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FINTECH'S FUTURE: UNVEILING AI'S IMPACT ON FINANCE

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INTRODUCTION

ABSTRACT
This paper delves into the transformative influence of Artificial Intelligence (AI) on the realm of finance within the FinTech (Financial Technology) landscape. It explores the multifaceted dimensions of AI's integration into financial services, highlighting both its potential benefits and the challenges it poses. Through a comprehensive examination of AI-driven innovations in banking, investment, insurance, and other financial sectors, this study sheds light on how AI is reshaping the financial industry. Additionally, it addresses critical considerations such as regulatory frameworks, cybersecurity, and ethical concerns in the context of AI's pervasive role in finance. By unveiling AI's impact on finance, this paper offers valuable insights into the future trajectory of FinTech and its implications for financial institutions, businesses, and consumers.

THEORETICAL BACKGROUND
From the 1950s to the 1960s, researchers embarked on a journey to explore the concept of creating machines that could simulate human intelligence, thus laying the early foundations for neural networks and machine learning in the realm of finance. Moving forward into the 1970s and 1980s, this exploration evolved into the emergence of rule-based expert systems, where AI systems hinged upon predefined rules to carry out functions like credit scoring and risk assessment within the financial sector.

As we transitioned into the 1980s and 1990s, AI techniques found their place in quantitative finance and algorithmic trading, with AI-driven models taking the lead in predicting market trends and algorithmic trading systems capitalizing on market inefficiencies. The 2000s marked significant progress in machine learning, with the adoption of decision trees, random forests, and support vector machines, revolutionizing credit risk assessment, fraud detection, and portfolio management.

The 2010s brought a new era, characterized by the rise of deep learning and the exploitation of big data. Deep learning, fueled by neural networks with multiple layers, became a prominent force, enabling AI systems to process vast datasets, thereby achieving more precise predictions. During this time, robo-advisors emerged as cost-effective alternatives to traditional wealth management, offering automated investment advice, while personal finance apps seamlessly integrated AI for budgeting, savings, and investment recommendations.

Furthermore, AI's role expanded into risk management and compliance, where it played a crucial part in detecting financial fraud, identifying money laundering activities, and ensuring adherence to regulatory standards. Natural Language Processing (NLP) was employed to analyze unstructured data such as news articles and social media to gauge market sentiment and make informed financial decisions.

In parallel, AI and machine learning found application in the realm of blockchain and cryptocurrency, where they were utilized to enhance security measures and analyze blockchain data for more effective and secure cryptocurrency transactions. Finally, in the same decade, some central banks began exploring the integration of AI-driven systems for the development and management of Central Bank Digital Currencies (CBDCs), aiming to modernize the monetary system and adapt to the evolving financial landscape.

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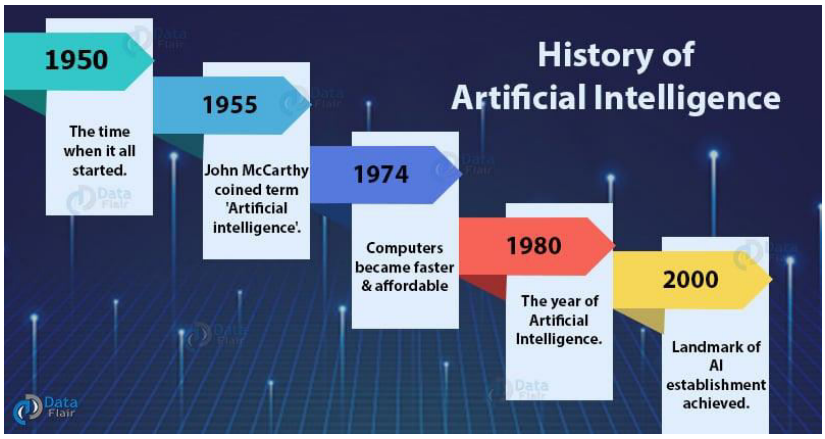
History of Artificial Intelligence



Source: https://data-flair.training/blogs/wp-content/uploads/sites/2/2019/09/History-of-Artificial-Intelligence.jpg

OBJECTIVES OF THE STUDY

- The primary objective of this study is to examine the practical applications of artificial intelligence within the financial industry. The study commences with an introductory overview.
- Another crucial facet of this research entails an in-depth investigation into the challenges posed by artificial intelligence in the financial sector. This analysis encompasses a comprehensive examination of both the positive and negative impacts associated with the adoption of AI.
- The research extends its focus towards exploring the potential future trajectory of artificial intelligence in the Indian context. Additionally, this section will provide informed recommendations based on the study's findings.

SCOPE OF THE STUDY:

The scope of the study titled "FinTech's Future: Unveiling AI's Impact on Finance" encompasses a comprehensive examination of the multifaceted relationship between Artificial Intelligence (AI) and the financial industry. This study aims to explore, analyze, and shed light on various dimensions within this domain. The key elements within the scope of this study include:

AI Applications in Finance: An investigation into the diverse applications of AI in the financial sector, including but not limited to algorithmic trading, risk assessment, fraud detection, robo-advisors, and customer service automation.

Quantitative Analysis: The study will delve into quantitative analysis, evaluating the quantitative benefits and outcomes associated with the integration of AI in financial processes.

Challenges and Risks: An exploration of the challenges, risks, and potential drawbacks posed by AI adoption in finance, such as algorithmic bias, data security, and regulatory compliance.

Future Outlook: The study will forecast and project the future landscape of AI in finance, considering emerging trends, opportunities, and potential disruptions.

METHODOLOGY

The research relies on secondary data and employs a descriptive research approach. The data used in this study has been sourced from a variety of scholarly journals, reports, and articles.

LIMITATIONS OF THE STUDY

Data Availability: The study's findings may be limited by the availability and quality of relevant data, particularly if comprehensive data on AI adoption in specific financial institutions is not readily accessible.

Time Constraint: The rapidly evolving nature of both AI and the financial industry may result in a limited timeframe for data collection and analysis. This limitation could impact the study's ability to capture the most up-to-date developments.

Scope and Depth: The study may not be able to cover all aspects and nuances of AI's impact on finance comprehensively, necessitating a focus on specific subdomains within the broader field.

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Regulatory Variability: Regulatory environments and policies related to AI in finance can vary significantly by region and country. This variability could limit the study's ability to provide a universally applicable analysis.

Resource Constraints: Constraints on resources, such as time, budget, and access to specialized expertise, may limit the depth of analysis and the range of research methods employed.

Changing Landscape: The fast-paced nature of both FinTech and AI means that the landscape is constantly evolving. The study may not capture emerging developments or paradigm shifts that occur after the research concludes.

REVIEW OF LITERATURE

Pinky Soni (2021) Artificial Intelligence (AI) stands as a groundbreaking technological advancement encompassing machine learning (ML) and algorithmic language. Its influence extends far beyond a single domain, permeating diverse sectors including automotive, healthcare, gaming, robotics, finance, surveillance, entertainment, space exploration, agriculture, e-commerce, and social media. The core objective of AI is the creation of intelligent, self-driven systems. This study narrows its focus to explore the manifold applications of artificial intelligence within the financial sector, encompassing banking, investment companies, and insurance firms. In the following sections, we provide a concise introduction to this subject. The study meticulously examines the various challenges faced by the financial industry due to the integration of AI, elucidating their far-reaching impacts. Furthermore, we present a balanced analysis, highlighting the advantages and disadvantages associated with the utilization of AI in financial sectors. One of the key aspects addressed in this study is the transformational potential of artificial intelligence within the financial industry. We delve into how AI is poised to bring about significant changes, revolutionizing traditional financial practices. Additionally, the study culminates in a set of well-considered recommendations, offering insights into how AI can be effectively harnessed to shape the future of financial institutions.

El Bachir Boukherouaa (2021) This paper explores the consequences of the swift adoption of artificial intelligence (AI) and machine learning (ML) within the financial industry. It underscores the advantages that these technologies offer in terms of enhancing financial depth and operational efficiency, all the while raising concerns about their potential to exacerbate the digital divide between advanced and developing economies. The paper contributes to the ongoing discourse by identifying and categorizing the distinctive risks associated with AI and ML, which have the potential to impact the stability and trustworthiness of the financial system. Furthermore, it delves into the policy challenges posed by these technologies and offers potential regulatory approaches. The dynamic and ever-evolving nature of AI and ML in finance implies that the complete spectrum of their strengths and vulnerabilities is yet to be fully comprehended. Recognizing the risk of unforeseen challenges, countries must reinforce their prudential oversight measures.

Reza Mardanghom (2019) the undeniable truth is that artificial intelligence (AI) and automation have been the focal points of research over the past few decades. Moreover, in recent years, their prominence has surged, with widespread adoption across various industries. While AI has often been associated with automating processes in the industrial sector, we are now witnessing a broader and more constructive utilization of this technology, particularly within the realm of financial services. The financial industry, however, has exhibited a certain degree of reluctance in embracing AI and recognizing its potential. Several factors have contributed to this hesitance, including uncertainties, regulatory concerns, the imperative need for enhanced cybersecurity measures, technological limitations, and the disruption it poses to established and profitable procedures. Nonetheless, companies operating in the financial services sector have begun to recognize the advantages that artificial intelligence can bring to their operations. This burgeoning interest has led some to label this transformation as the fourth industrial revolution, a revolution characterized by its highly disruptive nature, both in positive and negative aspects. AI solutions are enabling remarkable gains in efficiency, precision, and cost-effectiveness. However, this newfound power also necessitates a heightened sense of responsibility. As the financial sector undergoes rapid and substantial changes, the importance of precautions and security measures cannot be overstated. We, as humans, are still in the process of comprehending the myriad advantages and disadvantages that this technology brings. While the concept of artificial intelligence was introduced as early as the 1950s, its recent resurgence can be attributed to the exponential increase in computational capabilities and the vast troves of data now at our disposal.

