthcare, COVID, Health monitoring, Remote patient monitoring.

INTRODUCTION

The Internet of Things (IoT) can interconnect different objects and sensors can be added to them to provide a certain level of digital intelligence to the device. By integrating the digital universe and the physical universe, we make the world around us smarter and more responsive. This enables things to be retrieved and handled remotely using existing network infrastructure, allowing for more direct interaction between the real world and computer systems, resulting in increased efficiency, accuracy, and cost savings. IoT-based systems use sensors, IoT gateways, and applications to support patient monitoring.

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Health condition monitoring is a technique that allows you to actively monitor system or structural integrity during operation and throughout its useful life to avoid failures and reduce maintenance costs. The suggested system uses non-invasive sensors to monitor COVID-19 patients' heart rate, blood pressure, and body temperature. It collects information and sends it to the IoT over a wireless connection as it requires continuous monitoring. The doctors can determine the patient's condition and treatment remotely and can treat more than 500 patients. The system enables the use of IoT, sensors, and microcontroller programs, providing better user interaction and efficient information transfer.

The idea is to support medical staff and physicians in the continuous monitoring of patients who are not completely bedridden, while at the same time providing information about their physical condition, reducing mobility, and improving comfort.

RELATED WORKS

NilakanthaPaudel *et al*. [1], have proposed an IoT-based patient monitor where the sensors collect real-time data, which is delivered to the IoT gateway, which does basic computations before sending it to the main server in the cloud. It states that computations should be performed on the received data to provide meaningful results based on different analytical tools and techniques.

Jose Alfredo Alvarez Aldana *et al*. [2], have proposed a distributed monitoring architecture that has a consensus method that allows it to aggregate and offer more accurate and relevant results. This design can yield promising results with higher precision, and the consensus mechanism utilised here allows various nodes in a network to work together as a cohesive group.

Mainak Adhikari *et al*. [3], recommended a rule-based regulation on local edge devices to detect a patient's risk factor instantly. It shows that employing multiple data mining techniques to build a more refined dataset for COVID-19 illness prediction could improve the efficacy of the data fusion strategy.

As the clinical manifestations of corona viral infection are high fever, fatigue, and difficulty breathing, Hafsiya T.H *et al* ., [4] created a handheld physiological pre-test that was conducted based on IoT to closely monitor the patient's heart rate, temperature, blood oxygen saturation, and blood pressure. It allows remote collection of data and transmission, thereby preventing disease spread and providing an effective solution to the patient's condition.

Hoe Tung Yew *et al*. [5] created an IoT-based real-time remote patient monitoring system that ensures the integrity of real-time electrocardiograms (ECGs) and

transmits data to a web server *via* Message Queuing Telemetry Transport (MQTT). This enables zero package loss and packet error in both local and wide area networks, and it supports both real-time and store-and-forward modes. It also does not necessitate a high-quality network.

Mwaffaq Otoom *et al*. [6] created an IoT system to collect real-time symptom data from users in order to detect probable coronavirus cases. This enables us to track the treatment response of patients who have already recovered from the virus while also forecasting the treatment response of confirmed cases and learning more about the COVID-19 disease's characteristics.

Ibrahim Kareem Hanoon *et al*. [7] presented an inexpensive IoT-based application that helps patients check their health status by permitting clinicians to remotely monitor this information, with the goal of reducing the risk of COVID-19 virus transmission. According to the article, an Arduino-based device with sensors can be used to transfer data to a cloud server since it enables faster and more convenient diagnosis and supports a wide range of procedures.

Hasan K. NAJI *et al*. [8] established a system that offers access-monitoring services to COVID 19 mild-to-moderate symptoms and those who are in home quarantine. It claims that an alarm system that alerts healthcare personnel about abnormal readings and can reduce infection spread by avoiding contact between health professionals and the patient.

Geetanjali Rathee *et al*. [9], developed an ANN model for health monitoring and examined the findings with a biological scrutinizing method using BP, BR, and Viterbi algorithms to depict COVID-19 patients' progress and do monitoring in a timely manner. For specific patient categories, it is said to offer higher accuracy and a faster response time.

Olutosin Taiwo *et al*. [10], presented an example of a good home health assistance system to track patients' health and receive prescriptions from doctors while they remain at home. It recommends an Android-based mobile application that interacts with a web-based application for effective patient-doctor dual real-time communication, as well as sensors for automatic recording of patients' vital parameters.

METHODOLOGY

The solution we propose is an Internet-of-Things-based healthcare monitoring system that allows many COVID patients to be monitored remotely over the Internet. The system includes heart rate sensors, temperature sensors, and blood pressure transducers to monitor a patient's heart rate, temperature, and blood

pressure. The system then connects to Wi-Fi internet access and transmits that data over the internet. For remote display of patient data, data has been sent and retrieved *via* IoT from the IoT Gecko platform. Microcontroller-based circuitry owns the entire system. An alarm will be transmitted to the doctor remotely *via* IoT if an irregularity inside the patient's health is identified, or if the patient touches the emergency assistance button on the IoT gadget. It is attached to the request of the patient and continuously provides patient health data *via* the Internet, allowing clinicians to monitor and treat many patients remotely.

- Doctors may work with patients online without a risk of infection, and a single doctor can watch multiple patients at once.
- Immediate notifications in the event of health changes or emergency.

Fig. (**1**) depicts a block diagram of IoT COVID-19 patients' health monitoring.

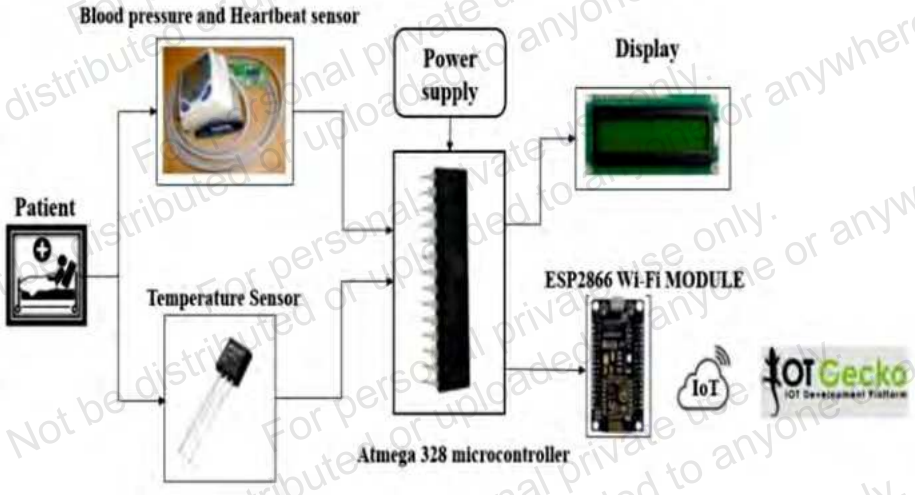


Fig. (1). Block diagram of IoT COVID patient health monitoring system.

HARDWARE DESCRIPTION

ATmega Microcontroller

The Atmel ATmega328 is an AVR-based 32K 8-bit microcontroller by Atmel. It has a throughput of nearly 20 MIPS @ 20MHz and can execute several commands in a clock cycle. It is designed for fine performance and low energy consumption. It has 32 kilobytes of programmed FLASH, 1 kilobyte of EEPROM, and 2 kilobytes of SRAM. It is capable of performing all general-purpose functions on a single computer-like unit.

Temperature Sensor

The LM35 line of temperature sensors is used in integrated circuits. Its output voltage is dependent upon temperature in degrees Centigrade in a linear fashion. As a result, the sensor is directly adjusted to Celsius. To achieve normal accuracy, no additional calibrating or trimming is necessary. It has a low output impedance, a linear output, and exact, one-of-a-kind calibration, making it easy to connect with the scanner or control circuitry. It consumes 60 watts of power and can function at temperatures ranging from -55 to 150 degrees Celsius.

Heart Beat Sensor

The photoplethysmography principle is used to power the heartbeat sensor. It can detect changes in blood volume in response to changes in light intensity. There are two types of photoplethysmography: transmissive and reflective. Reflective photoplethysmography was used. The light released by the heartbeat sensor captures fluctuations in blood flow induced by heartbeat pulses, which are detected by the sensor's detector. The detector produces an electrical signal proportional to the rate of heartbeat. The detector's output is filtered using a two-stage HP-LP circuit and then transformed to digital signals using a comparator or a simple ADC before being sent to the microcontroller.

Blood Pressure Sensor

The blood-sensing element has a small, watch-like form that fits over the wrist. It offers a fully automatic, high-accuracy intelligent automatic compressing and decompress system. For external electrical processing or display, it has serial data output at 9600 baud rates. The operational voltage is +5V with a controlled current of 200mA. The output reading is an 8-bit value in the form of fixed digits in ASCII format.

Wi-Fi Module

As a Wi-Fi module, the ESP8266 is used. It is a popular platform for mobile applications. It features an embedded Wi-Fi capability and can be easily included in any microcontroller-based design *via* the UART or CPU interface. It runs at a frequency of 2.4 GHz, which corresponds to a wavelength of 0.125 metres. It has a 32-bit RISC processor.

Display Devices

The proposed system employs 2 types of display devices.

LED

A light-emitting diode (LED) is a semiconductor light source that is used to indicate something. They consume less power, have a longer service life, are more robust, have smaller diameters, switch faster, and are more durable and reliable.

LCD

It is a data-display device made of electronic components. The system uses a 16X2 LCD display, which has 16 columns and 2 rows and therefore can show 32 characters at a resolution of 1280 pixels. The operating voltage ranges from 4.7 to 5.3 volts. It can function in both 4 and 8-bit modes.

Fig. (**2**) illustrates the workflow diagram of the proposed IoT COVID-19 patient health monitoring system.

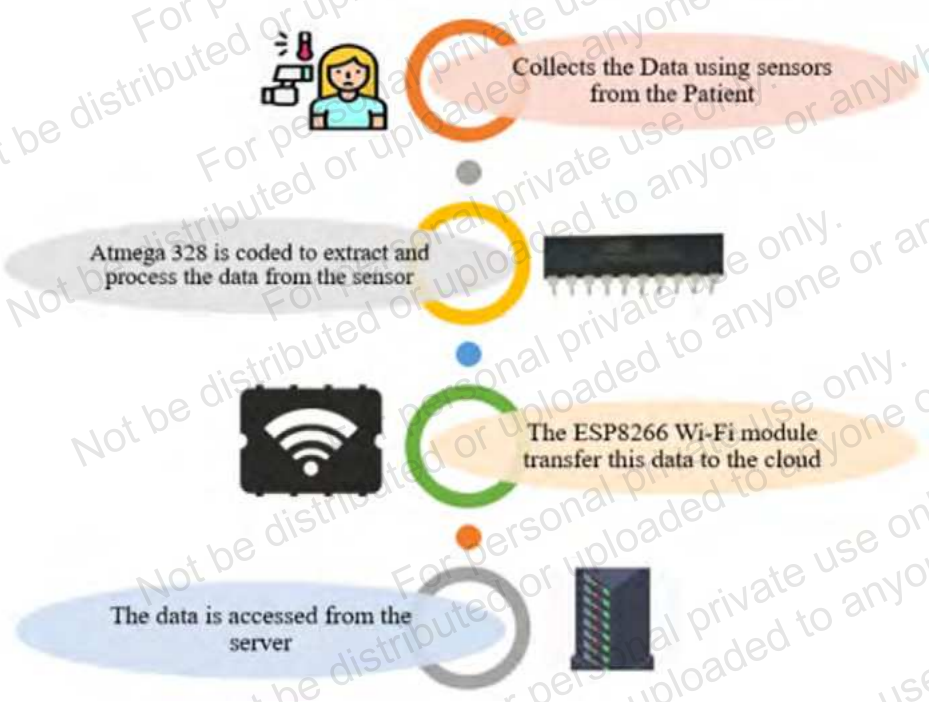


Fig. (2). Flow diagram of the proposed system.

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SOFTWARE DESCRIPTION

The ATmega Microcontroller is like the heart of the software. The Arduino project supplies the Arduino Integrated Development Environment, which is used to create and compile the application. Embedded C was used to create the software. The following is the key portion of the programming design: The first step is to connect all of the sensors' output reading points. It will begin to read the sensor-measured output once it is programmed and connected. For processing, the received sensor output is saved in the appropriate local register. Each sensor has a set of predefined values, such as minimum, normal, and maximum. If the obtained numbers are below the minimum to normal, the processing will proceed normally. However, if it was maximal and above, it would send a high-priority alarm and notify doctors with particular programming conditions.

The software can be divided into two sections:

Part 1

Hardware programming reads the input signals from the hardware (Arduino) system and sends them to IoT. The steps involved in programming the hardware can be seen in Fig. (**3**).

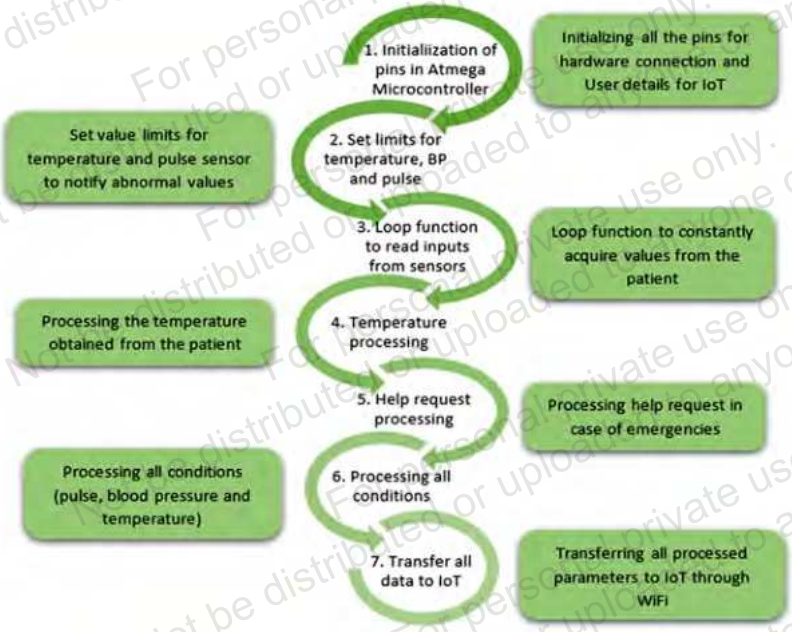


Fig. (3). Steps involved in hardware programming.

Part 2

Retrieving the data stored in IoT and displaying it from the server.

Step 1

Create an Account and Fill some required details.

Choose the applications for which the IoT system will be developed.

Step 2

Choose your desired layouts for data display.

The default designs for different applications available in IoT gecko are shown in Fig. (**4**).

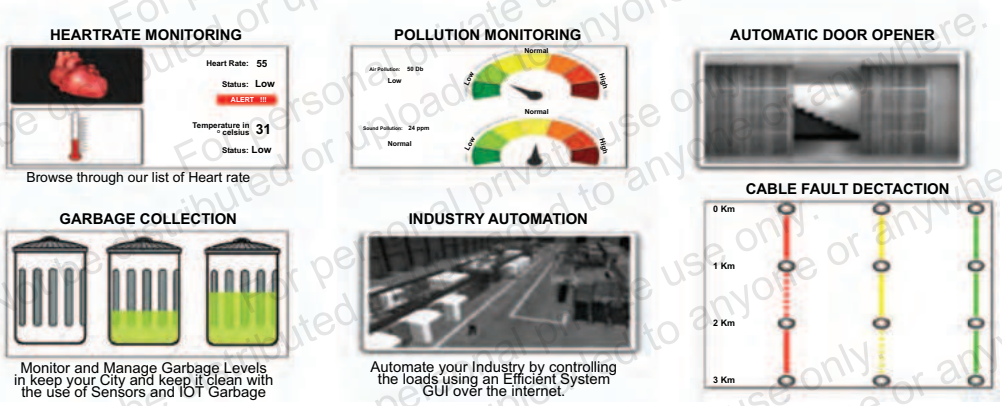


Fig. (4). Default design of IoT Gecko home screen.

Step 3

Login details will be emailed to you, and you will be able to view the IoT Gecko.

Step 4

Easy Integration: Connect electronics systems such as Arduino, Raspberry Pi, ARM, 8051, PIC, AVR controllers, and more to web servers.

RESULT AND DISCUSSION

The parameters namely heart rate, blood pressure, and temperature measured are displayed on the LCD screen (real-time) and it can also be accessed *via* IoT platforms both real-time and historical. The sensors are embedded in the patient

for monitoring. When the power supply is given, the vital parameters like BP, Heartbeat, and Temperature of a patient are captured and displayed on the LCD display as shown in Figs. (**5** & **6**).



Fig. (5). BP and heart rate shown on Pulse sensor display.

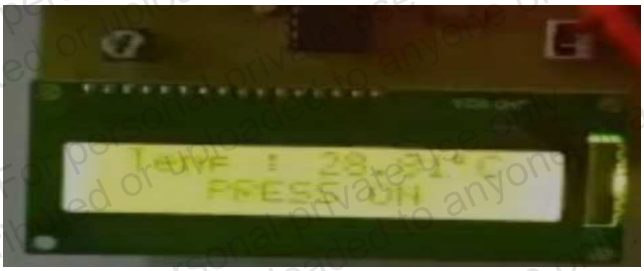


Fig. (6). Temperature displayed on LCD screen.

By logging into the corresponding account that has been created in the IoT server, continuous monitoring can be done through IoT. The patient's health professionals and doctors can also access this information. Fig. (**7**) depicts various output values of blood pressure, temperature, and pulse from various persons.

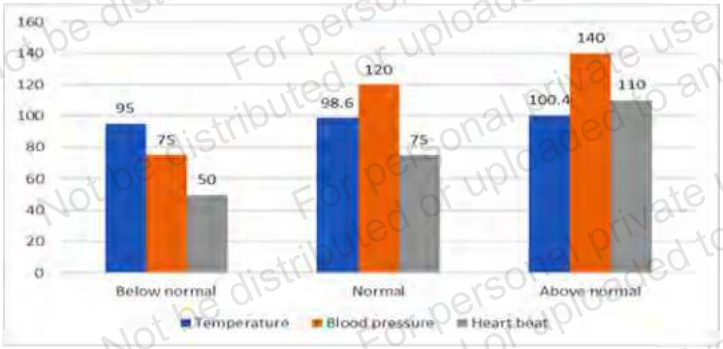


Fig. (7). Different outputs obtained from different patients.

Table **1** infers data of different individuals which shows varied parameters that can be classified into normal and abnormal ranges and alerts can be sent for abnormal variations in the parameters.

Table 1. Temperature, Blood Pressure and Heart Beat of Various Individuals.

-	Temperature [˚C]	Blood Pressure [mm/Hg]	Heartbeat [bpm]
Person 1	37.5	124/82	80
Person 2	36.8	118/79	76
Person 3	36	121/78	72
Person 4	36.3	115/79	71
Person 5	36.7	125/81	78
Person 6	37.3	117/76	83
Person 7	36.4	118/77	77
Person 8	36.9	120/81	73
Person 9	36.6	122/83	74
Person 10	37.2	121/82	85

Temperature unit is in the form of SI unit and is denoted using C (degree Celsius). The blood pressure is measured in mm/Hg (millimetre of Mercury). The heartbeat is measured in bpm (beats per minute).

CONCLUSION

As a result, this method can be utilized to keep track of patients at a distance. This system notifies the patient and doctor when abnormal readings are detected, and the data may be accessed at any time and from any location. Because the entire device setup was plug-and-play, it was extremely user-friendly. As a result, all patients, especially the elderly, will have a hassle-free experience. This type of medical setup will be critical in managing COVID-19 patients remotely, as well as having many other benefits in the future. In the future, this work can be extended to a mobile application with an alert system to access the data from anywhere and anytime. It can also be made into a wearable system by making the product compact.

REFERENCES

[1] N. Paudel, and R.C. Neupane, "A general architecture for a real-time monitoring system based on the internet of things", In: *Internet of Things* vol. 14. Elsevier, 2021, p. 100367.

[2] J. A. A. Aldana, S. Maag, and F. Zaidi, "A formal consensus based distributed monitoring approach for mobile IoT networks", In: *Internet of Things* vol. 13. Elsevier, 2021, p. 100352.

[http://dx.doi.org/10.1016/j.iot.2020.100352]

[3] M. Adhikari, and A. Munusamy, "iCOVIDcare: Intelligent health framework for COVID-19 using ensemble random forest in edge networks", *Internet of Things Elsevier,* vol. 14, p. 100385, 2021. [http://dx.doi.org/10.1016/j.iot.2021.100385]

[4] Hafsiyaand T. H., and Rose B., "AnIoT cloud based health monitoring wearable device for covid patients", *7th Int. Conf. Adv. Comp. Commun.sys. (ICACCS),* pp. 266-269., 2021.

[5] H.T. Yew, M.F. Ng, S.Z. Ping, and S.K. Chung, "IoT based Real-time Remote patient monitoring system", *16th IEEE International Colloquium on Signal Processing & its Applications (CSPA),* 2020.

[6] M. Otoom, N. Otoum, M.A. Alzubaidi, Y. Etoom, and R. Banihani, "AnIoT-based framework for early identification and monitoring of COVID-19 cases", *Biomed. Signal Process. Control,* vol. 62, no. 102149, 2020.

[7] I.K. Hanoonn, and M.I. Aal-Nouman, "Cloud-based COVID-19 patient monitoring using arduino", *IEEE 3rd East Indonesia Conf. Comp. Inform. Technol. Indonesia, ISTTS Surabaya,* pp. 292-296, 2021.
[http://dx.doi.org/10.1109/EIConCIT50028.2021.9431881]

[8] NAJI H. K., GOGA N., Karkar A. J. M., Marin I., and ALI H. A., "Internet of things and Health Care in Pandemic COVID -19: System requirements evaluation", *IEEE 7th Int. Eng. Conf. Res. Innov. amid. Glob. Pand. (IEC2021) Erbil, Iraq,* pp. 37-42, 2021.

[9] G. Rathee, S. Garg, G. Kaddoum, Y. Wu, D.N. K Jayakody, and A. Alamri, "ANN Assisted-IoT Enabled COVID-19 patient monitoring", *IEEE Spec.Sect.Adv.nt. Thing. Smart. Cyber-Phys.Infrastruc.Sys.,* vol. 9, pp. 42483-42492, 2021.
[http://dx.doi.org/10.1109/ACCESS.2021.3064826] [PMID: 34786311]

[10] Taiwoand O., and Ezugwu A. E., "Smart healthcare support for remote patient monitoring during COVID-19 quarantine", *Informatics in Medicine Unlocked,* vol. 20, Elsevier, p. Issue. 100428, 2020.

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Health Monitoring with Smart Pillows

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***Abstract*— An individual's subjective health is intricately linked to the quality of their sleep. Monitoring vital signs such as body temperature and perspiration during sleep is critical for both clinical diagnosis and sleep assessment. This project utilizes various sensors, including LM35 temperature sensors, accelerometer, pulse sensor, proximity sensor, Arduino UNO, Node MCU, buzzer, and LED. Embedded sensors track the patient's movements, temperature, pulse rate, Spo2, and sleep patterns throughout the night. Collected data, including sleep duration, interruptions, and quality, is sent to a mobile app for analysis. The Internet of Things (IoT) facilitates automatic oxygen supply activation if needed. IoT-enabled pillows adjust surface and room temperature, ensuring a comfortable sleep environment based on patient preferences. Real-time data on temperature, oxygen level, breathing and pulse rates, and sleeping patterns are displayed on a mobile or PC interface. Consequently, this smart pillow serves as an efficient patient monitoring system, offering portability and ease of use.**

***Index Terms*— sleep monitoring system, IoT-enabled pillow, vital Signs tracking, patient health monitoring, smart sleep environment.**

I. INTRODUCTION

The health of an individual is significantly subjective to the quality of their sleep. Monitoring essential signs during sleep, such as body temperature and perspiration, is important for both sleep estimation and clinical diagnosis. The need for a smart pillow in a health sensing system is driven by the recognition that sleep is integral to overall health. Real-time monitoring during sleep can offer valuable insights into an individual's well-being. By incorporating sensors like temperature, pulse, and proximity sensors, a smart pillow can comprehensively track vital signs, sleep patterns, and interruptions, allowing for early detection of potential health issues such as sleep apnea or respiratory disorders. The personalized health insights derived from continuous monitoring empower individuals and healthcare professionals to make informed decisions about lifestyle adjustments and interventions. Moreover, the integration of Internet of Things (IoT) capabilities in smart pillows facilitates seamless connectivity, enabling remote data access and collaborative health management.[1,2] With the ability to adjust environmental factors like room temperature, smart pillows contribute to creating an optimal sleep environment, promoting better sleep quality and overall health. In essence, a smart pillow serves as a user-friendly, portable, and efficient solution for proactive health monitoring, emphasizing the critical role of sleep in overall well-being.

Wang et al.'s introduces a novel smart pillow integrating pressure-sensitive FBG-embedded silicone buttons, offering precise sleep monitoring with potential applications in personalized sleep solutions [3]. Kau et al.'s proposes an advanced approach to sleep assessment, leveraging pressure sensors for comprehensive sleep quality evaluations [4]. Zhu et al.'s presents a wearable and washable solution for continuous sleep monitoring using

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triboelectric nanogenerator technology, emphasizing user comfort and convenience [5]. Moshayedi et al. focuses on recognizing and designing ergonomic sleep products, contributing to optimized sleep environments [6]. Gourlay's expands beyond sleep monitoring, introducing an EEG-based headpiece for monitoring everyday environments with potential broader applications [7]. Jeon et al.'s addresses the critical issue of sleep apnea with a closed-loop wearable IoT system, offering real-time monitoring and intervention [8]. MB et al.'s explores stress detection via sleeping habits, providing insights into potential early stress detection strategies during sleep [10].
Mekid and Chenaoua's introduces an Internet of Things (IoT)-enabled smart mask that monitors body parameters and location through cloud connectivity, showcasing advancements in wearable health technology [12]. Chen et al.'s exploration of the past, present, and future of sleep quality assessment reflects the continuous evolution in sleep monitoring methodologies, emphasizing the importance of comprehensive approaches [13]. Ma et al.'s introduces a highly sensitive and reliable flexible piezo electret sensor for non-contact sitting motion tracking and physiological signal monitoring, showcasing advancements in sensor technology for diverse applications [14]. Li's IoT Healthcare System based on ESP32, presented at the 2023 IEEE International Conference on Mechatronics and Automation, demonstrates the integration of IoT for healthcare in smart homes [15]. Liu et al.'s focuses on advancing smart cities into the 5G era through multi-field Internet of Things (IoT) applications powered by mechanical energy harvesters, contributing to sustainable urban development [16]. Shijitha et al.'s research on efficient morphological segmentation of brain hemorrhage stroke lesions employs MultiResUNet, demonstrating advancements in medical image analysis [17]. Kou et al.'s smart pillow, based on triboelectric nanogenerator arrays, offers a breathable and flexible solution for head movement monitoring during sleep [18]. Xing et al.'s MXene/MWCNT electronic fabric with enhanced mechanical robustness on humidity sensing showcases innovations in materials science for real-time respiration monitoring [19]. Sangeetha et al.'s smart mattress integrated with pressure sensor and IoT functions for sleep apnea detection reflects the intersection of sensor technology and healthcare, promising improved sleep disorder monitoring [20].
Cao et al.'s parametric study delves into the sleep thermal environment, providing insights into the impact of environmental conditions on sleep quality [21]. He et al. contribute with a smart flexible vital signs and sleep monitoring belt, leveraging MEMS triaxial accelerometer and pressure sensor technologies for non-intrusive monitoring [22]. Singh et al.'s analytical study on machine learning techniques delves into the multifaceted applications of machine learning within the realms of blockchain, AI, and IoT, offering valuable perspectives for researchers and practitioners [23]. Lee's design of a smart pillow system for managing sleep apnea addresses a critical health issue, suggesting potential advancements in sleep apnea management [24]. Rachakonda et al.'s "Sayopillow" introduces a blockchain-integrated privacy-assured Internet of Medical Things (IoMT) framework, emphasizing secure data handling in stress management considering sleeping habits [25]. Li et al.'s comparative study explores the intersection of thermal comfort and sleep quality, particularly in hot weather, offering valuable insights for designing innovative mattresses [26]. Song et al.'s investigation into the effects of phased sleeping thermal environment regulation sheds light on optimizing human thermal comfort and sleep quality [27]. Zimi et al.'s machine learning-based automatic detection of central sleep apnea events from a pressure-sensitive mat contributes to efficient event detection, while Sadek et al.'s comparison study introduces a new approach for detecting sleep apnea using a contactless bed sensor. Tamura et al.'s examination of body temperature, heat flow, and evaporation in wearable devices provides a foundational understanding of physiological parameters critical for seamless healthcare monitoring [30].
Waltisberg et al.'s contribution focuses on sleep quality monitoring with a smart bed, offering insights into the use of advanced technologies in capturing and analyzing sleep-related data [31]. Agawane and Mudhalwadkar present a forward-looking approach with their design of a smart pillow aimed at detecting and managing snoring, addressing a common sleep issue [32]. Ravishani et al.'s IoT-based smart pillow aims to enhance sleep experiences through connected technologies, reflecting the growing trend of incorporating Internet of Things (IoT) in sleep-related devices [33]. Dos Reis et al.'s smart companion pillow project from the EPS@ ISEP 2019 initiative contributes to the field of companion devices, showcasing potential applications beyond traditional sleep monitoring [34]. Ghoneim et al.'s IoT-based system for monitoring and soothing post-traumatic stress disorder (PTSD) patients extends the scope of sleep technology into mental health, addressing a crucial aspect of holistic well-being [35]. Ali et al.'s smart pillow for sleep apnea monitoring introduces a specialized device for managing a prevalent sleep disorder [36]. Veiga et al.'s IoT-based smart pillow for sleep quality monitoring in Ambient Assisted Living (AAL) environments reflects the broader trend of integrating technology for improved healthcare in residential settings [37]. Li's work on predicting body temperature from a smart pillow using machine learning underscores the potential of AI in enhancing personalized sleep monitoring. Zhang et al.'s real-time auto-adjustable smart pillow system for sleep apnea detection pioneers early efforts in developing responsive technologies for

sleep disorder intervention [39]. Together, these papers collectively contribute to the diverse landscape of sleep technology, showcasing advancements in monitoring, management, and the integration of IoT and machine learning in promoting overall sleep health.

II. Materials And Method

IoT (Internet of Things) technology has seamlessly integrated into various aspects of our lives, including our sleep routines, and one notable application is the development of smart pillows for health and wellness. These innovative pillows are equipped with embedded sensors that go beyond providing comfort—they actively gather data about your sleep patterns and habits. Throughout the night, these sensors track your movements and sleep patterns, collecting valuable information on factors such as sleep duration, interruptions, and overall sleep quality. This data is then transmitted to a mobile app for in-depth analysis, empowering users with insights into their sleep health. Moreover, the IoT-enabled pillows offer an additional layer of customization by allowing users to adjust the pillow surface temperature according to their preferences, contributing to the creation of a comfortable sleep environment. Users can conveniently monitor their sleep data, set preferences, and receive real-time feedback through a dedicated mobile app. importantly, these smart pillows also address health concerns by autonomously administering supplemental oxygen in cases where insufficient oxygen levels are detected, showcasing the potential for IoT technology to enhance not only comfort but also health outcomes in our sleep routines.

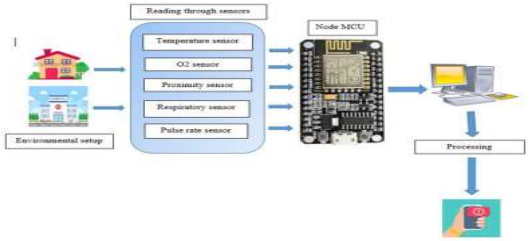


Figure 1: Hardware component integration of Health Sensing system.

Fig.1 shows the hardware components of IoT-enabled smart pillows contribute to the functionality and capabilities of these innovative devices. Here are details about the key hardware components mentioned:

A. Embedded Sensors

- *LM35 Temperature Sensors*: These sensors monitor the temperature of the pillow surface and are connected to the microcontroller (Arduino UNO or Node MCU). The collected temperature data can be transmitted to the cloud for further analysis and user preferences adjustment.
- *Accelerometer, Pulse Sensor, Proximity Sensor:* These sensors collect movement, heart rate, and proximity data, respectively, during sleep. The data is processed by the microcontroller and sent to the cloud or a mobile app for comprehensive sleep pattern analysis.

B. Microcontrollers

- *Arduino UNO and Node MCU*: These microcontrollers act as the central processing units, collecting data from sensors and managing the overall functionality of the smart pillow. Node MCU, with its Wi-Fi capabilities, facilitates the connection of the smart pillow to the internet, enabling data transmission to cloud servers or mobile apps.23.3 User Interface and Feedback
- *Buzzer and LED:* The buzzer and LED indicators can provide real-time feedback to the user. For instance, the buzzer may alert the user to changes in settings or health-related issues, while LEDs can convey information about the device status or user preferences. These indicators can be remotely controlled via the IoT framework.

C. Oxygen Supply System

- *Supplemental Oxygen System*: In an IoT-enabled context, the system for administering supplemental oxygen can be activated automatically based on real-time data analysis.
- All hardware components are interconnected and communicate through the IoT architecture. The microcontroller, equipped with Wi-Fi capabilities, establishes connectivity to the internet. The collected data is transmitted to cloud servers for storage, analysis, and accessibility through mobile apps.By embedding these hardware components into an IoT framework, the smart pillow transforms into an intelligent and connected

device capable of not only monitoring sleep health parameters but also providing a personalized and responsive sleep environment based on user preferences and real-time data analysis.

III. Results And Discussion

Given the comprehensive nature of IoT-enabled smart pillows in monitoring sleep patterns and vital signs, a time-series graph could be particularly informative. A line graph over time could visually represent fluctuations in key parameters such as body temperature, pulse rate, or oxygen levels. This dynamic representation would provide a clear visual understanding of sleep patterns, highlighting variations and trends throughout the night. Additionally, incorporating different colored lines for various parameters would allow for easy comparison and correlation analysis. This type of graph would effectively capture the evolving nature of sleep health, emphasizing the real-time data and insights provided by the smart pillow's IoT capabilities.

The development and implementation of our real-time smart pillow for continuous patient monitoring and sleep apnea detection mark a significant advancement in healthcare technology.The incorporation of sleep patterns and vital signs, including heart rate, patient status, respiratory rate, SpO2 level, temperature, and pulse rate, provides a comprehensive approach to monitoring key health indicators.The integration of an Internet of Things (IoT) system into both domestic and hospital environments introduces additional functionalities. The ability to adjust ambient temperature dynamically enhances patient comfort, while the automatic activation of oxygen cylinders adds an extra layer of safety and responsiveness to critical health situations.Fig.2 shows the experimental setup of health sensing system.



Figure 2: Experimental setup of Health Sensing system.

The buzzer generates a sound from an incoming electrical signal when it is greater than 350 C then the proximity sensor will turn into blue colour. Also when the object is been detected the setup will detect some vital parameters like O2 level, breathing rate and heart rate of the patients.

A notable feature of our technology is the patient gesture detection system, which facilitates seamless interaction between patients and healthcare professionals. This aspect not only enhances communication but also allows for a more personalized and responsive healthcare experience. Importantly, the affordability of this technology makes it accessible to a broad range of individuals, including immobile patients and those who are proactively interested in monitoring their daily health status. The cost-effectiveness contributes to the scalability and widespread adoption of the system. The results demonstrate the successful integration of diverse health monitoring features and IoT capabilities in a single, inexpensive device. The potential applications of this technology extend beyond hospital settings, catering to the needs of individuals in various environments. The positive implications for both patient care and proactive health management underscore the significance of this innovation in advancing healthcare solutions.Fig.3 shows the graphical view of measurement of Temperature.

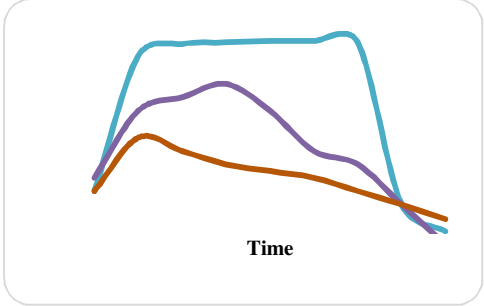


Figure 3: Measurement of Temperature

IV. CONCLUSIONS

The integration of IoT technology into smart pillows represents a transformative leap in the landscape of sleep health and monitoring. By seamlessly combining embedded sensors such as LM35 temperature sensors, accelerometers, pulse sensors, and proximity sensors with microcontrollers like Arduino UNO and Node MCU, these devices evolve beyond mere comfort providers into intelligent systems that actively track and analyze sleep patterns and vital signs. The IoT framework facilitates real-time data transmission to cloud servers, empowering users with personalized insights and feedback through mobile apps. The ability to adjust pillow surface temperature and autonomously administer supplemental oxygen showcases the adaptability and potential health interventions these pillows can offer. In essence, IoT-enabled smart pillows redefine the sleep experience, becoming integral components of proactive, connected, and user-centric approaches to sleep health

REFERENCES

[1] Yamada, Shuori, "Orthopaedic Pillow: Theory and Practice," Springer Nature, 2023.
[2] Triboelectric Nanogenerators as Sensing for Smart Home." Handbook of Triboelectric Nanogenerators. Cham: Springer International Publishing, 2023. 1621-1657.
[3] Wang, Heng, et al. "SleepSense: Smart Pillow with Pressure-Sensitive FBG-Embedded Silicone Buttons." IEEE
[4] Sensors Journal (2023).Kau, Lih-Jen, Mao-Yin Wang, and Houcheng Zhou. "Pressure-Sensor-Based Sleep Status and Quality
[5] Evaluation System." IEEE Sensors Journal 23.9 (2023): 9739-9754.
[6] Zhu, Zhiyuan, Maoqiu Pu, and Zisheng Xu. "Sleep monitoring based on triboelectric nanogenerator: wearable and washable approach." Frontiers in Psychiatry 14 (2023): 1163003.
[7] Moshayedi, Ata Jahangir, et al. "Recognition System for Ergonomic Mattress and Pillow: Design and Fabrication." IETE Journal of Research (2023): 1-19.
[8] Gourlay, Banu. "Multidisciplinary development of electroencephalogram (EEG)-based smart head piece prototype for everyday environments monitoring." (2023).
[9] Jeon, Yeong Jun, Sung Ho Park, and Soon Ju Kang. "Self-x based closed loop wearable IoT for real- time detection and resolution of sleep apnea." Internet of Things 22 (2023): 100767.
[10] Wang, Heng, et al. "SleepSense: Smart Pillow with Pressure-Sensitive FBG-Embedded Silicone Buttons." IEEE Sensors Journal (2023).
[11] MB, Nirmala, et al. "Detection of Stress through Sleeping Habits." Grenze International Journal of Engineering & Technology (GIJET) 9.1 (2023).
[12] Baig, Mirza Mansoor, and Hamid Gholamhosseini. "Smart health monitoring systems: an overview of design and modeling." Journal of medical systems 37 (2013): 1-14.
[13] Mekid, S., and K. Chenaoua. "IoT-Enabled Smart Mask for Monitoring Body Parameters and Location through Cloud." Internet of Things (2023): 100794.
[14] Chen, Yanyan, et al. "The past, present, and future of sleep quality assessment and monitoring." Brain Research 1810 (2023): 148333.
[15] Ma, Xingchen, et al. "Highly sensitive, ultra-reliable flexible piezoelectret sensor for non-contact sitting motion tracking and physiological signal monitoring." Nano Energy 111 (2023): 108424.
[16] Li, Songsheng. "IoT Healthcare System based on ESP32 for Smart Home." 2023 IEEE International Conference on Mechatronics and Automation (ICMA). IEEE, 2023.
[17] Liu, Long, Xinge Guo, and Chengkuo Lee. "Promoting smart cities into the 5G era with multi-field Internet of Things (IoT) applications powered with advanced mechanical energy harvesters." Nano Energy 88 (2021): 106304.
[18] Shijitha, R., P. Karthigaikumar, and A. Stanly Paul. "Efficient Morphological Segmentation of Brain Hemorrhage Stroke Lesion Through MultiResUNet." Computers, Materials & Continua 70.3 (2022).
[19] Kou, Haiying, et al. "Smart pillow based on flexible and breathable triboelectric nanogenerator arrays for head movement monitoring during sleep." ACS Applied Materials & Interfaces 14.20 (2022): 23998-24007.
[20] Xing, Huan, et al. "MXene/MWCNT electronic fabric with enhanced mechanical robustness on humidity sensing for real-time respiration monitoring." Sensors and Actuators B: Chemical 361 (2022): 131704.
[21] Sangeetha, T., et al. "Smart mattress integrated with pressure sensor and IoT functions for sleep apnea detection." Measurement: Sensors 24 (2022): 100450.
[22] Cao, Ting, et al. "Parametric study on the sleep thermal environment." Building Simulation. Tsinghua University Press, 2022.
[23] He, Chunhua, et al. "A smart flexible vital signs and sleep monitoring belt based on MEMS triaxial accelerometer and pressure sensor." IEEE Internet of Things Journal 9.15 (2022): 14126-14136.
[24] Singh, Law Kumar, et al. "An analytical study on machine learning techniques." Multidisciplinary Functions of Blockchain Technology in AI and IoT Applications. IGI Global, 2021. 137-157.
[25] Lee, Jong Chan. "Design of Smart Pillow System for Managing Sleep Apnea." Journal of the Korea Convergence Society 11.1 (2020): 33-39.

[26] Rachakonda, Laavanya, et al. "Sayopillow: Blockchain-integrated privacy-assured iomt framework for stress management considering sleeping habits." IEEE Transactions on Consumer Electronics 67.1 (2020): 20-29.
[27] Li, Xiaxia, Liming Shen, and Rosaria Califano. "The comparative study of thermal comfort and sleep quality for innovative designed mattress in hot weather." Science and Technology for the Built Environment 26.5 (2020): 643-657.
[28] Song, Cong, et al. "Effects of phased sleeping thermal environment regulation on human thermal comfort and sleep quality." Building and Environment 181 (2020): 107108.
[29] Zimi, Hilda, et al. "Machine learning-based automatic detection of central sleep apnea events from a pressure sensitive mat." IEEE Access 8 (2020): 173428-173439.
[30] Sadek, Ibrahim, et al. "A new approach for detecting sleep apnea using a contactless bed sensor: Comparison study." Journal of medical Internet research 22.9 (2020): e18297.
[31] Tamura, Toshiyo, Ming Huang, and Tatsuo Togawa. "Body temperature, heat flow, and evaporation." Seamless Healthcare Monitoring: Advancements in Wearable, Attachable, and Invisible Devices (2018): 281-307.
[32] Waltisberg, Daniel, Bert Arnrich, and Gerhard Tröster. "Sleep quality monitoring with the smart bed." Pervasive Health: State-of-the-art and Beyond (2014): 211-227.
[33] Agawane, Aishwarya, and Rohini Mudhalwadkar. "Design A Smart Pillow for Detection and Management of Snoring." 2023 IEEE 8th International Conference for Convergence in Technology (I2CT). IEEE, 2023.
[34] Ravishani, WM Samoda, et al. "IoT Based Smart Pillow for Improved Sleep Experience." 2022 4th International Conference on Advancements in Computing (ICAC). IEEE, 2022.Dos Reis, Alexandre Soares, et al. "Smart companion pillow–an EPS@ ISEP 2019 project." Robot 2019: Fourth Iberian Robotics Conference: Advances in Robotics, Volume 2. Springer International Publishing, 2020.
[35] Ghoneim, Mohamed S., et al. "An IoT based system for monitoring and soothing post-traumatic stress disorder patients." 2020 International Conference on Innovative Trends in Communication and Computer Engineering (ITCE). IEEE, 2020.
[36] Ali, Syeda Zuriat-e-Zehra, et al. "Smart pillow: Sleep apnea monitoring & minimization device." 2019 7th International Conference on Robot Intelligence Technology and Applications (RiTA). IEEE, 2019.
[37] Veiga, Alejandro, et al. "An IoT-based smart pillow for sleep quality monitoring in AAL environments." 2018 Third International Conference on Fog and Mobile Edge Computing (FMEC). IEEE, 2018.
[38] Li, Songsheng. "Prediction of body temperature from smart pillow by machine learning." 2019 IEEE International Conference on Mechatronics and Automation (ICMA). IEEE, 2019
[39] Zhang, Jin, et al. "A real-time auto-adjustable smart pillow system for sleep apnea detection and treatment." Proceedings of the 12th international conference on Information processing in sensor networks. 2013.

Smart Anesthesia Level Monitor During Surgery in the Intensive Care Unit



S. Selvi, R. Shijitha, P. K. Mani, S. B. Mohan, and M. Sasi Kumar

Abstract Major surgeries are performed to remove or reconstruct the infected part in the human body that leads to severe pain. In order to arrest this pain, Anesthesia is given to the region where operation is to be performed. At the time of surgery, patient will realise the pain when the level of Anesthesia reduces drastically. Hence there is a possibility of the patients to glide from their position. This may disturb the doctor as well as the patient while performing the surgery. Manual measurement is one of the methods to measure the anesthesia level of the patient which consumes more time. The other method is to sense the Anesthesia level in a particular part of the body and inject the medicine automatically to the patient according to the sensed value. If the system fails internally or due to external sources, the patient may suffer from pain, leading to several side effects. The major constraint that avoids the hospitals from utilising this device is its cost and size. The above constraint can be removed by placing the sensors on the surface of the skin that does not provide any pain or side effects. The device can also utilise multiple sensors for continuously monitoring the Anesthesia level and the severity around the injured parts of the body. The device is very compact and low cost compared to the existing system.

Keywords Anesthesia control · Microcontroller · Temperature sensor · Consciousness monitoring · Cerebral monitoring

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1 Introduction

Using drugs referred to as anaesthetics, anaesthesia is a means to manage pain during a procedure or operation. Controlling breathing, heart rate, blood pressure, rhythm and blood flow is one of its benefits. In order to render the patient unconscious and oblivious, general anaesthesia primarily affects the central nervous system and brain. Inhaled gas and injectable medications are used in tandem to deliver it through the patient's circulatory system. Inhaled gas anaesthetics and extra medications administered via an intravenous line are used to maintain anaesthesia after the initial injection. Local anaesthesia is a medication used to momentarily block pain perception in a specific body location. The person receiving a local anaesthetic is awake the entire time. A local anaesthetic can be injected directly into the area for minor surgery. A local anaesthetic is injected around important nerves or the spinal cord during regional anaesthesia to block the pain from a larger but still constrained area of the body. Most likely, you'll be given medication to help you unwind or fall asleep during operation. Spinal, epidural, and caudal anaesthesia, as well as nerve blocks, are the main varieties of regional anaesthesia. This study suggests a unique method for precise LoH estimation based on fractal characteristics and the Stationary Wavelet Transform. The depth Optimised temporal, fractal, and spatial learning model to determine the level of drowsiness in the patient regardless of age or the kind of anaesthetic used. Afterward, a multilayer perceptron network receives the feature set a subclass of feed-forward neural networks [1]. Electrocorticography reveals that the topological changes between electrodes covering the prefrontal and parietal cortices have no impact on traditional anaesthetic monitoring methods. In order to fill this gap, a framework based on a two-stream graph convolutional network, where one stream is used to extract node features and the other is used to retrieve topological structure features, was presented [2]. This article proposes EEG variability and analyses EEGV using nonlinear models to determine the depth of anaesthesia [3]. To enhance the performance, we employ a multi-stage training paradigm, which is supported by the visualisation of the high-level feature mapping. The usefulness of our proposed Anes-MetaNet is shown through experiments on the office-based anaesthesia EEG dataset in contrast to other approaches [4]. The system was able to remove auditory steady-state response cycles from less epochs and over smaller periods of time. The offered denoising approach for extracting 40-Hz auditory steady-state cycles, adaptive multilevel wavelet denoising [5]. This study examines the scrambling behaviour of the electroencephalogram, a gauge of awareness, using detrended fluctuation analysis [6]. The EEG signals taken during surgery from 58 patients were examined to determine the DOA observing capacity of periodicities discovered using PRSA. With sample entropy, detrended fluctuation analysis, and permutation entropy, the approach is contrasted [7]. This research proposes a multimodal head-patch device that measures EEG and frontal lobe near-infrared spectroscopy simultaneously. A mixed-mode dc-servo loop is suggested for EEG observation in order to cancel out the 200-mV electrode-dc offset for dry gel condition with a noise-efficiency value of 3.49 [8]. The feature data derived from the EEG is used to determine the phase

of the continuum using a unique approach. In the multidimensional feature space, it is thought that the feature data derived from EEG sequences corresponding to continuously deepening anaesthesia constitute a one-dimensional nonlinear manifold [9]. The suggested method is based on stationary wavelet transform analysis of a single-channel electroencephalogram data. We provide a clinical investigation that examines the benefits of the WAV/sub-CNS/ in comparison with the BIS monitor, which is now the standard in consciousness monitoring, in order to validate the suggested technique [10]. Research from the past suggests that brain monitoring utilising electroencephalography to check sedation levels may aid medical professionals in optimising drug dosing and avoiding the negative effects of over sedation and under sedation. The performance of sedation observing techniques, however, is inconsistent because they do a poor job of addressing patient variability on an individual basis [11]. This study demonstrates the creation of a system to regulate the amount of inhalation anaesthetic given to a patient based on that patient' auditory evoked potentials [12]. In this study, a deep learning CNN is developed to identify related activities from raw electroencephalography using a variety of various architectures. Then, CNN models are created and proficient to forecast DOA levels from EEG spectrum without the use of manually created features, resulting in a mapping procedure that is simple to understand and has a high level of efficiency and dependability [13]. The depth of sedation in "CU patients" can be determined using features obtained from the miniscule breakdown of EEG signals [14]. Blind folks can employ Light Fidelity technology and ultrasonic barrier perception for audio assistance. This technology provides spoken announcements for simple navigation. When an impediment is detected, the ultrasonic sensor detects it and alerts the controller via voice message [15]. Due to inadequate vision, veins are punctured needlessly. The vein may become permanently damaged or develop blemishes if the puncture is done incorrectly. A vein disclosure mechanism is necessary to solve these issues. We suggest a non-invasive, sensor-based, wearable therapeutic treatment for varicose veins that combines temperature and vibration therapy [16]. The respiration signal is filtered using a motion filter, which tracks the victims' movements and filters them using a processor. The signal is then transformed using a discrete wavelet transform (DWT) [17]. PIR sensors are used mostly for the task of detecting live humans. Even behind barriers, people can be detected with Ultra-Wide Band (UWB) radar. The signal from the radar and other sensors is processed using the Arduino UNO. Wi-Fi module with a built-in camera that is used to communicate with the robot and the rescue crew [18] PIR sensors are used mostly to detect human people who are still alive. It is suggested to use the Canny edge detection technique to extract the feature from the image. Using the Naive Bayes classifier, text characters are identified. The text that has been recognised in the photos is categorised, turned into speech using the MATLAB toolbox, and provided for blind persons as audio [19]. Applications of the suggested technique for 3-D segmenting the human liver and kidney in Computed Tomography (CT) scan volumes [20]. Due to heat stress and intense magnetic flux, the rotor slots expand. The magnetic stress and temperature stress of the rotor are acquired by the suggested ARSV approach using multimodal sensor [21]. This method proposes a novel technique for identifying various motor

faults and the prediction of Rotor Slot Size Variation (RSSV) under various motor fault conditions [22]. Thermal and magnetic stress causes the rotor slots of induction motors to expand. Magnetic stress is a significant issue that regularly occurs in motors but is seldom quantified or checked [23]. Using various wavelet transforms, the multimodal sensor signals data collected from various three-phase induction motor components are examined for various fault circumstances and rotor slot width recorded during runtime condition of the motor [24]. The wavelet transform's ability to accurately detect disturbances has been employed for the investigation of Power Quality disturbances under noisy conditions[25]

1.1 Need to Measure Body Temperature with Anaesthesia

Measuring the body temperature is very important during surgery. It also helps to detect the level of anaesthesia. The range of a healthy person's core temperature is 37.5–38.5 °C. Within the first 25 min after general anaesthesia induction, the body's core temperature typically drops by 1.5 to 1.9 degrees Celsius. Internal heat redistribution causes hypothermia, along with a number of other factors whose significance in any given patient is difficult to estimate. As a result, it might be challenging to interpret core temperature changes during the first 25 min after anaesthesia. Patients undergoing abdominal or thoracic surgery are more likely to experience significant postoperative drops in core temperature, but hyperthermia and malignant hyperthermia from other causes continue to be risks for all patients. As a result, in the majority of patients undergoing general anaesthesia lasting more than 25 min, body temperature should be monitored. Although it would be ideal to continuously monitor body temperature, most patients probably only need it every 10 min. Malignant hyperthermia is not brought on by the medications used during regional anaesthesia. Conduction anaesthesia can cause core hypothermia, which frequently shows up as shivering, particularly when significant bodily cavities are being operated on. Therefore, individuals who physicians believe are prone to develop hypothermia should have their core temperature monitored during epidural anaesthesia.

1.2 Problem Statement

The instrument which is used is of high cost and also consumes more time in measuring general anaesthesia. It automatically detects the level of anaesthesia and supply in accordance with the level. For minor operations, doctor will measure the temperature for detecting the anaesthesia level in the body. There are two ways of measuring the level of anaesthesia during surgery. The doctors will manually check the anaesthesia level by poking the region using a pin where anaesthesia is given. By doing so, the patient can differentiate where the pain is by the poking process and can inform the doctor.

2 Implementation

To overcome the disadvantages, automatic and periodic monitoring of the body temperature on the anaesthetic region can be done by an Anaesthesia Level Monitor. This device will display the temperature of the body thereby helping the doctor to make their work easy. This would be a reminder to the doctor who continuously monitors the anaesthesia during surgery. The main advantage of this device is, it can be implemented in low cost and is of a compact size and is portable. Therefore, based on the temperature value doctors can decide whether to inject anaesthesia further or not.

2.1 Hardware Implementation

The block diagram given above comprises of five LM35 temperature sensors, Microcontroller board, buzzer and a Graphical Liquid Crystal display with a Power supply. The temperature sensors will be placed on different regions where anaesthesia is given. The temperature sensors will sense the temperature on the body where it is placed and the analog signal will be sent to the microcontroller. The controller board will change the analog input signal into digital values which will be displayed in the graphical display (Fig. 1).

With an electrical output proportional to the temperature, the LM35 is an integrated circuit sensor that may be used to measure temperature. Instead of utilising a thermistor, temperature can be sensed more precisely. The output voltage may not need to be amplified because the LM35 produces a larger output voltage than thermocouples. The output voltage of the LM35 series precision integrated circuit temperature sensors is linearly proportional to the temperature in degrees Celsius. In comparison to linear temperature sensors calibrated in Kelvin, the LM35 device has an advantage because it does not require the user to deduct a significant constant voltage from the output in order to gain convenient Centigrade scaling. The LM35 device can deliver typical accuracies of 15 °C at room temperature and 35 °C over the entire temperature range of 65 °C to 140 °C without the need for any trimming. The gadget can be powered by a single power supply for two applications or by plus and minus supplies.

A buzzer is a piezoelectric audio signalling device. Beacons and buzzers are frequently used in alarm clocks and timers. These buzzers may go off if there is a faulty component on the device. Buzzers used for this purpose will act as a reminder if the level of anaesthesia falls below its actual dosage. LED is used to indicate the anaesthesia level for better understanding. We have used four different colour LEDs (Fig. 2).

The body temperature on different regions of the body will be sensed using the temperature sensors and will be displayed to the doctors using GLCD. GLCDs are like mini screen, so that the sensed values can be displayed clearly (Fig. 3).

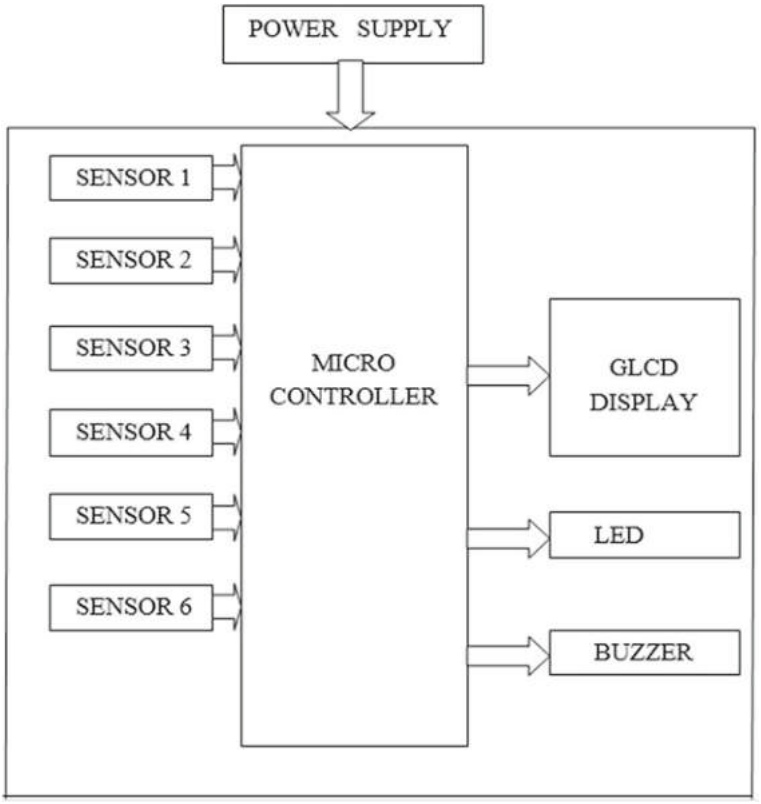


Fig. 1 Functional block diagram

Fig. 2 Buzzer



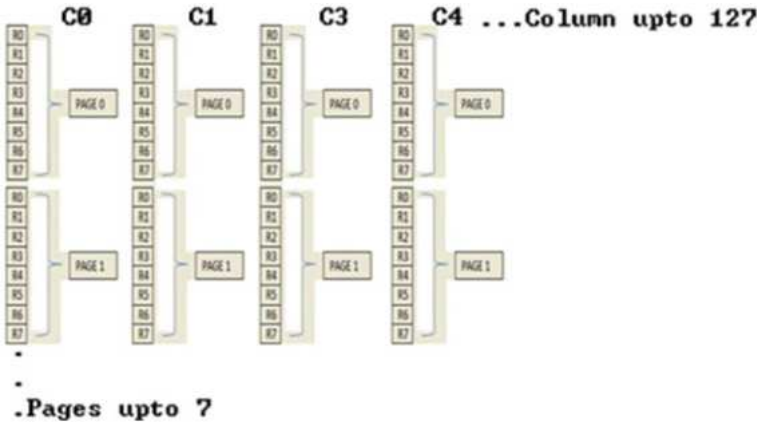


Fig. 3 Two KS0108 controllers

Images, characters, and numbers can be displayed on liquid crystal displays, sometimes known as LCDs, which are used as general-purpose computer displays. The graphic LCD measures 128 by 64 pixels. LCDs have backlights that give illumination. LCDs require lighting in order to produce a viewable image because they cannot emit light on their own. Unlike front lights, which are positioned in front of the LCD, backlights shine light on the LCD from the side or back of the display panel. Small displays, like those in watches, computer screens, TVs, and many others, often use backlights to make them easier to see in dimly lit environments (Fig. 4).

Graphical Liquid Crystal Display, or GLCD, has 128 horizontal columns and 64 vertical rows and includes two KS0108 controllers. Graphical Liquid Crystal Display, or GLCD, has 128 horizontal columns and 64 vertical rows and includes two KS0108 controllers.

A microcontroller is a multifunctional device that can read data, do simple computations on that data, and control its surroundings. A microcontroller's main function is to employ a fixed programme that is stored in ROM and that remains constant during the system's lifespan to regulate the operation of a machine. A microcontroller is an extremely integrated semiconductor that houses all or most of the components required for a controller on a single chip. The microcontroller can legitimately be referred to as a single-chip solution. Two USB ports, one host and one slave, are available on the Arduino Mega ADK. The Arduino IDE can download programmes to the Arduino and communicate with programmes that are running on the Arduino through the slave mode connector, which connects to a PC and emulates an RS-232 port on the PC. The host port connects to an Arduino device and enables communication between apps on Android and Arduino devices (Fig. 5).

There are three libraries needed to make the system work.

MAX342: handles the USB host chip.USB: handles the USB host connection Android accessory: checks the device connecting is one of the available accessory-enabled phones.

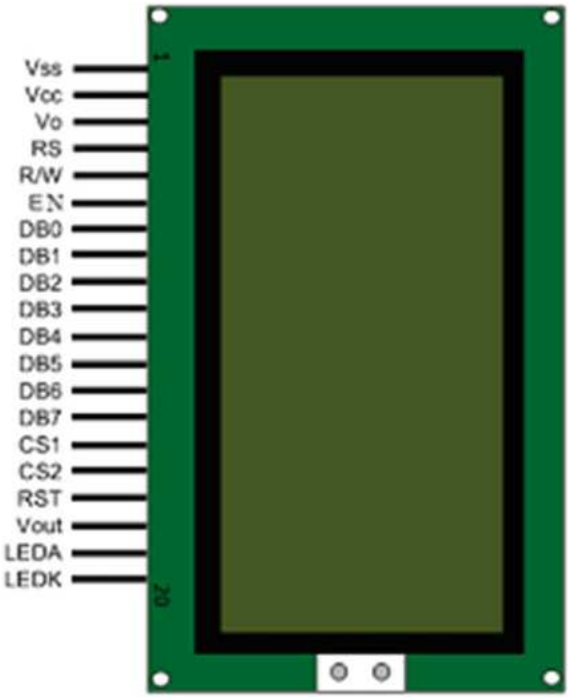


Fig. 4 1GLCD pin diagram



Fig. 5 Arduino mega ADK board

2.2 Software Implementation

Arduino is a tool for building computers that are more capable than desktop computers of sensing and controlling the physical world. It consists of a development environment for building software for the board's basic microcontroller and is an open-source physical computing platform. For physical computing, there are numerous additional microcontrollers and microcontroller platforms available. Similar capability is provided by MIT's Handy board, Phi gets, Net media's BX-24, Parallax Basic Stamp, and many other products. All of these tools take the complex microcontroller programming intricacies and put them in a convenient form. Working with microcontrollers is made simpler by Arduino as well, but it has several advantages over other platforms for educators, students, and curious hobbyists (Fig. 6).

3 Results and Discussion

It also indicates the doctor by different buzzers that help to detect if the level of anaesthesia has reached the normal temperature of the body. In the process of developing this project, there are some instances where errors are very prone to happen. Such errors are, interchange of pins configured on the controller board that leads to incorrect output. Battery damage due to complete drain.Battery failure due to reverse charging. These are some errors that happen to every beginner who is making his first drone. Some of these problems are very silly to see but can increase the expenses in a very large manner. All these errors can be crossed over by taking correct guidance and preventive measures (Figs. 7 and 8).

The sensors placed over the skin surface will sense the temperature value during the surgery and display the value automatically as shown. The conditions are if the value of A1 > NA value, where A1 is the first sensor placed in anaesthetic region then GLCD displays as less critical and checks the region A2 where the second sensor is placed in anaesthetic region. If A2 > NA value, then GLCD displays as critical and checks the region A3 where the third sensor is placed in anaesthetic region. If A3 > NA value, then GLCD displays as more critical and checks the region A4 where the fourth sensor is placed in anaesthetic region. If A4 > NA, then the GLCD displays as the most critical condition (Fig. 9).

As the doctor's doing surgery couldn't able to monitor the screen continuously. So we have indicated with the buzzer to alert the doctors. In our project, we have used four buzzers for the four sensors namely b1, b2, b3 and b4.

- Buzzer b1 will ring if A1 > NA
- Buzzer b2 will ring if A2 > NA.
- Buzzer b3 will ring if A3 > NA.
- Buzzer b4 will ring if A4 > NA.

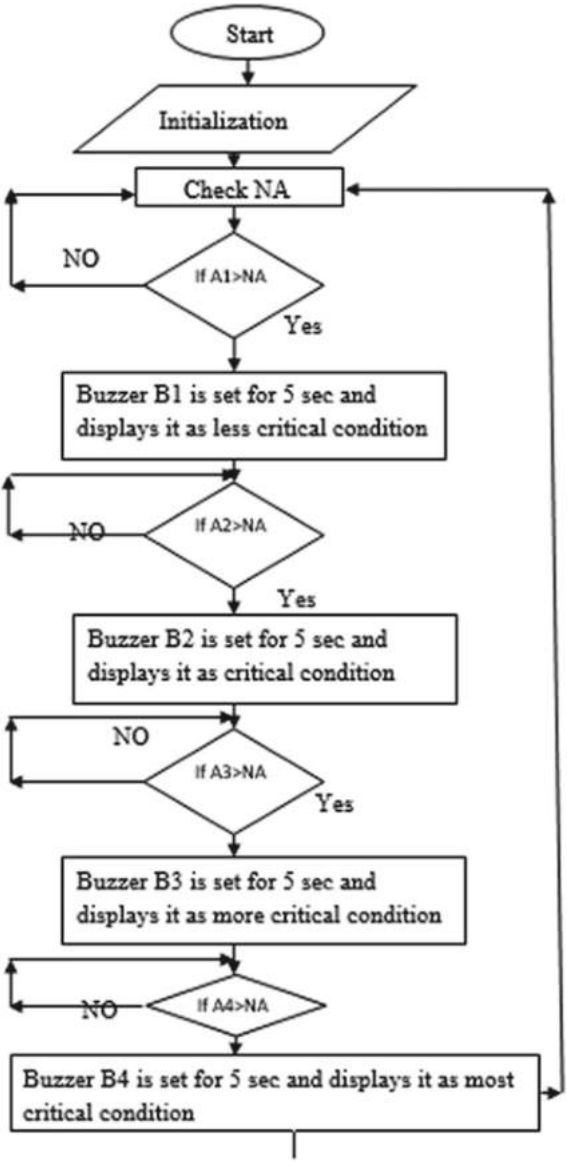


Fig. 6 Flowchart for the anaesthesia level monitor

The indication is done as shown in the images below. In our project, we have faced lot many difficulties and overcame those difficulties (Fig. 10).

Finally combining the above-mentioned steps, we get the output which senses the skin temperature. It is very compact and less expensive compared to the existing system (Fig. 11).

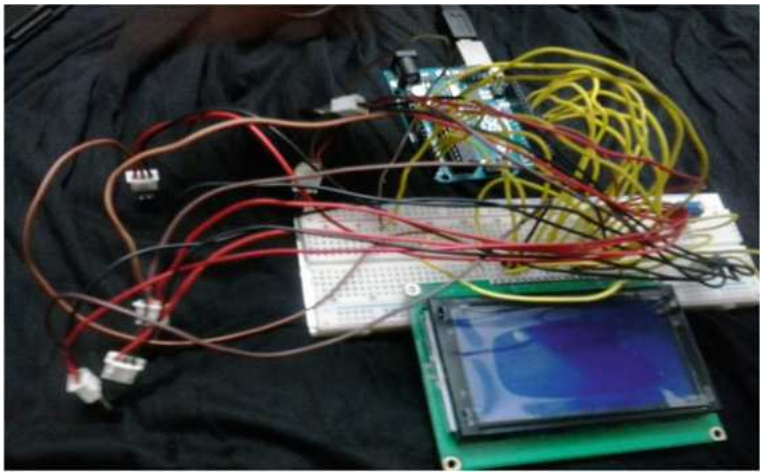


Fig. 7 Connection with Arduino Uno

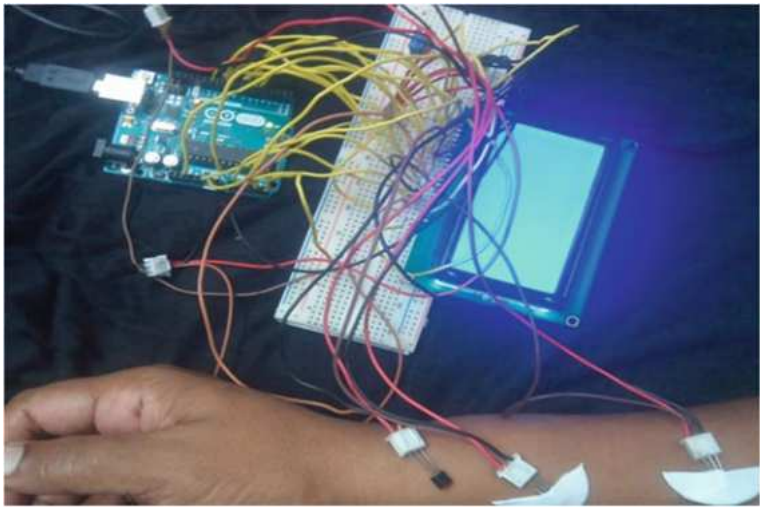


Fig. 8 Displaying the output in GLCD

We already know that prevention is better than a cure. In this case, also it's the same. Cure here becomes buying the damaged parts and replacing that increases the expenses. Such preventive measures, Calibration and Pin configuration can be done without errors when done by referring to some websites. Battery draining can be prevented by frequent checking of battery using a multimeter. Buzzers must be

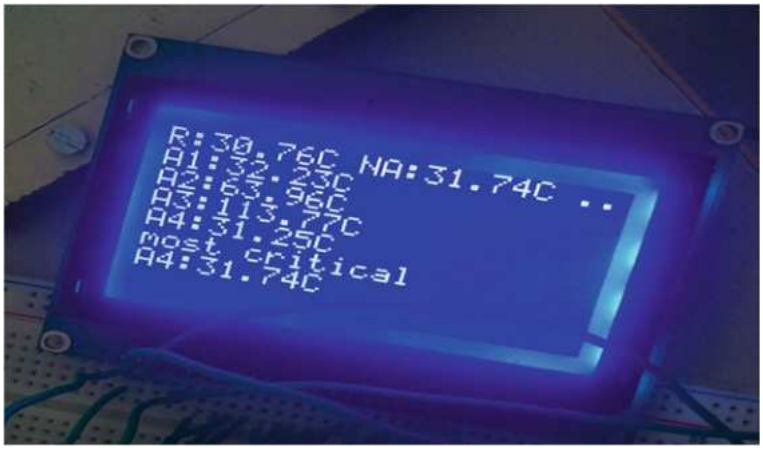


Fig. 9 Displaying the output

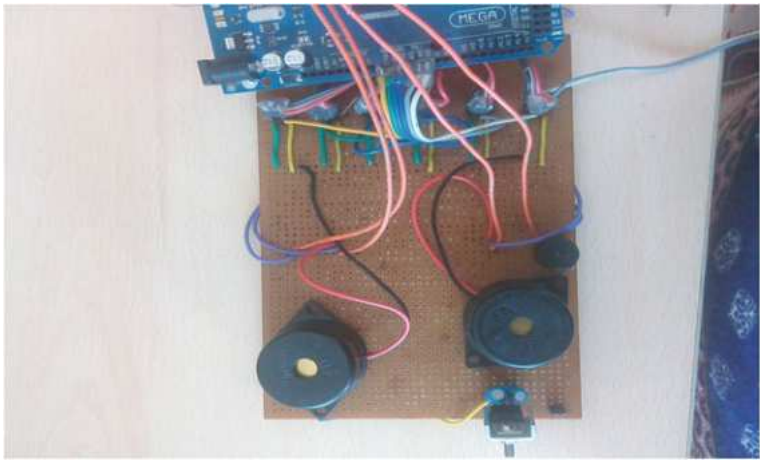


Fig. 10 Indication with buzzer

disconnected after its use immediately and must be checked prior to using it. Alignment of sensors with measurement of its readings can be done under the presence of guidance.

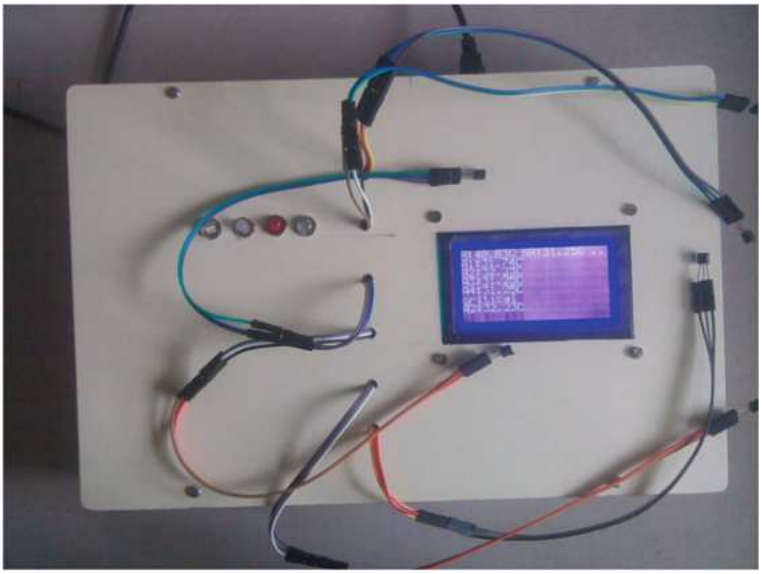


Fig. 11 Final output

4 Conclusion

This product can be used for the purpose of monitoring the skin temperature of the patient during surgery automatically in a particular location. It prevents pain for the patient in case if the anaesthesia level is drastically reduced in the body during surgery. It will help the doctor to perform surgery successfully by preventing the patient to glide from their position during surgery. It is life saving and time saving product. It is a very important application that can be used in the present medical field to sense the temperature in a particular location where the sensors have been placed. We tried using thermo imaging cameras which were capable of scanning the entire body and displaying the value by detecting where the temperature changes drastically. Again there was the disadvantage where the camera cannot get the data if any obstacles are present and cost of the camera is expensive. To make this more compatible, we tried using temperature sensor probes which are used in incubators or baby warmers. This needed a shield which was again much expensive. Finally, we tried using LM35 temperature sensor. With these temperature sensors, it was possible for us to measure the accurate temperature value of the body, especially in the anaesthetic region. Thus we have achieved in implementing the device in compact size which is also portable. When it's taken as medical services contract with government aid these improvisations can be done. Improvisations that can be made to are, Thermo imaging cameras can be applied instead of sensors. The reason behind us not using thermo imaging cameras of its high cost. Number of sensors and high cost sensors can be increased for the design of our project. Most accurate

level of anaesthesia can be recorded from the patient body during surgery by the use of the latest thermo imaging cameras. The project "Anaesthesia level monitor" is patentable. This project is mainly based on the relationship between anaesthesia level and body temperature. It is time saving and life saving project. This project is something that is going to be very useful to the society in medical application field. The advantage of this project is its low cost and easily affordable for all the hospitals.

References

1. Dutt MI, Saadeh W (2023) Monitoring level of hypnosis using stationary wavelet transform and singular value decomposition entropy with feedforward neural network. IEEE Trans Neural Syst Rehabil Eng 31:1963–1973. https://doi.org/10.1109/TNSRE.2023.3264797
2. Chen K, Xie T, Ma L, Hudson AE, Ai Q, Liu Q (2022) A two-stream graph convolutional network based on brain connectivity for anesthetized states analysis. IEEE Trans Neural Syst Rehabil Eng 30:2077–2087. https://doi.org/10.1109/TNSRE.2022.3193103
3. Chen Y-F, Fan S-Z, Abbod MF, Shieh J-S, Zhang M (2022) Nonlinear analysis of electroencephalogram variability as a measure of the depth of Anesthesia. In: IEEE transactions on instrumentation and measurement, vol 71, pp 1–13, Art no. 4004413. https://doi.org/10.1109/TIM.2022.3167793
4. Wang Q, Liu F, Wan G, Chen Y (2022) Inference of brain states under anesthesia with meta learning based deep learning models. IEEE Trans Neural Syst Rehabil Eng 30:1081–1091. https://doi.org/10.1109/TNSRE.2022.3166517
5. Haghighi SJ, Komeili M, Hatzinakos D, Beheiry HE (2018) 40-Hz ASSR for measuring depth of anaesthesia during induction phase. IEEE J Biomed Health Inform 22(6):1871–1882. https://doi.org/10.1109/JBHI.2017.2778140
6. Jospin M et al (2007) Detrended fluctuation analysis of EEG as a measure of depth of Anesthesia. IEEE Trans Biomed Eng 54(5):840–846. https://doi.org/10.1109/TBME.2007.893453
7. Liu Q, Chen Y-F, Fan S-Z, Abbod MF, Shieh J-S (2017) Quasi-periodicities detection using phase-rectified signal averaging in EEG signals as a depth of Anesthesia monitor. IEEE Trans Neural Syst Rehabil Eng 25(10):1773–1784. https://doi.org/10.1109/TNSRE.2017.2690449
8. Ha U, Lee J, Kim M, Roh T, Choi S, Yoo H-J (2018) An EEG-NIRS multimodal SoC for accurate Anesthesia depth monitoring. IEEE J Solid-State Circuits 53(6):1830–1843. https://doi.org/10.1109/JSSC.2018.2810213
9. Kortelainen J, Väyrynen E, Seppänen T (2011) Isomap approach to EEG-based assessment of neurophysiological changes during Anesthesia. IEEE Trans Neural Syst Rehabil Eng 19(2):113–120. https://doi.org/10.1109/TNSRE.2010.2098420
10. Zikov T, Bibian S, Dumont GA, Huzmezan M, Ries CR (2006) Quantifying cortical activity during general anesthesia using wavelet analysis. IEEE Trans Biomed Eng 53(4):617–632. https://doi.org/10.1109/TBME.2006.870255
11. Zheng W-L, Sun H, Akeju O, Westover MB (2020) Adaptive sedation monitoring from EEG in ICU patients with online learning. IEEE Trans Biomed Eng 67(6):1696–1706. https://doi.org/10.1109/TBME.2019.2943062
12. Nayak A, Roy RJ (1998) Anesthesia control using midlatency auditory evoked potentials. IEEE Trans Biomed Eng 45(4):409–421. https://doi.org/10.1109/10.664197
13. Liu Q et al (2019) Spectrum analysis of EEG signals using CNN to model patient's consciousness level based on Anesthesiologists' experience. IEEE Access 7:53731–53742. https://doi.org/10.1109/ACCESS.2019.2912273
14. Nagaraj SB et al (2018) Electroencephalogram based detection of deep sedation in ICU patients using atomic decomposition. IEEE Trans Biomed Eng 65(12):2684–2691. https://doi.org/10.1109/TBME.2018.2813265

15. Divya R et al. (2018) Indoor & outdoor navigation system for visually impaired people using visible light communication and image processing. Int J Innov Eng Res Manag 5(2), ISSN: 2348-4918
16. Varadharajan G et al. (2021) Smart Therapeutic treatment for varicose disease. In: Int J Res Appl Sci Eng Technol 9(1):161
17. Anish Kumar J et al (2021) IoT based human detection robot for rescue operations. Design Eng (8):4243
18. Madhavan G et al (2015) An UWB radar for trapped human detection and vital sign extraction. Int J Appl Eng Res 10(29):22448
19. Kalaiselvi U et al. (2014) Camera based assistive text reading system using gradient and stroke orientation for blind person. Int J Latest Trends Eng Technol 4(1):325
20. GodlyGini J et al (2017) A model-based validation scheme for organ segmentation in CT scan. Int J Res Electr Eng 4(2). ISSN No: 2349-2503 Page no: 4-9
21. Anish Kumar J et al. (2023) Prediction of rotor slot size variations in induction motor using polynomial Chirplet transform and regression algorithms. Arab J Sci Eng 48:6099–6109. https://doi.org/10.1007/s13369-022-07264-9
22. Kumar JA et al. (2023) Prediction of rotor slot size variation through vibration signal of three phase induction motor using machine learning. J Vib Eng Technol. https://doi.org/10.1007/s42417-023-00859-y
23. Jayakumar AK et al. (2022) Average rotor slot size variation measurement in induction motor using variable Q-factor transforms and regression algorithms. Iran J Sci Technol Trans Electr Eng 46:675–687. https://doi.org/10.1007/s40998-022-00502-8
24. Anish Kumar J et al (2022) Prediction of rotor slot width in induction motor using Dyadic wavelet transform and softmax regression. Int J Emerg Electr Power Syst. https://doi.org/10.1515/ijeeps-2022-0214
25. Poornima G et al. (2020) Classification of power quality disturbances using wavelet and neural network. Int J Adv Res Innov Discoveries Eng Appl 5(4):28–33

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Dedication

To

My Beloved Parents

Preface

Banking Sector in India is witnessing the remarkable change in recent days. In the vision of its great trained personnel, emergent banking technology, ease of use of banking services and the developing banking products, India is expediently positioned at the domestic and international banking front. The study of banking technology today is incomplete without the study of Mobile Banking Apps and Transaction Apps among the Digital Bank Customers and its impact on the Life styles. There is no doubt that knowledge-based industries such as information technology offer India a smooth route to world Banking Services. Yet far greater potentials and opportunities exist in the Banking sector also. The study of Mobile Banking Apps and Transaction Apps helps in understands the various uses and its influence such as socio-cultural factors, psychological factors, financial factors and economic development on the bankers as well as on bank customers in the current scenario. The subject is therefore very important for the students studying Commerce/Business subjects. This book is also useful to others who wish to understand the concept of Banking Technology products and its various services to them for their individual information.

Focus of the Book

The book focuses on the following objectives which remains unchanged in the present book:

01. To comprehend the efficacy in the usages, the perceptions and satisfaction levelsof Mobile Banking Apps (MBPs) and Transactions Apps (TAs) among Digital Customers;
02. To evaluate the challenges and opportunities in adoption of both MBPs and TAs by Digital Customers; and
03. To assess the consequence of business transaction through the select Mobile Banking Apps (MBAs) and Transaction Apps (TAs)in understanding the Cyber Security issues involved in the usage of Mobile Banking and Transaction Apps;
04. Find out the actions to resolve the cyber-attacks involved Mobile Banking Apps and Transactions Apps in various business transactions; and

05. Challenges and opportunities of digital customers intricate in the transactions apps and banking apps and to provide suggestions to overcome the issues faced by MBPs and TAs customers.

This textbook is designed to provide the readers a basic understanding of Mobile Banking Apps and Transaction Apps among the select Digital Bank Customers and its usages, benefits, satisfaction level, its attitude, preferences, and various impacts [economic (financial aspects) dimensions with the time duration of holdings; short, medium and long term] on the customers and also help in understand the impact on economic development of the Banking sector by using the more and more banking technology products, critical risks associated with long term usages and its services. Banks have started to rely increasingly on the Direct Selling Agents (DSAs)/ Direct Marketing Agents (DMAs) for marketing/ selling bank products. Mobile Banking apps and Transaction Apps is most convient services-products being marketed by banks for the benefits of both banker and Customers. This book also includes sample illustrations and few statistical data for the reader to understand related topicson Mobile Banking Apps (MBAs) and Transaction Apps (TAs) and its adoption in various activties. This book would be useful for every person as it is inevitable today to use the MBAs and TAs in various circumstances or in our routine transactions. The knowledge of MBAs and TAs makes a person appreciate the legal entanglement pertaining to their various banking transactions, avoid legal litigations and obtain timely benefits to the MBAs and TAs users.

With the intension of making the subject of Banking technology products and its services interesting and help the readers easy to understand the topic well. This book is an outcome of the research programme on The adoption of MBAs and TAs on Digial Bank Customers. As such, this book has important points to the bank customers, bankers, general public, students, and the educational institutions.

Audience of the Book

The adoption of MBAs and TAs among the select Digital Bank Customers is designed for the use in banking fields (Bankers and Bank Customers) and those seek the information on the Banking technology products and its services for their benefits. It will also be useful for the Banking officials, banker customers and general public who want to update their knowledge about the recent thinking in the MBAs and TAs, the subject matter has been discussed in conceptual-cum-analytical manner. It is the aim of the book to help readers develop skill to understand, analyze and interpret the impact of MBAs and TAs on Digital Bank customers and data to make good decisions in the utilizations of both MBAs and TAs in their routine life.

Dr. V. Vimala

Foreword

The rapid strides made in the banking technology products, services and information communication technology arena have tremendously impacted the way banking is made worldwide. Nowadays, the bank customer's does not have to enter the brick-and-mortar structure of the bank in order to get serviced by the bank. He or she can get all the services right at his or her doorstep on his or her desktop. Such is the quintessential influence of banking products like MBAs and TAs, made out of virtual services is a new and easier way of transactions. Technology as a convergence of several disparate disciplines such as Finance (including risk management), Information technology, Computer Science, Communication technology and marketing science. It presents the evolution of banking, the tremendous influence of information and communication technologies on banking and its products, the quintessential role played by computer science in fulfilling banks' marketing objective of servicing customers better at a less cost and thereby reap more profits. It also highlights the use of advanced statistics and computer science to measure, mitigate and manage various risks associated with banks' business with its customers and other banks. The chapter concludes by predicting that the Banking Technology impacts on various confirmatory factors which is discussed in the study taking into the consideration of all discipline to set for rapid growth in future.