Applications of Artificial Intelligence

Strategic Decision-Making: The study's insights can be utilized by financial institutions to make informed strategic decisions regarding the integration of AI technologies into their operations.

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Regulatory Guidance: Regulators and policymakers can use the study's findings to better understand the implications of AI in finance and develop regulatory frameworks that ensure responsible and ethical AI adoption.

Educational Resource: The study can serve as an educational resource for professionals, researchers, and students interested in the intersection of AI and finance.

Risk Assessment: Financial institutions can leverage the study's insights to assess the risks and benefits associated with AI adoption, particularly in the context of risk management.

Innovation: Fintech startups and innovators can draw inspiration from the study to develop new AI-driven financial products and services.

Investor Guidance: Investors and venture capitalists can use the study to identify emerging opportunities in the AI-driven fintech sector.

Industry Reports: The study's findings can be integrated into industry reports, whitepapers, or publications that aim to provide a comprehensive overview of AI's impact on finance.

Policy Formulation: Government agencies can consider the study's recommendations when formulating policies related to AI and finance.

Corporate Strategy: Financial organizations can align their corporate strategies with the study's insights to stay competitive in the evolving landscape of AI-powered finance.

Training and Development: Training programs and workshops can be designed based on the study's content to equip professionals with the knowledge and skills needed for AI implementation in finance.

Thought Leadership: The study can establish the researchers or the institution as thought leaders in the field of AI in finance, leading to opportunities for collaboration and consultancy.

Global Perspective: The study's findings can be compared with similar research from other regions to provide a global perspective on AI's impact on finance.

Public Awareness: The study can contribute to public awareness about the transformative potential of AI in finance, fostering discussions and debates on the topic.

Investment Decisions: Investment firms can use the study's insights to inform their investment decisions in AI-related fintech startups and technologies.

AI Adoption Roadmaps: Financial institutions can develop AI adoption roadmaps based on the study's recommendations, ensuring a systematic and effective integration of AI solutions.

CHALLENGES OF "FINTECH'S FUTURE: UNVEILING AI'S IMPACT ON FINANCE"

Data Availability and Quality: Availability and quality of data can vary significantly, impacting the study's ability to draw meaningful conclusions. Inaccurate or incomplete data can lead to biased results.

Rapid Technological Changes: The fintech and AI landscape is rapidly evolving. The study may struggle to keep up with the latest developments and may risk becoming outdated.

Ethical Considerations: The ethical implications of AI in finance are complex. Balancing the potential benefits with concerns like algorithmic bias and privacy can be challenging.

Limited Scope: Depending on the scope of the study, it may not cover all aspects of AI's impact on finance comprehensively, potentially missing important subdomains.

Resource Constraints: Constraints on resources, such as time and funding, may limit the depth and breadth of research, affecting the study's thoroughness.

Data Privacy: Handling sensitive financial data requires strict adherence to data privacy regulations. Ensuring compliance can be a significant challenge.

Interdisciplinary Nature: Research at the intersection of finance and AI may require expertise in multiple fields, which can be challenging to integrate.

Global Variability: Financial regulations and practices vary by region and country. Generalizing findings to a global context may be difficult.

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Predictive Nature: Predicting the future impact of AI in finance involves inherent uncertainty. The study may face challenges in making accurate predictions.

Complexity of Financial Markets: Financial markets are highly complex and influenced by numerous factors. Isolating the impact of AI can be intricate.

Lack of Standardization: The lack of standardized definitions and metrics in AI and fintech can make comparisons and analyses more challenging.

Bias and Objectivity: Maintaining objectivity and avoiding bias in the study's analysis and conclusions is crucial but can be difficult.

Regulatory Changes: Ongoing changes in financial regulations related to AI can impact the study's findings and recommendations.

Interview and Survey Challenges: If the study involves interviews or surveys, obtaining responses from relevant stakeholders can be time-consuming and subject to non-response bias.

Competing Research: There may be other studies and research initiatives in the same field, potentially leading to overlapping findings or competition for data sources.

Impact of FinTech's Future: Unveiling AI's Impact on Finance

The impact of the study "FinTech's Future: Unveiling AI's Impact on Finance" can be significant and far-reaching, influencing various stakeholders and areas within the finance industry. Here are some potential impacts:

Industry Insights: The study can provide valuable insights into the current state and future trajectory of AI in finance. Financial institutions, fintech startups, and technology providers can gain a deeper understanding of market trends and opportunities.

Strategic Decision-Making: Financial organizations can use the study's findings to inform their strategic decisions regarding AI adoption. This includes decisions related to technology investments, product development, and market positioning.

Regulatory Guidance: Regulators and policymakers can leverage the study to better understand the implications of AI in finance. It can help shape regulatory frameworks that promote responsible and ethical AI use while ensuring consumer protection.

Educational Resource: The study can serve as an educational resource for professionals, researchers, and students interested in the intersection of AI and finance. It can contribute to knowledge dissemination and academic discourse.

Innovation: Fintech startups and innovators can draw inspiration from the study's insights to develop new AI-driven financial products and services. It can stimulate innovation in the industry.

Investor Decisions: Investors and venture capitalists can use the study to identify promising investment opportunities in AI-related fintech ventures. It can guide investment decisions in the sector.

Policy Formulation: Government agencies can consider the study's recommendations when formulating policies related to AI and finance. It can contribute to the development of informed and forward-looking policies.

Global Perspective: The study's findings can be compared with similar research from other regions, providing a global perspective on AI's impact on finance. This can foster international collaboration and knowledge exchange.

Public Awareness: The study can contribute to raising public awareness about the transformative potential of AI in finance. It can lead to informed discussions and debates on the topic among a wider audience.

Corporate Strategy: Financial organizations can align their corporate strategies with the study's insights to stay competitive in the evolving landscape of AI-powered finance. It can influence the direction of corporate initiatives.

Thought Leadership: The study can establish the researchers or the institution as thought leaders in the field of AI in finance. It can lead to opportunities for collaboration, consultancy, and speaking engagements.

Training and Development: Training programs and workshops can be designed based on the study's content to equip professionals with the knowledge and skills needed for AI implementation in finance. It can contribute to workforce development.

PROS AND CONS OF FINTECH'S FUTURE: UNVEILING AI'S IMPACT ON FINANCE

Data Challenges: Access to high-quality and comprehensive financial data can be a significant challenge. Incomplete or biased data may affect the accuracy of the study's findings.

Rapid Technological Evolution: The fast-paced evolution of AI and fintech may result in difficulties in keeping the study's content up-to-date, potentially rendering some insights obsolete.

Ethical Dilemmas: Addressing the ethical implications of AI in finance can be complex. Balancing the potential benefits with concerns such as algorithmic bias, privacy, and fairness can be challenging.

Resource Constraints: Limitations in terms of time, budget, and access to specialized expertise may restrict the scope and depth of the study.

Regulatory Variability: Financial regulations and practices differ across regions and countries. Generalizing findings to a global context may be challenging.

Predictive Nature: Making predictions about the future impact of AI in finance inherently involves uncertainty, and actual outcomes may differ from projections.

Complex Financial Ecosystem: The financial ecosystem is intricate, influenced by numerous factors. Isolating the impact of AI can be challenging.

Consequences:

Impact on Decision-Making: The study's findings can influence the strategic decisions of financial institutions, potentially leading to greater AI adoption and investment in AI-driven technologies.

Regulatory Implications: Policymakers may use the study's insights to inform regulatory frameworks, potentially resulting in more comprehensive guidelines for AI in finance.

Innovation and Investment: Fintech startups and investors may draw inspiration from the study to drive innovation and allocate resources to AI-related projects.

Public Awareness: The study can contribute to raising public awareness about AI's transformative potential in finance, fostering informed discussions on its implications.

Educational Resource: The study can serve as a valuable educational resource, benefiting professionals, researchers, and students interested in AI and finance.

Thought Leadership: Researchers or institutions conducting the study may establish themselves as thought leaders in the field, leading to opportunities for collaboration and consultancy.

International Collaboration: Comparative analysis with similar research from other regions can stimulate international collaboration and knowledge exchange.

Corporate Strategy: Financial organizations may adjust their corporate strategies based on the study's insights, potentially impacting their competitiveness in the evolving landscape of AI-powered finance.

Investment Decisions: Investors may rely on the study's insights to make investment decisions in AI-related fintech ventures.

Workforce Development: Training programs and workshops based on the study's content can contribute to workforce development in the finance industry.

Ultimately, the consequences of the study will depend on its credibility, relevance, and the extent to which its findings are disseminated and acted upon by various stakeholders in the finance industry and academia. Addressing the identified problems can help maximize its positive impact.

THE FUTURE OF ARTIFICIAL INTELLIGENCE (AI) IN INDIA HOLDS IMMENSE POTENTIAL ACROSS VARIOUS SECTORS, FROM HEALTHCARE TO FINANCE, AGRICULTURE TO EDUCATION.

Here are some key insights into the future of AI in India along with recommendations:

****1. AI in Healthcare:**

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Future: AI will play a pivotal role in healthcare, aiding in disease diagnosis, personalized treatment, and telemedicine. AI-powered healthcare chatbots and virtual assistants will become commonplace.

Recommendation: Invest in AI research and development for healthcare, ensure data privacy and security, and train healthcare professionals in AI technologies.

****2. AI in Agriculture:**
Future: AI-driven solutions will improve crop yield predictions, pest control, and soil management. Precision agriculture and drone technology will be widely adopted.

Recommendation: Promote AI adoption in agriculture through government incentives, provide access to AI tools for farmers, and establish AI-powered agricultural research centers.

****3. AI in Education:**
Future: AI will enhance personalized learning experiences, automate administrative tasks, and provide intelligent tutoring systems. AI-driven analytics will help in identifying and supporting struggling students.

Recommendation: Integrate AI-driven ed-tech solutions into the education system, train educators in AI tools, and ensure equitable access to AI-powered education.

****4. AI in Finance:**
Future: AI will transform financial services with chatbots for customer support, AI-driven investment advice, and risk assessment. Blockchain and AI will work together for secure and efficient transactions.

Recommendation: Foster a regulatory framework for AI in finance, promote cybersecurity measures, and encourage research in AI-driven financial solutions.

****5. AI in Governance:**
Future: AI will improve public service delivery, optimize resource allocation, and enhance cybersecurity. Smart cities will utilize AI for infrastructure management.

Recommendation: Develop AI-driven e-governance platforms, ensure transparency in AI adoption, and train government officials in AI technologies.

****6. AI in Manufacturing:**
Future: AI-powered automation will revolutionize manufacturing processes, increasing efficiency and product quality. Predictive maintenance and supply chain optimization will be AI-driven.

Recommendation: Encourage Industry 4.0 initiatives, provide incentives for AI adoption in manufacturing, and establish AI centers for industry research.

****7. AI in Startups and Entrepreneurship:**
Future: India will witness a surge in AI-driven startups, focusing on various domains. These startups will drive innovation and economic growth.

Recommendation: Support AI-focused incubators and accelerators, provide funding for AI startups, and create a favorable ecosystem for entrepreneurial AI ventures.

****8. AI Ethics and Regulations:**
Future: Ethical considerations in AI will become paramount. India will develop comprehensive AI ethics guidelines and regulations to ensure responsible AI use.

Recommendation: Establish an AI ethics framework, encourage industry self-regulation, and collaborate with international bodies to harmonize AI regulations.

To realize this future of AI in India, collaboration between government, academia, industry, and civil society is crucial. Investment in research and development, infrastructure, and education will be vital to harness the transformative power of AI while addressing ethical and regulatory concerns. It's essential to strike a balance between innovation and responsible AI deployment to maximize the benefits for India's society and economy.

Pivotal Financial Technology Developments
Fintech trends are continually shaping the banking industry, with several areas emerging as new norms. Here are key fintech trends in banking:

Digital Payments and Wallets:
- The adoption of digital payment platforms and mobile wallets continues to rise.

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- Contactless payments, QR code-based transactions, and digital wallets are becoming the standard for retail and online payments.

Open Banking:
- Open banking initiatives enable the sharing of financial data between banks and third-party financial service providers.
- This trend promotes innovation, competition, and the development of new financial products and services.

Blockchain and Cryptocurrency:
- Blockchain technology is being explored for secure and transparent transactions, supply chain management, and identity verification.
- Cryptocurrencies like Bitcoin and Ethereum are gaining acceptance, with some banks offering cryptocurrency services.

Artificial Intelligence (AI) and Machine Learning:
- AI-powered chatbots and virtual assistants enhance customer service and streamline banking operations.
- Machine learning algorithms are used for credit scoring, fraud detection, and risk management.

Robo-Advisors:
- Robo-advisors provide automated investment advice and portfolio management services.
- They offer low-cost, algorithm-driven investment solutions, appealing to tech-savvy investors.

RegTech:
- Regulatory technology (RegTech) solutions help banks comply with ever-evolving regulatory requirements.
- Automated compliance monitoring, reporting, and data analysis are integral to regulatory compliance.

Neobanks:
- Neobanks, or digital-only banks, are challenging traditional banks with their user-friendly apps and low fees.
- They often provide high-interest savings accounts and budgeting tools.

Cybersecurity and Fraud Prevention:
- With the increasing digitalization of banking, cybersecurity remains a top priority.
- Advanced security measures, biometric authentication, and real-time fraud detection are key areas of focus.

Sustainable Finance:
- Sustainable and ethical finance is gaining traction, with banks offering green loans, sustainable investment options, and ESG (Environmental, Social, Governance) scoring.

Personalization:
- Banks are leveraging customer data and AI to offer personalized financial advice, product recommendations, and marketing campaigns.
- Personalization enhances the overall customer experience.

Peer-to-Peer (P2P) Lending:
- P2P lending platforms connect borrowers with individual or institutional lenders.
- These platforms provide alternative lending options and often offer competitive interest rates.

Real-Time Payments:
- Real-time payment systems enable instant money transfers between accounts, enhancing the speed and convenience of transactions.

Voice Banking:
- Voice-activated banking services through devices like smart speakers are becoming more common.
- Customers can check balances, transfer funds, and perform other banking tasks using voice commands.

Decentralized Finance (DeFi):
- DeFi platforms offer decentralized financial services, including lending, borrowing, and trading, often built on blockchain technology.

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Central Bank Digital Currencies (CBDCs):

- Several central banks are exploring the development of digital currencies, which could revolutionize the way money is issued and managed.

These fintech trends are reshaping the banking industry, improving customer experiences, increasing efficiency, and promoting financial inclusion. Banks that embrace these trends and adapt to changing customer expectations are well-positioned for future success. By 2035, there is a strong likelihood of a substantial surge in the adoption of AI within the Indian economy. While the United States and China have been at the forefront of AI technology adoption, India has been making significant strides towards embracing this transformative technology. This positive trend is not only opening up numerous job opportunities, with an estimated 200,000 jobs expected to be created for AI experts and professionals across various sectors, including education, healthcare, and retail, among others, but also ushering in a new era of technological advancement. One pivotal factor for success in this technology-driven landscape is the need for the right skill sets. The importance of upskilling and reskilling the workforce cannot be overstated in achieving seamless technology integration. In 2018, when the startup ecosystem began to flourish, the financial sector witnessed remarkable growth, with over 400 startups specializing in AI and machine learning. Several Indian cities, such as Bangalore, Hyderabad, Mumbai, and New Delhi, have emerged as thriving hubs for startups dedicated to AI, enhancing customer services and fostering innovation. The private sector has demonstrated a strong commitment to AI development, with substantial investments exceeding millions of dollars. In June 2018, NITI Aayog, the government's policy think tank, outlined a roadmap for the development of artificial intelligence in India. AI is seen as a catalyst for driving economic and social progress. Its potential applications range from traffic management, road health monitoring, and tracking individuals on blacklists to biometric solutions, among others. In a noteworthy development, on May 17, 2021, LG announced a significant investment of over $100 million over the next three years to establish a high-performance computing infrastructure dedicated to AI development. This infrastructure is designed to execute a staggering 95.7 quadrillion calculations per second. LG envisions that AI systems will find utility in various domains, from customer advisory services to the development of cancer treatment vaccines and eco-friendly plastics. A joint research initiative by the National Business Research Institute and Narrative Science revealed that more than 32% of financial services providers are already leveraging AI technologies in applications such as voice recognition, government finance, audit, and predictive analytics, among others. Prominent industry experts have also shared their insights on AI's potential impact:

Rajeev Agarwal, CEO of a payments platform, acknowledges that AI is still evolving and emphasizes the need for a robust digital infrastructure, high-quality data, and a skilled workforce to fully harness its capabilities. Rahul Sekar, cofounder and CTO at Shubh Loans, underscores the importance of adaptable policies and processes tailored to evolving customer needs, stating that next-generation customer experiences would be unattainable without AI. Gaurav Chopra, Founder & CEO of India Lends, and Manish Patel, cofounder of Mswipe, concur that Artificial Intelligence holds immense potential for the future growth of the Fintech sector. They believe that AI can revolutionize the financial services sector by enhancing efficiency and accuracy. In summary, India's journey into the realm of AI is marked by promising growth, significant investments, and the recognition of AI's potential to reshape industries, particularly the financial sector, as it strides toward a more efficient and technologically advanced future.

RECOMMENDATIONS

- AI finds applications across various industries and has the potential to reshape the employment landscape, necessitating a comprehensive understanding of its principles, particularly deep learning. Achieving significant success in businesses often hinges on effective collaboration between machines and human staff.
- The adoption of AI should align with the specific requirements of different sectors, highlighting the importance of having competent managers who can navigate this integration.
- To harness the power of AI, it is imperative to nurture individuals with specialized skills. Students should receive comprehensive training in machine learning and algorithmic languages. Universities and educational institutions should actively promote and offer courses in these domains.
- Government support is instrumental in fostering the growth of AI. This support ensures that we remain competitive on the global technological stage, preventing us from falling behind other nations in the realm of technology innovation.