This book will explore issues critical for success in providing usages of MBAs and TAs. The aim is to assist bank customers in utilizing the opportunities offered by banks which relatively new set of technologies. This book largely restricts itself to the MBAs and TAs impacts on the Digital Bank Customers in view of the problem, and is

therefore primarily focused on external factors, such as the socio-cultural, financial/ economical and psychological factors. It is not intended that the book should replace texts on existing banking technology products/banking management practices in its focused field, but rather that it be used as a complement to them. The main target audiences include researchers involved in the banking filed, undergraduate as well as postgraduate students of B.Com – Banking Technology, general management and technology management as well as practitioners of Banking technology products and services of e-banking. This book is of paramount importance can be seen by the fact that the academicians, researchers and professionals from all over the worldwide those interested in the utilization of Banking Technology products and its service.

The readings of this book will indisputably enrich the knowledge on phase of Impact of MBAs and TAs on Digital Bank Customers. I wish to appreciate the relevance of the topics of this research work and wish this book would surely bring insights in these fields and act as an eye opener to the scholars in this field of inquiry. I am of firm opinion that students, research scholars and academicians will find this book very useful as a source of reference for their research and the decision making in the broad area of Mobile Banking Apps (MBAs) and Transaction Apps (TAs).

Dr. V.Vimala

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DECLARATION

I hereby certify that the Seed Money Research Project Report entitled on ***Adoption of Mobile Banking Apps and Transaction Apps: Cyber Security Issues among Digital Customers*** a record of original work done by me in the Department of Commerce, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore – 641043, during the period 2022 – 2023 and that it has not formed the basis for the award of any Degree / Diploma / Associateship / Fellowship or similar title to any candidate of any other University or Institution.

Place : Coimbatore ***Dr. V. Vimala***

Date : 09th October, 2023

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Happiness cannot be expressed by words and help taken cannot be left without thanking. I would like to thank all who were a part of my life and my work.

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"A Friend is one of the nicest things we can have" So, I take this opportunity to thank and remember my dear friends for being so encouraging, supportive in completing my research work.

Place : Coimbatore **Dr. V .Vimala**

Date : 09th October, 2023

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List of Abbreviations

ACHs	*Authorisation of the Cardholders*
ADRs	American Depositary Receipts
AGFI	Adjusted Goodness of Fit Index
AILS	Adverse Impact on Lifestyle
AMOS	*Analysis of Moment Structures*
ANN	*Artificial Neutral Network*
ANOVA	Analysis of Variance
APACS	***Association forPayment Clearing Services Report***
APM	Authority of the Plastic Money holders
APR	Annualized Percentages Rates
ASBA	Applications Supported by Blocked Accounts
ATM	Automated Teller Machine
ATRAC	***Australian TransactionReport and Analysis Centre***
AVS	Address Verification Service
BOI	Bank of India
BT	***Business Technology***
BTP	Banking Technology Products
BTQ	Business Travel Quota
BTS	Banking Technology Services
CA	Cultural Affinity
CA	Cyber Attacks
CAR	*Capital Adequacy Ratio*
CARD	Credit Card Accountability Responsibility and Disclosure Act of 2009
CBN	Central Bank of Nigeria
CC	Cyber Crimes
CDR	*Credit Deposit Ratio*
CFA	***Confirmatory FactorAnalysis***
CFI	Comparative Fit Index
CH	Consumption Habits
CIBIL	*Credit Information Bureau (India) Limited*
CIR	Credit Information Report
CISP	Cardholder Information Security Program
CNP	Card/Cardholder Not Present
CRIS	Cardholder Risk Identification System
CRISL	*Credit Rating Information and Services Limited*
CRM	*Customer Relationship Management*
CS	Cultural Sovereignty

CS	Cyber Security
CSC	Card Security Code
CVV	Card Verification Value
DBC	Digital Bank Customers
DC	Digital Customers
DDA	Demand Deposit Account
DIR	*Differential Interest Rate Schemes*
DMA	Direct Marketing Agents
DNB	De Nederlandsche Bank
DNCR	Do Not Call Registry
DSA	Direct Selling Agents
EAD	Equal Monthly Installment Amount Due
EAD	Exposure at Default
EBPP	Electronic Bill Presentment And Payment
EBT	Electronic Benefit Transfer
ECS	Electronic Clearing Services
EDC	*Electronic Data Capture*
EDI	Electronic Data Interchange
EFT	Electronic Fund Transfer
EMI	Equal Monthly Installment
EMV Card	Europay, MasterCard and Visa Card
EPSO	E–Payment System Observatory
ER	Economic Recession
EU	European Union
FEMA	Foreign Exchange Management Act
FTC	Federal Trade Commission
FY	*Financial Year*
GCC	Gulf Corporation Council
GFI	Goodness of Fit Index
IADs	*Independent ATM Deployers*
IBA	Indian Bank's Association
ICBC	Industrial and Commercial Bank of China Limited
ICICI	Industrial Credit and Investment Corporation of India
IDBI	Industrial Development Bank of India (IDBI)
IDC	*International Data Corporation*
IFI	Incremental Fit Index
IMPS	*Interbank Transfer Payment Service*
IoE	Impact on Economy
IPO	*Intellectual Property Office*
IRDP	*Integrated Rural Development Program*

IS	*Information System*
ISOs	*Independent Service Organisations*
ISP	*Internet Service Provider*
IT	Information Technology
KCC	*Kisan Credit Card Scheme*
KYC	Know Your Customer
LGD	Loss given Default
LPG	*Liberalisation, Privatisation and Globalisation*
LSU	*Louisiana State University*
MAD	Minimum Amount Due
MBAs	Mobile Banking Apps
MBCS	Mobile Banking Cyber Security
MBS	Mobile Banking Security
MBT	Mobile Banking Transactions
MCMP	Merchant Charge Back Monitoring Program
MDR	Merchant Discount Rate
MES	Merchant Establishments
MICR	Magnetic Ink Character Recognition
MIFs	Multilateral Interchange Fees
NBFC	Non – Banking Financial Corporation
NCR	*National Cash Register*
NEFT	*National Electronic Fund Transfer*
NFE	***Near Field Technology***
NFI	Normed Fit Index
NPCI	*National Payment Corporation of India*
NPRB	***New Private Bank***
PCA	*Principal Component Analysis*
PCE	*Personal Consumption Expenditure*
PCFI	Parsimony Comparative of Fit Index
PCP	Psychosomatic Common Position
PCs	*Personal Computers*
PD	Probability of Default
PDA	***Personal DigitalAssistant***
PIN	Personal Identification Number
PM	Plastic Money
PNFI	Parsimony Normed Fit Index
PoP	***Point of Purchase***
PoS	Point of Sale
PPIs	*Pre – Paid Payment Instruments*
PSS	*Payment and Settlement System*

RBA	Reserve Bank of Australia
RBI	*Reserve Bank of India*
RFI	Relative Fit Index
RMSEA	Root Mean Square Error of Approximation
RRB	*Regional Rural Banks*
RTGS	*Real Time Gross Settlement*
SAMEA	South Asia, Middle East And Africa
SBI	State Bank of India
SBS	State Bank of Saurashtra,
SCF	Survey of Consumer Finances
SDSB	Social Diversity and Spending Behaviour
SEM	***Structural EquationModeling***
SFMS	*Structured Financial Message System*
SGRF	State General Reserve Fund
SHGs	*Self Help Groups*
SMEs	*Small and Medium Enterprises*
SoE	Scarcity of funds
SPNS	Shared Payment Network System
SVI	Security and Verification Issues
SWIFT	Society For World Wide Inter – Bank Financial Communication
TAs	Transactions Apps
TRAI	***Telecom RegulatoryAuthority of India***
US	United States
VSAT	Very Small Aperture Terminal
WLAs	*White – Label ATMs*

Adoption of Mobile Banking Apps and Transaction Apps: Cyber Security Issues among Digital Customers

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ABSTRACT

Today, most of banking transactions is performed using a computer, laptop or a smartphone. In each and every business activities in banks is mainly used from checking account statements to paying credit card bills, utility bills and transferring funds can be done online. Mobile banking began as an offshoot of internet banking to further aid convenience and ease of access. In 2018, almost all banks have mobile phone applications for financial transactions. These apps remove the requirement of having a computer or laptop to transfer funds, and with continued advancements, have made visits to the bank a rarity. Once a customer has downloaded the mobile banking app on their smartphone, banking transactions can be carried out as per their convenience.

The current research study mainly concentrate on the issues, challenges and opportunities of customers in adoption of Mobile Banking Apps (MBAs) and Transaction Apps (TAs) in the Digital Era. The research tries evaluate the efficacy of Mobile Banking Apps (MBAs) and Transaction Apps (TAs) in their routine transactions of Digital customers. It mainly focuses on the cyber security issues faced by the Digital Customers while use Mobile Banking Apps (MBAs) and Transaction Apps (TAs)for their daily activities. In every transactions such as buying and selling of goods and services through digital mode with the help of select banking and transaction apps. The structured research instruments will be used to assess the cyber security issues involved in the buying and selling of

products/ goods and services among the digital customers of Tamilnadu. Suitable statistical tools and techniques will be applied to find out the results of the study. In the study, the top Banking and transaction apps were chosen, Such as SBI Yono App and HFDC Apps. The Transaction Apps like Phone Pay and Google Pay were taken for the study. The outcome of the research will help the customer requirements in safe use of mobile banking applications and its apps in their business transactions to overcome the difficulties involved in various business activities. The study also identify and assessment reasons along with opportunities for effective use of apps among the customers.

Keywords: Mobile Banking Apps (MBAs), Transaction Apps (TAs), Customers, Cyber Security (CS), Digital Customers (DC), Banking Transactions and Banking Safety

Economic Empowerment of Women for Sustainable Development

T. S. Dhandapani Chettiar Chair
in the Field of Social Sciences
& Department of Economics
Avinashilingam Institute for Home Science and Higher Education for Women



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Social Entrepreneurship: Exploring the Key Dimensions of Social Factors

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Abstract

This study seeks to elucidate the intricate relationship between social entrepreneurship and key dimensions of social factors: social innovation, social proactiveness, social network, social vision, and social value creation.Social entrepreneurship thrives on innovation, often manifesting through novel solutions to entrenched social problems.It is characterized by a proactive stance, where entrepreneurs anticipate and respond to societal needs with agility and foresight. The cultivation of robust social networks is instrumental in the success of social ventures, facilitating resource mobilization, collaboration, and knowledge exchange. Central to the ethos of social entrepreneurship is a compelling social vision that transcends mere profit motives, guiding ventures towards meaningful impact and sustainable change. Moreover, social entrepreneurship is fundamentally driven by the creation of social value, where economic prosperity is intertwined with positive social outcomes. By delving into these key dimensions of social entrepreneurship, this paper illuminates the intricate interplay between entrepreneurial action and broader social dynamics. It underscores the transformative potential of social entrepreneurship in catalyzing positive change and building resilient, inclusive societies.

About Editors



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Dr. Malarvizhi. V is an Associate Professor of Economics in Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore-43. With 19 years of teaching experience she has presented 60 papers in International, National and Regional level Seminars/Workshops/ Conferences. She has published 72 articles in Journals. She has edited 3 books and special editor in 4 International Journals. She is the Content Writer and Camera Presenter for 2 modules e-PG Pathshala project. She has conducted one International conference, 3 National Seminars and one FDP. She has guided M.A/ M.Phil/ Ph.d students and completed one Major Research Project funded by ICSSR. She acted as a Chairperson/ Rapporteur in the International and National Conferences. She is a reviewer for International Journals. She received two excellent paper awards. She also serves as a Captain in National Cadet Corps (NCC) in the same Institution.



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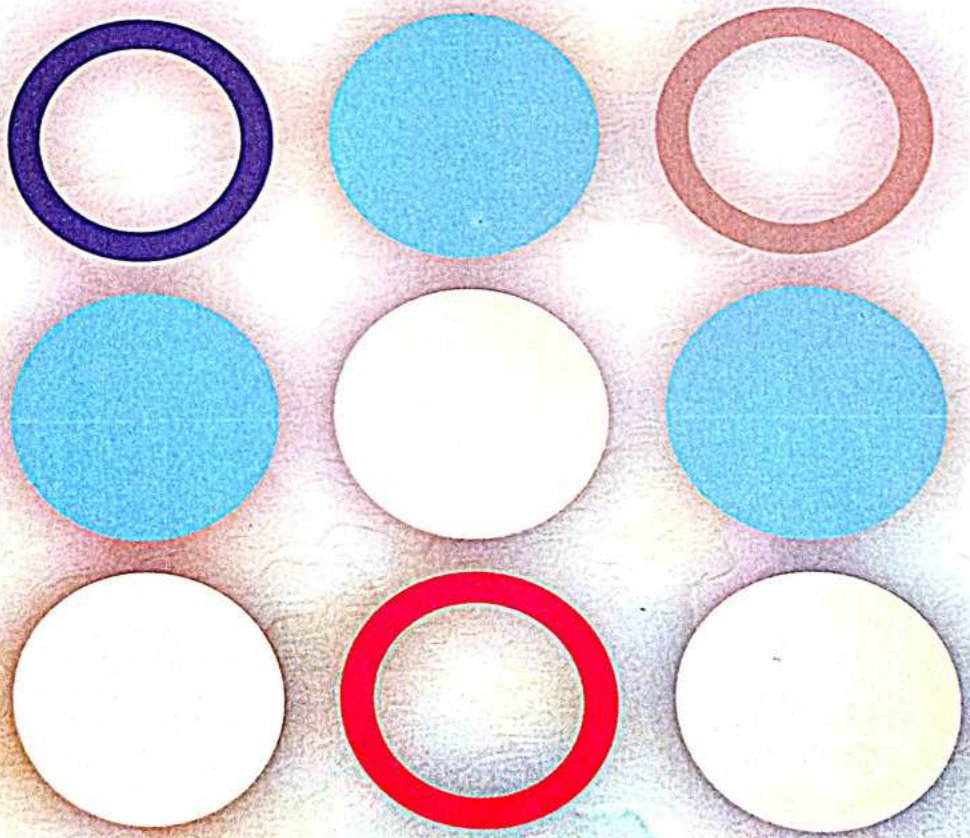
About Book

In the global pursuit of equitable progress, the empowerment of women emerges as not merely an ethical imperative but a pragmatic necessity. The imperative of women's economic empowerment finds resonance throughout history, woven into the fabric of social movements, policy reforms and economic progress. From the suffragette movements of the late 19th and early 20th centuries to the landmark conventions on women's rights and development in the latter half of the 20th century, the trajectory of gender equality has been marked by both triumphs and trials. The 1995 Fourth World Conference on Women in Beijing stands as a watershed moment, galvanizing global commitments to women's empowerment and setting forth an ambitious agenda for action. Subsequent milestones, including the adoption of the Sustainable Development Goals (SDGs) in 2015, further underscore the intertwined nature of gender equality and sustainable development. Over the years though the researchers, academicians and Government have tried to find ways and means for economic empowerment of women, many aspects of women's economic empowerment, entrepreneurship and innovation, workplace equality, global partnership etc are yet to be completely resolved. Little attention has been paid to the above aspects by the researchers, policy makers and development planners. The present volume titled "Economic Empowerment of Women for Sustainable Development" containing 35 papers covers different aspects and issues related to economic empowerment of women and sustainable development. It is an initiative for shedding light on the pivotal role women play in fostering sustainable economic development.The main themes which the volume covers are: financial inclusion, education and skill development, technology and digital inclusion, leadership, decision making, policy and advocacy. The volume will provide women's immense input and health for the academicians, researchers, policy makers and Government officials.

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Cognitive Influence on Technology Adoption

A Case Among Rural Women Entrepreneurs

Mary Treasa C.P. and Santhi P.

Introduction

Women's entrepreneurship has advanced significantly (Ughetto et al., 2020). The inclusion of digital technology in business increased the pace of women entrepreneurs to access more resources and make them active in the digital economy (Suseno and Abbott, 2021). Despite recent progress, equitable access to knowledge, technological know-how, marketing support, money, and training initiatives are denied that can broaden their horizons. Recent technologies exhibit the snowball effect, which describes how quickly and exponentially technology is evolving (Khasavneh, 2020). But, humans' cognitive abilities develop slowly over time and are unable to quickly learn or adapt to all of these technologies, specifically among rural women who have low exposure to digitalization. They generally lead a community living with families settled with male dominance. Lack of literacy, digital skills, and digital infrastructure are other factors. This process leaves a gap between people's abilities and knowledge and the acceptance of technology in their entrepreneurial activity. Cognitive factors can have a significant influence on an individual's decision to adopt technology. The literature on cognitive factors, such as digital trust, social influence, and technophobia towards technology adoption among rural women entrepreneurs, was found to be scanty. Hence, there is a need to investigate the direct effect of these cognitive factors on the technology adoption of rural women entrepreneurs. Accordingly, the research question was framed.

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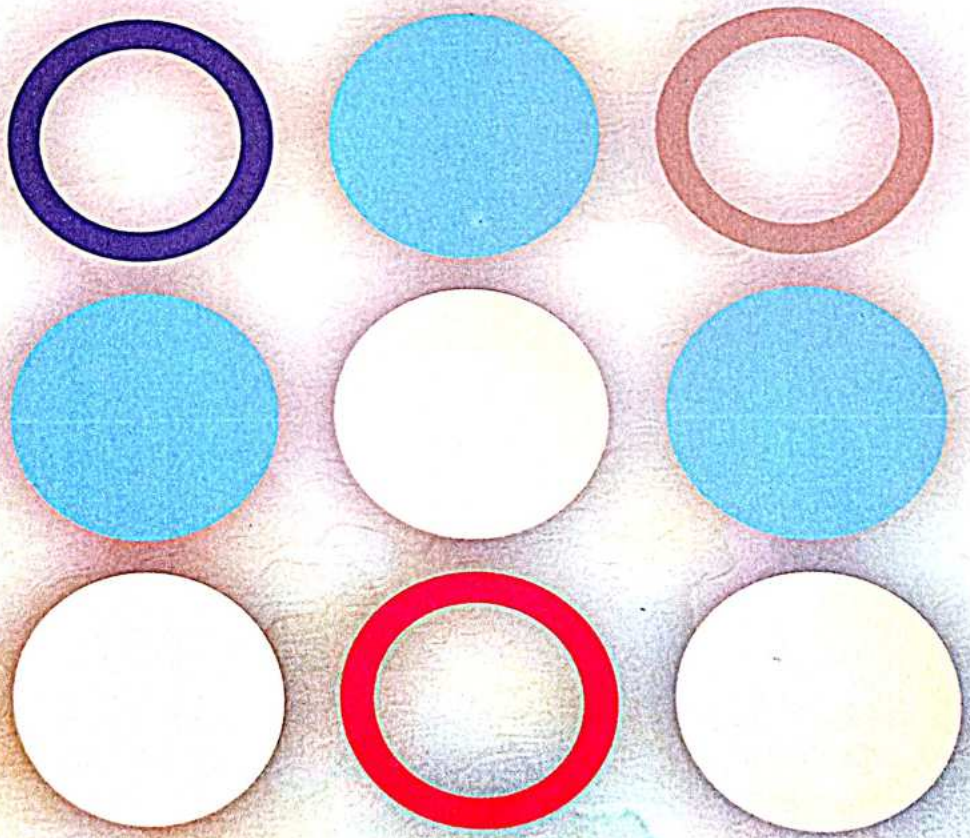
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Utilization of Digital Platforms in Business Operations by Select Social Entrepreneurs

Ramya S. and Santhi P.

Introduction

The evolution of digital platforms has been linked to the development of social entrepreneurship because these platforms raise the profile of a prospective chance for socially responsible enterprises. The occurrence of newer digital technologies and platforms, ways of collaborating and communicating together, and pathways for the exploration of opportunities led to a significant and highly dynamic competitive environment with new elements for all types of entrepreneurial enterprises (Elia et al., 2020). Utilizing digital platforms will be the most notable improvement to a networked society in an era of rapid technological advancement and pervasive digital technologies (Harris et al., 2012). Technology has progressed from the postal service, stereo, and mobile phone to the laptop and other modern devices, making it easier and faster for businesses to maintain interactions with their customers. Worldwide, more than a billion people use digital platforms for a range of purposes (Anderson et al., 2016; Karikari et al., 2017). This has completely changed the way information is gathered, which has increased consumer confidence in internet businesses (Kim et al., 2016). Digital platforms influence entrepreneurial business processes ranging from idea generation to business operation and have been found to influence social entrepreneur efficiency measures, entrepreneurial behaviour and mechanisms, as well as digital marketing (Fischer and Reuber, 2011). Fostering innovation and networking has prompted social entrepreneurs to start new firms (Hatammimi et al., 2015).

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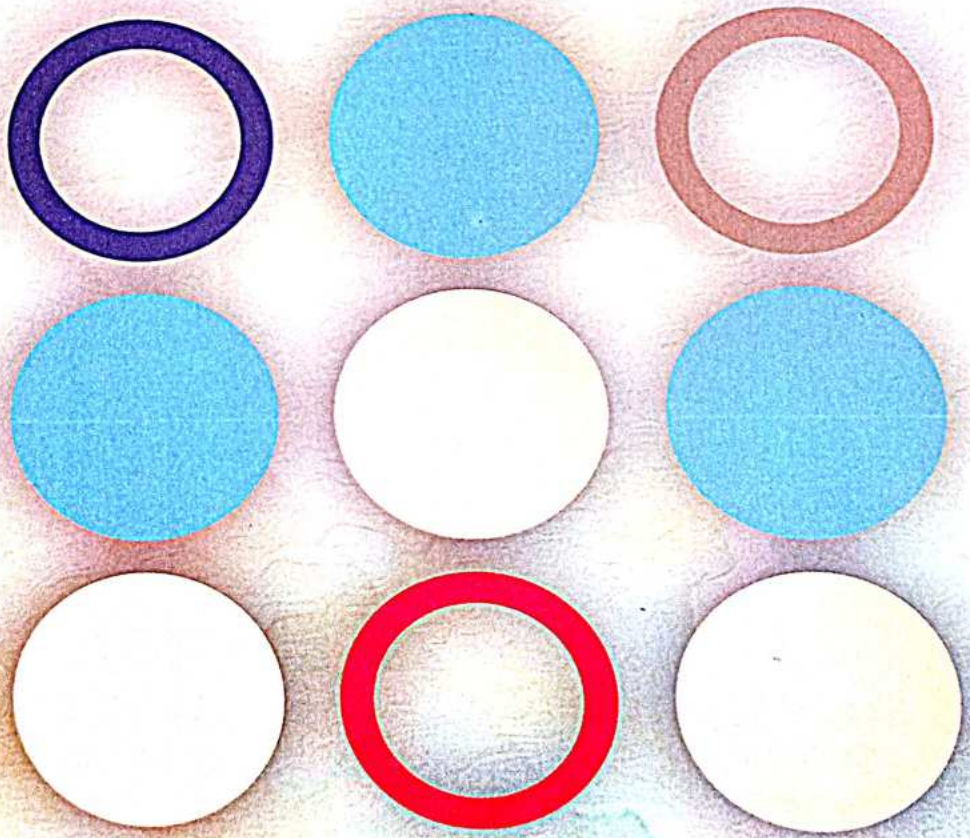
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Impact of Credit Card Use and Electronic Payments on Compulsive Buying Behaviour

Dharshini R. and Santhi P.

Introduction

Modern development systems have changed the buying behaviour of customers (Mashaqi et al., 2020). Changing from digitalization to digitization carries numerous new developments (Alzoubi et al., 2022), and one of the most important developments is the widespread adoption of online shopping around the world (Turban et al., 2012). In the present competitive world, internet frameworks and banking industries are considered the fundamentals of online purchasing and business money transfers (Alzoubi et al., 2022). The number of people who rely on online purchasing has increased (Rothengatter et al., 2021), and the financial sector is the important sector that uses electronic payments for transactions since they are convenient and quick. As a result, e-payment is acknowledged as a crucial component of Internet shopping without which it cannot be performed (Chavosh et al., 2011). Thus, compulsive buying has grown and emerged as a result of digital payments.

Objectives

- To find out the most used e-payment mode by compulsive buyers; and
- To examine the effects of e-payment systems on compulsive buying behaviour.

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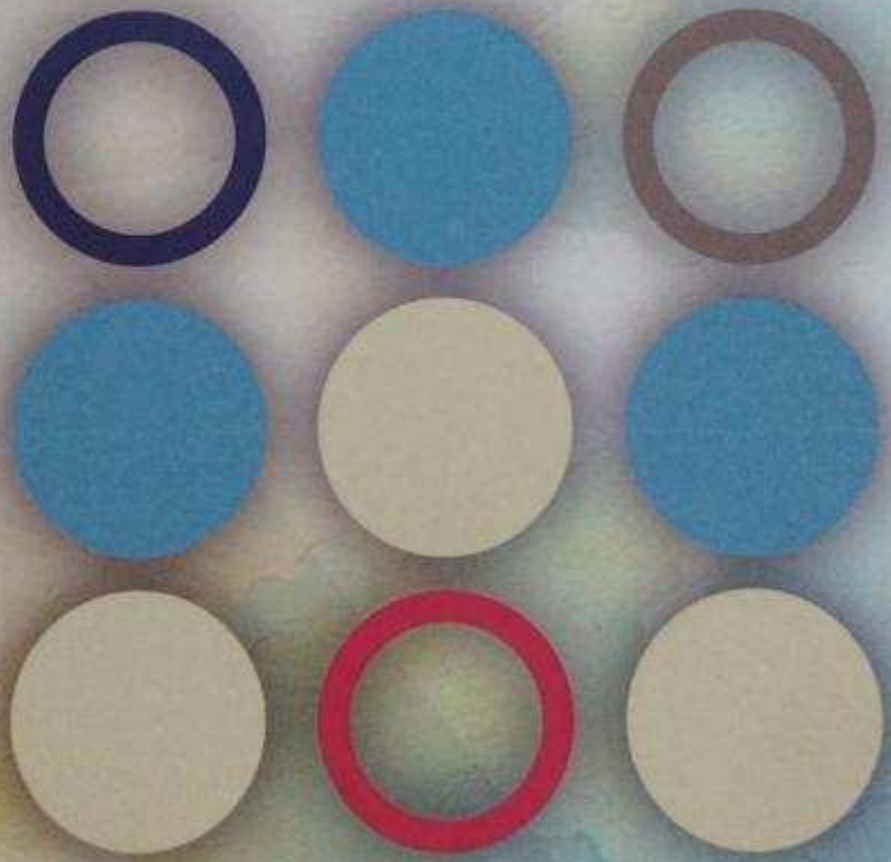
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Effectiveness of Online Advertising Strategies in the Marketing of Insurance Products in India

Prabha P. and Kanniammal K.

Introduction

Insurance is a contract between the insurer and the insured, whereby the insurer promises to compensate the insured against any loss or damage suffered by the latter on account of future contingencies. Life insurance policies come up with assurance and financial security, whereas general insurance policies promise to protect and indemnify the insured. In India, life insurance policies are often assumed as an avenue for investment rather than a tool for protection. There seems to be a lack of affinity towards the idea of getting insured voluntarily. Surveys have shown that only a meagre 15 per cent of buyers of insurance policies were self-motivated to buy insurance products, whereas the remaining 85 per cent got insured out of compulsion or persuasion by insurance agents or insurance web portals. No wonder why the insurance penetration in India is still in its infancy. Despite being the fifth largest economy in the world, insurance penetration in India is too disappointing. Life insurance penetration in India is as low as 3.3 per cent and general insurance penetration level is only 5 per cent. A lack of financial literacy, a lack of awareness and delinquent financial inclusion, etc. can be attributed to be the major reason behind that. However, insurance companies across the country are now concentrating on the Internet as an active medium of communication and online advertising as a strategic weapon to win customers. Search engine optimization (SEO), organic search (OS), pay-per-click (PPC), short message services (SMS), targeted emails, social media campaigns, and YouTube videos are being resorted to by insurance companies across India to inform, motivate, and persuade customers. At

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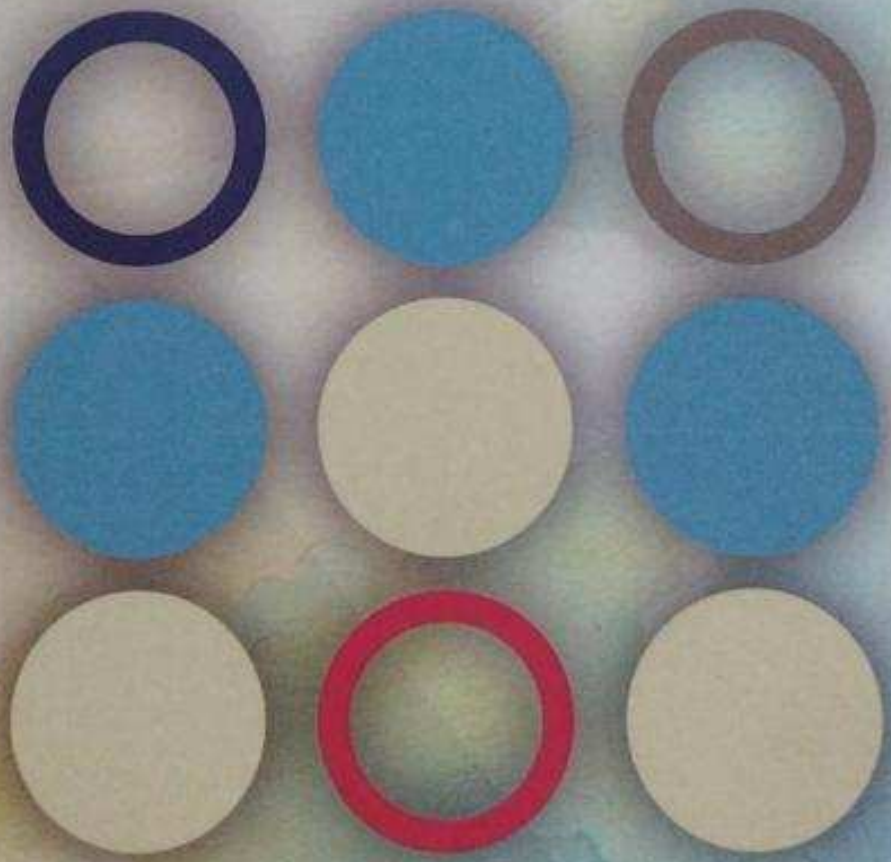
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Determining the Effects of Demonetization on Indian Sectoral Indices

Surya A. and Kanniammal K.

Introduction

High-denomination banknotes have frequently been demonetized in India. In 1938, the RBI produced notes with a maximum denomination of 10,000, followed by demonetization of banknotes with a denomination of 1,000 or greater in 1946. Large-denomination currencies (1,000, 5,000, and 10,000) were launched in 1954 in an effort to decrease unaccounted money. However, in 1978, they were all demonetized. First, 500 banknotes were introduced in 1987 in an effort to control the volume of banknotes in circulation as a result of inflation, and again in 2000, 1,000 banknotes were reintroduced in an effort to control the volume of banknotes in circulation. However, the first 2,000 yen banknotes were released in November 2016. Other nations around the world apart from India have also historically implemented demonetization. Most nations that had implemented demonetization shared some common goals, including reducing corruption and black money. To address this issue, the governments of these nations opted to demonetize their larger denomination notes. Demonetization would have varying effects on different industries based on supply and demand. Industries with a higher reliance on cash were more negatively impacted than those with a lower reliance. The stock market is a reliable predictor of how sectors will be affected by demonetization.

This study focuses on the impact of demonetization on the sectoral indices, particularly banks, Auto, fast-moving consumer goods (FMCG), and consumer durables.

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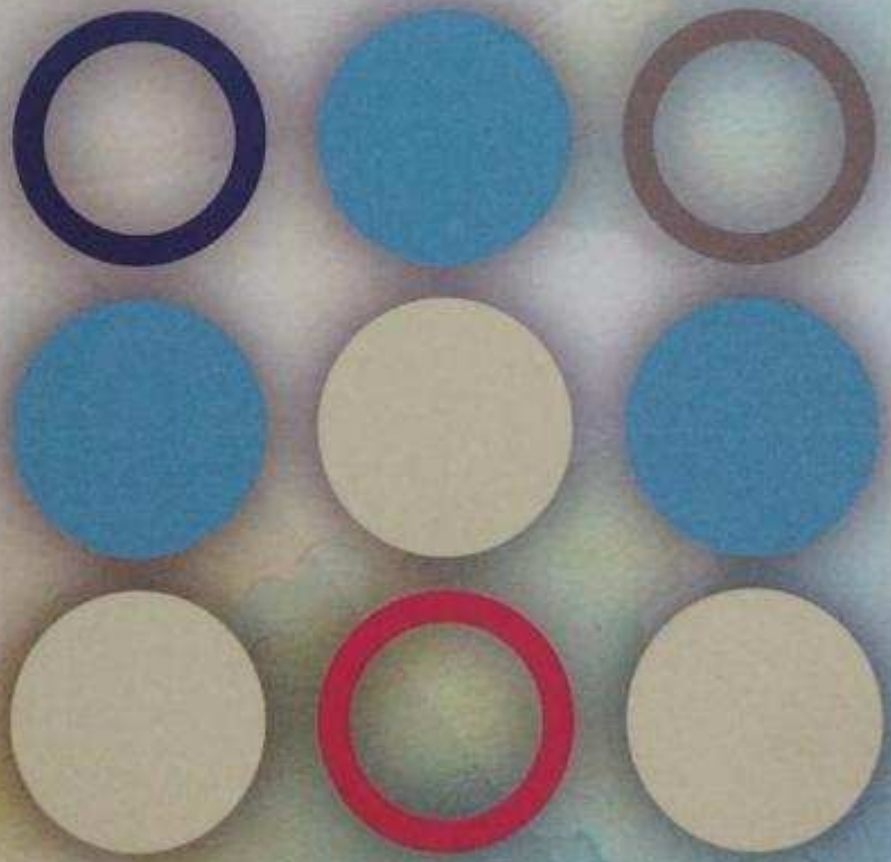
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Influence of Microfinance on Socio-economic and Psychological Empowerment of Women Micro-Entrepreneurs

Prameela P. and Kanniammal K.

Introduction

Women empowerment can be defined as an improvement in women's ability to make their own life decision. It enhances their capacity for decision-making, enabling individuals to actively contribute to their well-being. By boosting their courage and self-esteem and enabling the creation of various networks with other women in their community, microfinance is an important tool for empowering women. In addition, it enhances their ability to make decisions for their household. In many nations, microfinance institutions have a substantial impact on resolving economic issues of women, fostering prospects for self-employment, and growing enterprises for female entrepreneurs. Women who participated in microfinance credit programmes saw improvements in their financial standing, economic independence, and managerial abilities (Addai, 2017; Haimanot, 2007). The impact of microfinance is often assessed using persistent changes in income, rate of employment, and domestic spending. By taking into account the increases in outcomes, such as the literacy rate and dwelling type, the service impact of microfinance institutions can also be directly determined (Ertu and Tilahun, 2022).

Review of the Literature

Mohammed Mafizur Rahman et al. (2017), in their study, demonstrated that microfinance has a favourable effect on the majority of chosen metrics of women's empowerment. In the study of Mengstie

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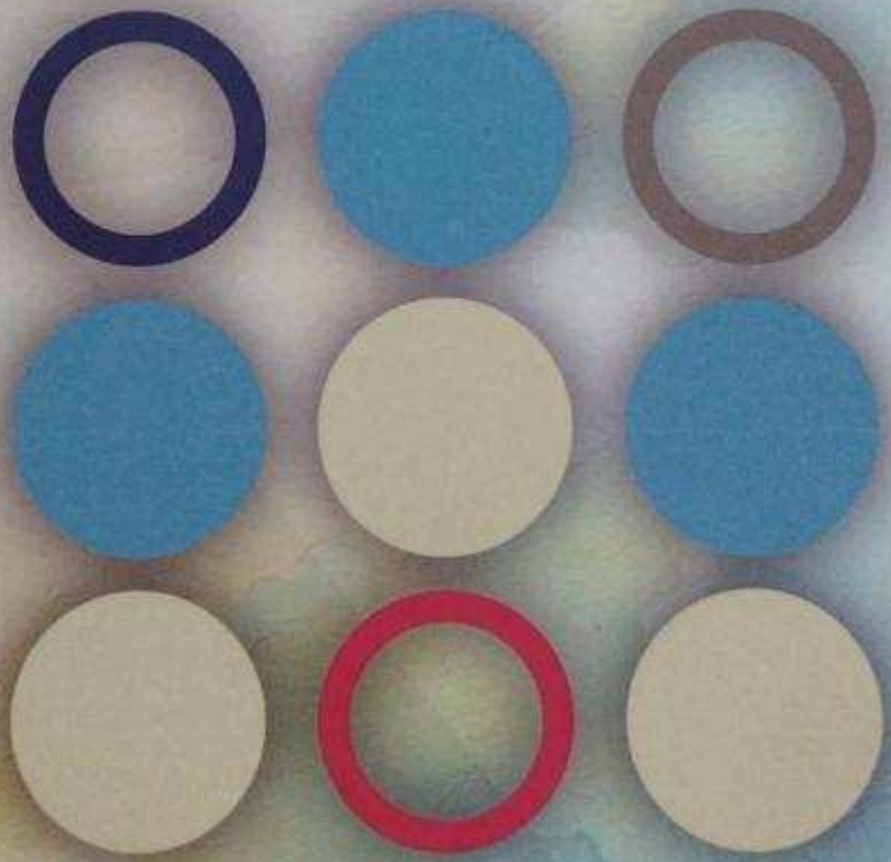
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Empowering Tribes Digitally

Examining Awareness, Savings and Investment Behaviour

Poongodi R. and Kanniammal K.

Introduction

Financial inclusion has gained immense importance and has become one of the prominent issues in policy-making worldwide. Financial inclusion is a process to make financial products and services accessible, appropriate, and affordable to all individuals and businesses, regardless of their income, savings, investment, credit, or size of the company. It is crucial for the social and economic advancement of those at the pyramid's base. In addition, it tries to shield vulnerable and disadvantaged people from the influence of lenders (Sarkar, 2022). The provision of different financial services to other social groups and their successful use, however, that may be accomplished, are the key indicators of the achievement of financial inclusion (Thomas and Suresh, 2020). The union government recently unveiled the Digital India programme, which aims to create a knowledge economy in India that is empowered by technology. The Digital India Initiative's notion of digital banking will benefit financial inclusion. India is moving towards financial inclusion online; it can be defined as digital access to and use of formal financial services by excluded and underserved populations (CGPA, 2017).

It has been discovered that states like Kerala, Tamil Nadu, Karnataka, Maharashtra, Andhra Pradesh, Punjab, Uttarakhand, Odisha, and West Bengal, have achieved a high level of financial inclusion. Haryana, Gujarat, Uttar Pradesh, Assam, Rajasthan, Jharkhand, Madhya Pradesh, Chhattisgarh, and Bihar had low rates of it at the same time.

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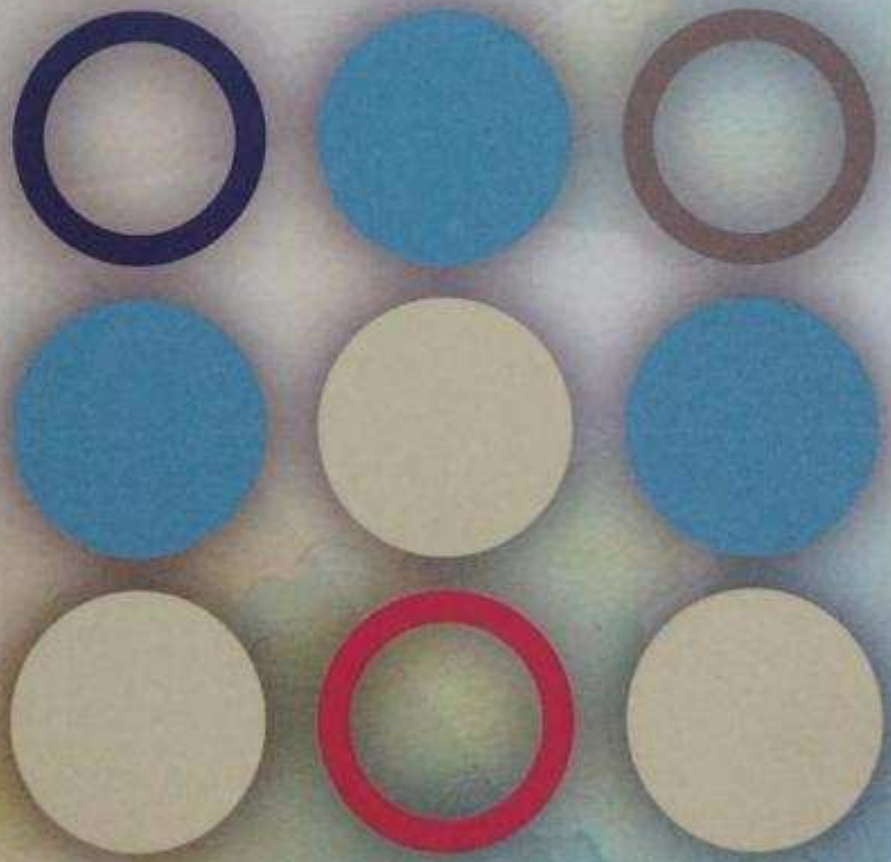
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Impact of Reforms in Banking Sector Performance

A Study on SBI Merger

Nisha P. and Kanniammal K.

Introduction

Merger and acquisition acts as an integral part of the economy and corporate business world. Most of the merger takes place for the purpose of expanding the market share of the company and for increasing its competitive edge. Banks are considered the heart of economic prosperity, and if there is a small change in its regulation, it affects the entire economy as a whole. Since 1961, the Indian banking industry has been on the path of transformation and consolidation. Banking Regulation Act, 1949, empowers the government to amalgamate weak banks with stronger banks. But the thrust on consolidation has emerged with the recommendations of the first Narasimham Committee, 1991, and the second Narasimham Committee in 1998. The committee recommended several accounts and reforms to strengthen the Indian banking sector.

The largest, oldest, and still existing bank is the State Bank of India. It was functioning as the Bank of Calcutta, and in 1809, it became the Bank of Bengal. In 1921, the Bank of Bengal, Bank of Bombay, and Bank of Madras were combined to form the Imperial Bank of India, and in 1955, it was renamed the State Bank of India. Under the State Bank of India (subsidiary) Act, 1959, SBI has given control over eight states associated banks in 1960.