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CONCLUSION

In conclusion, "FinTech's Future: Unveiling AI's Impact on Finance" provides valuable insights into the transformative potential of artificial intelligence (AI) within the financial industry. The study highlights the numerous ways in which AI is reshaping financial services, from personalized customer experiences to enhanced risk management and operational efficiency. The research underscores the importance of responsible AI adoption, ethical considerations, and regulatory frameworks to ensure that AI-driven financial solutions benefit both institutions and consumers alike. It also emphasizes the need for collaboration among stakeholders, including financial institutions, fintech startups, academia, and regulatory bodies, to navigate the evolving landscape of AI in finance effectively. As AI continues to advance, its role in the financial sector is set to expand, offering exciting opportunities for innovation and growth. However, this expansion also brings challenges related to data security, algorithmic bias, and regulatory compliance that must be carefully addressed. In summary, "FinTech's Future: Unveiling AI's Impact on Finance" serves as a valuable resource for policymakers, financial professionals, and researchers seeking to understand the profound impact of AI on the future of finance. It provides a foundation for informed decision-making and responsible AI integration, ultimately contributing to the continued evolution of the financial industry in an increasingly digital and data-driven world.

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AI ADVANCEMENTS IN PHARMACEUTICAL DRUG DEVELOPMENT: A COMPREHENSIVE REVIEW

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ABSTRACT
Artificial Intelligence (AI) has emerged as a transformative force in the realm of pharmaceutical drug development, revolutionizing traditional approaches and expediting the discovery and optimization processes. This comprehensive review delves into the significant advancements that AI has brought to the forefront of drug development, examining its impact on various stages of the pharmaceutical pipeline.

The review begins by outlining the foundational role of AI in target identification and validation, showcasing how machine learning algorithms analyse vast datasets to identify potential therapeutic targets with unprecedented precision. Moving into the realm of molecular design, the paper explores the integration of AI and chemo informatics, emphasizing the collaborative efforts that result in the design and optimization of drug candidates.

AI's influence extends to the crucial phase of preclinical drug development, where predictive modelling plays a pivotal role in assessing drug toxicity, pharmacokinetics, and bioavailability. This section critically evaluates the effectiveness of AI applications in improving the accuracy of preclinical studies, ultimately contributing to more successful and streamlined drug development processes.

The paper also highlights the role of explainable AI in fostering transparency and trust within the pharmaceutical industry. As the complexity of Artificial Intelligence models increases, the ability to interpret and communicate their decisions becomes paramount. Examining the ethical considerations surrounding AI in drug development, the review addresses issues of bias, accountability, and the need for robust regulatory frameworks.

Several case studies and successful applications of AI in pharmaceutical drug development are presented to illustrate the real-world impact of these technologies. The collective insights from these cases serve as a testament to the transformative potential of AI in accelerating drug discovery, reducing costs, and improving overall success rates.

In conclusion, this review provides a comprehensive overview of the manifold ways in which AI has advanced pharmaceutical drug development. The synergistic integration of AI technologies has not only expedited traditional processes but has also opened new avenues for innovation in the pursuit of novel and effective therapeutics. As the pharmaceutical landscape continues to evolve, understanding and harnessing the power of AI is essential for staying at the forefront of groundbreaking drug development.

Keywords: Artificial Intelligence, Pharmaceutical Drug Development, Machine Learning, Chemo informatics, Predictive Modelling

1. INTRODUCTION
The integration of AI into pharmaceutical research represents a groundbreaking leap forward, revolutionizing the way drug development has traditionally been approached. Historically, pharmaceutical research and development have been time-consuming and resource-intensive processes, with numerous challenges in identifying viable drug targets, designing effective molecules, and navigating the complexities of preclinical testing. [14] [17] The introduction of AI technologies has introduced a new era characterized by increased efficiency, accuracy, and innovation in each stage of drug development.

The purpose of this comprehensive review is to provide a thorough examination of the impact of AI in pharmaceutical drug development. [12] By focusing on key areas such as target identification, molecular design, preclinical development, and the critical aspects of transparency and trust, we aim to uncover the transformative potential of AI technologies in reshaping the landscape of pharmaceutical research. [2] As we navigate through these sections, we will explore the historical context, the evolution of AI applications, and the tangible benefits realized through case studies and real-world applications.

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2. Foundations in Target Identification and Validation:
Target identification and validation form the bedrock of successful drug development, as identifying the right biological target is fundamental to creating effective pharmaceutical interventions. Traditional methods often involve laborious and time-consuming processes, leading to challenges such as high costs and low success rates. The advent of AI has revolutionized this aspect, offering novel approaches that significantly enhance the efficiency of target identification. [16]

Machine learning algorithms, a subset of AI, have emerged as powerful tools in this domain. [22] These algorithms can analyze vast datasets comprising genetic, biochemical, and clinical information to identify potential therapeutic targets with unprecedented precision. [11] The capability to sift through immense amounts of biological data enables researchers to uncover subtle patterns and associations that might be overlooked through traditional methods.

Case studies in this section will illustrate the successful application of AI in target identification. For instance, the utilization of machine learning algorithms to analyze genomics data and identify specific genetic mutations associated with diseases has proven instrumental in pinpointing novel drug targets. [10] These examples serve as compelling evidence of the transformative potential of AI in accelerating the early stages of drug discovery. [13]

3. Revolutionizing Molecular Design with AI and Chemo informatics:
Molecular design is a pivotal stage in drug development, where the goal is to create compounds that interact specifically with the identified target to produce a therapeutic effect. [7] Traditionally, this process relied heavily on empirical knowledge and experimental trial-and-error, often leading to protracted timelines and resource-intensive endeavors. [19]

The integration of AI, particularly in collaboration with chemo-informatics, has revolutionized molecular design strategies. Chemoinformatics, which involves the application of informatics techniques to solve chemical problems, has found synergy with AI algorithms to expedite and enhance the molecular design process. [1] Through the analysis of vast chemical datasets, AI-driven approaches can predict molecular structures with high probabilities of exhibiting desired pharmacological properties. [4]

One noteworthy application is in the de novo design of drug candidates. AI algorithms, armed with an understanding of chemical structures and their relationships to biological activities, can propose entirely new compounds with the potential for therapeutic efficacy. [5] This transformative capability significantly accelerates the design phase, reducing the time and resources traditionally required for this critical step. [21]

Case studies will illuminate instances where the marriage of AI and chemoinformatics has led to successful molecular design. From optimizing existing compounds to proposing entirely novel structures, the real-world impact of AI in reshaping the landscape of drug design will be evident. [15]

4. Predictive Modelling in Preclinical Drug Development:
The preclinical development phase is a critical juncture in drug development, where the safety and efficacy of potential drug candidates are rigorously assessed before advancing to clinical trials. Historically, preclinical studies relied on animal models and experimental assays, which, while informative, were not without limitations, often resulting in a high rate of attrition as candidates progressed through the development pipeline. [30]

AI's foray into predictive modeling has significantly enhanced the efficiency and accuracy of preclinical drug development. Predictive modeling involves the use of AI algorithms to analyze data and make predictions about future outcomes. In the context of preclinical studies, this translates to the ability to predict drug toxicity, pharmacokinetics, and bioavailability with a level of precision not achievable through traditional methods. [27]

One prominent application of AI in this domain is in toxicity prediction. [6] Machine learning algorithms can analyze diverse datasets containing information on chemical structures and associated toxicity outcomes to build predictive models. These models can then identify potential toxicities early in the development process, enabling researchers to make informed decisions about the viability of a drug candidate.

Real-world examples and case studies will be explored to demonstrate the tangible impact of AI in improving the success rates of preclinical studies. From more accurate predictions of drug interactions to the identification of potential adverse effects, AI's contribution to enhancing preclinical drug development is a testament to its transformative potential. [28] [29]

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5. Explainable AI: Fostering Transparency and Trust:
As AI algorithms become more sophisticated, their decision-making processes become increasingly complex, leading to a growing concern about transparency and trust. Stakeholders in the pharmaceutical industry, including researchers, regulatory bodies, and the general public, require a clear understanding of how AI arrives at specific decisions to foster trust in its applications. [26]

Explainable AI addresses this challenge by ensuring that AI models are interpretable and transparent in their decision-making processes. This section will delve into the importance of explainability in the context of pharmaceutical research, emphasizing its role in mitigating concerns related to bias, ethical considerations, and accountability.

The discussion will touch upon the ethical considerations surrounding the use of AI in pharmaceutical research. Ensuring that AI applications are free from biases, both in the data used to train the models and the algorithms themselves, is crucial to maintaining the integrity of the drug development process. Additionally, the need for robust regulatory frameworks to govern the use of AI in pharmaceutical research will be explored. [25]

Case studies and examples will be presented to illustrate instances where explainable AI has been successfully implemented in pharmaceutical research. From ensuring unbiased patient selection in clinical trials to transparent decision-making in drug development, these examples will underscore the critical role of explainability in fostering trust in AI applications. [18]

6. Case Studies: Real-World Impact of AI in Drug Development:
This section will provide an in-depth exploration of various case studies that exemplify the real-world impact of AI across different stages of drug development. These case studies will serve to illustrate how AI has been successfully applied in diverse contexts, from target identification to preclinical development, and the subsequent translation of these findings into clinical applications. [23]

One case study may focus on a pharmaceutical company that employed AI-driven target identification to streamline their drug discovery pipeline, resulting in the identification of a novel therapeutic target for a previously challenging disease. [24] Another example might showcase the successful use of AI in optimizing drug [20]

7. Challenges and Future Directions
While AI has brought about significant advancements, challenges persist. This section examines current limitations, including data biases, algorithmic uncertainties, and ethical concerns. Additionally, it outlines potential future directions for AI in pharmaceutical drug development, such as increased collaboration, continued technological innovation, and the evolution of regulatory frameworks. [9]

CONCLUSION
In conclusion, the integration of AI in pharmaceutical drug development has ushered in a new era of innovation and efficiency. From target identification to preclinical studies, AI has demonstrated its capacity to accelerate processes, reduce costs, and improve overall success rates. As the pharmaceutical landscape evolves, a nuanced understanding of AI's capabilities and challenges becomes imperative for researchers and industry stakeholders alike.

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EFFECT OF AI CHATBOTS TOWARDS COMPETITIVE MARKETING STRATEGIES IN HYPER - COMPETITIVE BUSINESS ENVIRONMENT

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ABSTRACT
AI enabled chatbots has become an indispensable component of modern marketing strategies. These chatbots bring several advantages to the marketing landscape. They are availability is 24/7. The virtual AI chatbots operate round the clock, ensuring that customers can receive assistance and information at any time, regardless of business hours. Instant response in AI-powered chatbots deliver quick and accurate responses to customer queries, minimising waiting times and improving the overall user experience. Cost efficiency is that the chatbots reduce the need for human intervention in routine and repetitive tasks, leading to cost savings for business while maintaining service quality. Scalability is the Virtual chatbots can handle multiple conversations simultaneously, allowing businesses to scale their customer support without a proportional increase in manpower. Personalization is the AI enables chatbots to analyze user data and tailor responses based on individual preferences, providing a personalized experience for each customer. This paper focus on effective utilization of chatbots will lead to formulating competitive marketing strategies by the leading business organizations. This study evolves around the AI enabled competitive marketing strategies formulated by leading corporate like Uber , Lenskart, Coca-Cola , Nestle to wade through hyper-competitive environment .

Keywords: Artificial Intelligence (AI), Chatbots, Amplified brand awareness, Personalization, Precise targeting

Selected Reviews of literature

H. Gungor (2020)[1] has made a study on "Creating Value with Artificial Intelligence: A multi stakeholder perspective". This study gives a brief description of Artificial Intelligence and it's perceived value creation potential and also perceived risks from the point of view of multi stakeholders like customers, employees, shareholders, suppliers and the society as a whole. Narrow AI, General AI and Super AI are the three broad types of Artificial Intelligence discussed in the study. In creating value through AI and ML, the companies align with the triple bottom goals on social, economical and environmental, commonly known as 3P's, People, Profits and Planet.

Ming-Hui Huang and Roland T. Rust (2020)[2] has made a study on "A strategic framework for artificial intelligence in marketing". This study implies that AI tools can be used for understanding consumer expectations, in forming strategies for STP and in standardization and personalisation. The study is concluded by saying that AI tools can be used in marketing action (4Ps) and research (STP) while pointing out its limitations the authors feel that AI can be a powerful tool if it is wisely used by the marketers.

Phil Klaus and Judy Zaichkowsky (2020)[3] published an article on "AI voice bots: a services marketing research agenda". The integration of AI in voice bots has transformed the landscape of service marketing. This review might delve into how AI-powered voice bots enhance customer service experiences, their impact on customer satisfaction, and the challenges they pose. The paper might provide a comprehensive agenda for future research in this domain.

Dan Dumitriu et' al (2020)[4] published an article on "Artificial Intelligence Solution on Digital Marketing". This article investigates the current status of digital marketing, exploring whether researchers have examined the incorporation of voice search in marketing and keyword identification methods. Google Search Console is useful for SEO, helping discover keywords the site is already associated with the rise of automated marketing, spurred by intelligent algorithms, has become a notable sub-industry branch in the modern marketing landscape.

Worakamol Wisetsri et' al (2021)[5] has made a study on Systematic Analysis and Future Research Directions in Artificial Intelligence for Marketing. The goal of this study is to provide a comprehensive review of AI in marketing by analysing extant literature published between 1982 and 2020 machine learning, deep learning, and neural networks are the three fundamental concepts. Cobots for packaging, drones for delivery, and IoT for order tracking and order refilling make artificial intelligence the ideal solution for place management.

Marcello M. Mariani (2021)[6] has made a study on "AI in marketing, consumer research and psychology: A systematic literature review and research agenda". This research marks the inaugural attempt to present a

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cohesive perspective on the collective knowledge of artificial intelligence (AI) found in marketing, consumer research, and psychology literature. Employing a systematic literature review with a data-driven approach and quantitative methods such as bibliographic coupling, the study outlines the evolving intellectual landscape of AI research within these three realms.

Bozidar vlacic et' al (2021)[7] published an article on "The evolving role of artificial intelligence in marketing: A review and research agenda". AI continues to shape marketing strategies, It might highlight the evolution of AI's role, detailing its impact on various marketing aspects, such as customer behavior analysis, personalized marketing, and automation of repetitive tasks. The review could offer insights into how AI has transformed marketing, potentially discussing challenges and ethical considerations that come with its integration.

Ming-Hui Huang and Roland T. Rust (2021)[8] has made a study on "A Framework for Collaborative Artificial Intelligence in Marketing". This study establish a conceptual framework for the collaboration of artificial intelligence (AI) in marketing, offering systematic guidance on how human marketers and consumers can partner with AI. The implications extend to marketers, consumers, and researchers, with a focus on optimizing the AI-HI marketing team, understanding complementarity between AI and HI strengths for consumer decisions, and exploring innovative approaches to collaborative intelligence.

Jose Raman Saura et al (2021)[9] published an article on "Setting B2B digital marketing in artificial intelligence - based CRMs: A review and directions for future research". This paper likely explores the integration of AI within B2B digital marketing through CRM systems. The review might emphasize the challenges of implementing AI in B2B marketing, such as data privacy concerns and the balance between automation and personalization, and suggest future research areas focusing on AI's evolving role within B2B CRM strategies.

Abid Haleem et' al (2022)[10] published the article on "Artificial intelligence (AI) applications for marketing: A literature -based study". AI applications in marketing based on the information I was trained on. However, challenges like data privacy concerns, ethical implications, and the need for human oversight in decision-making are areas that require attention in the application of AI in marketing. This paper might delve deeper into these aspects and explore the nuances and trends in AI's role in marketing strategies.

INTRODUCTION

Lead Generation is a Chatbots can engage users in a conversational manner, collecting valuable information and qualifying leads for further marketing efforts. Data Collection and Analysis is a Virtual chatbots gather user data during interactions, contributing to a deeper understanding of customer behavior and preferences. This data can be leveraged for targeted marketing campaigns. Language Processing Improvements is an advancement in natural language processing (NLP) allow chatbots to understand and respond to user queries with increased accuracy, making interactions more human-like. Multi-Channel Integration is the Chatbots seamlessly integrate with various communication channels, including websites, social media platforms, and messaging apps, providing a consistent brand experience across channels. Enhanced Customer Engagement is through proactive engagement and personalized recommendations, virtual chatbots keep users interested and involved, fostering a positive relationship between the customer and the brand.

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Fig. 1: Several Segments for AI applications in Marketing Domain

AI Enabled Value Creation of Products

Around 35% of the startups fail due to the development of products which don't suit the needs and preferences of the consumers. The startups could be assisted with more accurate, precise qualitative as well as quantitative data which match the customer's needs through AI - fuelled data analysis. One of the major time consuming processes under the product development life cycle could be creating prototype or mock ups for the products developed. The AI could help create prototypes within few hours which could considerably save the wastage of resources, time and money. The feedback of customers during the testing phase could also be acquired quickly during the efficient usage of Artificial Intelligence. The new generative machine learning models could apply patterns for the conversation of inputs into outputs even for the unseen data which could help us to get a deeper understanding beyond the creative process.

Consider the color-discovery app created by Behr, the paint company. Using IBM Watson's natural language processing and Tone Analyzer capabilities (which detect emotions in text), the application delivers several personalized Behr paint-color recommendations that are based on the mood consumers desire for their space. Customers use the app to short-list two or three colours for the room they intend to paint. The actual sale of paint is then executed outside the app, although it does allow a connection to order from Home Depot.

AI Initiatives for Competitive Pricing Strategies

One of the major concerns under marketing could be fixing the right price for a product which could capture right value to the customers. Often, various price fixing strategies are used by the companies to determine the price of the product which could fail because the past, unstructured and future data is not analysed and market trends are not evaluated. Under the cost plus pricing, no matter how the demand changes, the price is often inelastic irrespective of the market conditions. While incorporating competitive pricing strategy, the companies often fix prices in response to the competitors which could considerably affect their profitability. There are various difficulties and challenges occurring in the price skimming, penetration pricing and other strategies. Often these strategies are lacking in providing appropriate value to the customers. These could be curbed with the help of Artificial Intelligence when algorithms are used to analyse the large amount of data and determine the responsiveness of customers towards price changes. The price optimisation with machine learning could use the past data, even unstructured data such as videos and images, competitor's price available in their websites and would create the pricing strategy by itself through algorithms in the dynamically changing environment.