Literature Review

Several studies have been carried out to know the performance of banks after the merger. Bhargav Sunilkumar Radiya (2019) in his study titled

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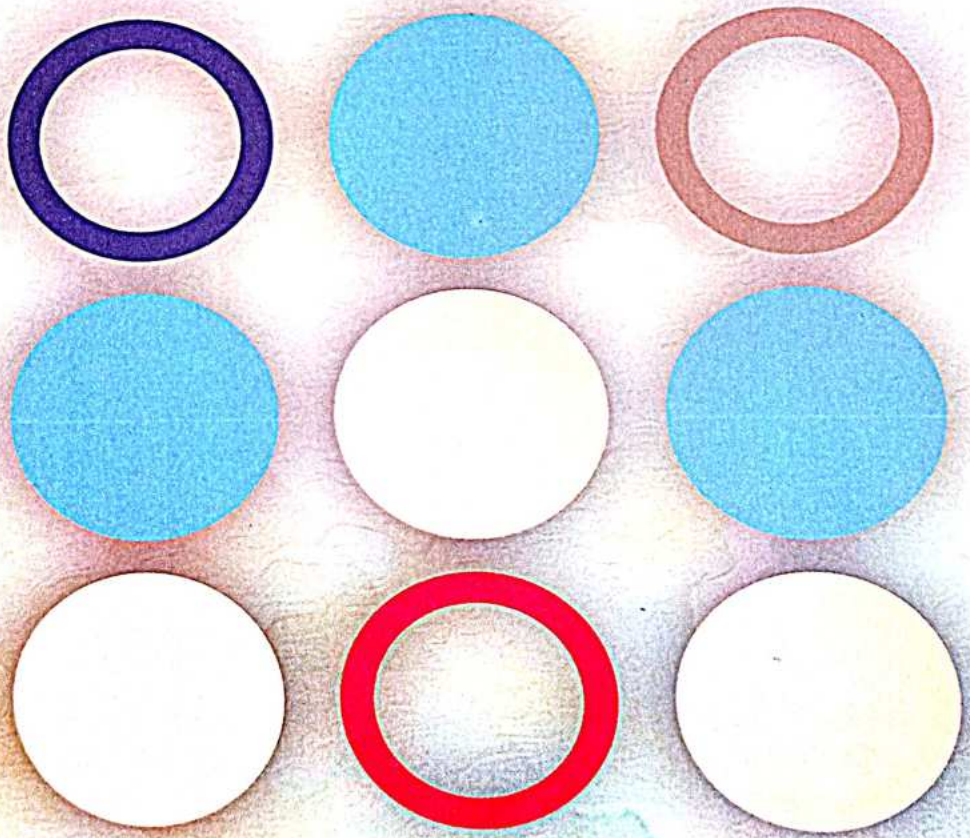
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Progress of Sustainable Finance in India

Sina E.S. and Vennila D.

Introduction

The world is on the verge of a climate catastrophe where billions of people already feel the consequences – rising global temperatures lead to increased heat waves, droughts, apocalyptic wildfires, and floods. Global greenhouse emissions will increase by nearly 14 per cent between 2010 and 2030 under current national commitments to climate action – this need to be reduced by 40 per cent by 2030 to limit warming to 1.5 per cent. Our unsustainable consumption and production patterns cause climate change, biodiversity, loss, and pollution. Recent incidents, such as COVID and the conflict between Russia and Ukraine, have created new ways of thinking and possibilities. The severity and magnitude of the challenges require accelerated global-scale action committed to and following the SDG pathway. We must pursue inclusive, resilient, and low-carbon development strategies.

The banking industry is a key driver in any country's economy for sustainable development adaptation. Banks have been focusing on more proactive strategies for the last two decades for handling sustainability issues in banking worldwide. Sustainable practices adaptation is the growing demand, creating more business opportunities for the banking system. Similarly, adopting sustainable banking practices becomes authoritative in the banking sector. In India, major economies are growing the fastest in integrating the social and environmental sustainability dimensions but have yet to adopt any proactive strategies or policies context in banking. The absence of such policies can create a gap for finance projects that do not qualify for international financing.

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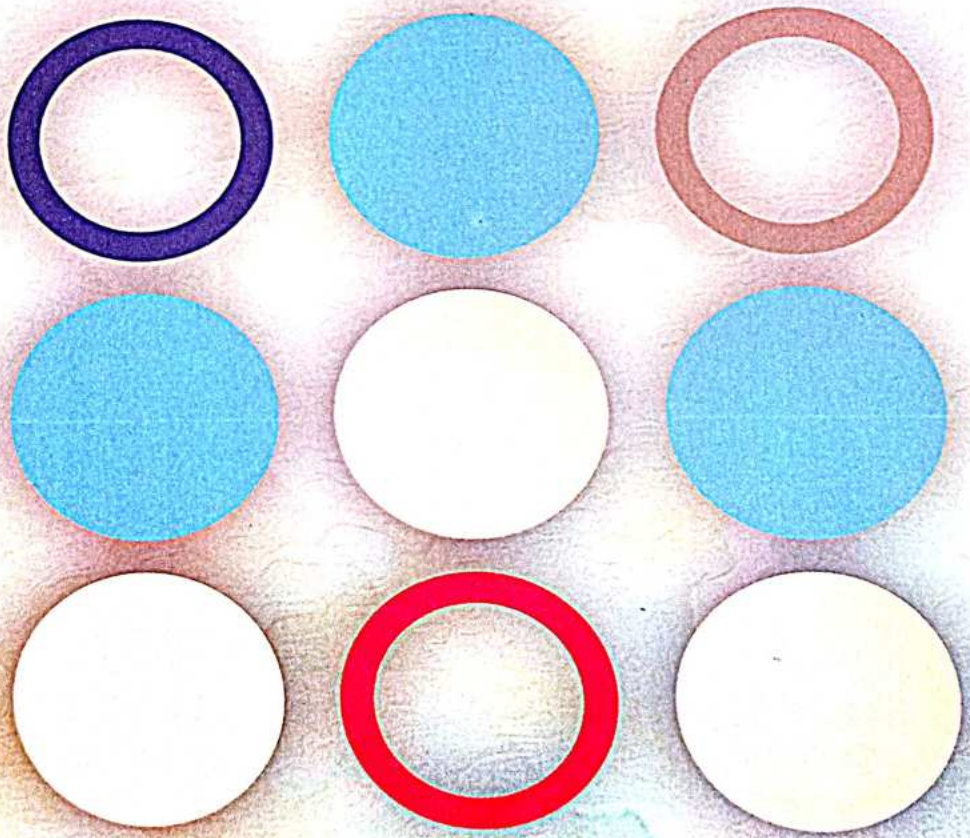
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Government Initiatives for the Technological Upgradation of the MSME Sector

Deslit Devid and Vennila D.

Introduction

Indian micro, small, and medium-sized enterprises (MSMEs) are the core of the economy that contribute to economic growth. Through business innovations, they significantly contribute to the expansion of entrepreneurial endeavours. They also provide large employment opportunities for the unemployed. Based on the National Sample Survey (NSS) in the 73rd round, which was conducted by the Office of National Sample Survey, from the Ministry of Statistics and Programme Implementation during 2015–2016, there were 633.88 lakh MSME units in the country, which are engaged in various economic activities. As per the survey, entrepreneurial activities, mainly in the MSME sector, have created 11.10 crore employment opportunities both in rural and urban regions of the country.

The Government of India has engaged in various policy initiatives for the sector to overcome the challenges. Many schemes are introduced frequently for the upliftment of this sector. The main schemes introduced are the Credit Linked Capital Subsidy Scheme and the Champions Scheme for Technological Upgradation. It is given importance because modernization and technological upgradation are having great significance in the present scenario. With these innovative measures, MSMEs can reduce the cost of production and other general expenditures (Kumar, 2009).

Review of the Literature

Bala Subrahmanya (2004) emphasized the effect of globalization and advancement happening through the reforms in the industries sector. The

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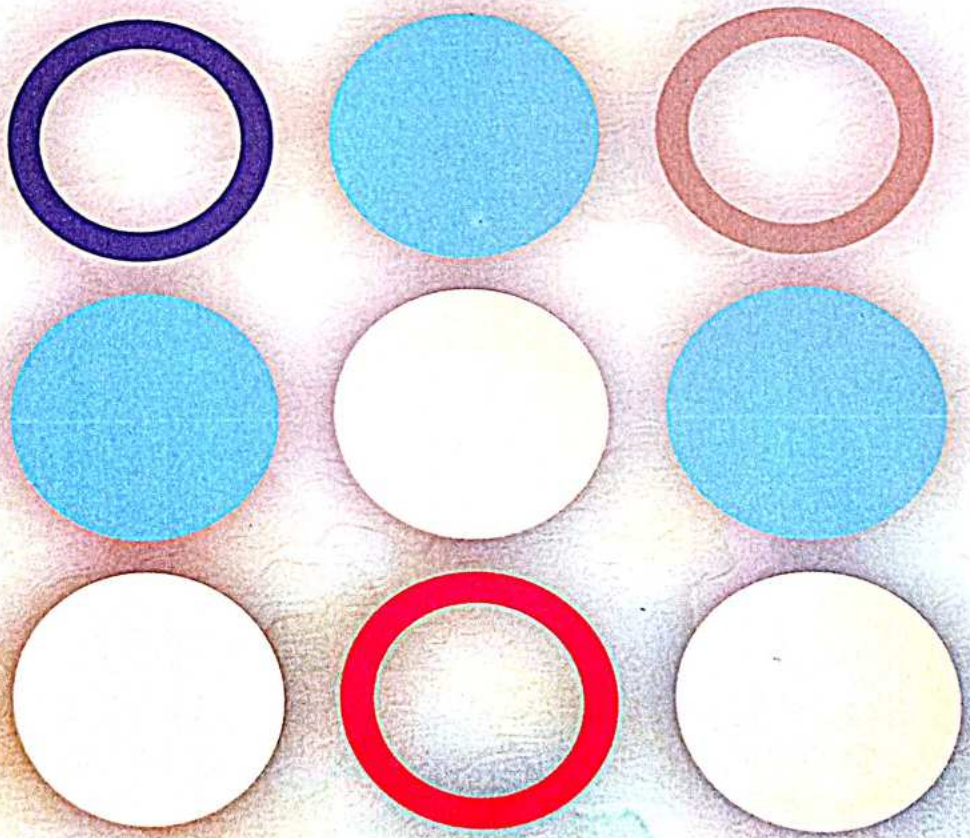
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Gender Wage Gap for Female Commercial Drivers

Banumathi R.C. and Vennila D.

Introduction

The gender pay gap in India was estimated to be 24.81 per cent in 2013. India is ranked among the bottom 10 nations in a report that examines the degree of female participation in the economy. As a result, in addition to unequal pay, there is also unequal representation because even though women make up nearly half of India's population (48% of the total), they only account for about one-fourth of the workforce as a whole. The percentage of women in the male domain has significantly increased over the last two decades. Women now make up about half of those in male-dominated professions, up from about a third previously. Women's access to managerial authority has been the subject of a flurry of empirical studies in recent years (Blum, Fields, and Goodman, 1994; Huffman and Cohen, 2004; Reskin and McBrier, 2000; Smith, 2002), as well as the unknown barrier that prevents women from obtaining management or high-status positions (Cotter et al., 2001; Hultin, 2003; Wright and Baxter, 2000).

The issue of access to male-dominated positions is crucial to understanding why there is still persistent gender inequality in the workforce, but the rise in women's presence also raises a wider, more provocative, and essentially sociological question. What happens to the status of a subordinate group when some of its members achieve positions from which they can reduce inequality? Gender is used to gain insight into this question. In particular, we investigate whether greater gender equality among male coworkers 'lifts all boats' by reducing the gender gap in the male domain (Wright, 1997). However, despite its importance for

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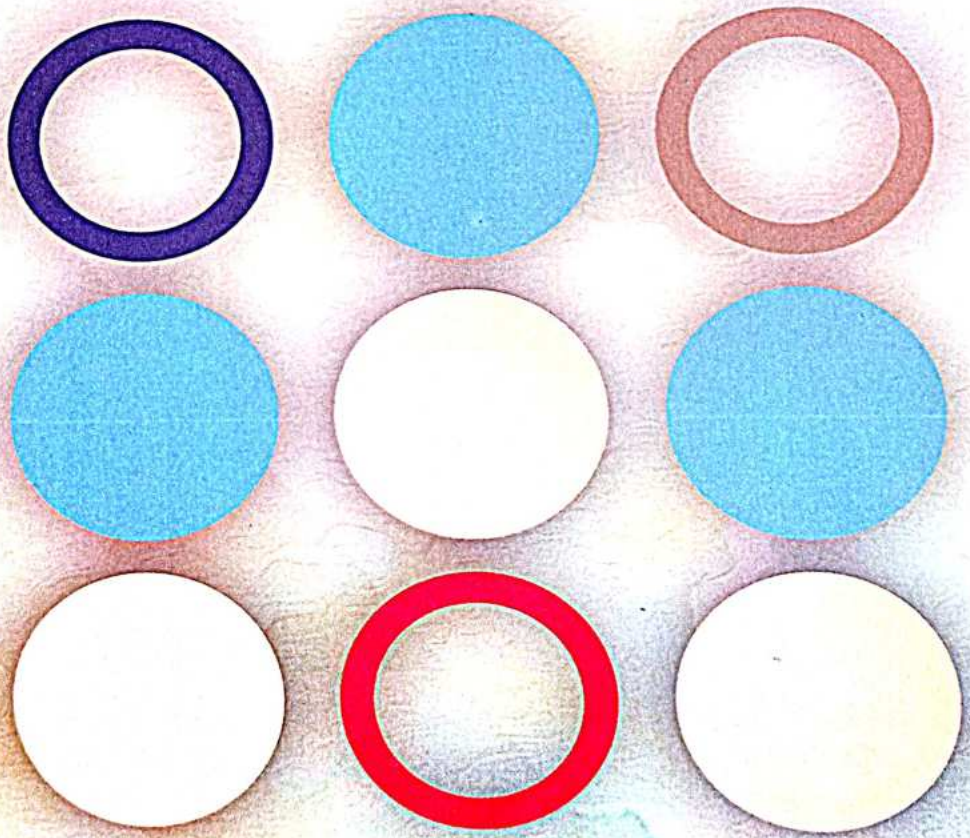
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Effects of Investor Perception Towards Web-Based Merchandising

Abinayasri V. and Vidhyakala K.

Introduction

The stock market landscape has transformed as a result of technology. They may now serve investors across the nation from any location without needing a trading floor. Prior to the introduction of screen-based trading, regional stock exchanges played a significant role in the capital market since they attracted local investors. Now that all of them have established screens-based trading, floors are connected to other stock exchanges. You might not consider the location or manner in which your broker would carry out the trade when you submit an order to purchase or sell stock. However, the location and manner in which your order is carried out can affect the total costs of the transaction, including the cost of the item you purchase. In 1983, the history of online trading began. Prior to placing the order, an investor must call his/her stockbroker.

Rapid technological advancement, especially the Internet, brought about profound disruption across many industries. And speaking of the stock market, the Internet has altered how it operates. An online trading platform was developed. Online trading is an investment activity based on the Internet that allows for stock trading in India. In the past several years, online trade has grown in popularity due to how simple and convenient it is. To satisfy the wants and desires of investors, so many enterprises are shut down through Internet trading.

Review of the Literature

R. Muneeswaran (2020) stated that recent technology development provides more information about investment avenues in the financial

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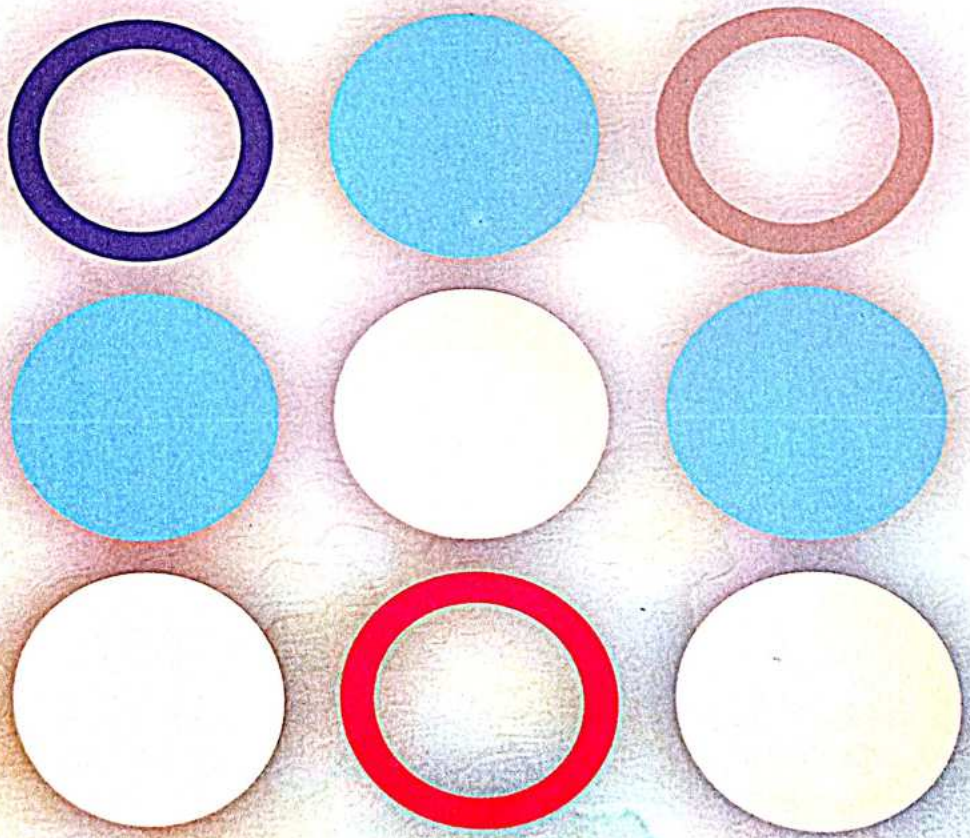
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Influence of Social Media Strategies on Consumer Choices

Exploring the Branded Cosmetics Segment

Farsana C. and Vidhyakala K.

Introduction

The cosmetics industry generates billions of dollars today. The Indian thermal cosmetics industry is the second largest exporter in the world after China. In recent decades, the Indian cosmetic industry has experienced rapid growth as Indian competitors began manufacturing domestic and international products to meet market demands. There was a strong demand for cosmetic products in India from the 1990s onwards, which led many of the world's top cosmetic brands to enter the market. There has been rapid growth in the Indian cosmetic industry in recent years due to increased concern among both men and women. It was generally assumed that consumer spending power and fashion sensibility were what drove the cosmetics industry. Companies have launched a variety of initiatives targeted at enhancing customer loyalty because they recognize the importance of retaining current consumers in this cutthroat, hostile environment (Ismail et al., 2012). Loyalty will be closely tied to the profitability and success of a business since loyal customers will buy more frequently, spend more money on new items, and recommend them to others. Organizations that have a high level of consumer loyalty will have a competitive advantage over their rivals (McMullan and Gilmore, 2010).

Review of the Literature

According to A. Kanwar and Y.C. Huang (2022), celebrity endorsement is a significant factor in consumers' purchase decisions. It was found that the association between celebrity endorsements and purchase intentions is mediated by brand trust and perceived quality. Customers care about

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AN EMPIRICAL ANALYSIS ON TECHNICAL FACTORSMOTIVATING CUSTOMER TOWARDS MOBILE WALLET ADOPTION

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Abstract

The payment system is continuously evolving due to the advancements in technology. The advent of the internet and mobile phones paved the way for the development of mobile wallets. The present study aims to examine the technological factors motivating customers towards mobile wallet adoption. Further, the study determines the most preferred mobile wallet application among the respondents. In this regard, primary data werecollected from 121 sample respondents who were selected on a convenient basis. The collected data underwent descriptive statistics, ranking techniques and regression analysis. Further, the study resulted that perceived ease of use, trialability and convenience influence the customer towards mobile wallet adoption.

Keywords: *Innovative Technology, Mobile wallet adoption, convenience.*

Introduction

A foremost technological revolution is leading today's world, particularly in the area ofInformation Technology (IT). The growth of IT is becoming a more tremendous and vital factor for thedevelopment of industries and businesses in the upcoming days (Gbongli Kolman, Dumor Koffi and Kissi Mireku Kingsford, 2016). Due to the development of technology, the payment system too evolved into electronic-based payments. In the olden days barter system was followed in which the goods were exchanged for other goods. The barter system has vanished by the development of cash and now the cash has been desperate by the emerging technology of mobile-based payment services. One such evolving mobile based payment service is a mobile wallet. Mobile wallets are those mobile-based applications in which the user can hold money electronically without using their bank accounts. They can make paymentsup to the amount of money they hold within their wallet and they can recharge the wallet using various bank accounts. During the process of transactions money can be sent from the wallet to the payment merchant.According to Robin Arnfield (2015), "Mobile Wallet is a digitalized virtual currency version which is available for the consumer on their mobile device or tablets, where money can be used for purchasing goods and services at anytime and anywhere with the hassle-free transaction".

Review of Literature

According to Rehman et al (2022), compatibility, observability, perceived ease of use, perceived usefulness, trialability and convenience have positively influenced towards the mobile wallet adoption. In addition to that Vyas et al (2019), the three technological factors

such as observability, trialability and compatibility have a significant relationship with perceived usefulness which leads towards mobile wallet adoption. Jin et al (2019) concluded that perceived usefulness, perceived ease of use and trialability were the significant technical factors that led towards mobile wallet adoption in Malaysia. Perceived usefulness, perceived ease of use and perceived risk of technological factors influences the customers toward mobile wallet usage.

Statement of the Problem

New innovative technology with advanced features is being introduced in the market day by day. One such novel technology is mobile wallet, which is being experienced by both new and existing users. According to Rehman et al (2022), "the various features such as convenience, rewards and cashbacks, remote access etc...influence the customer towards mobile wallet adoption. There are various factors that motivates the customer towards mobile wallet adoption. Thus, the present study provides an understanding of the impact of technical factors on mobile wallet adoption.

Scope of the Study

The main goal of the study is to comprehend the various technical factors that motivates the customer towards mobile wallet adoption. It provides an overview on the effect of technical factors on mobile wallets adoption and so it helps the fintech companies to enhance the features of mobile wallet in-order to attract new users.

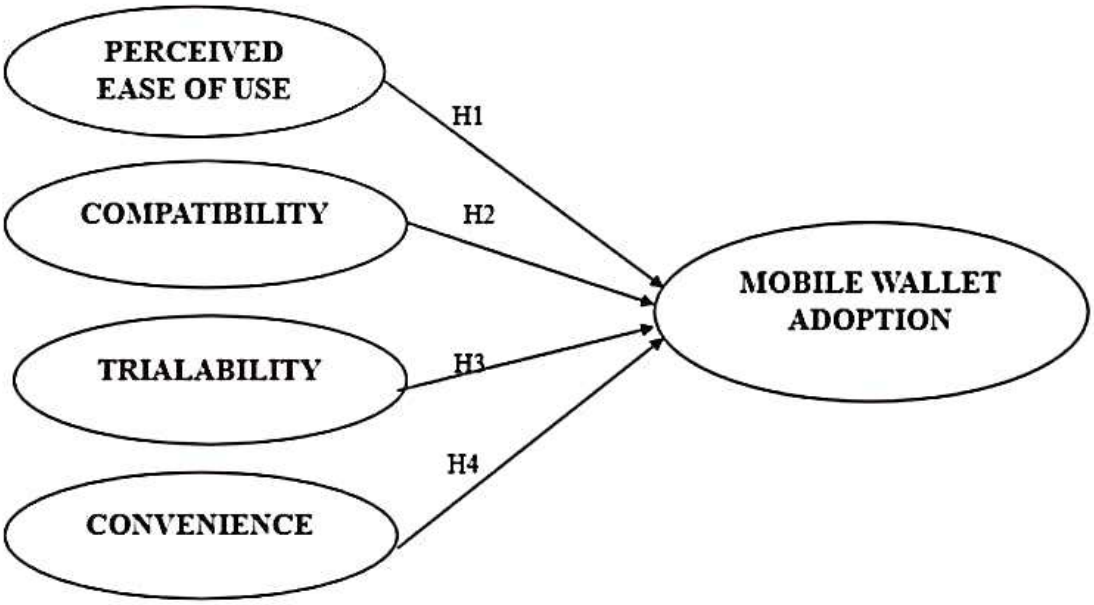
Objectives of the Study

To identify the most preferred mobile wallet among the respondents.

To analyse the effect of technical factors on mobile wallet adoption.

Theoretical Framework

To investigate the significant determinants that leads the customers towards mobile wallet adoption, thus the present study explores the technological factors such as perceived ease of use, observability, trialability and convenience and its impact on mobile wallet user's. The technological factors have been adopted from the previous research (Vijay et al, 2022).Perceived Ease of Use refers to the customers easy adoptability towards the newtechnology which means to be a user-friendly technology. Compatibility means a technology satisfies the needs, values and experience of the users.Trialability denotes the level at which the users or adopters are capable of trying out an innovation. Trialability is the process of pilot tests taken by customers towards a new technology before its adoption. Convenience means the reduced effort and time needed to learn a new innovation. Convenience is the most influential factor which drives the user's to be an adopters in the future.



1.1 Proposed Model of the Study

Hypothesis

H1: Perceived ease of use has a significant effect on mobile wallet adoption.
H2: Compatibility has a significant effect on mobile wallet adoption.
H3: Trialability has a significant effect on mobile wallet adoption.
H4: Convenience has a significant effect on mobile wallet adoption.

Research Methodology

Coimbatore was selected as the study location. It comprehends people with the highest literacy rate and so the people of Coimbatore are aware of new technologies and innovations.The convenience samplingmethod under the non-probability sampling technique was used for selecting the sample size of the study. Both the primary and secondary data were adopted for the study. The primary datawere collected using a structured questionnaire from 121 mobile wallet users. Secondary data were collected from various websites, books, articles andjournals. Subsequently, the Ranking technique and Regression analysis were used for analysis.

Analysis and Discussion

Profile of the Respondents

The Demographic Profile of the mobile wallet user's gives an overview that who were the mobile wallet adopters.

Table 1
Socio-economic Profile of the Respondents

Demographic Variables		Frequencies (N= 121)	Percentage
Age (in years)	Below 20	10	8.4
	21-40	82	67.7
	41-60	29	23.9
	Above 60	-	-
Gender	Male	67	55.4
	Female	54	44.6
Education	High School	9	7.4
	Under Graduate	32	26.4
	Post Graduate	56	46.2
	Diploma	12	10
	Professional Degree	10	10
Occupation	Students	82	18.1
	Employed	29	47.9
	Own business	-	20.8
	Home Maker	67	13.2
Monthly Income (in Rs)	Below 20000	54	14.8
	21000-40000	9	56.1
	41000-60000	32	13.2
	Above 60000	56	15.9

Source: Primary Data

Based on the results, most respondents are 20-40 years of age (68%), which shows that mobile wallets are more familiar among the young generations. Male customers (55.4 %) are highly using mobile wallets for their payment transactions. About 46.2 percent of the sample respondents are postgraduates, employed (48%) and were obtaining Rs.21000-40000 as their monthly income (56%).

Most Preferred Mobile Wallet Applications among the Respondents

The ranking technique was employed to have a thorough knowledge on the most preferred mobile wallets

Table 2
The Most Preferred Mobile Wallet Application among the Respondents

Mobile Wallet Applications	Total Score	Rank
Paytm	510	1
PayPal	468	2
MobiKwiK	397	4
Free Charge	390	5
Google Wallet	423	3

Source: Primary Data

The results depict that, Paytm is the most preferred application among the respondents which ranks first (510). PayPal is the second most preferred criterion (468) that attracts present-day customers by ensuring faster service in their busy schedules. Google Wallet (423) and MobikWik Wallets (397) attain third and fourth positions. Further, Free Charge (390) placedin the last position, which shows that people are more adopting towards mobile wallets.

Effect of Technical Factor's on Mobile Wallet Adoption among the Respondents

To have a thorough knowledge of technological factors and its impact on mobile wall users the data were gathered using a structured questionnaire. Further, the collected data underwent Regression analysis to define the relationship between technical factors and its impact on mobile wallet adoptions.

Table 3.1 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Annova				
					Sum of Squares	df	Mean Square	F	Sig.
1	.740[a]	.548	.532	.600	50.515	4	.360	35.102	.000[a]

a. Predictors: (Constant): Perceived Ease of Use, Trialability, Compatibility, Convenience

b. Dependent Variable: Mobile wallet Adoption

Source: Computed Data

Table 3.1 Model Summary shows that R= 0.740 which signifies the multiple correlation coefficient values which reveal the high degree of predictive accuracy. Further, the selected independent variables have influenced the mobile wallet adoption. Since the result, the R2 value is .548. This infers that 55percent of the variation in the dependent variable (mobile wallet adoption) can be explained by the independent variables (Perceived ease of use, Trialability, Compatibility and Convenience).

The independent factors are statistically and significantly forecast the dependent variable, (F=35.102, P<0.001). Therefore, the regression model is found to be fit.

Table 3.2 Effect of Technical Factors on Mobile Wallet Adoption among the Respondents Coefficients

Coefficients						
Model		Unstandardized Coefficients		Standardize d Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.356	.314		4.319	.000
	Perceived Ease of Use	.446	.067	.587	6.636	**.000**
	Compatibility	.070	.084	.064	.832	.407
	Trialability	.358	.092	.347	3.888	**.000**
	Convenience	.232	.091	.253	2.553	**.013**
a. Dependent Variable: Mobile Wallet Adoption						

Source: Computed data

A coefficient analysis explains the association between the variables (both dependent an independent). The coefficient analysis shows that perceived ease of use(β= 587; P< 0.01), and trialability (β= .347; P< 0.01) were found to have a highly significant relationship with mobile wallet adoption. Thus, the research result from Table 3.2, shows that convenience (t=2.553) was found tobesignificant and which leads tomobile wallet adoption.On the other hand, compatibility(β= .064; P> 0.05) is found to be statistically insignificant.

Suggestion

Though the Digital India concept is motivating the customer towards digital payment adoptions, educating and training of mobile wallet is essential to raise the mobile wallets users in India.

The service providers, which means the fintech companies must offer a wide range of facilities in a user-friendly manner so that the public can access the latest technology efficiently.

Conclusion

Today, in the era of information technology, every business wants to deliver their products and services through electronic channels" (Maitlo, 2015). An extended form of information technology helps the people adopt towards digital payment services that are offered by fintech companies. And one such digital payment application is mobile wallets. There are various factors motivating the customer towards mobile wallet adoption. The technical factor is the most important factor that motivates the customer towards mobile wallet adoption. Thus, the study resulted that perceived ease of use, trialability and convenience of technological factors have a significant relationship with mobile wallet adoption.

References

1. Alaeddin, O., Altounjy, R., Zainudin, Z., & Kamarudin, F. (2018). From physical to digital: Investigating consumer behaviour of switching to mobile wallet. Polish Journal of Management Studies, 17(2), 18-30.
2. Elgazouly, M. Y., AbdelAziz, G. S., & Abdelgawad, D. F. (2022). Toward a cashless economy: Exploring Drivers of Mobile Wallets Adoption from Consumers' and Service Providers' Perspectives. The Academic Journal of Contemporary Commercial Research, 2(3), 75-98.
3. Fosso Wamba, S. (2022, April). Determinants of Mobile Wallet Adoption: A Longitudinal Approach Applying an Extension of the Technology Acceptance Model in Cameroon. In World Conference on Information Systems and Technologies (pp. 37-46). Cham: Springer International Publishing.
4. Govender, I., & Sihlali, W. (2014). A study of mobile banking adoption among university students using an extended TAM. Mediterranean journal of social sciences, 5(7), 451.
5. Hidayat-ur-Rehman, I., Alzahrani, S., Rehman, M. Z., & Akhter, F. (2022). Determining the factors of m-wallets adoption. A twofold SEM-ANN approach. Plos one, 17(1), e0262954.
6. Kumar, S., & Gupta, A. (2021). Factors Affecting Adoption of M–Wallets: Moderating role of Financial Incentives. Ramanujan International Journal of Business and Research, 6, 132-143.

7. Latha, R., & Vatchala, C. (2019). Exploring the Factors Influencing the Mobile Wallet Usage Intention. International Journal of Engineering Development and Research, 7(2), 77-81.
8. Mater, W., Matar, N., Alismaiel, O. A., Al Moteri, M. A., Al Youssef, I. Y., & Al-Rahmi, W. M. (2021). Factors influencing the intention behind mobile wallet adoption: Perceptions of university students. Entrepreneurship and Sustainability Issues, 9(1), 447.
9. Sunny, P., & George, A. (2018). Determinants of behavioral intention to use mobile wallets--a conceptual model. Journal of Management (JOM), 5(5), 52-62.
10. Vyas, P Shukla & N. Pandya (2019). exploration of mobile wallets adoption among smart phone users in varoda city of gujarat states. The Indian Journal of Commerce, vol. 72, No. 1.

About the College

STC, established in 1997 by V.S.V. Vidyaa Mandir trust, has completed its 25 years of academic service in the field of higher education. Affiliated to Bharathiar University, Coimbatore, the institution is offering 18 UG programmes and 8 PG programmes and 13 research programmes in various disciplines. It is the first institution in the Pollachi educational District to have ISO 21001: 2018 Certification from the International Standards Organization.

Features

The college has been re-accredited twice with "grade by NAAC and has been granted Autonomous status by the UGC in 2008-2009.

The College has also received the Second Best College award among the affiliated colleges of Bharathiar University, and second rank holder in sports and athletics contiuously during the last 12 years.

About the School of Commerce

The department of commerce, established in the year 1997, has highly qualified, dedicated and experienced faculty who are not only good in teaching but also actively participating in research activities and publication of research articles. The department envisages lifetime value for education, entrepreneurial skil, business traits, leadership skills and ethics among the students. The department offers B.Com, B.Com (CA), B.Com (PA), B.Com (ABA),B.Com (B&I),B.Com (BA),B.Com (IT),M.Com., M.Com (IB)., and Ph.D programs.

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CUSTOMER SATISFACTION TOWARDS FINTECH PRODUCT AND SERVICES

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Abstract:
The advancement of financial technology is crucial for financial institutions to both attract and hold to new clients. Since new technology increases customer pleasure, it is always uncertain how aware consumers are of it and how willing they are to use or adapt to it. Despite the requirement, the goal of the current study is to comprehend how satisfied clients are with FinTech use as well as their perceptions of it. The research study is based upon the primary data collected through questionnaire from 51 respondents who ae utilising financial technology. The findings of the research study indicates that fintech have become very significantly part and it has positive impact on the customer satisfaction of its users.
Keywords: *Customer satisfaction, fintech, awareness, adoption.*

Introduction

Fintech, often known as financial technology, is the use of technology to provide financial solutions. The phrase first appeared in the early 1990s and currently denotes a sector that is expanding quite quickly. Regulators, business people, consumers, and academics have only begun to pay close attention to the sector since 2014 (Janos Nathan berberis, 2016).The number of smartphone users has considerably increased as more and more affordable smartphones have become available. from 2020, over a third of the world's population, or 6.1 billion people, will be smartphone owners, according to research from network experts Erricson. In the human civilization, bartering was used to exchange products instead of actual money by using a variety of items like plants, crops, or animals like sheep or chicken (Chern Yong Xian, 2018).

The digital economy is gaining popularity. Technology plays a significant part in making daily life more convenient in the digital age. This may be seen in customer behavior, which has switched to more online services such as purchasing products, booking movie tickets, and booking hotels, as well as banking transactions. The primary business of any banking institution is investment. While most people rely on banks for loans or investments, peer-to-peer (P2P) lending is becoming more popular around the world (Prapasri Siri, 2023).

Review of Literature:

1. Barathy Doraisamy et al (2022), In their study "Empirical research on factors affecting customer satisfaction towards fintech products and services in Sungai, kedak" The study aimed to investigate customer experiences with Fintech products and services and identifies the sources of customer satisfaction and dissatisfaction associated with the several factors that impact the use of Fintech products and services in Sungai Petani, Kedah. The data was collected 200 respondents and study using descriptive analysis, frequency analysis, and correlation analysis were applied.

The study resulted security, convenience, and service quality have affected customer satisfaction with Fintech products and services.

2. Abu Bakkar Siddik et al (2021), In their study "Factors influencing the adoption intention of using mobile financial service during the COVID-19 pandemic: the role of FinTech" The study aimed to o investigate the role of MFS platforms in economic resilience by empirically evaluating the determinants that influence the intention of Bangladeshi users toward adopting MFS platforms during the COVID-19 pandemic. The data was collected 227 from potential users of MFS in Bangladesh. The study uses the structural equation model to analyse the data. The study results indicated that the users' perceived risk did not influence their intention to adopt MFS platforms during the pandemic.
3. Hasnan Baber (2019), In their Study "FinTech, Crowdfunding and Customer Retention in Islamic Banks" The study aimed to investigate the influence of FinTech applications and crowdfunding on customer retention in Islamic banks of Malaysia and the United Arab Emirates. The data was collected 535 customers in Malaysia and United Arab Emirates. The study uses various analysis reliability analysis, factor analysis and regression analysis. The study resulted to emphasis on expanding the range of applications of FinTech services by Islamic banks so that the customer will stay longer with the bank.
4. Dr, Saurabh singh et.al (2023) In their study on "millennial consumers response towards fintech products using TAM model" The study aims to analyse the impact of perceived ease of use, perceived usefulness, and behaviour intention on actual use in using fintech products. The data has been collected from 250 respondents and their using multiple regression analysis. The study results can be said that Perceived ease of use, perceived usefulness and behavior intention positively affect actual use of Fintech Products.
5. Mauro Sciarelli and Anna Prisco et al (2021), In their study "Factors affecting the adoption of blockchain technology in innovative Italian companies: an extended TAM approach" The Purpose of the study s to identify the determinants for users' behavioral adoption of Blockchain, exploring the relationships among these variables and investigating whether the proposed model can provide a more comprehensive manner to understand the adoption of Blockchain technology. The data has been collected from 108 Italians company. The study used Partial Least Squares Structural Equation modeling (PLS-SEM). The study resulted "efficiency and security" is an important driver of firms' decision-making process to adopt Blockchain. Moreover, the results show that perceived usefulness is a strong predictor of the intention to use Blockchain in business processes.

Objectives of the Study:

- To Identify the factors leading towards adoption of fintech.
- To analyze the problems being faced by the users of fintech.

Research Methodology:

Research methodology may be understood as a science of study how research is done scientifically. a system of models, procedures and techniques used to find the result of research problem it is called research methodology.

It is necessary for the researcher to know not only research methods or techniques but also methodology. Researchers not only need do know how to develop certain indices or tests.

Sample and Data Collection:

Coimbatore was selected as the study location. The city of Coimbatore, also referred to as the Manchester of south India, is in the western region of the Tamil Nadu state. Sample study denotes the number of respondents of the study and is known as samples of research work. The study involves 51 samples. Coimbatore district customers are the sample unit. The primary data has been collected data from through questionnaires.

Analysis and Interpretation:

ANOVA:

There is no significant mean difference between problems to analyze the problems being faced by the users of fintech and educational qualification.

One-way ANOVA was conducted to examine the impact of experiencing theft of information on various groups. There was no statistically significant difference found between groups, f(4,46)=1.181,p=.332F(4,46)=1.181,p=.332, indicating that the experience of theft of information did not significantly vary across different scenarios.Card Details and Sensitive Information for the experience of theft related to card details and sensitive information, the ANOVA revealed no statistically significant difference between groups, f(4,46)=2.028,p=.106F(4,46)=2.028,p=.106, suggesting that the experiences did not significantly differ across the scenarios.Face Transaction FailuresFor face transaction failures, there was no significant difference found between groups, F(4,46)=.606,p=.660, indicating that the frequency of face transaction failures did not significantly vary across the scenarios.Slow FinTech PerformanceThe ANOVA results showed no significant difference in experiences of slow FinTech performance due to infrastructure issues between groups, F(4,46)=.381,p=.821.Overcharged for Services was no statistically significant difference found between groups regarding being overcharged for services, f(4,46)=.484,p=.748, suggesting that the experiences did not significantly differ across the scenarios.Unauthorized Transactions the ANOVA results revealed no significant difference in experiences of unauthorized transactions,F(4,46)=1.049,p=.393, indicating that the occurrences of unauthorized transactions did not significantly differ across the scenarios.Refunded Amount of Failed Paymentfor the refunding of failed payments, the ANOVA indicated no significant difference between groups, F(4,46)=1.681,p=.171, suggesting that the refunding experiences did not significantly differ across the scenarios.Transaction Charges Informationwas no statistically significant difference found between groups regarding the amount of information related to transaction charges,F(4,46)=.363,p=.834, indicating that the experiences did not significantly differ across the scenarios.Finally, Hidden Chargesfor experiences related to hidden charges, the ANOVA revealed no significant difference between groups, F(4,46)=.635,p=.640, suggesting that the experiences did not significantly differ across the scenarios.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
I have experienced the it of my information	Between Groups	6.488	4	1.622	1.181	.332
	Within Groups	63.159	46	1.373		
	Total	69.647	50			
My card details and some sensitive information	Between Groups	10.201	4	2.550	2.028	.106
	Within Groups	57.838	46	1.257		
	Total	68.039	50			
I face transaction failures quite often	Between Groups	1.728	4	.432	.606	.660
	Within Groups	32.782	46	.713		
	Total	34.510	50			
I experiences low fintech performance due to lack of infrastructure	Between Groups	1.384	4	.346	.381	.821
	Within Groups	41.793	46	.909		
	Total	43.176	50			
I have been overcharged for services	Between Groups	2.452	4	.613	.484	.748
	Within Groups	58.293	46	1.267		
	Total	60.745	50			

I have seen un authorised transaction from my account	Between Groups	7.797	4	1.949	1.049	.393
	Within Groups	85.497	46	1.859		
	Total	93.294	50			
I was not refunded the amount of my failed payment	Between Groups	6.735	4	1.684	1.681	.171
	Within Groups	46.088	46	1.002		
	Total	52.824	50			
I received very less information related to transaction charges by	Between Groups	2.240	4	.560	.363	.834
	Within Groups	70.937	46	1.542		
	Total	73.176	50			
I have been charged with hidden a mounts and fintech portal never	Between Groups	3.473	4	.868	.635	.640
	Within Groups	62.880	46	1.367		
	Total	66.353	50			

Table 1

Factor Analysis:

The factor analysis is used to find out the important factors or variables to Identify the factors leading to the adoption of fintech. The outcome of factor analysis is presented the above table 2, as given below.

Table 2

Descriptive Statistics

Table 2	Mean	Std. Deviation	Analysis N
Government awareness and promotions	2.2157	1.40447	51
Family and friends	2.3922	.77662	51
Reference groups	2.5686	1.06311	51
Wider acceptance and spread of fintech	2.6275	1.23225	51
Charges and withdrawal limiton ATMs	2.7451	.99686	51
Monetary incentives like cash backs and discount coupons	2.569	.9435	51
Advertisements off in tech provider	2.6863	.98975	51
Reward system such as gifts and loyalty points	2.6471	1.18023	51

The descriptive statistics table presents the means, standard deviations, and sample sizes (N) for several factors influencing the adoption of financial technology (fintech) among 51 respondents. The means for the factors range from 2.2157 to 2.7451, indicating the average level of influence perceived by the respondents. The standard deviations, which vary from 0.77662 to 1.40447, reflect the degree of variability or dispersion in responses around the mean for each factor. Among the factors, "Charges and withdrawal limit on ATMs" (M = 2.7451, SD = 0.99686) appears to have the highest mean score, suggesting that respondents perceive this factor as relatively influential in fintech adoption. Conversely, "Government awareness and promotions" (M = 2.2157, SD = 1.40447) has the lowest mean score, indicating comparatively less perceived influence.

Table 3

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.559
Bartlett's Test of Sphericity	Approx. Chi-Square	108.177
	df	28
	Sig.	.000

The Kaiser-Meyer-Olkin measure of sampling adequacy was found to be .559, suggesting moderate adequacy of sampling for the variables included in the analysis.

Additionally, Bartlett's test of sphericity yielded a statistically significant result, $\chi^2(28) = 108.177$, $p < .001$, indicating that the correlation matrix is significantly different from an identity matrix and thus suitable for further factor analysis.

Communalities		
	Initial	**Extraction**
Government awareness and promotions	1.000	.819
'Family and friends	1.000	.750
Reference groups	1.000	.649
Wider acceptance and spread of fintech	1.000	.712
Charges and withdraw allimiton ATMs	1.000	.726
Monetary incentives like cash backs and discount coupons	1.000	.488
Advertisements off intech provider	1.000	.756
Reward system such as gifts and loyalty points	1.000	.681
Extraction Method: Principal Component Analysis.		

Table 4

Every variable in the communality initially is expected to share 100% variance. Henceinitiallyevery item is having value 1.00 which mean 100% variance share by each item. The communalities after extraction suggest the amount of variance retained by the extracted components. Higher values indicate that the variables are well-represented by the components, whereas lower values suggest that the variables might not be adequately captured by the components.In this analysis, it appears that the variable "Monetary Incentives like Cashbacks and Coupons" has a relatively low communalities value after extraction (.388), indicating that it may not be well-represented by the extracted components compared to the other variables.

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.264	28.305	28.305	2.264	28.305	28.305	2.036	25.452	25.452
2	1.927	24.090	52.395	1.927	24.090	52.395	1.968	24.598	50.050
3	1.289	16.109	68.504	1.289	16.109	68.504	1.476	18.454	68.504
4	.985	12.311	80.815						
5	.555	6.936	87.751						
6	.414	5.176	92.927						
7	.340	4.256	97.183						
8	.225	2.817	100.000						
Extraction Method: Principal Component Analysis.									

The initial eigenvalues represent the variance explained by each component before rotation.The extraction sums of squared loadings and rotation sums of squared loadings denote the variance explained by each component after extraction and rotation, respectively.Components 1, 2, and 3 are notable for explaining substantial portions of the variance, with Component 1 explaining the highest percentage.As the component number increases, the percentage of variance explained generally decreases.Components beyond the third component may not be significant in explaining additional variance, considering the sharp decline in the percentage of variance explained.

Table 6

Rotated Component Matrix[a]			
	Component		
	1	2	3
Government awareness and promotions	.895		
Family and friends	.836		
Monetary incentives like cash backs and discount coupons			
Wider acceptance and spread of fintech		.833	
Reference groups		.764	
Charges and withdrawal limiton ATMs	-.505	.660	
Advertisements off intech provider			.868
Reward system such as gifts and loyalty points			.809
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 5 iterations.			

The idea of rotation is to reduce the number of factors on which the variables under investigation have high loadings.

Rotation does not actually change anything but makes the interpretation of the analysis easier.If the value is lower than the required value of 0.5 or the set limit (which could be 0.6 too as per the researcher's need of including the desired factor loading) for one of the components, then that variable could be considered for further analysis.

Findings and Conclusion:

After analysing data and review of national and international studies, it can be said that fintech has gained the momentum in the field.On the one hand, it provides competitive benefits including speed, transparency, time savings, and resource optimization. It also offers a great deal of client service. The younger generation is more adept with technology. As a result, they are happier and more at ease than the older generation. On the other hand, customers are continuing to have worries about security, trust, and data confidentiality. The ease and degree of satisfaction at a given moment are also influenced by age, gender, and other factors. The demographic factors show that the female and male categories are widely use in fintech with the young to mature age range of 25 to 50 years old. The level and the bulk of them fall into the Graduation to Post-Graduation degree of education in terms of background. However, when considering the effect of financial technology implementation on customer satisfaction in the financial industry

References:

1. Khazaei, A., Manjiri, H., Samiey, E., & Najafi, H. (2014). The effect of service convenience on customer satisfaction and behavioral responses in the banking industry. International Journal of Basic Sciences & Applied Research, 16-23.
2. Lee, J. E., Rao, S., Nass, C., Forssell, K., & John, J. M. (2012). When do online shoppers appreciate security enhancement efforts? Effects of financial risk and security level on evaluations of customer authentication. International Journal. Human-Computer Studies, 70, 364-376.
3. Ming-Chih, C., Shih-Shiunn, C., Hung-Ming, Y., & Wei-Guang, T. (2016). The key factors influencing internet finance services satisfaction: an empirical study in Taiwan. American Journal of Industrial and Business Management, 750.
4. Mustafa, A., & Mark, T. (2017). A Framework for assessing payment security mechanisms and security information on e-commerce web sites. Research Gate, 16(1), 64-73.
5. Ogbanufe, O., & Kim, D. J. (2018). Comparing fingerprint-based biometrics authentication versus traditional authentication methods for e-payment. Elsevier Decision Support Systems, 106, 1-14.
6. Ong, T. S., Hong, Y. H., Teh, B. H., Soh, P. C., & Tan, C. P. (2014). Factors that affect the adoption of internet banking in Malaysia. International Business Management, 55-63.

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STC, established in 1997 by V.S.V. Vidyaa Mandir trust, has completed its 25 years of academic service in the field of higher education. Affiliated to Bharathiar University, Coimbatore, the institution is offering 18 UG programmes and 8 PG programmes and 13 research programmes in various disciplines. It is the first institution in the Pollachi educational District to have ISO 21001: 2018 Certification from the International Standards Organization.

Features

The college has been re-accredited twice with "grade by NAAC and has been granted Autonomous status by the UGC in 2008-2009.

The College has also received the Second Best College award among the affiliated colleges of Bharathiar University, and second rank holder in sports and athletics contiuously during the last 12 years.

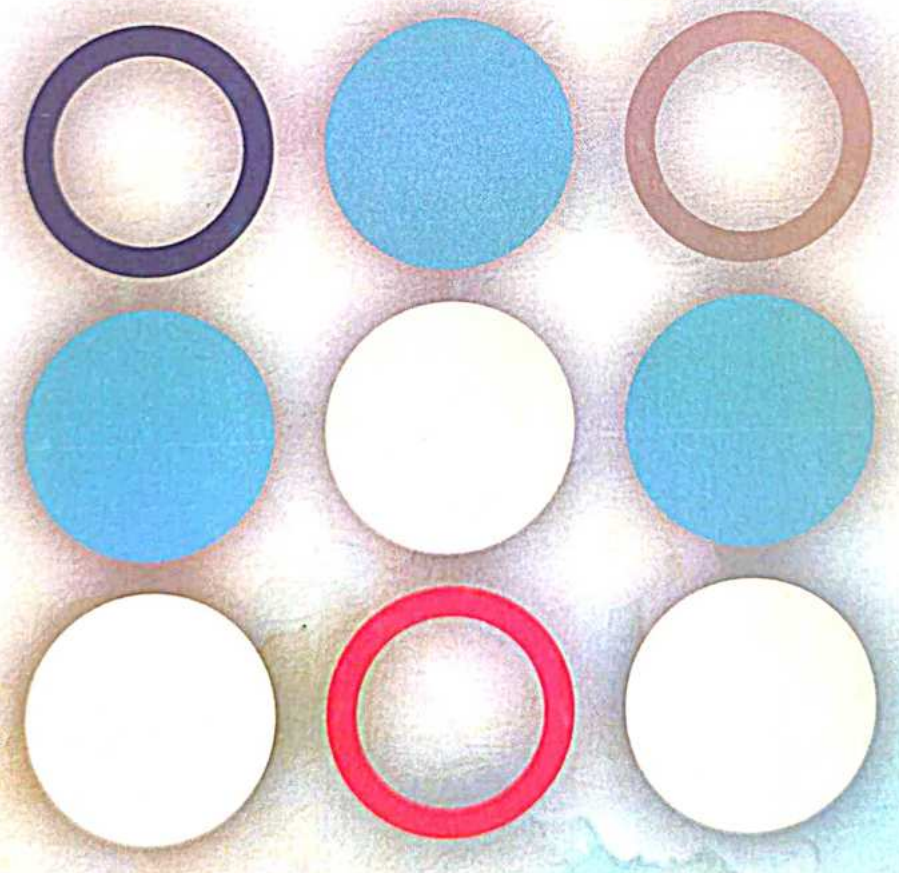
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The department of commerce, established in the year 1997, has highly qualified, dedicated and experienced faculty who are not only good in teaching but also actively participating in research activities and publication of research articles. The department envisages lifetime value for education, entrepreneurial skil, business traits, leadership skills and ethics among the students. The department offers B.Com, B.Com (CA), B.Com (PA), B.Com (ABA),B.Com (B&I),B.Com (BA),B.Com (IT),M.Com., M.Com (IB)., and Ph.D programs.

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TECHNOLOGY REVOLUTION AND INDIAN INDUSTRY



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Technology Revolution and Indian Industry

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Role of Artificial Intelligence in Digital Marketing

Special Reference to Coimbatore City

Malarvizhi A. and Deivanai P.

Introduction

A recent trend in marketing, business, education, science, and industrial equipment is artificial intelligence (AI). It has now evolved in advertising. AI's quick development delivers innovative marketing and research alternatives. AI in marketing is used to predict customers' upcoming buying choices and improve the experience for them. Big Data, web advertising, and digital video advertising are the three major foundations of AI. Marketing is the strategic tool responsible for identifying, anticipating, and profitably meeting customer needs. AI helps to recognize human intellect and develop intelligent creations. AI has the potential to grow and have a significant impact in three business sectors. The modules are customer care, advertising, and promotion.

Statement of the Problem

AI is one of the greatest events that affect digital marketing worldwide in the 21st century. It is a revolutionary technology that makes use of numerous software technologies to facilitate corporate operations and attract clients. According to this, many advertising firms have updated their traditional technique to serve a larger range of individuals. The versatility of the YouTube advertising medium makes it stand out from other digital advertising media. The ability of AI to interface with various kinds of individuals is its greatest strength. So, this study is going to explain how AI influencing plays the main role in today's marketing world and how it helps to take the purchase decision easily.

Review of the Literature

Human intelligence gives birth to AI, which is exhibited by robots. According to Russell and Norvig (2002), the definition of AI is a system that contains intelligent robots that deliver its objectives. Because of years of hard work by professionals, AI has recently advanced to an extraordinary standard.

Due to the massive volume of data it processes, data ingestion plays a crucial role in artificially intelligent systems. Based on their analyses and needs, these intelligent systems take the data into regard. In companies, such as Google and Amazon, for instance, there is a huge volume of data that is challenging for humans to understand. In addition, AI systems store data about a lot of people and their addresses from a broad range of sources.

Objectives of the Study

1. Factors influencing choosing a product with the help of AI.
2. Role of AI in digital marketing.

Methodology and Design

Sample Method

The random sampling method was used for the study with a good questionnaire. The study area is the Coimbatore city.

Sample Size

The sample size is 250 respondents from Coimbatore city.

Demographic Profile of Respondents

The majority of respondents were female, i.e. 58.3 per cent and the majority of people belong to the age group of 25–34 years, i.e. 55.3 per cent. The majority of respondents are graduates, i.e. 61.9 per cent. The majority of respondents are employees from private concerns, i.e. 57.2 per cent. The majority of respondents lay down an income between ₹ 25,000 and ₹ 50,000 per month.

Reliability and Validity Analysis

The Cronbach's alpha value was measured using SPSS software to assess the dependability. Nun Zio (1978) asserted that the value needs to be higher than 0.7 to be considered reliable. Each construct's worth is displayed in Table 1.

The relationship between variables and factors (factor loading), which must be more than 0.7, was calculated using factor analysis. The efficiency of samples is measured using the Kaiser-Meyer-Olkin value. For the factor analysis to occur, the value has to be at least 0.5.

Table 1

Cronbach Alpha Reliability Analysis

Construct	Cronbach Alpha	Number of Items
Natural language processing	0.69	2
Deep learning	0.75	3
Facial recognition	0.76	3
Voice recognition	0.69	2

Table 2

Factors Influencing Natural Language Processing
Kaiser-Meyer-Olkin Measure of Sampling Adequacy

Sources	Factor Loading	Explained Variance	KMO	Alpha
AI helps to deduct errors	0.750	75.792	0.500	0.69
AI helps to identify human errors	0.790			

Based on data in Table 2, the variable has a strong value, with factor loadings of each item at 0.750 and alpha 0.69. But, the KMO number is precisely 0.5, which is the data adequacy level.

Table 3

Factors Influencing Deep Learning
Kaiser-Meyer-Olkin Measure of Sampling Adequacy

Deep Learning	Factor Loading	Value Calculated	KMO	Alpha
AI helps us learn more new things	0.642	67.362	0.455	0.69
AI helps to improve marketing innovation	0.776			
New innovations easily get	0.752			

Based on data in Table 3, the variable has a strong value, with factor loadings of each item at 0.750 and alpha 0.69. But, the KMO number is precisely 0.5, which is the data adequacy level.

Table 4

Factors Influencing Facial Recognition
Kaiser-Meyer-Olkin Measure of Sampling Adequacy

Sources	Factor Loading	Explained Variance	KMO	Alpha
AI helps to identify suitable things	0.66.8	5.067	0.557	0.657
Get more ideas	0.753			
AI helps to take quick decision-making	0.8.96			

Deep learning items that have values above 0.69, suggesting strong factor loading, and 67.36 per cent of the variable were explained. Strong value is represented by the Kaiser-Meyer-Olkin of 0.455 per cent and the alpha of 85 per cent with an adequate sample size for entertainment.

All the face-recognition factors gave all major factor loading values, which is supported by the variance of 5.067 per cent. It is okay for the KMO value to be greater than 0.557.

Table 5

Factors Influencing Voice Recognition
Kaiser-Meyer-Olkin Measure of Sampling Adequacy

Sources	*Factor Loading*	*Explained Variance*	*KMO*	*Alpha*
Eliminate human interferences	0.881	79.147	0.500	0.715
Entertainment factors	0.881			

Two voice recognition variables provide a respectable factor loading outcome. The variance that is explained is 79.147 per cent. Strong values are provided by the KMO of 0.500 and the alpha value of 0.715 buying behaviour.

Table 6

Correlation Analysis Results of Various Factors

Sources	*NLP*	*DL*	*FR*	*VR*
Natural language processing	1.000			
Deep learning	4.940	1.000		
Facial recognition	0.432	0.396	1.000	
Voice recognition	0.309	0.3.45	0.2.4	1.000

The correlation between the variables is given in Table 6. The outcome shows that practically every construct has a positive variable. The strongest benefit can be seen in the relationship between deep learning and speech recognition (4.940). Therefore, it can be said that there is a greater correlation between AI and customers' product-buying behaviour.

Limitation of Research

The main limitation of the study is that the sample size of respondents was restricted to 250 only.

Most of the young respondents are using AI, and many of them are aware of AI and they hesitate to learn the technique of AI.

Conclusion

AI is used in several marketing-related sectors. The marketing solutions based on AI utilized five branches of it: (a) text recognition; (b) voice

recognition; (c) image recognition; (d) deep learning; and (e) robots. Among all of them, advertising was the most used choice. However, the largest technology firms, such as Google and Microsoft, are the only ones developing voice activation models for real use. Based on the research and comparative studies, using AI in marketing has enhanced customer quality of life.

References

Antons, D. and C.F. Breidbach (2018). 'Big data, big insights? Advancing service innovation and design with machine learning', *Journal of Service Research*, 21(1), pp. 17–39.

Baker, M.J. and M. Saren (eds). (2016). Marketing Theory: A Student Text. Sage.

Bauer, J. and D. Jannach (2018). 'Optimal pricing in e-commerce based on sparse and noisy data', *Decision Support Systems*, 106, pp. 53–63.

Bennett, A.R. (1997). 'The five Vs? A buyer's perspective of the marketing mix', *Marketing Intelligence & Planning*, 15(3), pp. 151–156.

Booms, B. (1981). 'Marketing strategies and organizational structures for service firms', *Marketing of Services*, pp. 47–51.

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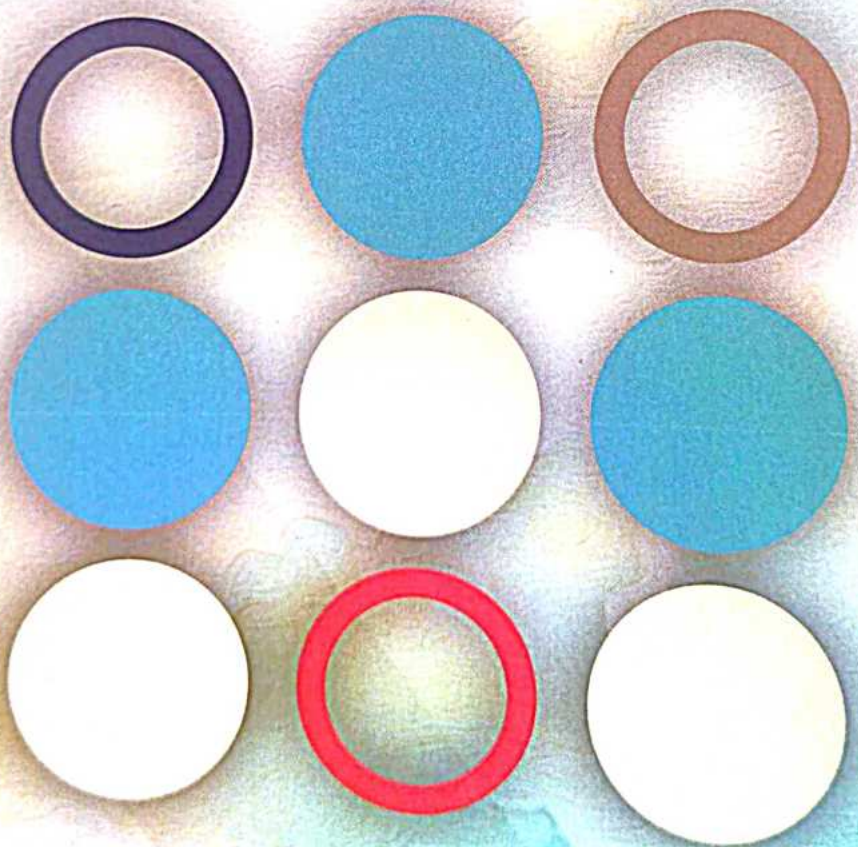
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Technology Revolution and Indian Industry

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8

A Study on Consumer Perception of Digital Payment Methods

Malathi B. and Deivanai P.

Introduction

'Cashless' refers to a society that utilizes less cash or a cashless transaction economy in which real money is not used for payments. Smartphones are a basic component of one's life and an expedient device for digital payments (Yadav, 2017). The transition to a cashless future economy will be marked by the digitalization of the payment system today's economy sends and receives money electronically. In keeping with current advancements in technology and payment system strategies, which have significantly affected the stakeholders in the payment system, the development of cashless payment instruments is moving forward extremely quickly (Dinh, Vu and Ayayi, 2018). Users and providers of non-cash payment system services are constantly searching for substitutes to non-cash payment instruments that are more effective and secure and support the level of security of cashless transactions, thanks to the help of ever-improving technology (Hong, 2015). Recent trends show that India is moving closer to a cashless economy, thanks to technology and a supportive Indian government. To do this, there is a need to increase consumer and government engagement in India so that IT and artificial intelligence (AI) may be used more quickly (Aggarwal, Malik, Mishra and Paul, 2021). Indian economy is currently experiencing a tendency to move away from cash transactions and towards cashless ones (Sumathy and Kp, 2017).

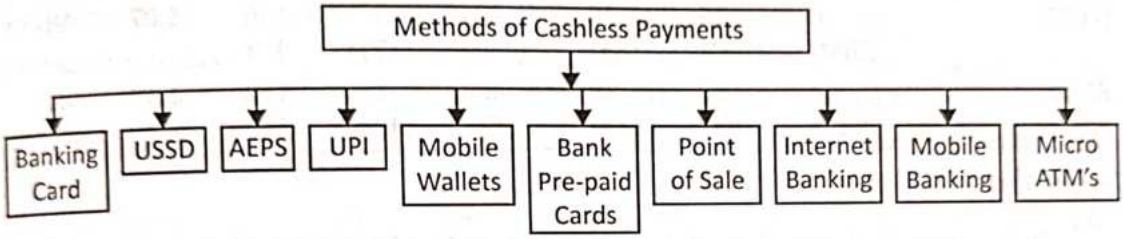
Methods of Cashless Payments

A cashless society is one in which financial transactions are carried out through the exchange of digital information (often an electronic

representation of money) between the parties involved in the transaction rather than actual banknotes or coins (Mohd., 2020). As one of the primary functions of the digital Asian nation as an area of promoting cashless transactions and turning the Asian country into a less-cash culture, 'faceless, paperless, and cashless' is one of digital India's stated ambitions (Deepa and Lalitha, 2020). To encourage cashless transactions and make India a cashless society, a variety of digital payment methods are available.

Figure 1

Methods of Chashless Payments



Objectives of the Study

The objectives of this research are as follows:

1. To determine perceived and how demographic factors affect the adoption of digital payment methods.
2. Moreover, to examine the effectiveness of AI in digital payment.

Research Methodology

This study relies on primary data and secondary data. This research focuses on the cashless society and customers' perceptions of adopting digital modes of payment with the help of AI. Data from respondents were gathered using a carefully constructed questionnaire. Customers were approached to obtain data using a Simple Random Sampling method. In this survey, the sample size decided was 150. Research and statistical tools employed in this study are Likert Five-Scale, Garret ranking, and Chi-Square methods used to evaluate the data method.

Table 1

Different Modes of Digital Payment of Respondents

Mode of Payments	No. of Respondents					Total Score	Mean Score	Rank
	HS 5	S 4	N 3	DS 2	HDS 1			
Banking card	52 (260)	47 (188)	31 (93)	12 (24)	8 (8)	150 573	3.82	II
USSD	28 (140)	14 (56)	37 (111)	32 (64)	39 (39)	150 410	2.73	VII
AEPS	19 (95)	21 (84)	27 (81)	37 (74)	46 (46)	150 380	2.53	VIII

Cont'd...

...Cont'd

Mode of Payments	No. of Respondents					Total Score	Mean Score	Rank
	HS 5	S 4	N 3	DS 2	HDS 1			
UPI	61 (305)	30 (120)	22 (66)	25 (50)	12 (12)	150 553	3.68	I
Mobile wallets	32 (160)	26 (104)	38 (114)	30 (60)	24 (24)	150 462	3.08	V
Internet banking	39 (195)	35 (140)	26 (78)	29 (58)	21 (21)	150 492	3.28	IV
Point of sale	58 (290)	43 (172)	27 (81)	13 (26)	9 (9)	150 578	3.85	III
NEFT	40 (200)	25 (100)	28 (84)	20 (40)	37 (37)	150 461	3.07	VI
RTGS	22 (110)	17 (68)	38 (114)	32 (26)	41 (41)	150 359	2.39	IX

Source: Primary Data.

It is stated from the above-mentioned table that the factor 'UPI' stands the first rank with a mean score of 3.68. The second rank is followed by the variable 'Banking card' with a mean score of 3.82. The 'Point of Sale' variable is the third rank with a mean score of 3.85. The 'Internet Banking' factor ranks fourth with a mean score of 3.28. Followed by the variable 'Mobile Wallets' stands in the fifth rank with a mean score of 3.08. The variable 'NEFT' stands in the sixth rank with a mean score of 3.07. 'USSD' stands in the seventh rank with a mean score of 2.73. 'AEPS' stands in the eighth rank with a mean score of 2.53. Followed by the variable 'RTGS' stands in the ninth rank with a mean score of 2.39.

Table 2

Reasons for Using Digital Payments Among the Respondents

S.No.	Reason	Garret Score	Garret Rank
1	Rapid payment	8,002	II
2	Convenient or 24*7 transactions	8,545	I
3	Security and privacy	7,811	IV
4	Transactions are easier to track	6,920	V
5	Rewards, discounts, and offers	7,849	III
6	Convenient for carrying and paying	6,661	VII
7	To avoid using cash	6,862	VI

Source: Primary Data.

Table 2 is an upshot that convenient or 24×7 transactions points or cash back got the first rank with a maximum score of 8,545; the benefit of an easy payment period secured the second rank with a score of 8,002, and easy to carry and make payment occupied the last rank with the minimum score of 6,661.

Table 3

Regarding the Challenges of Making Cashless Transactions for Respondents

Mode of Payments	No. of Respondents					Total Score	Mean Score	Rank
	HA 5	A 4	N 3	DA 2	HDA 1			
There is no security or protection	57 (285)	43 (172)	31 (93)	11 (22)	8 (8)	150 580	3.86	IV
Merchant acceptance needs to be improved	39 (195)	31 (124)	48 (144)	20 (40)	12 (12)	150 515	3.43	VII
Limited access to the internet	59 (295)	43 (172)	31 (93)	12 (24)	5 (5)	150 589	3.92	II
Low digital awareness	61 (305)	40 (160)	31 (93)	11 (22)	7 (7)	150 587	3.91	III
Technical expertise	48 (240)	33 (132)	27 (81)	23 (92)	19 (76)	150 621	4.14	I
Illiteracy and its impact	56 (280)	42 (168)	21 (63)	18 (36)	13 (13)	150 560	3.73	V
There are a few points of sale	23 (115)	19 (76)	27 (78)	32 (64)	49 (48)	150 381	2.54	IX
Internet scams are on the rise	46 (230)	34 (136)	31 (93)	24 (48)	15 (15)	150 522	3.48	VI
Small payments issues	36 (180)	31 (124)	42 (126)	24 (48)	17 (17)	150 495	3.30	VIII

Source: Primary Data.

Table 3 states that the factor 'Technical expertise' stands the first rank with a mean score of 4.14. Followed by the variable 'Limited access to the internet' stands in the second rank with a mean score of 3.92. The variable 'Low digital awareness' stands in the third rank with a mean score of 3.91. The factor 'There is no security or protection' stands the fourth rank with a mean score of 3.86. Followed by the variable 'Illiteracy and its impacts' stands the fifth rank with a mean score of 3.73. The variable 'Internet scams are on the rise' stands in the sixth rank with a mean score of 3.48. 'Merchant acceptance is lacking' stands for the seventh rank with a mean score of 3.43. 'Small payments issues' stands for the eighth rank with a mean score of 3.30. Followed by the variable 'There are a few points of sale' stands in the ninth rank with a mean score of 2.54.

Table 4

Chi-Square Analysis Based on Consumer Awareness of AI in Cashless Transaction

S.No.	Statement	Gender	Age	Educational Qualification	Income
1	Before making an online purchase, read the terms and conditions	0.038*	0.163	0.061	0.572
2	Understanding of risks and threats	0.066	0.255	0.001	0.026*

Cont'd...

...Cont'd

S.No.	Statement	Gender	Age	Educational Qualification	Income
3	Before downloading any mobile applications, review the terms and conditions	0.000*	0.429	0.004*	0.025*
4	Determining whether the website's address starts with 'https://'	0.086	0.511	0.028*	0.410
5	Knowledge of security and privacy software	0.000*	0.047*	0.014*	0.026*
6	Knowledge of transactions made when utilizing public WiFi	0.030*	0.309	0.280	0.188
7	The use of OTP as a secure payment method	0.026*	0.957	0.015*	0.039*

Source: Primary Data.

Table 6 has a p-value of 0.05. Consumers' genders are associated with their willingness to read terms and conditions before engaging in online purchases and with their knowledge that such transactions should not be conducted via open WiFi. The level of education and monthly income of consumers is related to their awareness of the dangers and risks involved in online transactions. Before installing mobile applications, reading the terms and conditions is associated with gender, educational attainment, and monthly income; only educational attainment is associated with determining whether a website begins with 'https://' for security purposes. Gender, age, educational level, and monthly income are all related to ad-blocking and spy-detection software knowledge.

Evaluation of Findings

The research findings suggest that digital payment use has become increasingly popular because of the enormous number of smartphone users. There are numerous ways to send and receive money digitally, including 'Debit and Credit cards, Internet banking (NEFT/IMPS/RTGS), Mobile banking, Digital wallets, Aadhar Enabled Payment Service (AEPS), and Unified Payments Interface (UPI)'. Customers profit from the quickness and simplicity of digital transactions made possible by UPI since they are simpler to carry out. With the aid of AI and IT, this problem can be solved. The top-tech companies in the world are far away in this field. Thus, India has the first-mover advantage and can dominate financial technology. The Indian government is moving towards 'Digital India'; UPI provides perks, such as cashback, discounts, etc. to attract customers.

Conclusion

The 'Digital India programme' is the Indian government's main endeavour to make India a knowledge economy and digitally enabled society,

according to sources. Among other things, digital India is supposedly faceless, paperless, and cashless. India is getting closer to becoming a cashless society because of many available digital payment methods. According to the report, people are knowledgeable about digital payments. People think that cashless systems have few advantages, such as making it easier to trace currencies, helping to prevent money laundering and corruption, managing black money, and lowering banking costs. Thanks to IT and AI, people are solving problems with security, risk, and trust, and terms and conditions inform people of the dos and don'ts. Those who favour doing away with cash in all transactions believe that doing so will improve transactional transparency.

References

Aggarwal, K., S. Malik, D.K. Mishra and D. Paul (2021), 'Moving from cash to cashless economy: Towards digital India', *Journal of Asian Finance, Economics and Business*, 8(4), pp. 43–54.

Deepa, D. and V. Lalitha (2020). 'The reality of cashless economy in India', JAC: *A Journal of Composition Theory*, 13(1), pp. 86–92.

Dinh, T.L., Manh-Chiên Vu and A. Ayayi (2018). 'Towards a living lab for promoting the digital entrepreneurship process', *International Journal of Entrepreneurship*, 22(1), pp. 1–14.

Haq, M.B. and H. Tabrez (2014). 'Consumer response towards the usage of plastic money with an emphasis on increase of shift of plastic money in India by consumers from Credit cards to Debit cards', *International Journal of Multidisciplinary Research*, 4(5), pp. 93–102.

Mohd., S. (2020). 'Moving from cash to cashless: A study of consumer perception towards digital transactions', *PRAGATI: Journal of Indian Economy*, 7(1), pp. 1–13.

Setyanto, R.P. and W.A. Sunarjo (2021). 'Will cashless payment become consumer's transaction habit in the "new normal" era?', *Trikonomika*, 20(1), pp. 47–53.

Shah, A.M., N. Eisenkraft, J.R. Bettman and T.L. Chartrand (2016), 'Paper or plastic? How we pay influences post-transaction connection', *Journal of Consumer Research*, 42(5), pp. 688–708.

Sumathy, M., and Kp, V. (2017). 'Digital payment systems: Perception and concerns among urban consumers', *International Journal of Applied Research*, 3(6), pp. 1118–1122.

Yadav, P. (2017). i-Manager's Journal on Management, Research Papers. 12(1), pp. 7–14.

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Entrepreneurial Dynamics Towards Vision 2047

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CHAPTER

Perception and Buying Behavior of Consumers on Green Practices

Dr. P. Deivanai

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Abstract

The research is based on the green marketing strategies on consumer green products are becoming more popular, and people are becoming more conscious of them. The finding of this research is based on the consumer awareness on green items especially in urban areas because of the city lifestyle people are not adapted to the green purchasing because they are used to the common product or the brand they use on daily basis. In this research according to the data collection maximum people are aware of the green product the respondents are collected individually and also they are likely to pay a fair premium for eco sustainable items and due to corporate strategies that they portraying which is not green product so people are not trusting the loyalty and trust of the product. The research of the study is collected around certain number of responses and calculated the awareness, purchase intention and buying behavior of the consumers is collected based on the questionnaire. According to the knowledge therefore the green ecological behavior it's important to adopt due to the environmental concern and people's health wise and make aware how important to use on daily basis.

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INTRODUCTION

Going green does seem to have admirable qualities for several market participants. A good marketing strategy protects natural resources, developing countries, customers, production strategies, generic drug manufacturing techniques, and the distribution network.

The ecosystem's present status and prospects regarding global warming, air, water, and ecological restoration have all been clear benefactors of green marketing. Environmental issues might well be affected by green products. The combustion of fuel producing power and the use

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The ecosystem's present status and prospects regarding global warming, air, water, and ecological restoration have all been clear benefactors of green marketing. Environmental issues might well be affected by green products. The combustion of fuel producing power and the use

of carrier containers are two main causes of global warming. Sustainable marketing initiatives mainly focus on product development strategies to reduce the need for alternative sources of energy. For example, innovative components are designed with gasoline efficiency improvements that noticeably consume less energy.

This research survey is based on the consumer's behavior and their purchasing attributes on green products and also the study is concentrated on how the consumer is following the green products based on their lifestyle. It will help to know the green items are important to our daily basis. Making aware how the chemical products bring side effects to living beings and also to the environment like water, air and soil. To understand the purchase behavior of the consumer nowadays the consumer are moving to the trend of green items at the same time they are not used to it they are getting comfort with non-green products.

In this study we are making awareness on value of eco-behaviors and individual interests on green items and their usage on daily basis and educating the people about the importance and creating awareness on urban areas due to the limited usage of green items in urban areas more than rural areas.

Statement of the problem

Green marketing has become the driving force behind the business strategies in the marketing to come up due to the environmental concern by introducing the personal care products and household care products. In urban areas still some of the people are not used to the green items due to the lifestyle making awareness to the people and because of the business strategies that they portraying which is not green product so people are not trusting the loyalty and trust of the product. At the same time people are interested in paying more to the green items because they have the concern on their family by choosing the traditional product to their family and influencing them.

- What are the marketing strategies that influence consumer to purchase green products?
- What are the motives that attract the consumer's intention on green based products?
- What type of shops they preferred by consumer to purchase green products?

Objectives

- To analyze the consumer awareness about green practices.
- To make significant survey and analyze the consumer most preferable shops.
- To analyze pre purchase and post purchase behavior of the customer.

Literature Review

1. **Mohd. Danish Kirmani (2007)** Consumer Attitude towards Green Products in India an Empirical Investigation" The results of this study can assist sustainable product manufacturers with implementing ideas to safeguard the environment and the role of businesses in the current environmental catastrophe. Particularly in the Indian environment, the impact of internet in business practices it easily adapt the people's thinking about the green products. According to this study due to health awareness people shift to normal products to traditional usage and also they demand on green items only and also ready to pay for the green items.

2. **Bhatia, Mayank (2007)** "Impact of Green Marketing Practices on Consumer Behavior Study with reference to Consumer Durable Goods in India". The aim of the study for a cleaner safer environment issues and challenges with respect to green marketing to analyze the consumers and purchasing behavior of the people to know the importance of the green items benefits to their life and also the surroundings benefits to breathe clean air and also the government possess the importance of using the green items. It includes broad range of activities by introducing the consumer to purchase the green items how important to their day to day life following government norms and regulations in day to day life.
3. **Gupta Ashwini Kumar (2007)** "Green marketing in India" Green marketing strategies like following certain Designing for the ecosystem, positioning for the environment, disposing of the environment, and environmental costing, logistical sustainability and what were the dimensions of the link between brand image developed by companies and corporate performance, and where do they execute individuals? And introducing fundamental principles of green products for a safer environment and following the sustainable fashion and recyclable products so that least damage is caused to nature and the environment. This article outcome is to disposal of the products, development, manufacturing and consumption.
4. **Shashikala, K (2007)** "Concern about the environment In order to meet future demands for socially and ecologically responsible corporate behavior, industry must include environmental principles into its operational strategy An evaluation of green marketing policies and practices-A study with reference to selected companies in Karnataka" they are concern about the future environmental and following the traditional marketing it reaches easily to the consumers and audience. To engage their audience and increase their reach, businesses employ marketing channels such as print, broadcast, telemarketing, and direct mail.

Research methodology

Research is an informative action, and inherently the term should be utilized from a specialized perspective. Research is an action of given new ideas, to tackle an issue about a theory or practice.

Research design

In the current investigation, both primary and secondary data were gathered. The present study has collected from the people's individual opinion in Coimbatore district based on rural and urban areas. It is collected in the form of questionnaire.

Sample size

The sample size is collected around 211 responses and convenience sampling is used. The study is targeted on rural and urban areas of Coimbatore district.

Tools of Analysis

The raw data collected and carefully classified, edited and tabulated for the present analysis the analysis was done based on percentage analysis, factor analysis, cross tabulation were used in this study.

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Simple percentage

Percentage analysis used to show the distribution of the respondent based on variables. The percentage analysis is the simple frequency and descriptive analysis over the selected circumstances.

$$\text{Percentage of the respondents} = \frac{\text{No.of respondents}}{\text{Total no.of respondents}} \times 100$$

Cross tabulation

Cross-tabulation is utilized to quantitatively examine the connection between various factors. It shows how relationships change starting with one variable gathering then onto the next. It results from sub-gatherings of review respondents.

Factor analysis

Factor analysis is a statistical tool for depicting changes among observable variables that is used to measure them. The principle component analysis was applied to arrive variable having Eigen value greater than one were selected for analysis and communality is calculated to show how much of each variable is accounted.

Reliability analysis

The properties of measuring scales and the items that help compensate the scales may be studied using reliability analysis. The reliability analysis technique produces a variety of regularly used scale reliability metrics as well as information on the correlations between specific scale items.

Chi-square test

The chi-square test is among the most basic and widely used statistical significance. In this case study it was used to examined the relationship among socio-economic profile as well as green goods purchase habits.

Analysis and Interpretation

Data collected from primary sources was analyzed using percentage analysis, factor analysis, cross tabulation and reliability analysis. These collected data are processed to make them useful to turn into information. To know the consumer awareness and buying behavior towards green products.

Cross tabulation

Classification of source of information about green products based on occupational status.

The Table 1 exhibits that the Occupational status of the respondent and the source of information about green products. The Occupational status of the respondent is classified into five categories. They are as follows: Student, Business, Professional, Employee and Housewife. The following Table 1 explains the classification of the respondent based on the career status and the source of eco-friendly product information.

Figure 1 Cross tabulation of occupational status and source of information

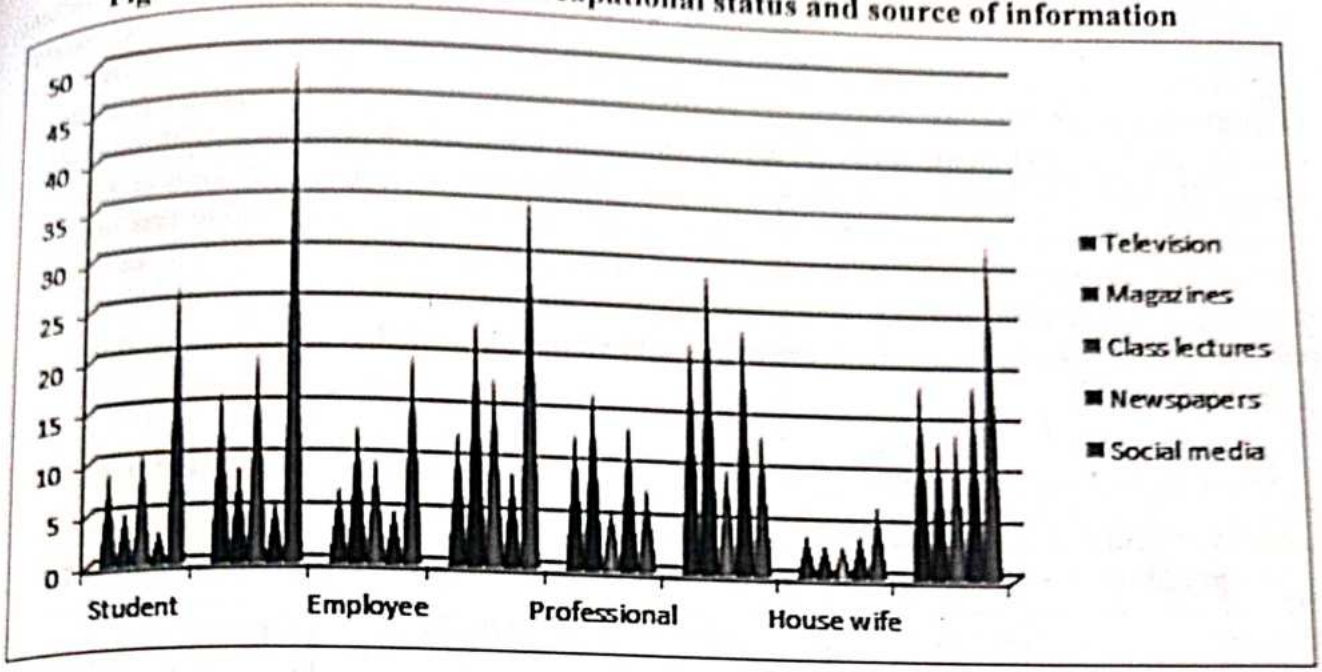


Table 1 Classification of source of information about green products based on occupational status

Occupation	Sources of information					Total
	Television	Magazines	Class lecture	Newspapers	12Social media	
Student	9 (16.40)	5 (9.10)	11 (20.00)	3 (5.50)	27 (49.10)	**55 (26.06)**
Employee	9 (26.50)	7 (20.60)	5 (14.70)	7 (20.60)	6 (17.60)	**34 (16.11)**
Professional	13 (22.40)	17 (29.30)	6 (10.30)	14 (24.10)	8 (13.80)	**58 (27.48)**
House wife	4 (19.00)	3 (13.60)	3 (14.30)	4 (19.00)	7 (33.30)	**21 (9.95)**
Business	1 (4.50)	3 (13.60)	5 (22.70)	2 (9.10)	11 (50.00)	**22 (10.42)**
Total	**34 (16.10)**	**41 (19.40)**	**35 (16.60)**	**28 (13.30)**	**73 (34.60)**	**211 (100.00)**

(Figures in the parentheses are the percentage to respective row total)

Source: Primary data

From the Table 1 exhibits the Occupational status of the respondents and the source of information based on green products. The majority 27.48 percentages of the respondents who were a professional, among these the majority of (29.30) percentage of the respondents are aware through magazines. The next majority of (24.10) percentage of the respondents are aware through newspapers. The next majority of (22.40) percentage of the respondents are aware through television. The majority 26.06 percentages of the respondents who were a student, among these the majority of (49.10) percentage of the respondents are aware through social media. The next majority of (20.00) percentage of the respondents are aware through class lectures. The next majority of (16.40) percentage of the respondents are aware through television. The Table 6 concludes that the majority of the respondents are aware and gaining knowledge about the green product on magazines.