Supply Chain Solutions by AI

Lack of databases could adversely affect the availability of inventories during the situation when it is demanded most. Michael Dell effectively handles these situations. Dell, for instance, might discover that there is a greater demand than supply for 60 GB hard drives. Instead of delaying delivery, the company works with suppliers to

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maintain inventory levels of the 60 gig drives and provides 80 gig hard drives at special prices. Similarly, Dell reduced its repair time from 43 to 17 days by introducing real-time and historical reporting for inventory and service reviews. With proper recording of data and incorporation of Artificial Intelligence, the demand could be forecasted using the past data from various sources and inventories could be managed well. The marketing mix's essential elements of product availability and access are necessary to boost client happiness. Product distribution relies on networked relationships, logistics, inventory management, warehousing, and transportation concerns. It is primarily mechanical and repetitive in nature. Coots with Artificial intelligence is used in packaging, drone delivery, and Internet of Things order tracking and refilling. Customers and providers alike gain from the distribution process's automation and standardization. Apart from its usefulness for distribution AI in management offers chances for client interaction inside the service environment. Robots that perform and are equipped with AI codes that convey emotions are beneficial.

Role AI in Branding, Brand Promotion and MARCOM

The traditional promotional activities have their own problems such as limited reach, reliance in traditional media, geographical boundaries, lack of real time interaction and feedback. Additionally, measuring the impact of promotions was often less precise compared to the data-driven analytics available in the digital age. AI in promotion has revolutionized marketing strategies. It enables personalized content recommendations, targeted advertising, and data-driven insights. AI algorithms analyze user behavior to tailor promotions, improving relevance and engagement. Chatbots powered by AI enhance customer interactions, providing instant support. Additionally, predictive analytics helps forecast trends, optimizing promotional campaigns for better effectiveness. This is evident at Wayfair, an online furniture retailer, where artificial intelligence is used to identify potential buyers and select things to display to them based on their browsing history. For example, systems that manage the complete ad buying and placement process come equipped with machine learning that makes split second decisions about which digital ads to present to users. Netflix has utilized integrated machine learning to provide its consumers with video suggestions. These recommendations are displayed as options in the menu when viewers visit the website. Hence, AI has the ability to process a vast amount of data for the precise audience targeting and dynamic adjustments, making promotions more efficient in the digital era.

Automated STP (Segmentation, Targeting, Positioning) and Behavioural Analysis through AI

Traditional segmentation strategies might ignore changing consumer tastes and behaviours since they frequently rely on rigid, predetermined criteria. Enabling AI could significantly enhance accuracy and precision of segmentation, efficiently scale the segmentation efforts, real time data analysis and adaptive targeting, personalisation and improved customer experience. Furthermore, manual segmentation procedures may not fully utilize the potential of the data that is provided and might be time-consuming. By identifying and creating segments using data-driven algorithms, artificial intelligence (AI) can be utilized to optimize and customize client segmentation. Customers can be divided into segments according to their value, loyalty, or potential by using clustering algorithms to categorize them based on similarities and differences. Based on a customer's experiences with your business, classification algorithms can be used to predict qualities like age, gender, income, and personality. Systems for making recommendations can make suggestions for goods, services, or deals based on a user's past purchases, requirements, and preferences. By analyzing customer reviews, comments, and feelings, natural language processing can help you improve your offerings in terms of goods and services as well as customer satisfaction. It can also help you customize messaging and tone for different target audiences.

Offering a full range of tools and solutions to assist businesses in attracting, engaging, and delighting customers, HubSpot has made a name for itself in the marketing sector. HubSpot is a software company that specializes in inbound marketing and offers tools to help companies increase sales and optimize their marketing campaigns.

It's features and functionalities to enhance the customer segmentation efforts includes:

- **Automated Segmentation**: The artificial intelligence tool streamlines the segmentation process, obviating the necessity for manual analysis and conserving valuable time and resources. Marketers can swiftly discern pertinent segments based on key criteria and behaviours.
- **Behavioural Analysis**: The artificial intelligence tool scrutinizes customer behaviours across diverse touchpoints, encompassing website visits, email interactions, social media engagements, and more. This thorough analysis furnishes a comprehensive perspective of each customer's preferences, aiding in the identification of optimal targeting strategies.

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- **Predictive Modelling**: Harnessing the capabilities of artificial intelligence, the tool can formulate predictive models that foresee future customer behaviours and preferences. This empowers marketers to proactively tailor their messaging and offers, staying ahead in addressing customer needs.
- **Dynamic Audience Segmentation**: HubSpot's artificial intelligence tool facilitates dynamic audience segmentation, enabling marketers to adjust their targeting strategies in real-time. As customer behaviours and preferences undergo changes, the tool identifies evolving trends, ensuring that marketing endeavours remain pertinent and efficacious.

Personalization is essential in today's cutthroat online environment if you want to stand out and engage your target audience. Untargeted, generic commercials are just not effective anymore. Artificial Intelligence (AI) can help with that. You may use AI to develop customized, targeted advertisements that connect with your audience and produce better outcomes. AI can assist us with the design of personalized ads in a number of ways such as enhancing the effectiveness of advertisements by providing highly relevant and appealing adverts to consumers, increasing revenue from current clients by successfully and frequently interacting with them and boosting acquisition rates by focusing on new audiences according to their interests and geographic location. AI algorithms analyze large datasets to identify patterns, preferences, and trends, enabling more precise and effective targeting of specific audiences or objectives. This can lead to improved efficiency and better outcomes in reaching desired goals. A real-time example of AI in targeting is online advertising platforms that use machine learning algorithms to analyze user behavior and preferences instantly. These algorithms process data such as browsing history, search queries, and social media activity to deliver targeted advertisements to users in real time. This allows advertisers to present personalized content to individuals based on their interests and online behavior, increasing the likelihood of engagement and conversion.

By assisting organizations, artificial intelligence has the ability to revolutionize marketing initiatives by unique positioning

- Make compelling brand positioning statements that appeal to their intended market.
- Examine consumer preferences, behavior, and rivalry to yield insightful information.
- Provide a distinctive and persuasive brand positioning statement.
- Acquire more insight into their intended audience
- Expect the results of their marketing tactics

As a result, companies are better able to comprehend their target market and project the results of their initial and follow-up marketing campaigns. Netflix is a great example of the power of an AI positioning statement. Here’s an excerpt: “As the world’s leading Internet television network with over 160 million members in over 190 countries, our members enjoy hundreds of millions of hours of content per day, including original series, documentaries, and feature films. We invest heavily in machine learning to continually improve our member experience and optimize the Netflix service end-to-end. As researchers, we innovate using machine learning in many areas where we prototype, design, implement, evaluate, and productionize models and algorithms through both offline experiments and online A/B testing.”

Impact of AI on Amplified Brand Awareness

One important component of the consumer's consciousness is brand awareness. Customers gain a better understanding of the brand's values as well as its worth from this, as it helps them form opinions about it. One of a company's most valuable assets is its brand, particularly in highly competitive industries. A company's success or failure can be determined by its audience's ability to discern its brand from that of its rivals and by its ability to deliver a unique message.

To amplify brand awareness, consider leveraging social media campaigns, influencer partnerships, and creating engaging, shareable content to reach a wider audience. Consistency in branding across platforms also plays a crucial role. Additionally, explore targeted advertising to reach specific demographics, participate in relevant industry events, and encourage user-generated content to foster community engagement around your brand. Monitoring analytics can help refine your strategies for maximum impact.

In contemporary consumer interactions with brands, individuals seek more than industry-leading products and services. They actively seek brands that align with shared values and authentically endorse these principles.

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The rationale behind this inclination is rooted in the enhanced ability of prospective customers to establish a connection and trust in an organization that genuinely embodies its values. Brand amplification serves as a mechanism to articulate the essence of a brand by emphasizing its values, narratives, and fundamental message.

Contemplate the distinctive aspects that differentiate your brand from competitors, discern its unique attributes, and elucidate the significance of its actions. Such insights serve as foundational elements for effectively amplifying your brand. A comprehensive understanding of your brand's core facilitates the communication of authentic and compelling narratives to your audience.

One might question the necessity of brand amplification for competitiveness. The unequivocal answer is affirmative, particularly if the aspiration is to construct a consistent experiential framework across diverse customer touchpoints.

A meticulously devised and articulated brand strategy yields benefits extending beyond the audience. It equips internal staff and external agencies with a brand hierarchy, enabling the establishment of consistency across various customer touchpoints. Whether it is the typeface on your website's landing page or the logo adorning your products, a well-articulated brand strategy influences all key assets. Above all, brand amplification delineates the framework for the business one aspires to develop. It delineates the preferred composition of the workforce, the values upheld, and notably, the values vehemently opposed. Now equipped with foundational knowledge regarding brand amplification and its imperative, the focus shifts to the practicalities of implementation.