Table 2. Association between Socio-economic profile and Sources of Information

Socio-economic profile	Chi-square	Degrees of freedom	Pearson's P value	Significant/ Non-Significant
Gender	9.184 a	4	0.057	Significant
Age	15.566 a	12	0.212	Non-significant
Residential area	7.814 a	4	0.099	Significant
Occupation	34.667 a	16	0.004	Significant
Nature of family	9.381 a	4	0.052	Significant

Significant (P values <=0.05); Not Significant (P values>=0.05)

Source: Primary data

The hypothesis result is accepted in four circumstances, namely gender, residential area, employment, and family nature, as shown in Table 9. The hypothesis result is not accepted in only one case that is age. It is concluded that gender, residential area, occupation and nature of family of the respondents have a tremendous impact on the information source of green products.

Classification of kinds of green products based on residential area

The Table 3 depicts the surrounding residential categorization and types of green products. The respondent's residential area is divided into two groups. They are classified as: Rural area and urban area. The following table illustrates the respondent's classification based on their living region and a range of environmentally friendly goods based on customer choice.

The categorization of different types of green items depending on residential area is shown in Table 3. The majority of respondents who live in urban centers 83.88 are inclined to favor green products of various types, among these the majority of (33.89) percentage of the respondents preferred shops based on beauty products. The next majority of (32.20) percentage of the respondents are preferred shops based on personal products. The next majority of (18.64) percentage of the respondents are preferred shops based on home care products. The responders who reside in remote areas (rural) majority of 16.11 percent of the total were likely to prefer kinds of green products, among these the majority of (41.17) percentage of the respondents are preferred shops based on home care products. The next

majority of (32.35) percentage of the respondents are preferred shops based on personal products. The next majority of (18.64) percentage of the respondents are preferred shops based on home care products. Table 3 concludes that the majority of respondents choose outlets that provide green items such as home care products.

Table 4 Association of the socio-economic profile and kinds of green products

Socio-economic profile	Chi-square	Degree of freedom	Pearson's P-value	Significant / Non-Significant
Gender	2.781 a	3	0.427	Non-Significant
Residential area	9.739 a	3	0.021	Significant
Educational qualification	25.546 a	12	0.012	Significant
Marital	1.864 a	3	0.601	Non-Significant
Occupational	14.895 a	12	0.247	Non-Significant

Significant (P values <=0.05); Not Significant (P values>=0.05)

Source: Primary data

The hypothesis result is accepted in two circumstances, namely, residential area and educational qualification, as shown in Table 4. In three circumstances, namely gender, marital status, and occupation, the hypothesis result is not accepted. It is determined that the respondents' living location and educational qualifications have a substantial impact on the types of green products.

Table 5. Reliability and normality statistics

Factor	Items	Skewness	Kurtosis	Cronbach Alpha	Mean	SD
Environmental conscious	5	0.123	0.027	0.757	2.348	0.695
Price	4	-0.593	-0.179	0.733	3.728	1.171
Health	5	0.313	-0.179	0.842	2.424	0.735
Tradition	4	-0.495	-0.850	0.785	3.355	1.144
Individuality	3	0.046	0.198	0.727	2.426	0.721

Cornbach alpha

The Table 5 shows alpha coefficient of Cronbach's alpha ranges from 0.727–0.842. All the items are considered acceptable for this study. The health factor has higher consistency with the value (0.842). Furthermore the other four dimensions have a value, which indicates that they are reliable. Hence all the values are acceptable.

Skewness and Kurtosis statistics

To determine the data's normality, skewness and kurtosis were determined. If all of these descriptive variables, skewness and kurtosis, are less than or equal to + or –1, the distribution is

within the normal range and can be deemed normal. If the values are larger than or equal to + or −1, the distribution is beyond the normalcy range and cannot be termed normal. All the skewness and kurtosis statistics in the above falls between +1 or −1 which implies that the distribution is considered as normal. Thus, the normally statistics of skewness and kurtosis is accepted.

FACTOR ANALYSIS

Factors influence on lifestyle based on tradition and individuality

The factors influence on lifestyle on green products on individual consumers in Coimbatore district.

Table 6

	Variables	Factor1	Factor2	Factor3
LF1	**Environmental conscious:** I buy re-cycled products		0.786	
LF2	I throw garbage in selective containers	0.686		
LF3	I switch over from product to product for ecological reason		0.651	
LF4	I am willing to pay more for quality rod-ucts	0.678		
LF5	I try to protect environment by purchase quality products	0.679		
LF6	**Price:** I look for offers and coupons	0.591		
LF7	I watch by budget carefully	0.609		
LF8	I encourage my family to adopt environ-mentally friendy behaviors	0.619		
LF9	Health of my family depends on the healthy food I serve	0.729		
LF10	I plan menu for family consumption	0.695		
LF11	**Health:** I always avoid food products with additive and fast food	0.720		
LF12	I try to eat fruits and vegetables	0.503		0.511
LF13	**Tradition:** I would like to eat traditional food		0.725	
LF14	I do not pay attention to advertisements			0.757
LF15	Following green based appliances		0.553	
LF16	**Individuality:** I am not easily affected by other people's opinion			0.730

LF17	I do sometimes influence what my friends buy		0.557	
LF18	I like to take individual responsibility in purchasing environment friendly purchase			0.715
	Eigen values	8.434	46.860	46.860
	Percentage of total variance	1.320	7.332	54.192
	Cumulative percentage of variance	1.158	6.434	60.626
	Extraction method	Principal component analysis		
	Rotation Method	Varimax with Kaiser Normalization KMO and Bartlett's Test		
	Kaiser-Meyer-Olkin Measure of sampling Adequacy	0.918		
	Bartlett's Test of Sphericity: Approx. Chi-square	2030.130		
	Df	153		
	Sig	0.000		

Source primary data:

It is noticeable from Table 3 that the factors influencing customer purchasing behaviour persuade people to purchase ecological items.Factor analyses on 18 major factors are analyzed in this thesis. Principle component with a varix and Eigen value were used for this study which the value is more than 1. The suitability of factor analysis was validated with the help of Kiser-Meyer-Olkin measure of sampling. Adequacy was 0.918 and Bartlett's test of sphericity (2-2036.130, $p<0.000$).

Findings

A. Factor analysis findings

- ✓ Health of my family depends on healthy food I serve (0.729) avoid fast food with additive food products (0.720), planning menu for family consumption (0.695), have large positive loadings on factor 1, so this factor describes health was more influencing in green products.
- ✓ Buying only recycled products (0.786), shifting product to product for ecological reason (0.651), has a positive loading on factor 2, so this factor describes environmental conscious.
- ✓ They are not easily affected by other people's opinion (0.730), individual responsibility in purchasing environment friendly products (0.715), has a positive loading on factor 3, so this factor describes individuality.

B. Findings of reliability test

- ✓ The majority of health convenience factor has a highest level of consistency with the value of 0.842.
- ✓ The majority of 0.785 cronbach value has been accepted for the reliability traditional factor.
- ✓ The majority of cronbach value of 0.757 has been accepted for the reliability consistency with the environmental conscious.
- ✓ The majority of price value with the cronbach value 0.733 has been accepted for the reliability consistency
- ✓ The majority of individuality factor with the cornbacth value of 0.727 has been accepted for the reliability consistency.

Classification based on Cross Tabulation

A. Source of information

- ✓ With regard to the age of the respondents who are aged 21-40 years with the majority of 38.20 percentages (n = 42) are aware through social media.
- ✓ With regard to gender classification the male respondents with the majority of 30.40 percentages (n=38) are aware through television.
- ✓ As an occupation, the majority of professional with 29.30 percentages (n=17) are aware through magazines.
- ✓ Based on the classification of nature of the family, who were living on a nuclear family are aware through television with the majority of 33.30 percentage (n=39).
- ✓ In relation to residential area, the respondents who were residing on a urban area with the majority of 37.90 percentage (n=67) are aware through social media.

Findings of chi-square test

- There is a major relation between gender and information sources.
- There is no significant statistical link between age and information sources.
- There is a link between the nature of a family and the sources of information.
- There is a major link between profession and information sources.
- There is a major link between the residential area and the information source.

Preferable shops

- ✓ With regard to the age of the respondents who are aged 21-40 years with the majority of 24.54 percentages (n=42) are preferred other category.
- ✓ With regard to gender classification the male respondents with the majority of 28.00 percentages (n=35) are preferred for green appliances store.
- ✓ On the basis of annual income, the respondents who were under the category of 2.5–5.5 lakhs with majority of 29.70 percentages with the respondent (n=30) are preferred for green appliances store.

- On the basis of educational qualification, the respondents who were under the category of post graduate with the majority of (26.86) percentages (n=18) are preferred for food and nature store.
- Based on the classification of residential area, who were living in the urban area with the majority of (25.98) percentages (n=46) are preferred shops for green appliances store.

Findings of chi-square test

- Gender and information sources have a strong relationship.
- No statistically significant correlation exists between age and information sources.
- There is a relationship between a family's nature and its information sources.
- A strong correlation exists between occupation and information sources.
- The residential area and the information source have a strong connection.

Implications of the study

- Advertising the benefits of green household appliances and other allied products would attract homemakers towards purchase/consumption of green products.
- To attract the rural oriented lifestyle consumers, the organization need to create awareness through communicating positive information about green products in promotional campaigns.
- The preference of green products among consumers can be enhanced by quoting the significance of environmental benefits in the product label.
- Under educational qualification, the respondents who have studied up to school level are not health conscious due to the attraction of junk food. Hence marketing practitioners and institutional authorities should quote the importance of green foods in diets among students.
- The limited usage of green products due to high cost and unsure brands was observed in this study. These drawbacks can be solved by offering products suited to all income classes and providing detailed information on product features.

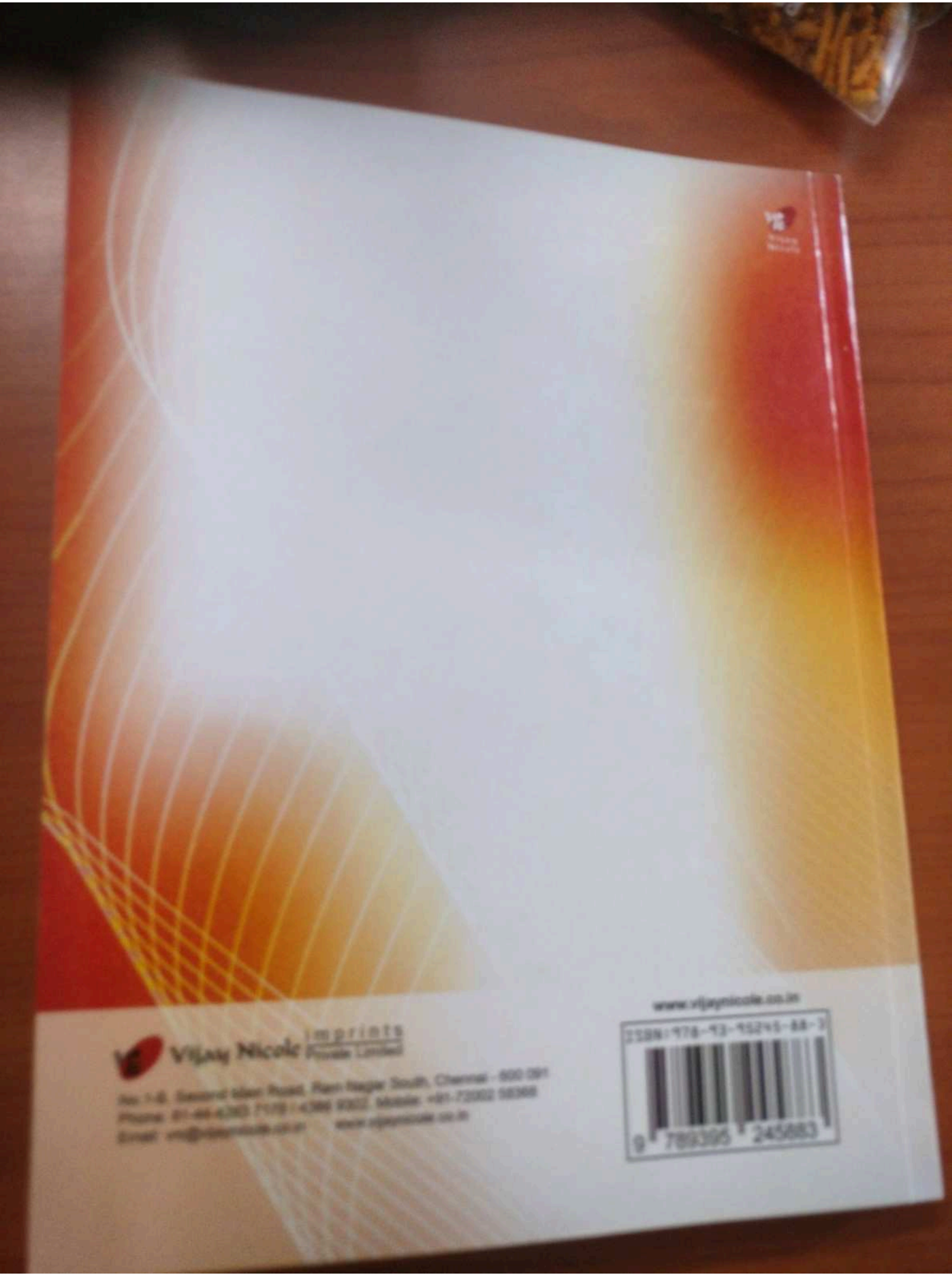
CONCLUSION

People are aware of green products and they do purchase but there is lack of trustworthiness in buying because they use the term green image on the product but the ingredients are not green products and more unfamiliar brands. In this paper, portrayed that consumer awareness and purchasing behavior most of them are preferred to move with green products and appliances which is environmental friendly and also they are influence on the social media with the majority of 110 percentages in youth generations are motivated and influenced. The study has been tried to say the issues being faced to the society and concern about the environment every individual should get aware and move on to green products and have a healthy lifestyle.

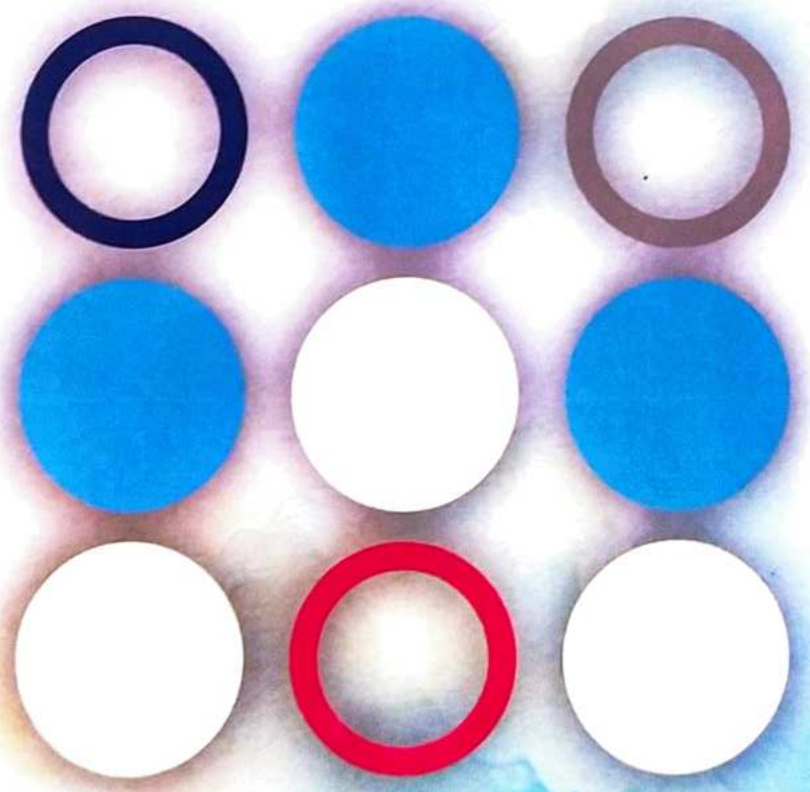
References

1. Ali Tezer, H Onur Bodur (2019). The green consumption effect: How using green products improves consumption experience Journal of consumer research, (JCR) 47, (1), pp. 25-39.

2. Shri ram (2020). Research trends in green product for environment: A bibliometric perspective International Journal of environmental research and public health 8469(17), pp 1-21.
3. N.Divyapriyadarshini (2019). Consumer awareness towards green products and its impact International Journal and Innovation in Social science (IJRISS), 3, (10), pp. 2454-6186.
4. Yeowkaryan & Rashad Yazadanifard (2014). The concept of green marketing and green product development on consumer buying approach, Global Journal of Commerce & management perspective (GJCMP), 3, (2), pp.33-38.


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Impact of the COVID-19 Pandemic on the Growth of UPI

Sukritha K.R. and Vimala V.

Introduction

Since demonetization in 2016 until the negative effects of COVID-19, the digital payment sector in India has grown steadily (Mishra and Ghumre, 2022). In place of physically transferring money, digital payments use online or digital platforms to conduct financial transactions between two or more parties. It is a platform that enables round-the-clock payment and receipt of money throughout the globe via computer or mobile device without the need for any physical contact. Since the COVID-19 pandemic, which resulted in full lockdown regulations that forced all economies to suffer a setback, the concept of digital payment has existed for a decade but is now trending more quickly, particularly in Indian towns and villages (Singhal, and Gupta, 2021).

The Indian government has placed a strong emphasis on digital payment systems as a part of the Digital India project. The government launched numerous new digital payment methods through the National Payments Corporation of India (NPCI) in order to improve and advance the settlement of the digital payment system. In this regard, it introduced several products and services. The unified payment interface (UPI) is one among them (Joshi, 2017). NPCI developed this mobile payment platform with a single-window system. It prevents the necessity to repeatedly insert sensitive data, such as bank account information, for the customers (Jawade, and Suryavanshi, 2021).

Review of the Literature

Somanjoli Mohapatra (2017) studied that all NPCI systems have a common interface, which improves interoperability and the customer

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11 CHAPTER

Growth Performance of Bharat Bill Payment System (BBPS) Services

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Abstract

All retail payment and settlement operations are governed by the National Payment Corporation of India (NPCI). A significant portion of retail payment transactions includes paying bills. Bharat Bill Payment System is an ecosystem developed by the Reserve Bank of India (RBI) and operated by the National Payments Corporation of India (NPCI).It is a one-stop ecosystem for all recurring bills, offering all customers in India a reliable, secure, and interoperable "Anytime, Anywhere" recurring payment service. It accepts a variety of payment methods and offers immediate SMS or receipt confirmation of payment along with the Be-assured mark. Hence, it has been determined that the current players (both banks and non-banks) who serve the needs of bill payments along with the consolidation of payment services would be a part of BBPS. By transferring bill payments from cash to electronic channels, it would facilitate the transition to a cashless society. This study provides an overview of the Bharat Bill Pay System (BBPS) in India, with the aid of secondary data, the study analysesthe growth of BBPS and the performance of Biller categories in BBPS.

Keywords: BBPS, NPCI, RBI, Cashless, Bill Payments.

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INTRODUCTION

India is experiencing a massive digital transformation. The payment system will become more digital as society moves towards a cashless future (Sumathy & Vipin, 2017). Due to consumer demand for less expensive alternatives to traditional financial services, technology in the financial services sector is essential for the survival of organisations (Nagarjuna, 2019). Using digital payments helps governments save money and promote transparency while also lowering the cost of processing payments. Additionally, when tax receipts increase along with the enhanced documentation, transparency, and general economic growth that digital payments bring about, the

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Revolutionizing Payments: The Strategic Role Of Financial Technology In India's Digital Economy

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Abstract

Financial technology, or fintech for short, is the application of technology to innovative financial services and solutions. The fintech sector uses technological innovations in blockchain, artificial intelligence, software, mobile apps, and other areas to improve and streamline a range of financial operations. India has been regarded as a major global hotspot for financial technology innovation throughout the past ten years. Governments, investors, and multinational corporations are interested in investing in this space and interacting with the ecosystem to create a Fintech-enabled India. Despite the global economic issues, India's digital payment industry has experienced exceptional growth, demonstrating the resilience and promise of its fintech-driven ecosystem.According to a recent report from Matrix Partners and Boston Consulting Group, as market demand grows based on financial inclusion, Indian fintechs are predicted to generate revenue to the tune of $190 billion by 2030. Building more inclusive and effective financial services and fostering economic development are made possible by the continuous digitization of financial services and money.The study endeavors to examine the key components of fintech, highlight its relevance, and explore the connection between financial technology and digital payments.

Keywords: Fintech, Financial Services, Digitization, Digital Payment

Introduction

The terms "financial" and "technology" are combined to form the term "fintech". In order to improve and automate financial services and procedures, technology is used, frequently in the form of software, applications, and other digital tools. Technology that lowers or does away with the expenses associated with financial intermediation is referred to as fintech (Das, 2019). Innovative solutions in banking, payments, lending, insurance, investing, and other areas are offered by fintech companies through the use of technology. The efficiency, affordability, and accessibility of financial services are the three main objectives of fintech. Through the provision of technologically sophisticated and user-friendly alternatives, fintech companies frequently pose a threat to established financial institutions. Digital

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EXPLORING THE RISING DEMAND FOR ESG EXPERTS IN CORPORATE DECISION-MAKING AND SUSTAINABLE INVESTING

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Abstract

In recent years, there has been an apparent shift in corporate landscapes towards sustainable practices, with Environmental, Social, and Governance (ESG) considerations gaining unprecedented prominence. This research article delves into the escalating demand for ESG experts in corporate decision-making and sustainable investing, aiming to unwrap the factors driving this surge and its implications for businesses and the broader financial system. Through an extensive review of corporate practices, investor behavior, and regulatory landscapes, the research identifies key catalysts boosting organizations to prioritize ESG factors in their strategic decision-making processes. Furthermore, it explores the

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T. S. Dhandapani Chettiar Chair
in the Field of Social Sciences
& Department of Economics
Avinashilingam Institute for Home Science and Higher Education for Women



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Unlocking ESG Investment: A Guide for Analysing BRSR for Sustainable and Ethical Investment Decisions

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Abstract

The need for legitimate ESGinformation has significantly increased as sustainable investment gains pace and investors increasingly want to match their financial aims with ethical and environmental issues. Theshortcomings of conventional financial indicators in capturing non-financial risks and opportunities are to be considered, and it makes a compelling argument for incorporating ESG data into investment decisions. The paper describes an approach for efficiently analyzing BRSRs of Indian companies and intends to reveal the opportunities for making wise decisions on sustainable investment. It suggests ways to validate data from reliable sources, lowering the possibility of distortion and greenwashing and helps to unleash the actual potential of ESG investments, by bridging the gap between the availability of ESG information and educated investment decisions. Besides, it provides valuable insights for all the stakeholders interested in advancing corporate sustainability practices, promoting responsible business conduct and thereby contribute towards accomplishing SDGs.

Keywords: ESG, Investment, BRSR, Sustainability, Ethical & SDGs.

About Editors



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Dr. Malarvizhi. V is an Associate Professor of Economics in Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore-43. With 19 years of teaching experience she has presented 60 papers in International, National and Regional level Seminars/Workshops/ Conferences. She has published 72 articles in Journals. She has edited 3 books and special editor in 4 International Journals. She is the Content Writer and Camera Presenter for 2 modules e-PG Pathshala project. She has conducted one International conference, 3 National Seminars and one FDP. She has guided M.A/ M.Phil/ Ph.d students and completed one Major Research Project funded by ICSSR. She acted as a Chairperson/ Rapporteur in the International and National Conferences. She is a reviewer for International Journals. She received two excellent paper awards. She also serves as a Captain in National Cadet Corps (NCC) in the same Institution.



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About Book

In the global pursuit of equitable progress, the empowerment of women emerges as not merely an ethical imperative but a pragmatic necessity. The imperative of women's economic empowerment finds resonance throughout history, woven into the fabric of social movements, policy reforms and economic progress. From the suffragette movements of the late 19th and early 20th centuries to the landmark conventions on women's rights and development in the latter half of the 20th century, the trajectory of gender equality has been marked by both triumphs and trials. The 1995 Fourth World Conference on Women in Beijing stands as a watershed moment, galvanizing global commitments to women's empowerment and setting forth an ambitious agenda for action. Subsequent milestones, including the adoption of the Sustainable Development Goals (SDGs) in 2015, further underscore the intertwined nature of gender equality and sustainable development. Over the years though the researchers, academicians and Government have tried to find ways and means for economic empowerment of women, many aspects of women's economic empowerment, entrepreneurship and innovation, workplace equality, global partnership etc are yet to be completely resolved. Little attention has been paid to the above aspects by the researchers, policy makers and development planners. The present volume titled "Economic Empowerment of Women for Sustainable Development" containing 35 papers covers different aspects and issues related to economic empowerment of women and sustainable development. It is an initiative for shedding light on the pivotal role women play in fostering sustainable economic development.The main themes which the volume covers are: financial inclusion, education and skill development, technology and digital inclusion, leadership, decision making, policy and advocacy. The volume will provide women's immense input and health for the academicians, researchers, policy makers and Government officials.

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A Study on the Impact of Kudumbashree Mission on Rural women Entrepreneurial Aspirations

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Abstract

Given that a sizable portion of the population resides in rural areas, rural economic development is crucial in emerging nations like India. Women are in charge of developing the rural economy. They devote a large percentage of their money to provide for the needs of the family. The state of Kerala launched Kudumbashree as a campaign to end poverty there. It encourages women to take part in various economic initiatives that raise both their own and their dependents' standards of living. The purpose of this study is to determine how the Kudumbashree mission has impacted women entrepreneurs and how satisfied they are to be a part of the Kudumbashree. Correlation and regression methods were used to analyse data and discovers that women business owners are more influenced by the Kudumbashree promotional help. Since the Kudumbashree raises their standard of living, they are pleased with it.

Key words: *Kudumbashree Mission, Rural women entrepreneurial aspirations, Start-Up Village Entrepreneurship programme, standard of living.*

Introduction

In India, there is a significant discrepancy in economic development between rural and urban areas. The fundamental reason for this is because rural communities specialise in agriculture. While industries are concentrated in cities. Agriculture tends to develop at a slower rate than industry. It widens the income gap between rural and urban areas. In this context, rural industrialisation through rural entrepreneurship is an excellent means of hastening the rural development process. (Khanka, 2016)Entrepreneurship comes before industrialization. The formation of a new business in a rural region that provides a new commodity, services, or creates a unique market, or employs current technology, is referred to as rural entrepreneurship. It generates direct job opportunities, encourages a more appropriate allocation of revenue, allows for the effective mobilisation of undiscovered investment and talent, and promotes the development of villages, small towns, and economically disadvantaged areas. This also contributes to the development of a more balanced regional economy

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ARE NBFC-MFIs EXTENSIVELY OUTREACHING IN THE INDIAN MICROFINANCE INDUSTRY

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ABSTRACT

The microfinance sector played a significant and leading role in the country's economic development. Entrepreneurship is the process of starting a business. The outcome of processes is the enterprise, which is composed of individual business units. NBFC-MFIs play an important role here by assisting micro entrepreneurs with funding assistance. Through microcredit Non-banking financial companies have been playing an increasingly important role in alleviating poverty in rural areas and underprivileged areas of society. In order to measure the outreach of NBFC-MFIs, microfinance institutions are measured by their performance. The outreach efforts of MFIs also focus on extending loans and financial services to borrowers. By providing self-employment opportunities and facilitating income generation to the most vulnerable sections of society, microcredit can be viewed as making a positive impact on empowerment and entrepreneurship. Due to high competition among Microcredit service providers, it is time to know NBFC-MFIs outreach in Microcredit. The disbursement of funds required only social collateral, not physical collateral, which gives NBFC-MFIs a wide scope for expansion. The present paper is an attempt to study the outreach of NBFCS-MFI in promoting micro entrepreneurship.

Keywords: Entrepreneurship, Microfinance, Microcredit, NBFC-MFIs, Outreach

INTRODUCTION

The NBFC-MFI category was introduced in 2011 as a new category in the NBFC sector, in order to reach the undeserved in Microfinance. The microfinance industry is composed of NBFC -MFIs, Banks, SFBs, NBFCs, and Non-profit MFIs. (MFIN annual report 2020) Among NBFC-MFIs is play an important role in providing financial assistance in the form of microfinance and enabling borrowers to build assets and acquire self-employment (Goel R.& Aggarwal M 2020) These are the companies a diverse group of financial intermediaries that serve as an alternative channel of credit for the Indian economy amid the banking monopoly (Mohan, B. 2014) NBFCs are a significant player in the Indian financial system by providing credit to low-income people and solidarity lending groups for self-employment and wealth creation (Shah, S R.& Chacharkar D Y, 2020). Small local borrowers and the unorganized sector benefit from the credit provided by these companies. Microfinance is a crucial component of the economic development of any country. There are many channels that provide microfinance credit to people, among them NBFC-MFI are very effective channels of giving small loans to the poor and underprivileged section of the society.(Roy P& Patro B 2021). The NBFC-MFI's most important responsibility is empowering vulnerable sections of society. The mission of MFIs is to provide loans to individuals and small businesses from poor strata of society.,



INTEGRATING ADVANCEMENTS IN EDUCATION, AND SOCIETY FOR ACHIEVING SUSTAINABILITY

RESEARCH AND EVIDENCE-BASED STRATEGIES FROM THE DEVELOPING WORLD

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3 Awareness and Agitation of Women Investors towards Derivative Market

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Abstract: Global finance has modified dramatically in current decades. Electronic processing, globalization, and deregulation have all converted markets, with most of the maximum crucial modifications related to derivatives. The by-product marketplace is newly begun in India and it isn't always recognized by every women investor, so there are numerous steps taken to create attention amongst women traders approximately the derivative segment. It is important for an investor to stay updated about these financial instruments if they are to stay in the game. Therefore, this study focuses on the "Awareness and Agitation of Women Investors towards Derivative Market", through which the women investor's investment behaviour is given much importance because much of the focus has been on the role played by small investors in the markets. The retail investors actually increase the price efficiency of the stock and their entry into the market also increases liquidity.

Keywords: Derivative markets, Women investors, Awareness, Agitation

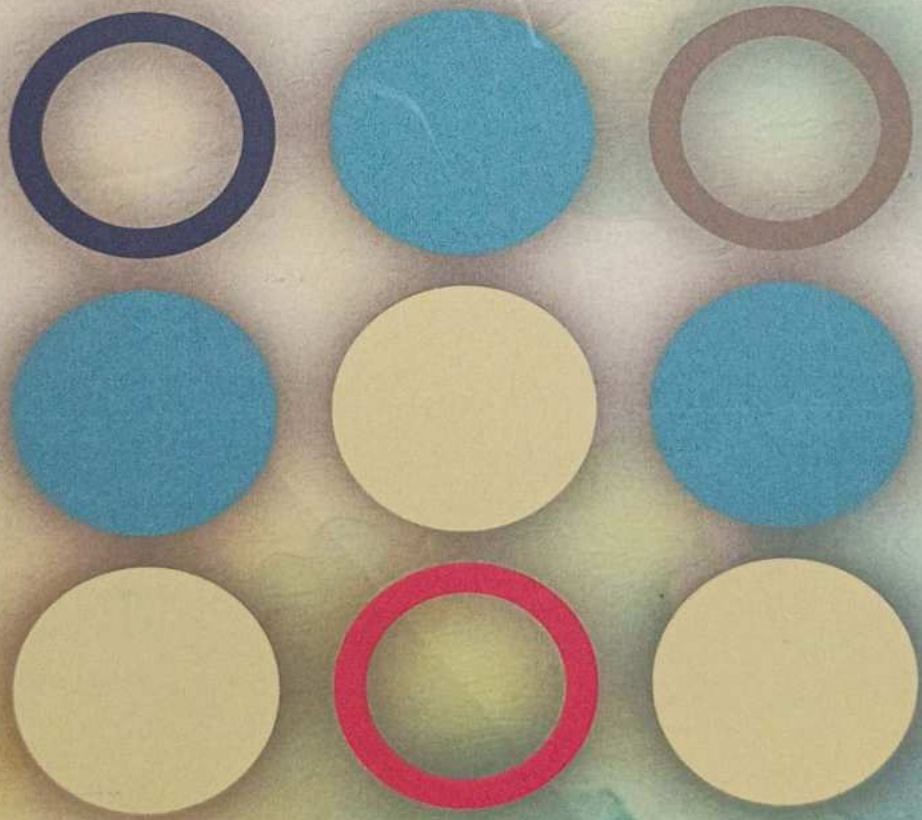
1. Introduction

A derivative is a monetary tool that has a price decided with the aid of using the rate of the underlying asset. The term "Derivatives" means there is no independent price, *i.e.*, their prices are completely got from the price of the underlying asset. The underlying asset may be securities, commodities, bullion currency, livestock, etc. In different words, derivatives imply forward, futures, options, and different hybrid contracts, related for the motive of settlement success to the price of a designated actual or monetary asset or to an index of securities.

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TECHNOLOGY REVOLUTION AND INDIAN INDUSTRY



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Online Trading

A Boom for Investors

Mageswari S.S. and Sasirekha P.

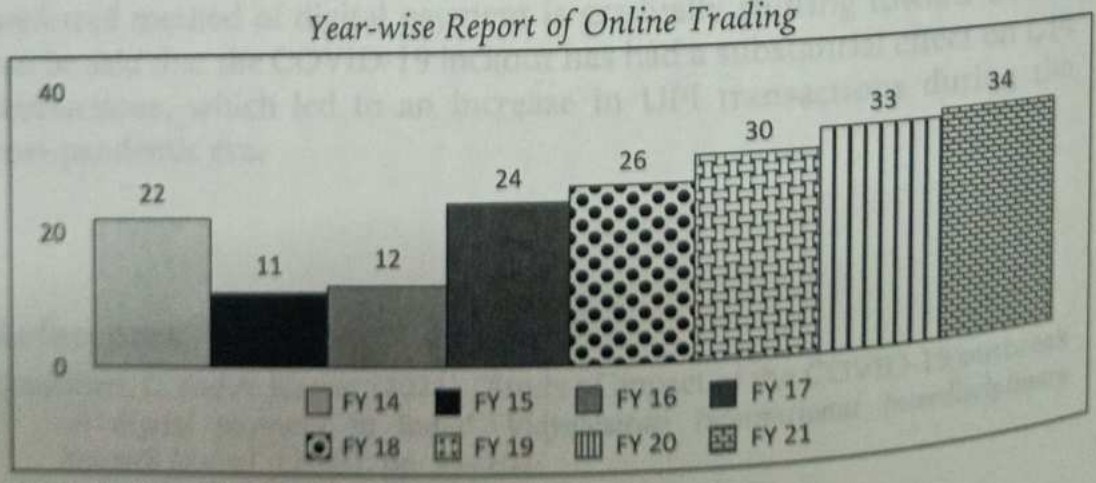
Introduction

Online trading is a platform that allows anyone to purchase and sell shares, money, and other commodities from the comfort of their own home. Special knowledge and training are optional to use the online platform. Online trading has changed how the market operates and how investors access the market. In almost every nation, trading has moved online. The National Stock Exchange (NSE) and the Bombay Stock Exchange successfully carry out online trading.

Before online trading became popular, traders had to call their brokerage firms to place 'buy' and 'sell' orders so that they could carry out trades (Singh and Malhotra, 2020). It used to be a lengthy process that

Figure 1

Year-wise Report of Online Trading



Source: NSE, 2022.

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Technology Magnification in Taxation Through GST

An Overview

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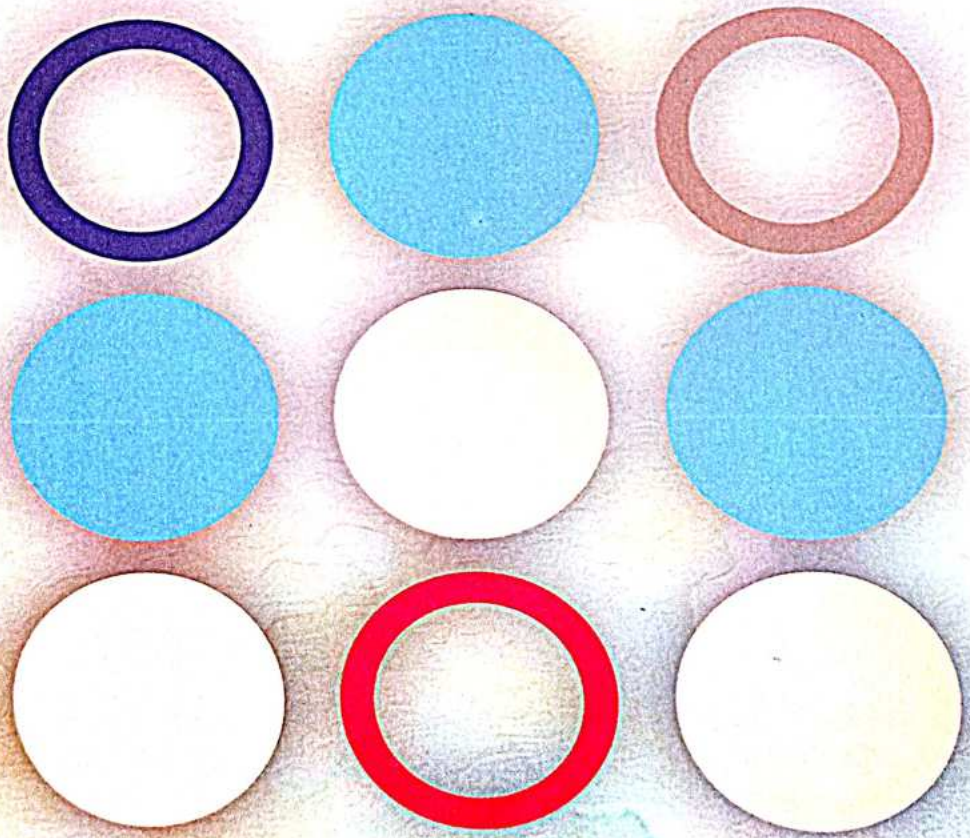
Introduction

The government of any country needs funds to carry out its duties, such as overseeing organizations, building infrastructure, and funding public projects. The majority of the government's funds come from taxes. India has two main tax systems, i.e. direct tax and indirect tax, similar to other nations. Instead of taxing individual income, indirect taxes are levied on products and services. In the past, these levies frequently led to increased consumer costs and a convoluted system of various taxes. However, the taxation structure underwent a dramatic upheaval on 1 July 2017, when the Goods and Services Tax (GST) was implemented in India. The GST shortened the procedure and replaced several indirect taxes. It is a comprehensive tax that is imposed at every stage of production and collected at the point of consumption. The transition to a destination-based tax has ushered in technology breakthroughs and advantages for the public good.

Review of the Literature

Anand Nayyar (2017) examined the Indian GST and emphasized the history of the taxation system. Akanksha Khurana (2016) looked at the history, goals, and effects of the planned GST on the country's current tax system. Nishita Gupta (2014) set out to research the idea of GST and how it affects the Indian economy. Shefali Dani (2016) examined how GST affected the Indian economy. Mohammed Azam Khan (2012) outlined the importance of the GST in India and the potential for state revenue generation. Deepak Adhana (2015) concentrated on the GST concept and its development in India.

TECHNOLOGY REVOLUTION AND INDIAN INDUSTRY



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How Social Media Can Promote Green Marketing

An Analysis

Rihana Banu A.R. and Vinitha A.

Introduction

Social media has evolved into a daily communication tool for people. Users are exchanging a lot of information, and the information shared through this medium is more trustworthy than the information available in traditional media. In addition, they discuss current environmental concerns and exchange environmental tips. Businesses view social media as a communication tool that allows them to engage with specific customers. Otherwise, it would be challenging to connect with worldwide consumers. Social media is a tool that green consumers use to find and share information. Through images, videos, and other hypermedia, social media is being utilized to boost the credibility of businesses' claims about their commitment to sustainability and to encourage them to engage in practical activities.

Review of the Literature

The study of Ajai Pal Sharma (2021) gives a general review of green products and the discrepancy between customer attitudes and actual purchasing behaviour towards green goods. Major determinants of consumer decisions include perceived usefulness, historical experiences, eco-environment content, and eco-labelling. The research of Elur Nabivi (2020) is based on that contemporary consumers are becoming more aware of these issues, thus corporations are employing 'green marketing' strategies in response. Marketing communication refers to the creation and promotion of goods that are thought to be eco-friendly. The

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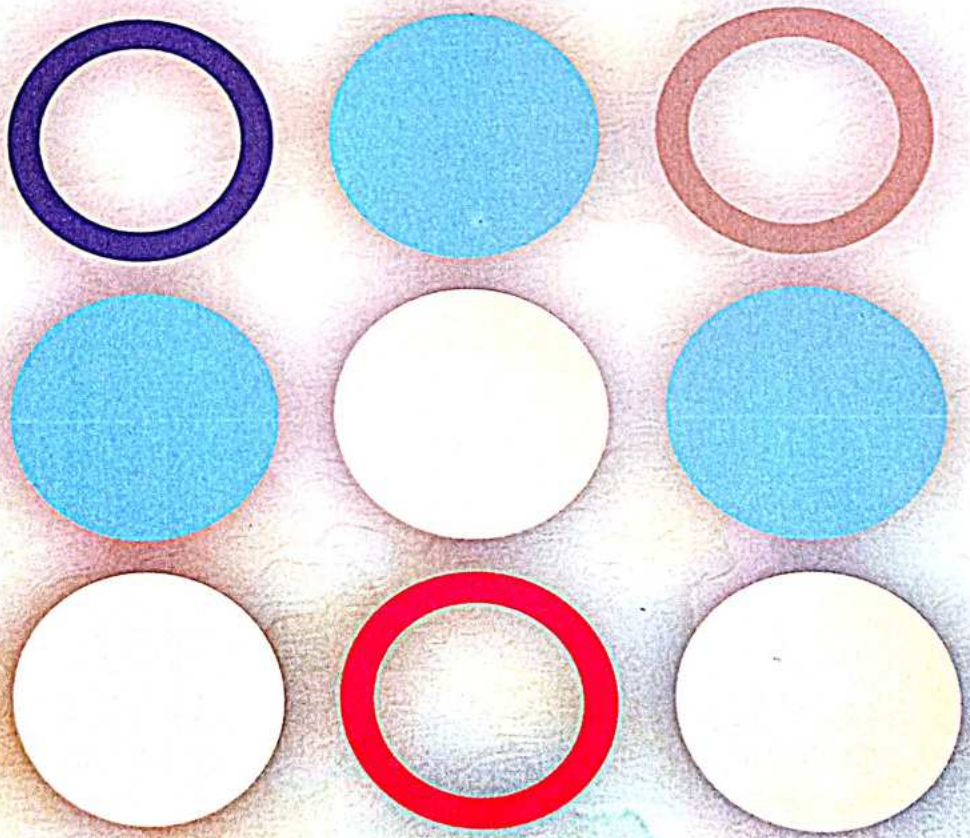
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Preferences of Consumers on the Purchase of Poultry Products Through Digital Platforms

Rihana Banu A.R. and Anitha P.

Introduction

Poultry are trained birds, such as chickens, turkeys, ducks, and geese, kept by human beings for their meat, eggs, and feathers. The word poultry comes from West and English poultries, and later it has changed to poultry. Poultry originated from the agriculture sector; mostly chickens are farmed in greater numbers. They produce 42 per cent–57 per cent of poultry meat worldwide, and 60 billion chickens are consumed per annum. Poultry is one of the second most eaten meat in the world. Over 70 per cent of the meat supply in 2012; poultry provide high nutrition benefits and high-quality protein with a lower proportion of fat. Poultry is of many types, including chickens, ducks, and turkeys.

The word 'chicken' refers to a medium-sized, chubby bird with an upright posture and meaty red comb and feathers on its head. Males are called 'cocks' and females are named 'hens'. With a number of 23.7 billion as of 2018, increasing from more than 19 billion birds in 2011, chickens are one of the most common domestic birds. More chicken compared to any other bird is produced worldwide. A duck is a medium-sized aquatic bird. Ducks are farmed mainly for their meat and eggs and various breeds have been developed in ducks. A certain breed of duck can lay 200 eggs per year and reach up to 3.5 kg demand for an egg, which is lower than for chicken. UK and USA consume more ducks. Turkey is one of the large birds. People consume turkey because it has more nutritional content. The production of turkeys has become more in number in Western countries. In 2019, the US increased the production of turkey by 229 million due to high demand. The US turkey industry currently exports more than 10 per

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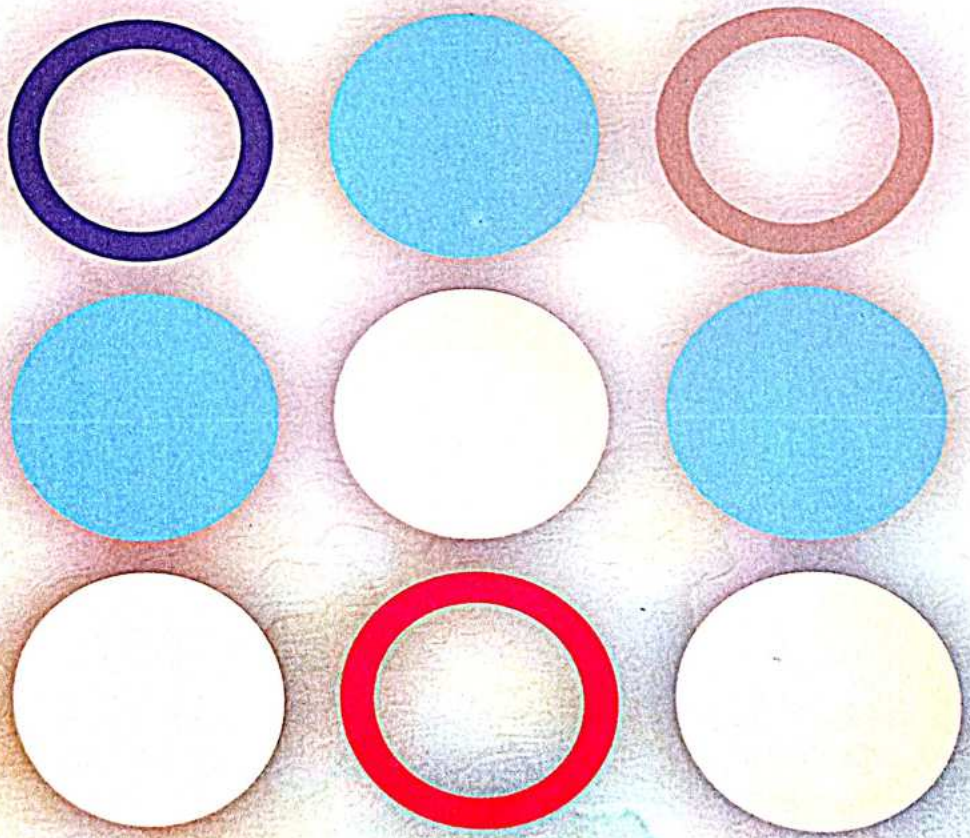
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Willingness and Technology Adoption Towards Cryptocurrencies Investment

Kavitha S. and Rangeela R.

Introduction

The communications version of electronic cash would allow online payments to be sent directly from one person to another without going through a financial institution. In the year 2009, after the global crash of 2008, the first form of cryptocurrency emerged in the form of Bitcoin. It was introduced by Nakamoto (2008), an anonymous group or individual that introduced Bitcoin as the first digital currency for easier day-to-day transactions from individual to individual. In the past few years, cryptocurrency and Bitcoin are more attractive and immense in media. Bitcoin is playing an increasingly important role in cryptocurrency exchanges around the world. By using cryptocurrency, users can exchange value digitally without a third party. Cryptocurrency works on the theory of solving encryption algorithms to create unique hashes that are finite in number. Here are several hundreds of cryptocurrencies and the applications of blockchain technology. Virtual currencies are unilaterally linked to the real economy; a conversion rate exists to purchase the currency. A cryptocurrency user is a natural person or legal entity who obtains coins to use, and the purchased currency can subsequently be used to buy virtual goods and services. The future of Bitcoin, like any other type of cryptocurrency, will crucially depend on the extent to which consumers use it and how merchants will most likely accept it.

Various Countries that Use Cryptocurrency

The 16 of the largest crypto exchanges that are accessible in India are listed here. The volume of trade is variable; this list is ordered as per 24-hour trading volume in US $, as of the close of 1 November 2021.

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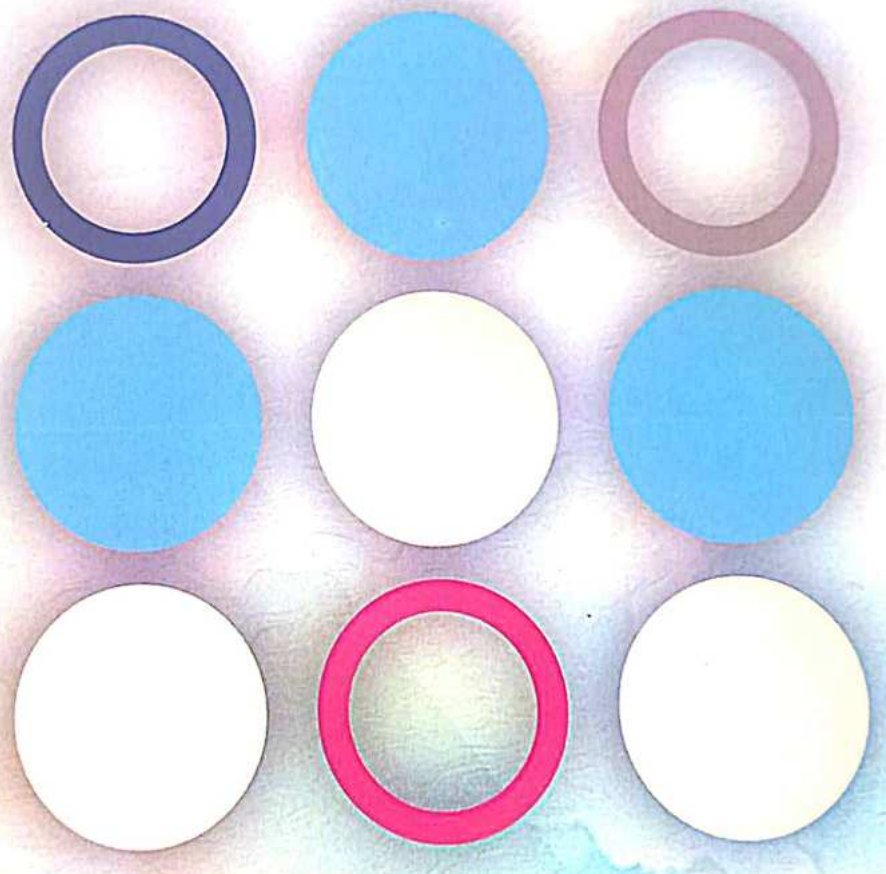
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A Study on Customer Satisfaction with Sony Products

The Case of Coimbatore City

Mathuthra O. and Priyanka K.

Introduction

Many of the brand companies are launching new products in the current world. One of the leading manufacturers of products in various categories, including televisions, cell phones, watches, video games, computer hardware, etc. is Sony. A Japanese multinational conglomerate corporation is called Sony Corporation. It was established in Nihonbashi, Tokyo, Japan, on 7 May 1946. Headquarters are located in Tokyo, Japan's Minato City. A consumer is someone who consistently brings us what they want. Sony items are the most popular among consumers. So, it is our responsibility to provide their requirements. This study focuses on the reasons why it is important to identify competitors and how doing so might facilitate successful planning for the launch of Sony products. This makes it easier to assess the value of strategic planning for Sony products. A superior strategy plan to outperform the competition is to sell Sony products. This brand builds brand and attitude equity. Since Sony is a well-known brand, customers had no trouble being pleased with the electronics.

Review of the Literature

Every individual has particular needs and a strong desire to have those expenditures paid, according to S. Santhini, R. Jeeva Bharathi, and G. Meena Priya's analysis from 2013. The buyer buys those products in the hope that they will satisfy his/her demands. If the product does not satisfy his/her demands, he/she will return it and look for a different one that will. Therefore, in order for a producer's business to thrive, customers'

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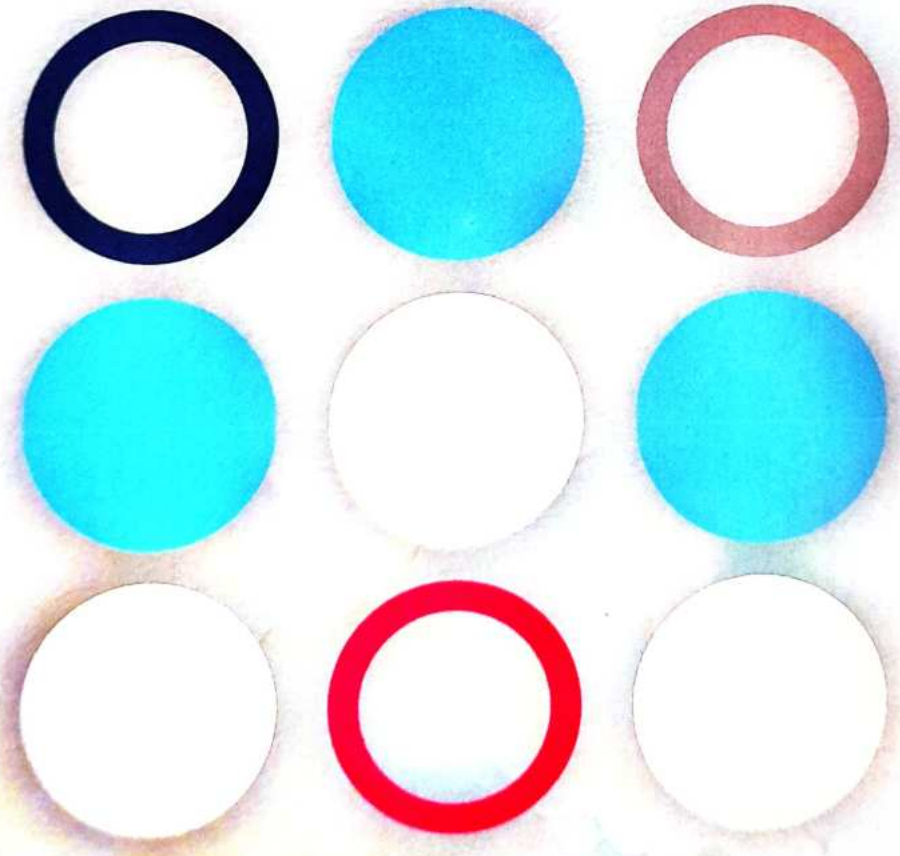
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Consumers' Buying Actions Concerning Himalaya Herbal Products

A Study in Coimbatore City

Mathuthra O. and Poornima Devi A.

Introduction

In determining a consumer's desire to make a future purchase, customer happiness is a crucial consideration. Attribute and fulfilment can be distinguished from one another, despite the fact that fulfilment has been characterized as the gap between assumption and achievement. Ayurveda, often known as the science of life, was a traditional, aggregate approach to analysis and therapy that may have been the world's first system of medicine. An international pharmaceutical firm with headquarters in Bengaluru, Karnataka, India, is called Himalaya Wellness Company (formerly known as Himalaya Drug Company). It was first founded in 1930 in Dehradun, India, by Mohammad Manal. It creates ayurvedic ingredients in its health care products, which are sold under the brand name Himalaya Herbal. They use cutting-edge research to produce ayurvedic goods that are up to pharmaceutical standards. These products, which are natural, efficient, and safe, have aided thousands of individuals in leading better, fuller lives. They placed a strong emphasis on wellness and helping people maintain their health.

Review of the Literature

D. Lavanya (2014), in her study entitled 'A study on factors influencing purchase behaviour of skin care products among working women in Madurai', stated that in today's society, both men and women increasingly use cosmetics and beauty items. Others use it to improve their physical looks, while some of them use it to boost their self-esteem. Most of us use cosmetics to boost our confidence. The Indian cosmetics sector is growing in terms of product development and marketing. Indian customers are

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Harnessing Internet of Things (Iot) for Operational Efficiency in Retail Stores: Innovations, Benefits, and Challenges

K. Karthikeyan, T. C. Brindha, D. Sujaritha, E. Dhanasekar, O . Mathuthra, and R. Gowrishankar

Abstract This study explores how the Internet of Things (IoT) positively impacts retail store operations, integrating retail marketing, working capital, analytics, and cloud systems to achieve greater control over data and enhance technological sophistication. IoT supports decision-making in product category management, pricing strategies, promotional mix, communication channels, supply chain management, customer care services, cash management, payment systems, inventory management, data privacy and security, feature customization, and employee management through

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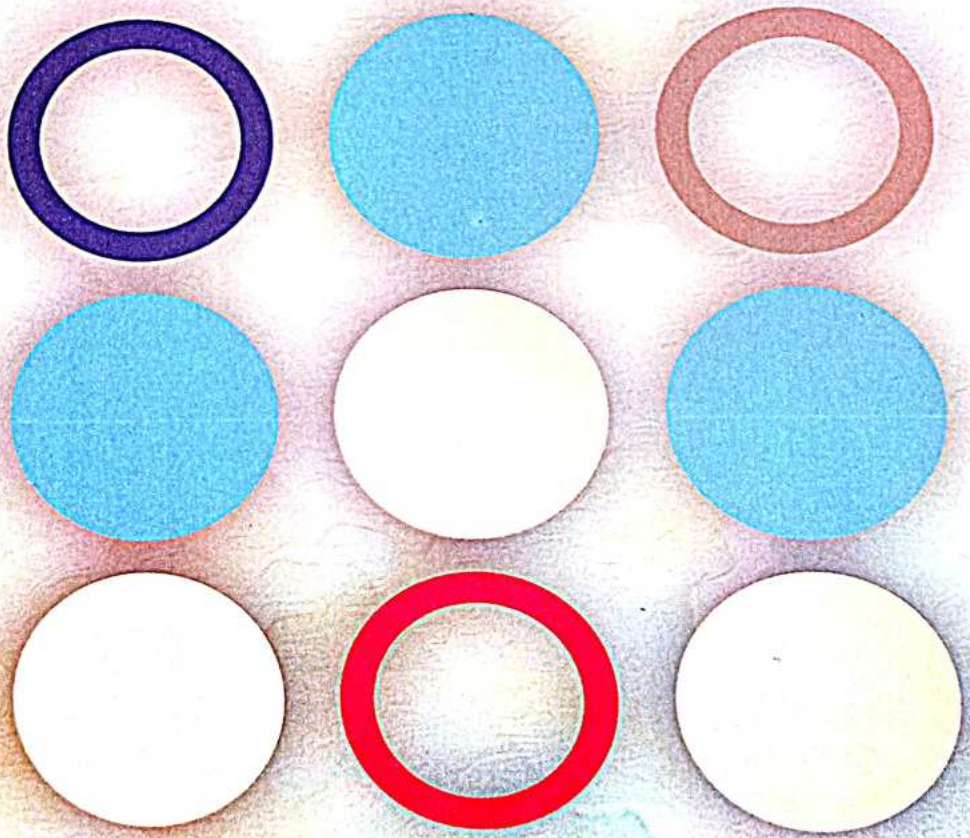
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the automation of big data analysis. By addressing challenges in retail store operations, the study emphasizes the need for specific and comprehensive conceptualizations and measures of analysis within organized retail outlets. The article defines and operationalizes control activities to capture retail store effectiveness using IoT, based on data collected from 230 functional heads in organized retail stores whose well adopted with IoT. Focusing on quantitative measure validation, the study confirms that retail heads can make strategic decisions for retail expansion by leveraging IoT in their businesses. The findings are validated through simple percentage analysis, ANOVA, correlation, regression, and the SEM model, presenting both theoretical and practical implications. The Internet of Things has impact on the retail store operation and performance. Further the key variables in the segment should given focus analysis for rapid growth and development of retail sectors.

Keywords Retail store management system · Internet of Things in retail industry · Retail cloud system · Supply chain management in retail · Modern technologies in retail

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Role of Artificial Intelligence in Digital Marketing

Special Reference to Coimbatore City

Malarvizhi A. and Deivanai P.

Introduction

A recent trend in marketing, business, education, science, and industrial equipment is artificial intelligence (AI). It has now evolved in advertising. AI's quick development delivers innovative marketing and research alternatives. AI in marketing is used to predict customers' upcoming buying choices and improve the experience for them. Big Data, web advertising, and digital video advertising are the three major foundations of AI. Marketing is the strategic tool responsible for identifying, anticipating, and profitably meeting customer needs. AI helps to recognize human intellect and develop intelligent creations. AI has the potential to grow and have a significant impact in three business sectors. The modules are customer care, advertising, and promotion.

Statement of the Problem

AI is one of the greatest events that affect digital marketing worldwide in the 21st century. It is a revolutionary technology that makes use of numerous software technologies to facilitate corporate operations and attract clients. According to this, many advertising firms have updated their traditional technique to serve a larger range of individuals. The versatility of the YouTube advertising medium makes it stand out from other digital advertising media. The ability of AI to interface with various kinds of individuals is its greatest strength. So, this study is going to explain how AI influencing plays the main role in today's marketing world and how it helps to take the purchase decision easily.

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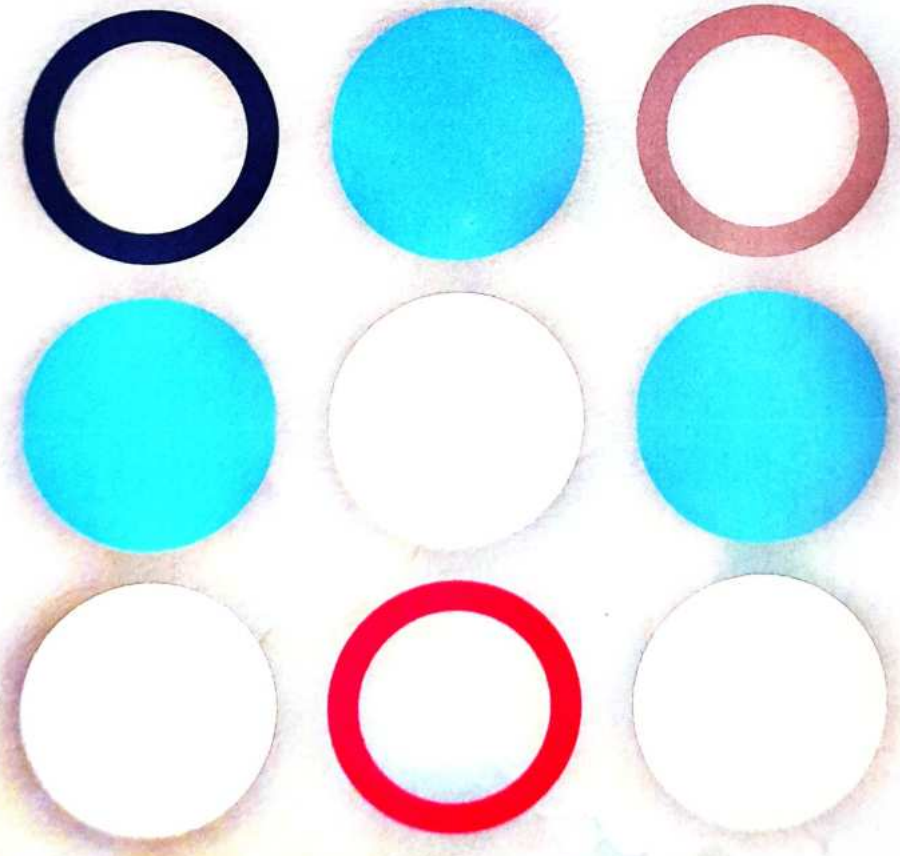
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Motivation Behind Digital Banking Adoption

An Empirical Analysis

Arthi D. and Ponvarshini S.

Introduction

Digital banking is the 'process of performing banking activities over the internet, and it is also referred to as Internet or Electronic Banking'. Though it emerged in the 90th century, its growth was speeded up in the mid of 20th century. In India, digital banking and its importance arise after technological development. The number of digital banking users raises daily at a faster rate. Not only are digital banking customers rising, but its various services and features are up-to-date as per the customer's needs, and the apps developed by the banks are also user-friendly nowadays. Though various changes exist, customers in rural areas still need help accessing digital banking services compared to cities. Thus, it enables customers to shift from traditional banking to digital banking. With the advent of new technologies, various online services are provided by banks through their online mode, which are user-friendly, more secure, and operate without any interception.

Scope of the Study

The main scope of this study is to understand the concept of digital banking behaviour among the respondents. It provides an overview of the factors influencing digital banking transformation.

Review of the Literature

Mohan et al. (2021) stated, 'Online Banking is much easier than offline banking, and customers also prefer digital banking rather than visiting the bank in person'. Kaur et al. (2021) stated, 'along with the traditional

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Sign Language Recognition Using Deep Learning

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Sign Language Recognition Using Deep Learning

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ABSTRACTCommunicating with deaf and speech imp aired people has never been easier. Therefore, the use of language eventually became one of the best ways fo r deaf and speechimpaired people to communicate wit h the rest of the world. The use of language facilitates communication between disabled and healthy people a nd provides direct communication. The purpose of this article is to convert sign language into text to facilitat e communication between deaf and hearing people.

Although this job has significant social impact, the complex hand movements and movements make it incredibly difficult. A user should be able to record the hand sign in this work and the system will anticipate and show the hand gesture's title or text output. This system goes through a number of processing steps, some of which involve various computer vision techniques.

Image pixels with values A and Z, none, deletion and s pace are the extracted features. In this project, we use a convolutional neural network (CNN) to classify symp toms and train the network on training images. When we think about how to process images and make predi ctions, we think of convolutional neural networks (CN N).

Keywords-Convolutional Neural Network (CNN), Deep Learning, Sign Language, Model and Gesture(Keywords).

1. INTRODUCTION

   When considering sign language, very few people are able to help the hearing or visual impaired understand what is being communicated. In addition, despite popular belief, sign language is not a universal language. People communicate with the individual using language that is simple for him or her to understand and retain in their minds.There is no denying the importance of speaking to someone in their own language.

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Since the beginning of human civilization, language has played a significant role in human interaction. Humans use language as a means of expressing their feelings and thoughts in order to comprehend the cues of the outside world. Nothing in this world has meaning without language. People take language for granted because we are so immersed in our daily routines that we fail to recognize its significance. It is extremely sad that there are people with communication impairments in our society who are frequently ignored and left behind.

1. PROBLEM DEFINITION

   Different regions use different sign languages. Additionally, sign language differs depending on the language used in any given country. Signs for American Sign, for instance the signs of Brazilian Sign Language are distinct from language. Simply put, because every language in the world is spoken differently, every language also has a unique sign language. This makes it even more difficult for the community of people with disabilities and the community of normal people to communicate. Written communication is an alternative method of communication because verbal communication is time-consuming, impersonal, and impractical in an emergency. Additionally, compared to face-to-face communication, this alternative method of communication is difficult and slow. If we consider an emergency situation, then it is important and necessary to communicate quickly. Therefore, written communication in this situation is not well-structured and systematic.

   Riya Sunil Kumar Patel et al (2021), The concept of Language Recognition (SLR) involves developing deep learning models and computer vision that can rec ognize and understand descriptions in images. The aim

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   is to create a system that can transform sign language into a compatible alphabet to facilitate communication between deaf or hardofhearing people and people who cannot speak. Monocular camera competition is difficu lt as background noise, occlusions, and other environm ental factors can affect motion recognition. Therefore, building accurate and reliable SLR systems requires tr aining these models using deep learning (e.g., convolut ional neural networks) and significant behavioral data. The main aim of SLR is to promote the accessibility an d participation of language users as a means of

commu nication and enable them to communicate effectively with the wider community.

2. LITERATURE SURVEY

In this study, RaziehRastgooet.al (2021) examines the deep learning model for visual language recognition that has been proposed in the last five years. Although all models of the model show that symbol information has better recognition accuracy, there are still some problems that need to be solved. Convolutional neural networks (CNN) and deep Boltzmann machines (RBM) are the most advanced deep learning models for computer problems (Wu, 2019). We introduce classification to improve the information structure of discrete and continuous words. We also review the applications, literature, hybrid models, challenges, and future directions of the topic.

In this article, NecatiCihanCamgÃ¶z et al. (2022) improved the initial translation work and presented improved translation through markerbased annotation that can recognize multiple markers. In fact, luster tokenization is required for cuttingedge translation work. At the same time, we offer a unique Transformerbase architecture that learns sign language recognition and translation at the end of the course. This is done by combining authentication and translation issues into a unified system that uses loss of physical link (CTC). This collaborative strategy simultaneously solves the realtime learning problem and improves performance without the need for real- Timedata.

In this paper, Yanqiu Liao et al. (2019) proposed a more effective and efficient video-based language recognition method. This paper will introduce a new development method called BLSTM3D Residual Network (B3D ResNet) to replace the old method based on the video system. The new B3D ResNet model aims to reveal spatiotemporal features and

describe the nature of individual movements in dynamics. Language skills. To define deep learning tools such as Faster RCNN, a B3D ResNet model is first used to detect the hand and separate its activity from the background. The B3D ResNet model is then used to capture and analyze the features of the input video sequence. Sequential distribution of video ideas leads to recognition of gestures and mastery of good sign language.

In this article, Mohammad Saad Amin et al. (2022) proposed gesture recognition in a sensor-based model using smart gloves and different sensors. These sensors include a capture and distance sensor, an accelerometer that measures the angle and degree of movement, and a tilt sensor that measures body curvature. At this stage, language

is represented as numbers with unique values created using special characters. Therefore, as a model based on the image sensor, there is no need for preprocessing.

In this article, P.K. Athira et al. (2019) suggest that sign language interpreting systems are becoming increasingly important to reduce the social isolation of India's large deaf and hard of hearing population. It can recognize finger-spelled words in Indian Sign Language (ISL), static and dynamic single-handed gestures, and even static two-handed gestures from live video. Using Zernike moments for keyframe extraction significantly slows down the computation. In addition, he suggests better techniques for eliminating assonance when writing the alphabet. Features are extracted from the video in real-time during pre-processing using skin tone segmentation. After the joint removal step, appropriate character vectors are extracted from the gesture sequence.

In this paper, SamiyaKabirYoume et al. (2021) suggested that CNN outperforms advanced machine learning techniques, especially in computer vision tasks. CNNs are mostly used for object recognition and classification using visual image analysis. This study focuses on the classification of static images of Bangladeshi personality types using these deep learning architectures. Neural network architecture for this model. The family of VGG networks performs best in BSL detection among other deep learning-based architectures.

In this article, Riya Sunil Kumar Patel et al. (2021) has a great social effect, but complex gestures and hand movements are very difficult. This work

requires that the user can record hand movements and the system can predict and display the name or output text of the hand movement. The system goes through many processing steps, some of which involve various computer vision techniques. A function from which image pixels with values between 0 and 1 are extracted When we think of how to manipulate images and how to classify them, we think of Convolutional Neural Networks (CNN).

In this paper, Xiao, Q., et al. (2020) suggested that sign language production (SLG) is necessary to enable reverse communication from hearing to deaf individuals. This method can be applied to other interactions between information sequences. This method yields an approximate fitting posterior distribution that results in skeletal sequences with a variety of human-recognizable styles. A two-way correlation test was performed on a large database of

500 CSLs. Due to the short execution time of the proposed algorithm, this algorithm achieves high detection accuracy in both real and synthetic data. The generated data also helps to improve the performance of the discriminator.

In this article, Dongxuli et al. (2020) reported that the purpose of visual feedback is to improve deaf people's ability to communicate with others. However, most language documents currently contain only a few words. Specifically, we use and compare two different models: (1) a full viewbased approach and (b) a 2D hu manbased approach. We also proposed a new posebase d temporal graph complexity network (PoseTGCN), w hich further improves the performance of the pose algo rithm. These networks simultaneously model the spatia l and temporal dependencies of human location traject ories. Our results show that the modelbased model and the modellike model perform equally well with 10% t o 62.63% accuracy at 2000 words/total, indicating goo d performance and difficulty of information.

In this article, Junfu Pu et al (2019) present a n optimization method for integration for monitoring weak continuous language recognition. The above two modules are optimized in many aspects. The encoder& decoder sequence learning network consists of two dec oders: LSTM decoder and CTC decoder. Soft Dynami c Time Warp (Soft DTW) correlation with optimal lear ning is used to jointly train the two algorithms. Soft Dynamic Time Warp (Soft DTW) alignment constraints along with maximum likelihood criterion training are used to jointly train both decoders. 3D-

ResNet is fine-tuned as training labels with lossy classification, using convolutional paths that represent potential alignments between input video clips and character words. In the next iteration, the encoder and decoder sequence learning networks are optimized using the extracted improved features after fine-tuning. In this article, Cheok, M.J. et al. (2019) suggested that appearance-based recognition and model-based recognition use different approaches for feature extraction. Appearance-based methods extract useful information from pixels, while model-based methods include volume and skeletal modeling. Although SURF is computationally more efficient than SIFT, its performance is not as consistent as SIFT. PCA and LDA are used in a combined function to improve accuracy. Recent research on gesture recognition uses hybrid feature extraction techniques such as DTW and HMM for dynamic gestures and SVM and ANN for static gestures. This model achieved 96.5% accuracy. Sign language recognition has a large vocabulary, but scalability issues are a

challenge.

In this paper, YuecongMin et al. (2021) proposed to identify unsegmented characters from image streams based on vision, a Continuous Sign Language Recognition (CSLR) method was developed.One of the most important problems in CSL R training is overfitting, and previous studies have sho wn that reverse training can partially solve this proble m, but more time should be devoted to training.In this work, we return to the retraining methods used in rece nt CSLR studies and conclude that specific features m ust be adequately trained to solve the overfitting proble

m. That's why we want to see compatibility (VAC) to i mprove the performance of relationship managers. In p articular, the proposed VAC has two loss schedules: o ne manages the prediction matching between the featur e extractor and the relationship model, and the other on ly focuses on vision vision.

In this article,Han,X.,et.al(2022)Move into in dependent places and difficult times. Through the integ ration of push and selfmonitoring, the lightweight spati otemporal channel monitoring module is designed to h elp the network focus on important information based on space, time and channel length. This model include s two submodels of Channels called Temporal Attentio n and Spatiotemporal Attention. Deploying this modul e in R (2 + 1)D demonstrates the effectiveness of the p repared method by producing results comparable to or

better than state-of-the-art methods on the CLS- 500, Jester, and EgoGesture datasets.

This article Nguyen, M. Al did it. (2021), this article reviews deep learning techniques for language recognition. In this paper, we propose a capsular netwo rk (CapsNet) that promises to achieve this goal. We als o proposed an optional kernel network (SKNet) with a listening algorithm to extract spatial information. Sinc e sign language is an important part of communication, the difficulty of realtime recognition of sign language in digital video has become a new problem in the field. The benefits of this study are as follows. (1) Accordin g to specific data, the overall recognition accuracy of CapsNet is as high as 98.72%. (2) SKNet uses tracking system to achieve the highest recognition rate reachin g 98.88%.

3. METHODOLOGY AND IMPLEMETATION

    1. METHODOLOGY

        Methodology is the theoretical analysis of the methods used in some researches. It differs from a method in that the purpose of a method is not to

provide a solution. Alternatively, the method provides a theoretical basis for understanding what factors, processes, or best practices can be applied to a specific situation, such as calculating specific outcomes.

It also means:

1. “Analysis of methods, rules and theories used in this discipline”;
2. “The study of methods used or employed in the field”;
3. “The study or explanation of a process.”

Methodology is the scientific method that explains how research is conducted and describes the methods used in the study. In a sense, this described process defines the method or manner in which the data is collected, or perhaps the factors to be calculated. The methodology does not describe specific methods, but much attention is paid to its nature and the specific method or methods that pursue the goals.

1. SIGN LANGUAGE RECOGNITION SYSTEM

   Figure 1: Sign language recognition system

2. DATA COLLECTION

   The dataset contains images of hand gestures representing letters of the American Sign Language alphabet. This dataset is collected from kaggle website and the dataset provided in the link https://www.kaggle.com/code/aminesnoussi/ameri can-sign-languagerecognition/input. This dataset was created to help develop machine learning models for recognizing and interpreting these hand gestures.

   The dataset consists of two folders, one for training and one for testing, each containing a set of images in JPG format. The training folder contains 365 images, while the testing folder contains 95 images. Each image is 200 x 200 pixels in size and is labelled with the corresponding letter of the alphabet that the hand gesture represents.

   There are a total of 29 classes in the dataset, corresponding to the 26 letters of the alphabet and three additional classes for space, delete, and nothing. The “space” class represents a space between words, the “delete” class

represents the action of deleting a character, and the “nothing” class represents when no hand gesture is present.

3. CONVERT FOLDER INTO DATAFRAME OF IMAGES

   Importing various libraries related to computer vision,cv2 and numpyare used for computer vision and numerical computing respectively. pandas and matplotlib are used for data manipulation and visualization respectively. ImageDataGenerator,

   MobileNet, and Dense are specific classes and functions within the TensorFlowKeras library that are useful for deep learning tasks involving image data.

   The get_paths_labels function takes a path argument representing the directory path containing the image files to be processed, and an optional allowed extension argument that specifies the file extension of the image files to include (default is “jpg”). The function creates a directory object from the path argument using the Path class and then uses the glob method to find all files in the directory and its subdirectories with the specified file extension.The function then creates a Pandas Series object from the file paths and sets its name to “path”. It also creates another Pandas Series object from the file path strings by extracting the second-to-last folder name as the label for each image, and sets its name to “label”.

   The function concatenates the two Series objects along the columns axis to create a DataFrame with two columns: “path” and “label”. The function shuffles the rows of the DataFrame randomly using the sample method with frac=1 (which means to use all rows) and resets the index of the shuffled DataFrame. The function returns the shuffled DataFrame. The resulting DataFrame can be used as input for machine learning models that require input data in the form of file paths and their corresponding labels. This function can be useful for organizing and preprocessing large datasets of images for deep learning tasks.

4. READING DATASETS AND COMBINE TRAINING AND TESTING DATASETS

   The Visualize_samples function takes an ImageDataGenerator object as input, randomly selects a set of image samples and their labels, and visualizes them in a grid using matplotlib. It uses the get_image function to

read and convert the images to RGB format, and sets the title of each image to its corresponding label. The function also allows the user to specify the grid size and figure size of the plot. This function can be useful for quickly checking the quality and diversity of the data generated by an ImageDataGenerator.

The get_paths_labels function is used to read two image dataset and creates two separate Pandas DataFrames containing the file paths and labels of the images in each dataset. The dataframes are then concatenated into a single dataframe containing all images using the pd.concat function. Data used to train

machine learning models.

Figure 2: Read Datasets And Counts Classes

The counts of each unique value in the second column (the class column) of the dataset and sorts them in ascending order. The resulting series is printed using the ‘head’ method to display all counts.

5. PREPROCESSING DATA

The process function processes a single image by converting its color channels from BGR to RGB, resizing it to 224×224 pixels, applying the MobileNetpreprocessing function, and adding an extra dimension to it for batch size. theKerasImageDataGenerator is used to perform data augmentation techniques such as horizontal flipping, brightness adjustment, and zooming on the input images. It also splits the dataset into training and validation subsets using a specified validation split percentage.

The flow_from_dataframe method is then used to create generator objects for both the training and validation data, with options to specify the target image size, color mode, batch size, and class mode. It takes the dataframe of image paths and corresponding labels as input, as well as the column names for the path and label data. Finally, we use a subset parameter to distinguish between training and validation sets.

Figure 3: Visualizing the Sample of Labelled Dataset

The above diagram shows the sample of labelled dataset of alphabet contains A to Z, other three classes delete, space and nothing from the

training dataset. The sample images are displayed randomly based on the 4*4 matrix format.

6. CONVALUTIONAL NEURAL NETWORK ARCHITECTURE

The convolutional neural network architecture uses the MobileNet model as its foundation. MobileNet models are used as pre-trained models and imported from Keras application modules. The input geometry is set to (224, 224, 3). This has to do with image size and color. The “include

_top” parameter is set to False. This means that the fin al sample set used for classification is not included. Th e “weight” parameter is set to “imagenet”. This means that the weighted model is first learned from the Image Net dataset.

The “PretrainedModel” object is set to no train ing. This means that the weight of this layer does not c hange during operation. A dense layer with 128 neuron s and ReLU activation is added to the output of the pre trained model, followed by another dense layer with 1 28 neurons and ReLU activation. Finally, a thick layer consisting of 29 neurons and softmax activation is add ed as the output layer. This corresponds to the number of groups in the file. The training value determines the size of the optimizer during training. Higher education

leads to faster integration, but it can also lead to people becoming better at solving problems.

7. FEATURE EXTRACTION

Feature extraction is a technique used in machi ne learning and computer vision that involves extractin g important features from raw data that can be used to improve the performance of a model. In image recognition, for instance, a feature is a measurable property of an image such as edges, corners, or textures. Feature extraction involves detecting and describing these features in a way that can be used to represent an image as a set of numerical values.

This allows the model to automatically extract high-level features from the input images without having to manually engineer them. The MobileNet model is initialized with pre-trained weights, which allows it to recognize a wide range of features such as shapes, textures, and colors.

The MobileNet model is then modified by removing the top layer and adding a few dense layers to enable it to perform the specific task at hand – classifying images into 29 different categories. Finally, the last layer is set to output a probability distribution over 2 classes using a softmax activation function.

8. VISUALIZE CLASSIFICATIONS

   The visualize_classifications function takes a trained model, a data generator, and other optional arguments as inputs. It selects a random subset of images from the data generator, processes them using the process function, makes predictions using the provided model, and visualizes the predictions alongside the true labels. The function can be useful for assessing the performance of a model and gaining insight into which samples are misclassified.

9. COMPARISON

   The graph is used to visualize the comparison between training and validation accuracy, loss, and mean squared error (MSE) of a neural network model. The history object, which contains the training metrics, is used to extract the values for accuracy, validation accuracy, loss, validation loss, MSE, and validation MSE. These values are plotted using Matplotlib based on the number of periods.

   The first graph shows the training and validation accuracies across epochs, with the maximum validation accuracy highlighted by a green dot. Finally, the third MSE plot shows the training and

   validation, with the lowest MSE validation highlighted with a green dot.

   These visualizations help you understand the performance of your model over time and identify issues that need to be addressed. By observing trends in accuracy, loss, and MSE, you can decide how to modify your model to improve performance.

4. RESULTS AND DISCUSSION

1. RECORDING AND ANALYZING MODEL METRICS DURING TRAINING

   The code metrics = pd.DataFrame(history.history) creates a DataFrame called metrics that contains the recorded metrics from the model training process. This DataFrame organizes the metrics, such as loss and accuracy,

into columns, allowing for easy analysis and visualization of the model's performance over each epoch.

Figure 4: Recording and Analyzing Model Metrics During Training

2. PREDICTED SIGN LANGUAGE IMAGES

In this part, randomly selecting row_col_len^2 indexes from the data generator labels. It retrieves the classes, labels, and filepaths corresponding to the randomly selected indexes. It retrieves the images corresponding to the filepaths and applies some processing to them. It makes predictions using the provided model on the processed images and converts the predicted class indices to their corresponding class labels.