AI Enabled Marketing Strategies in Leading Corporate

Olay

An illustrative example can be found in Procter & Gamble's Olay Skin Advisor, employing deep learning to analyze customer-taken selfies, evaluate age and skin type, and suggest suitable products. Integrated into the Olay.com e-commerce and loyalty platform, this system has demonstrated enhanced conversion rates, reduced bounce rates, and increased average basket sizes in certain regions. However, the integration with retail stores and Amazon has proven challenging, given their substantial contribution to Olay's sales. Unfortunately, the Skin Advisor is not accessible on Olay's comprehensive store site on Amazon, hindering the brand's capacity to provide a seamless, AI-assisted customer experience in that space.

Lenskart

Lenskart initially faced three core challenges: ensuring precise prescriptions, finding well-fitting glasses, and enabling customers to visualize how glasses would appear on them. However, through continual innovation, Lenskart has devised inventive solutions to overcome these obstacles. A notable example is the implementation of a selfie-based method, allowing customers to capture a selfie via Lens kart’s mobile app. Leveraging advanced technology, the app accurately determines the suitable size of glasses for each individual, accessible on both Android and iOS devices. Additionally, Lenskart employs augmented reality to enable customers to virtually try on glasses, facilitating an informed decision-making process.

Addressing the challenge of eye tests, Lenskart introduced a convenient home eye test solution through its app. Users can easily locate nearby optometrists and schedule eye tests at home in various cities. Complementing this, Lenskart has established over 1400+ physical stores nationwide, offering comprehensive eye tests in the pursuit of ongoing innovation, Lenskart has embraced artificial intelligence (AI). Using AI, Lenskart efficiently processes extensive data, providing personalized recommendations. Combining high-quality customer-captured pictures with anonymized data, Lens kart’s AI algorithms accurately determine glasses that complement facial features. This AI-driven approach significantly reduces the time customers spend in finding the perfect pair of glasses.

Nestle

To increase the efficacy and efficiency of its 15,000 marketers' efforts, Nestlé uses artificial intelligence (AI) to create creative guidelines. To be more precise, they are utilizing an artificial intelligence system known as "Cortex" to offer creative rules and standards that guarantee brand coherence and adherence to advertising regulations. This step might start a chain reaction among major participants in the food sector and raise demand for Nestlé's products, particularly if other businesses use AI-driven marketing tactics of a similar nature.

Areas benefited by Nestlé:

Personalization: Nestlé can better understand the preferences and behavior of individual consumers by utilizing AI to evaluate customer data. This allows the company to develop marketing efforts that are

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specifically catered to the requirements and interests of each individual customer. This may result in more devoted clients as well as more focused and successful advertising.

Innovation: Nestlé can spot new prospects for product development and innovation by employing AI to examine consumer feedback and market trends. This could result in the development of more inventive and enticing food products that cater to the shifting needs and tastes of consumers.

Sustainability: According to Nestlé, artificial intelligence (AI) is being used to help the company meet its sustainability objectives, which include cutting waste and enhancing the environmental effect of its goods. By streamlining its production and supply chain with artificial intelligence, Nestlé may lessen its environmental impact and win over more environmentally conscious consumers. This could encourage more ethical and sustainable behaviours, which would benefit the food business as a whole.

These adoptions of Artificial Intelligence by Nestlé could globally increase the demand for the Nestlé products, paving the way for the adoption of AI - driven marketing strategies by various other companies, leads to advancements in AI and machine learning technology, improves sustainability and responsive production practices.

Uber

Uber is currently accessible in over 900 cities worldwide and over 70+ countries. It is admirable how they applied machine learning and artificial intelligence. Their operations are heavily reliant on AI, thus the debate over whether or not to employ it has long since passed. Uber matches drivers with passengers, matches fraud, assesses risks, tracks routes, and much more using AI. Another term for Uber is an AI-first business. Businesses that integrate AI and ML into every product and process are known as AI-first companies. They think AI should be used to run every function within the company.

Uber concentrates on two areas of machine learning: operations and research. They assess how they can incorporate technology into their products during operations. Conversely, the research domain team concentrates on developing next-generation technologies. Every internal team at Uber uses Michelangelo as the de facto platform. Uber used Michelangelo to develop its features.

Estimated Time of Arrival:

Uber use ML in addition to the conventional approach to overcome this issue and get more accurate results. To anticipate ETA, the organization combines real-time data, historical data, and machine learning algorithms. This model, named Deep ETA, was constructed with Michelangelo's assistance.

Demand and Supply Equilibrium:

For Uber to run its business, it must control the gap between supply and demand. With the resources at their disposal, the corporation must service numerous places with a restricted number of cars.

To address the issue, the organization has divided the solution into two phases.

- **Demand Prediction:** Uber predicts the number of taxis needed in a given area and time by analysing historical data. Starting in 2019, the business employed deep learning architecture to enhance the forecast.
- **Guaranteeing Supply**: In a given area, for instance, there is a great demand for taxis, but there are not enough of them available.

Uber resolves the problem by providing the drivers with a heatmap that shows them the areas of strong demand. Additionally, a price multiplier is displayed, telling the drivers how much more money they will make when they travel to that location.

Coca-Cola

Coca-Cola is asking customers to envision what a limited-edition drink and new AI-powered experience from the future may taste and feel like. Coca-Cola Y3000 Zero Sugar was jointly developed by humans and artificial intelligence by analyzing the feelings, goals, tastes, colours, and other aspects that fans foresee for the future. Coca-Cola was inspired to create the distinctive taste of Y3000 by the perspectives of fans from around the globe and information gained from artificial intelligence. For a brief period, the zero-sugar product will be offered in a few markets, including those in the US, Canada, China, Europe, and Africa. An original taste variant of Coca-Cola Y3000 is also available to consumers in the US and Canada. Coca-Cola Y3000 Zero Sugar has a visual identity that is both optimistic and futuristic. The design, which was jointly produced with artificial intelligence, shows liquid in a changing, evolving condition, conveyed through alterations in shape and color that highlight a bright future. A futuristic vibe is created with a light-toned color scheme that contrasts silver

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with violet, magenta, and cyan. The recognizable Spencerian Script depicts the human connections of our future world through a connected matrix with flowing dot clusters. Coca-Cola Creations gives the recognizable Coca-Cola brand fresh life through connections, innovation, and teamwork. The limited-edition flavour of each successive, surprise-and-delight drop, along with designs and experiences inspired by sports, video games, music, and other consumer passion areas, bring the "Real Magic" idea to life.

CONCLUSION

One of the key takeaways from the integration of AI in marketing is the ability to harness vast amounts of data. AI algorithms excel at processing and analyzing data at a scale that surpasses human capacity, enabling marketers to glean valuable insights into consumer behavior, preferences, and trends. This data-driven approach empowers businesses to make informed decisions, tailor their campaigns with precision, and deliver personalized experiences that resonate with individual consumers. Moreover, the advent of AI has given rise to advanced predictive analytics, allowing marketers to anticipate trends and consumer needs. By leveraging machine learning algorithms, businesses can forecast market fluctuations, identify emerging patterns, and stay ahead of the curve. This proactive approach not only enhances the agility of marketing strategies but also positions companies to adapt swiftly to evolving market dynamics. Customer engagement has undergone a profound transformation with the infusion of AI technologies. Chatbots, powered by natural language processing, have become integral in providing instant and personalized customer support. These AI-driven assistants are available around the clock, enhancing user experience and fostering customer satisfaction. Additionally, AI enables marketers to create hyper-targeted campaigns, ensuring that promotional content reaches the right audience at the right time through channels tailored to individual preferences. In the realm of content creation, AI has emerged as a game-changer. Generative algorithms can produce compelling and contextually relevant content, alleviating the burden on human creators.AI-generated content can be tailored for specific audience segments, optimizing engagement and resonance. The responsible use of AI is crucial to avoid unintended consequences and potential biases in decision-making processes. Striking a balance between leveraging the power of AI and upholding ethical standards will be essential in fostering trust among consumers and maintaining the integrity of marketing practices. The integration of AI in marketing marks a paradigm shift, offering unparalleled opportunities for efficiency, personalization, and innovation.

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APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN HEALTH CARE SYSTEM

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ABSTRACT
Artificial intelligence (AI) technologies continue to develop in broad range of disciplines during recent years, including the healthcare system. The increase in computer hardware and software applications are widely used in the modern medicine field. This progress provides new opportunities as well as challenges which can be effectively resolved using AI directions in healthcare. AI can perform healthcare tasks better than humans and the its application may prevent large-scale automation of healthcare professional jobs in near future. It has the ability to significantly improve healthcare, and nursing in particular. It can also help realize the promise of individualized and precise treatment. AI can speed up discovery, improve precision, lessen disparities, and help reduce unpredictability in care. It has the ability to empower patients and enable medical staff to relate to their patients as healers who are backed by the greatest available medical research and analytical technologies. However, there are other obstacles to overcome in order to apply successfully. Structural, technological, legal, and cultural barriers are to be removed so as to integrate AI into the core of healthcare.

Keywords: Artificial intelligence (AI), Healthcare, Machine learning, Medical research.

INTRODUCTION
Artificial Intelligence (AI) refers to a set of technologies that allows machines and computers to simulate human intelligence. AI technologies have been developed to analyse a diverse array of health information which consists of data pertaining to the patient as well as clinical, behavioural, environmental, and drug data encompassed in the biomedical literature. Because of the potential to automate many tasks currently requiring human intervention, AI has attracted considerable interest from a variety of fields [10]. AI methodologies are now commonly used in computer vision, speech recognition, and natural language processing (NLP). AI technologies can simulate human intelligence at a variety of levels. Both machine learning (ML) and deep learning (DL) are subsets of AI. Machine learning allows systems to learn from data at the most in the basic level. Deep learning is a type of Machine Learning which uses more complex structures to build models [5].