It creates a figure with row_col_len rows and columns to display the images and their classification labels. It iterates over each row and column in the figure and plots an image along with its true and

predicted labels. It helps in understanding how well the model is performing on different classes.

Figure 5: Predicted Sign Language Images

This image represents the randomly predicted sign language images with true and predicted alphabet of the image.

3. CAMPARISON

    1. Training and Validation Accuracy

    Accuracy is a measure used to evaluate the eff ectiveness of classification models. It measures the per centage of samples correctly classified for the entire sa mple. To calculate accuracy, divide the number of corr ectly predicted samples by the total sample and multipl y the result by 100.However, accuracy is not always the best measure, especially when the dataset is unbalanced or the cost of misclassification varies between classes, so it is important to consider the context and specific requirements of the problem. Accuracy = (Number of correctly predicted samples) / (Total number of samples)

To express accuracy as a percentage, the result is often multiplied by 100.

Figure 6: Training and Validation Accuracy Figure 6: Training and Validation Accuracy

shows that both the training accuracy and validation

accuracy start from a low value and gradually improve with epochs. However, towards the end of the epochs, the validation accuracy seems to plateau and does not show much improvement, while the training accuracy continues to improve. The green dots in both graphs indicate the periods with the highest credit accuracy and the lowest credit loss.

2. Training and Validation Losses
   Training Loss shows how well the model fits the training data and is minimized by adjusting the model parameters during training.Validation loss will help you evaluate the generalization performance of your model and detect overfitting or underfitting. Minimizing validation losses is important to ensure good performance with new and unknown data. Batch mutual entropy:

   Training Loss = -(1/N) * (y_actual * log(y_pred)) Validation Loss = -(1/N_val) * (y_actual * log(y_pred))

   Figure 7: Training and Validation Loss

   Figure 7: Training and validation losses shows that the training and validation losses both start from high values and decrease with periods. . However, at the end of the period, the credit losses start to increase while the training losses continue to decrease. The green dots in both charts show the periods of highest credit accuracy and lowest credit losses.

3. Training and Validation Mean Squared Errors (MSE)
   The mean square error (MSE) calculates the differ ence between the predicted and actual values for each model, sums them, and averages them. By squaring the differences, larger errors are amplified, giving more weight to outliers. The resulting value

represents the average squared error, with a lower MSE indicating a better fit to the data.

MSE is widely used because it provides a continuous and differentiable measure of error. It is particularly useful when the target variable has a wide range or contains outliers. However, MSE can be

sensitive to outliers due to the squaring operation, and it doesn't provide direct interpretability of the error in the original scale of the data.

The formula for MSE is as follows:

MSE = (1/N) * (y_pred – y_actual)^2

Figure 8: Training and Validation Mean Squared Errors (MSE)

The diagram shows the training and validation mean squared errors (MSE) over the epochs. The green dot indicates the lowest validation MSE achieved during the training.

4. CONFUSION MATRIX VISUALIZATION FOR MODEL EVALUATION

The given code calculates and visualizes the confusion matrix, By examining the confusion matrix, you can evaluate the accuracy of your model and identify misclassification patterns and areas where your model needs improvement.

Figure 9: Confusion Matrix Visualization for Model Evaluation

The diagram shows the confusion matrix for the predicted labels with the true labels of the validation data.

5. CONCLUSION AND FUTURE SCOPE

Sign language recognition technology has come a long way and could revolutionize the way people with hearing loss communicate. Classification of the American Sign Language (ASL) alphabet and implementation of a neural network model for the

three classes of omission, gap, and no action using the MobileNet architecture. The model is trained on the ASL alphabet dataset and evaluated on the validation set.

The MobileNet model is a convolutional neural network (CNN) architecture widely used for image classification tasks. MobileNet models are enhanced with additional dense layers to learn more complex patterns and improve classification accuracy. During the accuracy training process, the model is classified using the Adam optimizer and the mutual entropy loss function. Training and validation and training and validation losses are monitored and visualized using graphs.

After training, the model achieved a prediction accuracy of 90.22% on the validation set. This accuracy value indicates the model's ability to corectly classify gestures in the ASL alphabet. It is important to note that the accuracy achieved may vary depending on factors such as dataset quality, model architecture, and training duration. Finally, we present a comprehensive pipeline for training and evaluating a MobileNet-based model for alphabetic ASL gesture classification and demonstrate the effectiveness of deep learning in sign language gesture recognition.

Future work can be expected to train this model on datasets containing continuous signs of sign language. In this way, we can identify the complete set of symbols that gives us the output of the sentence. We can also expect the system to recognize dynamic symbols to provide output with meaningful sentences for specific symbols. The system can be further expanded by adding a voice recognition feature. It helps strengthen the system by converting speech into sign language.

6. REFFERENCES

1. Rastgoo, R., Kiani, K., & Escalera, S. (2021). Sign language recognition: A deep survey. Expert Systems with Applications, 164, 113794.
2. Amin, M. S., Rizvi, S. T. H., & Hossain, M. M. (2022). A Comparative Review on Applications of Different Sensors for Sign Language Recognition. Journal of Imaging, 8(4), 98.
3. Y. Liao, P. Xiong, W. Min, W. Min and J. Lu, "Dynamic Sign Language Recognition Based on Video Sequence With BLSTM-3D Residual
Networks," in IEEE Access, vol. 7, pp. 38044- 38054, 2019, doi:

10.1109/ACCESS.2019.2904749.

4. Camgoz, N. C., Koller, O., Hadfield, S., & Bowden, R. (2020). Sign language transformers: Joint end-to-end sign language recognition and translation. In Proceedings of the IEEE/CVF conference on computer vision and pattern recognition (pp. 10023-10033).

5. Athira, P. K., Sruthi, C. J., & Lijiya, A. (2022). A signer independent sign language recognition with co-articulation elimination from live videos: an Indian scenario. Journal of King Saud University- Computer and Information Sciences, 34(3), 771-781.

6. S. K. Youme, T. A. Chowdhury, H. Ahamed, M. S. Abid, L. Chowdhury and N. Mohammed, “Generalization of Bangla Sign Language Recognition Using Angular Loss Functions,” in IEEE Access, vol. 9, pp. 165351-165365, 2021, doi: 10.1109/ACCESS.2021.3134903.

7. NETWORK, U. C. N. (2021). SIGN LANGUAGE RECOGNITION SYSTEM USING CONVOLUTIONAL NEURAL NETWORK (Doctoral dissertation, CALIFORNIA STATE UNIVERSITY SAN MARCOS).

8. Xiao, Q., Qin, M., & Yin, Y. (2020). Skeleton- based Chinese sign language recognition and generation for bidirectional communication between deaf and hearing people. Neural networks, 125, 41-55.

9. Li, D., Rodriguez, C., Yu, X., & Li, H. (2020). Word-level deep sign language recognition from video: A new large-scale dataset and methods comparison. In Proceedings of the IEEE/CVF winter conference on applications of computer vision (pp. 1459-1469).

10. Pu, J., Zhou, W., & Li, H. (2019). Iterative alignment network for continuous sign language recognition. In Proceedings of the IEEE/CVF conference on computer vision and pattern recognition (pp. 4165-4174).

11. Cheok, M. J., Omar, Z., & Jaward, M. H. (2019). A review of hand gesture and sign language recognition techniques. International Journal of Machine Learning and Cybernetics, 10, 131-153

12. Min, Y., Hao, A., Chai, X., & Chen, X. (2021). Visual alignment constraint for continuous sign language recognition. In Proceedings of the

    IEEE/CVF International Conference on Computer Vision (pp. 11542-11551)..

13. Gurbuz, S. Z., Gurbuz, A. C., Malaia, E. A., Griffin, D. J., Crawford, C. S., Rahman, M. M., … & Mdrafi, R. (2020). American sign language recognition using rf sensing. IEEE Sensors Journal, 21(3), 3763-3775.

14. Han, X., Lu, F., Yin, J., Tian, G., & Liu, J. (2022). Sign language recognition based on R (2+ 1) D with spatialtemporalchannel attention. IEEE Transactions on Human-Machine Systems, 52(4), 687-698.

15. Lu, J., Nguyen, M., & Yan, W. Q. (2021). Sign language recognition from digital videos using deep learning methods. In Geometry and Vision: First International Symposium, ISGV 2021, Auckland, New Zealand, January 28-29, 2021, Revised Selected Papers 1 (pp. 108-118). Springer International Publishing.

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Medical Image Video Watermarking Using Deep Neural Network Technique

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Abstract
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Abstract:
A new technique of watermarking for medical data protection using a neural network is explained in this research. The neural network is used in conjunction with the Levenberg-Marquard method to enhance the control of watermarking strength as well as the performance of traditional watermarking techniques. When compared to earlier data security solutions, the simulation results show that the suggested scheme is more effective. Our approaches for measuring gait pathology with common cameras make quantitative motion estimation more accessible in hospitals and at home, allowing researchers to perform large-scale investigations of musculoskeletal and neurological problems. Digital watermarking has been extensively researched as a way of preserving the intellectual property rights of high-value-added digital photographs. Machine learning and Deep Neural Network (DNN) have recently driven us to robust applications in the huge advancement of Artificial Intelligence. Trained DNN models have made it simple for researchers to achieve state-of-the-art findings. However, distributing these trained models is always a difficult process, especially in terms of security and protection. This paper suggests a DNN model for digital watermarking that examines Deep Neural Network intellectual property, embedding watermarks, and owner verification. This model used to test this method. As a result, this model is resistant to counter-watermark attacks. Our approach checks the ownership of all remotely extended deep learning models reliably and promptly without altering the model's accuracy for standard information inputs. Digital information may now be easily changed, copied, distributed, and stored, resulting in secure information ownership.

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I. Introduction

The framework of multimedia dissemination has shifted as a result of the digital age. Utilizing contemporary software-based technologies, elevated copies of digital information are made and transmitted via the web. Video has a wide range of applications, including video streaming, video calls, DVD, video-on-demand, and high-definition television, which has created a security challenge because videos may be easily interfered with, falsified, or manipulated. In cases of verification, unlawful acts like forging, tampering, and modifying breach security and copyright. Cryptography-based security protocols provide only guarantees for data integrity, secrecy, and authenticity during the transmission of data over a pu... external server. Such security measures, on the other hand, do not guard against unauthorized copyin... As a result, digital watermarking systems that recognize copyrighted products and provide content verification are required. Digital watermarking is the process of inserting copyright signs and other data like ownership, source, and destination into music, video, digital movies, as well as other multimedia items [1], [2]

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A REVIEW ON LUNG CANCER DETECTION USING DEEP LEARNING ALGORITHMS

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ABSTRACT

The project titled "A REVIEW ON LUNG CANCER DETECTION USING DEEP LEARNING ALGORITHMS" addresses the formidable global health challenge of lung cancer, emphasizing the crucial need for early detection to improve treatment efficacy and elevate survival rates. The research leverages advanced Deep Learning techniques to refine lung cancer identification, contributing significantly to medical image analysis. Three distinct algorithms, namely a Simple Feed Forward Neural Network (SFNN), an in-built Multilayer Perceptron (MLP) Classifier, and a custom-built MLP Model, are meticulously evaluated using histopathology images of the lungs, classifying them as "Cancer Affected" or "Healthy Lungs." The findings reveal the in-built MLP Classifier as the top performer, suggesting its promising practical integration into clinical settings. The custom-built MLP Model also demonstrates significant efficacy, showcasing the potential of personalized Deep Learning Approaches in medical imaging. Conversely, the SFNN Model highlights the critical role of algorithm selection in optimizing lung cancer detection. These insightful findings contribute to the evolving landscape of deep learning applications in diagnosing lung cancer, emphasizing the significance of algorithmic choices for achieving optimal outcomes in clinical settings.

Keywords—Lung cancer, Detection, SFNN, in-built MLP Classifier, custom-built MLP Model, medical images.

I. INTRODUCTION

Lung cancer detection is a paramount concern in healthcare, necessitating innovative strategies for early identification and improved treatment outcomes. Deep learning algorithms, specifically the Simple Feed Forward Neural Network (SFNN), in-built MLP Classifier, and custom-built MLP Model, have emerged as pivotal players in reshaping the landscape of lung cancer diagnostics. This imperative stems from the urgency to intervene promptly and enhance patient outcomes.

The SFNN, renowned for its intricate pattern recognition capabilities, is adeptly employed to decipher nuanced features within histopathology images of the lungs. Its hierarchical architecture enables the identification of subtle relationships within the data, making it a valuable tool for detecting potential indicators of lung cancer. Simultaneously, the in-built MLP Classifier, drawing on pre-trained models or default settings suitable for image classification, leverages established knowledge gained from extensive training on diverse datasets. This depth of pre-existing knowledge enhances its adaptability to various scenarios. The custom-built MLP Model, tailored to the unique characteristics of lung cancer detection, provides a personalized and targeted approach to identifying malignancy-related patterns.

In the course of this study, each algorithm undergoes rigorous evaluation, classifying histopathology images into "Cancer Affected" or "Healthy Lungs." The results paint a compelling picture. The in-built MLP Classifier emerges as the frontrunner, showcasing a remarkable accuracy rate that positions it as a practical solution for seamless integration into clinical settings. Following closely, the custom-built

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A REVIEW ON BOOK RECOMMENDATION USING NLP AND ML METHODS

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ABSTRACT

The project titled "BOOK RECOMMENDATION BASED ON NLP AND ML METHODS" , utilizing advanced Natural Language Processing (NLP), elevates the book discovery process for avid readers by delivering personalized recommendations. Through sophisticated Exploratory Data Analysis (EDA), sentiment analysis, and feature engineering, it tailors book suggestions based on individual reading preferences.With a focus on key factors such as Series Information, Numbered Series, Theme, and Author, the recommender system identifies reader preferences for continuous narratives and serial storytelling. The incorporation of numbered series ensures recommendations in the correct sequence, enhancing the overall reading experience.Additionally, the system explores themes and topics that resonate with readers, offering books aligned with their interests and moods. Special attention is given to the influence of authors, enabling users to discover more works from their favorite writers.Harnessing the power of NLP and data analysis, the Book Recommender creates a dynamic, user-centric reading experience, serving as a valuable tool for book enthusiasts in search of their next literary adventure.

Keywords—book recommendation ,NLP ,ML ,feature engineering ,User-centric ,EDA ,Literary Adventure,Series Information

I. INTRODUCTION

In later years, the merging of Natural Language Processing (NLP) and Machine Learning (ML) procedures was introduced in a modern time of personalized suggestion frameworks over different spaces. Among these spaces, the domain of writing stands out as an especially rich ground for development. The project titled "BOOK RECOMMENDATION BASED ON NLP AND ML METHODS" epitomizes this advancement, advertising a modern arrangement to the lasting challenge of finding captivating peruses in the midst of a tremendous ocean of scholarly offerings.

At its center, this extension looks to engage ardent perusers with a personalized book revelation involvement that rises above ordinary strategies. Leveraging the control of progressed NLP calculations, the framework dives profound into the printed subtleties of books, extricating profitable experiences that advise its suggestion handle. Through fastidious Exploratory Data Analysis (EDA) and include building, the framework picks up a nuanced understanding of peruser inclinations, perceiving designs and associations that might evade more shortsighted approaches. One of the key qualities of this Book Recommender lies in its capacity to cater to the assorted needs and inclinations of perusers.

By considering components such as Arrangement Data and Numbered Arrangement, the framework guarantees that suggestions are not fair person diamonds but a portion of a bigger story embroidered artwork, upgrading the in general pursuing involvement. Besides, by analyzing topics and origin, the framework goes past surface-level suggestions, diving into the more profound resonances that make certain books really memorable. Central to the viability of this recommendation system is its user-centric approach. Instead of advertising nonexclusive proposals based exclusively on ubiquity or deals figures, the framework prioritizes the interesting tastes and interface of each peruser. Through nonstop input circles and versatile calculations, it refines its proposals over time, guaranteeing that clients are reliably displayed with choices that adjust with their advancing

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Pedestrian detection is a crucial technology in diverse fields involving computer vision, video surveillance, content-based image retrieval, and assisted driving. It plays a significant role in motion analysis, necessitating accurate identification and tracking of pedestrians, which is challenging due to their non-rigid nature and variable appearances. The prevailing approach in pedestrian detection emphasizes statistical learning methods, focusing on feature extraction and pedestrian classification. This data-driven methodology reflects a commitment to enhancing the accuracy and effectiveness of pedestrian detection systems. The intricacies of the background, especially when identifying small and medium-sized pedestrians, contribute to the difficulties encountered in conducting pedestrian detection tests. In tackling the influence of pedestrian scales on detection accuracy, this paper introduces three ResNet101-based models specifically designed to address the impact of pedestrian scales on detection. It will also examine detection accuracy across various scales in feature maps and resolutions. The research analyzes the proposed algorithm's efficacy in multi-scale pedestrian detection, revealing that fusing high-level semantic and low-level detailed features enhances detection, surpassing methods like RPN-ped. The Ped-fused-mutiRPN approach proves resilient to scale changes. Comparative evaluation with other algorithms shows a substantial reduction in the miss rate (MR) at a 10% false positive rate, establishing the proposed method's notable superiority. The algorithm's efficiency is underscored through processing time comparisons, indicating a favorable balance between accuracy and speed.

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I. Introduction

Pedestrian detection is highly relevant in security, autonomous driving, and mobile robotics. Its broad impact spans applications like surveillance, retail analytics, emergency response, and health monitoring, contributing significantly to innovative city initiatives. This crucial technology is pivotal in advancing safety, efficiency, and interaction across diverse fields, establishing itself as a vital component in various applications. As a result, pedestrian detection research has always been a highly sought-after and popular research direction in the field of computer vision. The detection involves the task of ascertaining whether an input image (or video frame) contains pedestrians and, if detected, providing information about their respective locations [1]. Pedestrian detection has received a lot of attention from researchers as an important component of human-computer interaction, pedestrian re- identification, video surveillance, robotics, assisted driving, and unmanned driving systems [2]. The pedestrian detection algorithm can be broadly categorized into three stages: candidate window selection, feature extraction, and classifier design [3]. Conventional methods for pedestrian detection typically employ manually crafted features, with a majority utilizing sliding window scanning as the candidate window extraction algorithm for its computational efficiency [4]. In order to obtain better pedestrian detection results, the researchers proposed to use candidate area algorithms such as selective search [5] instead of the traditional sliding window strategy, the algorithm improves detection accuracy while reducing time complexity.

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Chapter 12

Enhancing Energy Efficiency in Intrusion Detection Systems for Wireless Sensor Networks Through Zigbee Protocol

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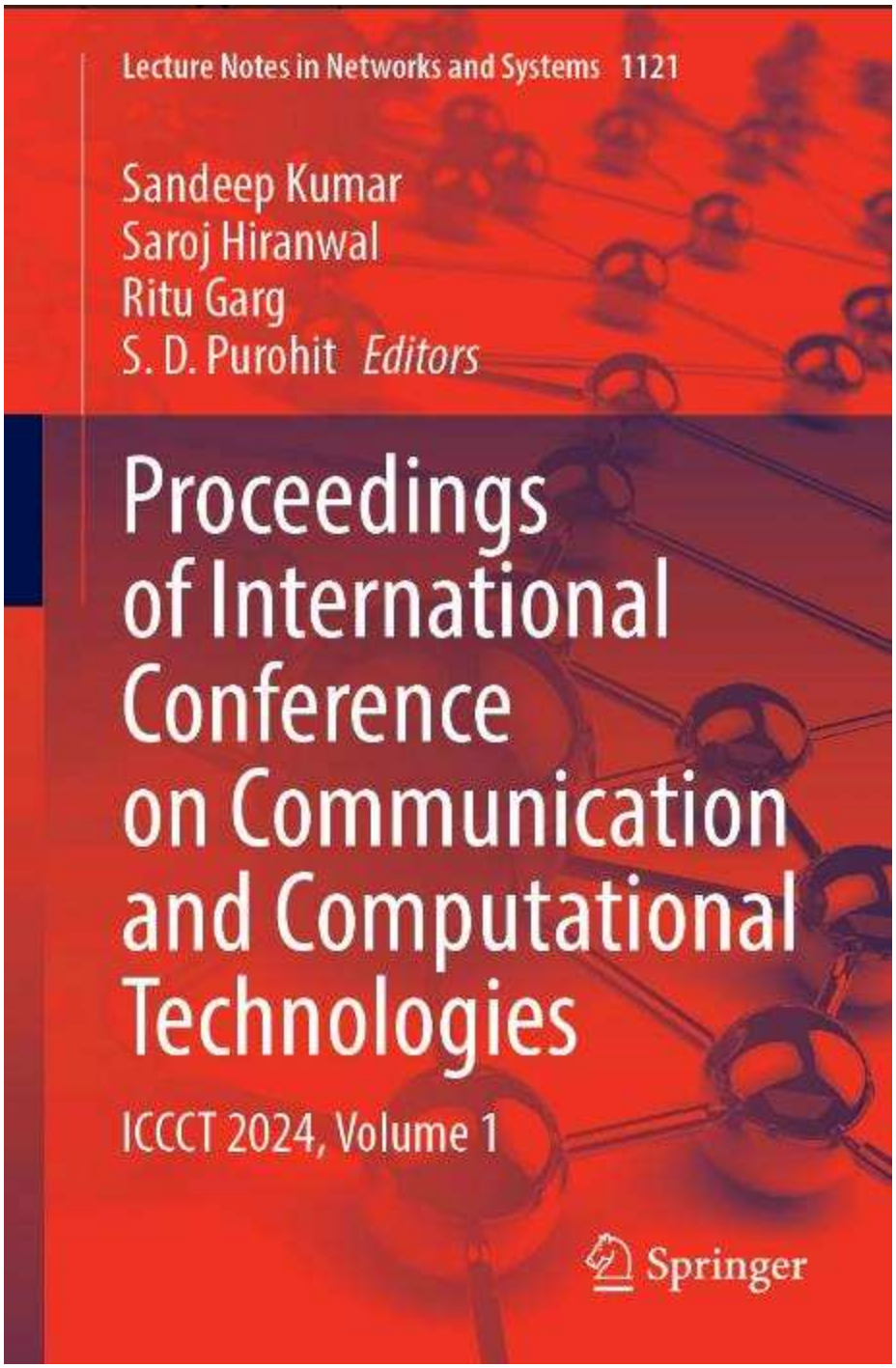
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ABSTRACT

Wireless sensor networks (WSNs) are important in various applications, including environmental monitoring, healthcare, and industrial automation. However, the energy constraints of sensor nodes present significant challenges in deploying robust security mechanisms, such as intrusion detection systems (IDS). The method involves using data aggregation, node selection, and energy harvesting techniques to reduce energy consumption while maintaining the accuracy of the IDS. The effectiveness of the proposed approach is evaluated using simulation experiments. This chapter offers a promising solution for providing effective and energy-efficient intrusion detection in ZigBee-based WSNs. The study found that applying machine learning techniques, specifically SFA, can significantly improve the energy efficiency of Zigbee protocol in wireless sensor networks. Results indicate that using these techniques energy consumption is up to 95.42% and 190 μW / node, IDS prediction ratio is 98.5%, and accuracy is 99.5%

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while maintaining network performance.

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Epidemic Prediction using NLP Techniques and Supervised Machine Learning Algorithms

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Abstract. The early identification and forecasting of epidemics using social media data is known as epidemic prediction using the Twitter dataset. It's crucial to forecast and identify infectious diseases early in order to limit the impact they have on communities. Pandemics and other infectious diseases pose a major threat to public health. Due to their real-time and user-generated nature, social media sites like Twitter have emerged as important sources of data for epidemic surveillance. However, manually analyzing huge amounts of Twitter data is a difficult and time-consuming operation. This research intends to investigate how well Twitter data may be used to forecast epidemic outbreaks. A collection of tweets about the Influenza epidemic was acquired, processed, and studied using various supervised machine learning techniques such as Support Vector Machine(SVM), Logistic Regression, Decision Tree and Random Forest are examined. Text processing and Natural Language Processing (NLP) are essential components that focus on understanding and manipulating human language and this research work also uses these NLP Techniques to process the Twitter Data. On test data, the Random Forest model enhances previous model architectures and achieves a highest accuracy over 0.98 to classify epidemic-related activity into the four stages of early warning, peak, outbreak, and decay followed by SVM, which is efficient.
Keywords: Epidemic Prediction, Influenza, NLP Techniques Machine Learning

1 Introduction

Social media sites like Twitter have become a significant resource for current news on a range of subjects including health-related issues in recent years[1,7,8]. Predicting the development and spread of infectious diseases like flu, which can have serious public health repercussions, is one area of study. Prediction about flu after COVID-19 is essential for proactive public health measures, efficient resource utilization, and minimizing the impact on individuals and communities. It builds on the lessons learned during the COVID-19 pandemic and contributes to a more resilient and responsive healthcare system. To analyse Twitter data and forecast the possibility of influenza outbreaks, Machine Learning(ML) algorithms can be employed. Large volumes of Twitter data about flu, including keywords, hash tags, and mentions of symptoms or treatments must be gathered and processed in order to do this[6,10]. To

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Performance Analysis of Cyberbullying Threats in Social Media Using Machine Learning Techniques

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***Abstract*— Cyberbullying is the use of internet media to harass, threaten, or hurt others, has become a widespread problem on social media platforms. As social media becomes more prevalent, so does cyberbullying, which hurts victims' mental health and well-being. This study examines the performance of multiple Machine Learning (ML) algorithms in detecting cyberbullying tweets on social media. Racism and sexism-based Twitter dataset is taken for study obtained from Kaggle repository consisting of 28,357 samples with 5 attributes. The dataset which consists of raw tweets applied for data preprocessing using a Natural Language Toolkit (NLTK). To detect and classify cyberbullying (sexism/racism) tweets, five Supervised Machine Learning (SML) models are developed: a Naive Bayes, a Random Forest, a K-Nearest Neighbor, a Support Vector Machine, and a Decision Tree model for classification. Precision, Accuracy, F1-Score, Recall, Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and R-squared (RS) are used to evaluate the designed models. Based on comparison of the models, it is discovered that the Random Forest and Support Vector Machine algorithms outperforms with maximum accuracy of 97% in identifying cyberbullying tweets.**

Keywords*—Cyberbullying, NLTK, Racism, Sexism, Supervised Machine Learning.

I. INTRODUCTION

Social media networks provide incredible communication channels, but they also expose young people to potentially dangerous situations online. Cyberbullying is a global phenomenon sufficient to the enormous number of users on social media networks [1]. 90% of cyberbullying victims are female [2]. As a result, people are scared to file complaints, particularly in India, because they are afraid of society [3]. According to BBC in India, the first instance was registered in 2009 [4]. Cyberbullying is a one-of-a-kind and global cybercrime that is accountable to the virtual environment [5].

The impact of cyberbullying on numerous Social media networking sites cannot possibly overlooked, and substantial control requires Cyberbullying to deal with such a difficult cyberbullying situation [6]. Effective cyberbullying detection control and prevention methods are required. To detect and control cyberbullying, researchers employ a variety as well as supervised, semi-supervised, and unsupervised machine learning algorithms like Random forest, Decision Tree, K-Nearest Neighbor, Naïve Bayes, and Support Vector Machine SML models to detect and classify the Cyberbullying tweets by incorporating NLTK preprocessing methods [7]. The primary contributions of the study are:

- To detect and classify the Cyberbullying tweets using SML methods by encompassing NLTK preprocessing methods.
- The five SML models are deployed to suggest a suitable model for detecting cyberbullying tweets.
- A significant comparative analysis is made between the developed models using the performance validation metrics such as Precision, Accuracy, F1-score, Recall, MSE, MAE, RMSE, and RS are validated for the robustness of the model for Cyberbullying detection.

The remaining part of the article has been separated into the sections listed below: Section II investigates the literature and the present status of supervised machine learning algorithms that detect cyberbullying. Section III discusses the methods used to find the optimal Supervised Machine Learning model for detecting cyberbullying tweets. Section IV gives the experimental findings and effectiveness of SML models. Section V culminates with the conclusion and future perspective of the article.

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A Study on Anomaly Detection using Machine Learning Techniques

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***Abstract*—Anomaly detection is an essential element in diverse domains and demands effective methodologies to identify deviations from expected data patterns. This article offers an in-depth evaluation of machine learning methods for anomaly identification, highlighting a range of traditional and unconventional approaches. The study covers classification models, ensemble approaches, clustering algorithms, auto-encoders, semi-supervised techniques, and hybrid models with an emphasis on supervised and unsupervised learning. Supervised learning analysis demonstrates the application of classification models, including Decision Trees and Support Vector Machines, in differentiating between typical and anomalous patterns. It is investigated if ensemble methods, including Random Forests and Boosting, can increase detection accuracy by merging models.**

To find anomalies in unlabelled datasets, the study focuses on unsupervised learning and examines clustering algorithms such as k-means and Density-Based Spatial Clustering of Applications with Noise (DBSCAN). As neural network designs, auto-encoders are assessed based on how well they can capture complex representations of typical input and highlight variations that point to abnormalities.

We explore semi-supervised learning procedures, particularly when a large number of unlabelled examples are coupled with a small amount of labeled data. Novel methods and mixed models that incorporate various components are also taken into consideration to strengthen anomaly detecting abilities.

The discussion continues with assessment metrics and problems with unbalanced datasets, offering an extensive overview of the details involved in evaluating model performance. Case studies and real-world applications show how these machine-learning approaches can be applied effectively in a variety of fields.

The paper concludes by summarizing the studied methods and emphasizing their advantages and disadvantages. This review seeks to contribute to the developing field of machine learning anomaly detection by identifying challenges and suggesting future research directions. It also offers useful insights for both researchers and practitioners working on a variety of applications.

Keywords—Anomaly detection, supervised learning, unsupervised learning, ensemble approaches, auto-encoders

I. INTRODUCTION

The capacity to identify abnormalities has become crucial to maintaining the integrity, security, and effectiveness of systems in an era dominated by an enormous inflow of data across various domains. Deviations from typical patterns or behaviors are known as anomalies, and they may be signs of mistakes, security lapses, or inconsistencies in the way things are done. The employment of machine learning approaches in anomaly detection has become essential in strengthening system resilience against unanticipated deviations as the digital landscape undergoes continuous change.

improving accuracy, and enhancing customer experience.

In addition, the book also outlines issues, challenges and opportunities for customers following their migration to mobile banking apps (MBAs) and transaction apps (TAs) in this digital era. Cyber security issues faced by digital customers while employing mobile banking apps (MBAs) and transaction apps (TAs) for their business activities too have been duly highlighted.



Dr. V. Vimala is presently Assistant Professor, Department of Commerce, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu. She holds Ph.D. from Kuvempu University, Shankaraghatta, Karnataka. She has published almost 41 articles in reputed national and international peer-reviewed journals. Apart from guiding Ph.D. research scholars, Dr. Vimala has successfully organized 3 national level workshops and 2 national level conferences.

She also served as National Service Scheme (NSS) programme officer during the period 2012 to 2020 and continues to render her valuable services to the adopted villages under the NSS. She has also been a recipient of 17 awards and recognitions.

Her areas of research interest include banking law and practice, financial accounting, insurance sector/actuarial science, income tax law and practice, business ethics and corporate governance, international financial management, forex management and international business.

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Banking, Robotic Process Automation (RPA) and Cyber Security

V. Vimala

NEW CENTURY

Banking,
Robotic Process Automation (RPA) and Cyber Security



V. Vimala

Information technology (IT) has transformed the banking sector globally. Banks are using electronic and telecommunication networks for delivering a wide range of value added products and services. The present book encompasses a wide range of facets, including: (i) digital banking, payment systems, mobile banking and transaction apps; (ii) robotic process automation (RPA) in the banking sector; and (iii) banking frauds, cyber security and data protection.

Technological revolution in the field of electronics and telecommunications has helped bring about sophisticated developments in the payment systems of many countries. Banking sector in India has been a major beneficiary of the inroads made by information technology. Many new processes, products and services offered by banks and other financial intermediaries are now IT-centred.

Effective integration of technology with sound business practices requires business process re-engineering. Most of the initiatives regarding technology are aimed at providing better and more efficient customer service, by offering multiple options. The death of distance, which is a by-product of technology, has become a reality in the banking sector. Another major development witnessed in recent years is the growth of multiple delivery channels for customers, such as internet-based banking, mobile banking and anywhere banking. This has benefited the customers and banks alike. While customers now have a wide variety of options to choose from, banks have been able to reduce their costs which have had a positive impact on their profitability.

Digitization has coincided with increased prominence of platforms and marketplaces that connect diverse agents in social and economic activity. The present book provides insights to understand robotic process automation (RPA) in the banking sector, and its awareness, risks and opportunities. Robotic process automation (RPA) has emerged as a game-changing technology for the banking sector, enabling banks to automate repetitive, manual, and time-consuming tasks. The use of RPA has revolutionized banking operations, by streamlining processes, reducing costs,

continued on back side....

Banking, Robotic Process Automation (RPA) and Cyber Security

Banking,
Robotic Process Automation (RPA)
and Cyber Security

By

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About the Book

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In addition, the book also outlines issues, challenges and opportunities for customers following their migration to mobile banking apps (MBAs) and transaction apps (TAs) in this digital era. Cyber security issues faced by digital customers while employing mobile banking apps (MBAs) and transaction apps (TAs) for their business activities too have been duly highlighted.

About the Author

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Dedication

to

MY BELOVED PARENTS

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Preface

The banking system forms the core of the financial sector of an economy. The role of commercial banks is particularly important in underdeveloped countries. Through mobilisation of resources and their better allocation, commercial banks play an important role in the development process of underdeveloped countries. By offering attractive saving schemes and ensuring safety of deposits, commercial banks encourage willingness to save among the people. By reaching out to people in rural areas, they help convert idle savings into effective ones. Commercial banks improve the allocation of resources by lending money to priority sectors of the economy. These banks provide a meeting ground for the savers and the investors. Savers may not invest either because of inadequate savings and/or lack of risk-taking spirit.

The banking industry all over the world has undergone transformation since the early 1980s under the impact of deregulation, advances in information technology and globalisation. These forces have increased competitive pressures which have: (a) unleashed the strong forces of restructuring and consolidation with the number of banks declining all over the world, and (b) prompted banks to seek new sources of revenue beyond traditional products. These, in turn, have led to the blurring of distinctions among providers of various financial services and emergence of financial conglomerates. Although these developments have made institutions more efficient by lowering transaction costs, they have also challenged the traditional regulatory arrangements based on institutions. Also, heightened competitive pressures, by squeezing profit margins of institutions, could lead them to pursue riskier strategies, raising the possibility of failure. Financial instability can also impinge on a country's ability to pursue a prudent macroeconomic policy. The safety and soundness of financial institutions, therefore, have come to occupy a centre-stage in the policy making.

Under the forces of liberalisation and globalisation, many

banking institutions have expanded beyond their home countries and traditional lines of business leading to emergence of large international banks. Many product innovations and new ways of doing business have also emerged that have led to widespread use of securitisation, derivatives and other financial products linking traditional banking functions to the operations of capital markets, whereas these developments have led to some degree of efficiency in financial intermediation, new issues have emerged over the past year that merit attention. Most, if not all of these large banks have become financial conglomerates operating in all the different segments of the financial sector. This movement has been enabled both by technological developments leading to faster transmission of financial transactions and financial innovations, and by falling national barriers allowing cross border capital flows.

Information technology (IT) has transformed the functioning of businesses, the world over. It has: (a) bridged the gaps in terms of the reach and the coverage of systems (b) enabled better decision-making based on latest and accurate information, (c) reduced costs and (d) improved overall improvement in efficiency. In the Indian context, the financial sector, especially the banking sector, has been a major beneficiary from the inroads made by IT. Many new processes, products and services offered by banks and other financial intermediaries are now IT-centred.

Banks have traditionally been in the forefront of harnessing technology to improve their products, services and efficiency. They have, over a long time, been using electronic and telecommunication networks for delivering a wide range of value-added products and services. The delivery channels include, inter alia, direct dial-up connections, private networks, public networks and the devices including telephone, personal computers (PCs), automated teller machines (ATMs), networking of ATMs in the form of shared payment networks, and core banking solutions.

With the popularity of PCs, easy access to internet and world wide web (www), internet is increasingly used by banks as a channel for receiving instructions and delivering their products

and services to their customers. This form of banking is generally referred to as internet banking, although the range of products and services offered by different banks vary widely both in their content and sophistication. Effective integration of technology with sound business practices requires business process re-engineering and banks in India need to follow up on the beginnings made in this regard.

Reserve Bank of India (RBI) has played a proactive role in the implementation of IT in the banking sector. IT-based initiatives are focused on meeting the three-pronged objective of better house keeping, improved customer service and overall systemic efficiency.

India with its uniquely rich payment ecosystem is now emerging as a global leader in innovative population scale payment systems. RBI and the Government have articulated a vision of a less-cash society and guided its evolution with feet firmly on the ground.

The growth of financial services in India has largely been led by the banks. RBI and the banks have led the initial thrust, development and support of digital payments infrastructure and systems. Non-banks have entered the market and expanded the range of payment services available to the Indian clients backed by their strength in technology and customer-centric innovation. Banks and non-banks are partnering to offer the combination of trust and innovations to the Indian customers.

The present book encompasses a wide range of facets, including: (i) digital banking, payment systems, mobile banking and transaction apps; (ii) robotic process automation (RPA) in the banking sector; and (iii) banking frauds, cyber security and data protection.

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Coimbatore *Dr.V.Vimala*

(Dr. V. Vimala)

Abbreviations/Acronyms

ACHs	Authorisation of the Cardholders
ADRs	American Depositary Receipts
AGFI	Adjusted Goodness of Fit Index
AILS	Adverse Impact on Lifestyle
AMOS	Analysis of Moment Structures
ANN	Artificial Neutral Network
ANOVA	Analysis of Variance
APACS	Association for Payment Clearing Services Report
APM	Authority of the Plastic Money holders
APR	Annualized Percentages Rates
ASBA	Applications Supported by Blocked Accounts
ATM	Automated Teller Machine
ATRAC	Australian Transaction Report and Analysis Centre
AVS	Address Verification Service
BOI	Bank of India
BT	Business Technology
BTP	Banking Technology Products
BTQ	Business Travel Quota
BTS	Banking Technology Services
CA	Cultural Affinity
CA	Cyber Attacks
CAR	Capital Adequacy Ratio
CARD	Credit Card Accountability Responsibility and Disclosure Act of 2009
CBN	Central Bank of Nigeria
CC	Cyber Crimes
CDR	Credit Deposit Ratio
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CH	Consumption Habits

CIBIL	Credit Information Bureau (India) Limited
CIR	Credit Information Report
CISP	Cardholder Information Security Program
CNP	Card/Cardholder Not Present
CRIS	Cardholder Risk Identification System
CRISL	Credit Rating Information and Services Limited
CRM	Customer Relationship Management
CS	Cultural Sovereignty
CS	Cyber Security
CSC	Card Security Code
CVV	Card Verification Value
DBC	Digital Bank Customers
DC	Digital Customers
DDA	Demand Deposit Account
DIR	Differential Interest Rate Schemes
DMA	Direct Marketing Agents
DNB	De Nederlandsche Bank
DNCR	Do Not Call Registry
DSA	Direct Selling Agents
EAD	Equal Monthly Installment Amount Due
EAD	Exposure at Default
EBPP	Electronic Bill Presentment And Payment
EBT	Electronic Benefit Transfer
ECS	Electronic Clearing Services
EDC	Electronic Data Capture
EDI	Electronic Data Interchange
EFT	Electronic Fund Transfer
EMI	Equal Monthly Installment
EMV Card	Europay, MasterCard and Visa Card
EPSO	E–Payment System Observatory
ER	Economic Recession
EU	European Union
FEMA	Foreign Exchange Management Act
FTC	Federal Trade Commission
FY	Financial Year

GCC	Gulf Corporation Council
GFI	Goodness of Fit Index
IADs	Independent ATM Deployers
IBA	Indian Bank's Association
ICBC	Industrial and Commercial Bank of China Limited
ICICI	Industrial Credit and Investment Corporation of India
IDBI	Industrial Development Bank of India (IDBI)
IDC	International Data Corporation
IFI	Incremental Fit Index
IMPS	Interbank Transfer Payment Service
IoE	Impact on Economy
IPO	Intellectual Property Office
IRDP	Integrated Rural Development Program
IS	Information System
ISOs	Independent Service Organisations
ISP	Internet Service Provider
IT	Information Technology
KCC	Kisan Credit Card Scheme
KYC	Know Your Customer
LGD	Loss given Default
LPG	Liberalisation, Privatisation and Globalisation
LSU	Louisiana State University
MAD	Minimum Amount Due
MBAs	Mobile Banking Apps
MBCS	Mobile Banking Cyber Security
MBS	Mobile Banking Security
MBT	Mobile Banking Transactions
MCMP	Merchant Charge Back Monitoring Program
MDR	Merchant Discount Rate
MES	Merchant Establishments
MICR	Magnetic Ink Character Recognition
MIFs	Multilateral Interchange Fees
NBFCs	Non-banking Financial Company

NCR	National Cash Register
NEFT	National Electronic Funds Transfer
NFE	Near Field Technology
NFI	Normed Fit Index
NPCI	National Payment Corporation of India
NPRB	New Private Bank
PCA	Principal Component Analysis
PCE	Personal Consumption Expenditure
PCFI	Parsimony Comparative of Fit Index
PCP	Psychosomatic Common Position
PCs	Personal Computers
PD	Probability of Default
PDA	Personal DigitalAssistant
PIN	Personal Identification Number
PM	Plastic Money
PNFI	Parsimony Normed Fit Index
PoP	Point of Purchase
PoS	Point of Sale
PPIs	Pre-Paid Payment Instruments
PSS	Payment and Settlement System
RBA	Reserve Bank of Australia
RBI	Reserve Bank of India
RFI	Relative Fit Index
RMSEA	Root Mean Square Error of Approximation
RRB	Regional Rural Banks
RTGS	Real Time Gross Settlement
SAMEA	South Asia, Middle East And Africa
SBI	State Bank of India
SBS	State Bank of Saurashtra,
SCF	Survey of Consumer Finances
SDSB	Social Diversity and Spending Behaviour
SEM	Structural Equation Modeling
SFMS	Structured Financial Message System
SGRF	State General Reserve Fund
SHGs	Self-help Groups

SMEs	Small and Medium Enterprises
SoE	Scarcity of funds
SPNS	Shared Payment Network System
SVI	Security and Verification Issues
TAs	Transactions Apps
TRAI	Telecom Regulatory Authority of India
US	United States
VSAT	Very Small Aperture Terminal
WLAs	White Label ATMs