Machine learning (ML), a popular subdiscipline of Artificial Intelligence, utilizes large datasets and identifies interaction patterns among variables. These techniques can discover previously unknown associations, generate novel hypotheses and drive researchers and resources towards most fruitful directions [9]. Machine learning can be applied in various fields, including financial, automatic driving, smart home, etc. In medicine, machine learning is widely used to build automated clinical decision systems. Most machine learning approaches fall into two main categories, viz., supervised, and unsupervised methods. Supervised methods are great for classification and regression. Recent examples include detection of a lung nodule from a chest x-ray and the risk estimation models of anticoagulation therapy, implantations of automated defibrillators in cardiomyopathy, classification of stroke and stroke mimic, outcome prediction in infectious diseases, detection of arrhythmia in electrocardiogram, design and development of in silico clinical trials [13].

Deep learning is a subset of ML which mimics the operation of the human brain using multiple layers of Artificial Neuronal Networks (ANN) to generate automated predictions from training datasets. Deep learning is compelling in image recognition as well as in modelling disease onset using temporal relations among events. A deep neural network was trained on more than 37,000 head computed tomography scans for intracranial haemorrhage and subsequently evaluated on 9,500 unseen cases, reducing time to diagnosis of new outpatient intracranial haemorrhage by 96% with an accuracy of 84% [14].

Foundational Concepts in AI:
The Core concepts and methodologies that form the basis of AI systems include:

- **Natural Language Processing (NLP**) is used in clinical concepts such as symptoms, diagnoses and treatments from narrative text, such as clinical notes.
- **Classifiers** map input data into categories based on training data in which the proper classification is known, i.e., labelled, so new data can be correctly categorized [17].
- **Artificial Neural Networks (ANN)** provides systems modelled on biological nervous systems and it simulates the human brain processes.

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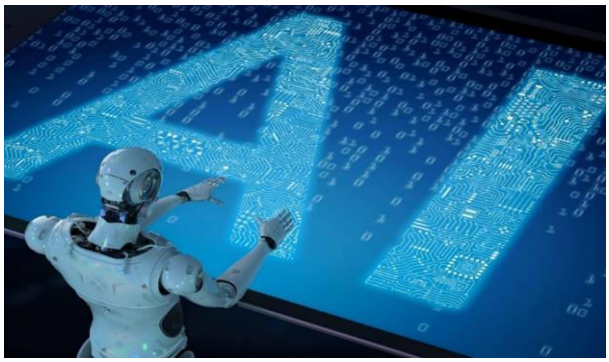
- **Machine Learning (ML)** can process large volumes of data and extract meaningful information from it to address practical problems.
- **Augmented Intelligence** is intended to assist humans in utilizing or extending their own capabilities [15].
- **Image/Speech Analysis** provides for extracting meaningful information from images such as MRIs or recorded speech, as opposed to numeric, categorical or text data.

GOALS OF AI:

- To create an expert system.
- To implement human intelligence in machine.
- To make a smart task by applying a human intelligence like understanding natural language, recognizing pattern and solving problems.[6]



ADVANTAGES OF AI

Reduction of Error
Artificial Intelligence helps us to reduce risks in most cases by reaching accuracy with greater degree of precision.

Digital Assistants
The AVATARS are used as digital assistants by high advanced organizations to save human resources [2].

No Breaks
The Machine does not require frequent breaks and refreshments like humans as it can work for long hours. They can continuously perform without getting bored.

Increase of work efficiency
The AI powered machines have amazing efficiency to finish a particular repetitive task.

They avoid human errors in a task to achieve accurate results.

Reduce Cost of Training and Operation
The deep learning and neural networks algorithm is used in AI to learn new things like humans do and avoids the necessity to write a new code every time [2].

DISADVANTAGES OF AI

High cost
Its implementation involves huge costs and more expenses are to be incurred for repair and maintenance of machines.

Lack of Personal Connections
We cannot rely too much on these machines for educational oversights as we cannot interact with them personally for clearing our doubts [6].

Addiction
As we rely on machines heavily to perform our everyday tasks, we will not be able to do these tasks without these machines in future.

Efficient Decision Making
As these computers are getting smarter every day, they can demonstrate the ability not only to learn but also to teach other computers [7].

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Lesser Jobs
We are aware that machines do routine work and repeatable task much better than humans. Moreover, machines are used instead of humans in order to increase a profitability in business. It may lead to unemployment and thus cause great impact on humans.

APPLICATIONS OF AI IN HEALTH CARE SYSTEM
Al has various applications in health care and pharmacy which are as follows:

- Disease identification
- Electronic health records
- Applications of AI in nursing
- Drug discovery and manufacturing
- Clinical trial research
- INSILICO modelling
- Selected healthcare AI applications

DISEASE IDENTIFICATION
AI has increasing applications in health care and research mainly concentrating around cancer, nervous system, and cardiovascular diseases, because these are the leading causes of disability and increase mortality rate. However, chronic diseases (e.g., type 2 diabetes, inflammatory bowel disease, difficile infection) have also been getting considerable attention. United States Food and Drug Administration (FDA) has permitted application of diagnosis software designed to detect wrist fractures in adult patients in recent discoveries [21]. Several studies are looking for the potential of artificial intelligence in timely and precise disease diagnosis and treatment. For example, in 2015 - Report by Pharmaceutical Research and Manufacturers of America, more than 800 drugs and vaccines are in trial phase to treat cancer. Google's DeepMind Health, announced multiple partnerships including some eye hospitals in which they are developing technology to address macular degeneration in aging eyes. Oxford's Pivotal® Predicting Response to Depression Treatment project is aiming to produce commercially-available emotional test battery for use in clinical setting. One of the goals of precision medicine in cancer is the accurate prediction of optimal drug therapies from the genomic data of individual patient tumours.[22]

Electronic Health Records (EHRs)
It is an effective tool for documenting and sharing healthcare information. It is an Integrating machine learning-based modelling designed specifically for administrative datasets which can facilitate the detection of potential complications, improve health care resource utilization, and outcome at a personalized level [11]. It helps to diagnosis, clinical decisions and personalized treatment suggestions and handwriting recognition of transforming into cursive or sketched handwriting into digitalised characters. One of the goals of precision medicine in cancer is the accurate prediction of optimal drug therapies from the genomic data of individual patient tumours [14].

Applications of AI in Nursing
AI can serve as “nurse coaches” to help patients manage a health condition or make behavioural changes using pre-recorded video clips and training materials that are triggered by algorithms as each patient uniquely works through the virtual session [15]. AI can support nursing care management applications as well as simulation training of nursing and other healthcare professionals. AI can help nurses improve quality, safety and reduce costs as they deliver care. The future will be informed by data and intelligent technologies that can recommend action based on information, harnessing the power of AI so nurses can deliver care better, faster, and more safely [16].

Drug Discovery and Manufacturing
In the field of drug development and manufacturing initial screening of drug compounds to predicted success rate based on biological factors, R&D discovery technology; next-generation sequencing. Previous experiments are used to train the model. Optimization softwares are used to design the processes for new drug development. GPU (graphics processing unit) - accelerated deep learning to target cancer and age-related illnesses by above organization. Benevolent Bio's deep learning software, powered by the NVIDIA DGX- AI supercomputer (it ingests & analyses the information to find connections and propose drug candidates) [22]. It may lead to develop a Targeted drug discovery is preferred in pharmaceuticals due to the explicit mechanism, higher success rate, and lower cost when compared to traditional blind screening. Machine learning is now utilized in

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the drug discovery process due to the factors such as high costs of drug development, increasing availability of three-dimensional structural information that can guide the characterization of drug targets, and extremely low success rates in clinical trials [23].

Clinical Trial Research

In clinical trials, Machine learning is used to shape, direct clinical trials and advanced predictive analysis in identifying candidates for clinical trials, remote monitoring and real time data access for increased safety, biological and other signals for any sign of harm or death to participants [14]. It helps in finding best sample sizes for increased efficiency, addressing and adapting to differences in sites for patient recruitments, using electronic medical records to reduce data errors. It has been used in clinical trial design and data mining. For example, adopted feedforward feature selection and gradient boosting in cross-trial prediction of treatment outcomes in depression. investigated the usage of a support vector machine to boost the power of clinical trials and reduce the clinical trial sample size [18].

INSILICO Modelling

Insilico modelling approach was introduced to describe the numerical methods used in drug development in oncology by modelling biological systems in the setting of clinical trial studies and hospital databases, paving the way to predictive, preventive, personalized and participatory medicine [13]. This approach gives the researchers the ability to partially replacing animals or humans in a clinical trial and generates virtual patients with specific characteristics to enhance the outcome of such studies. These methods are especially helpful for paediatric or orphan disease trials and can be applied in pharmacokinetics and pharmacodynamics from the preclinical phase to post-marketing [19]. Insilico clinical trials can have considerable potentials in design and discovery phases of biomedical product, biomarker identification, dosing optimization, or the duration of the proposed intervention.

Selected Healthcare AI Applications:

Selected applications spanning multiple disciplines and applications

- **Clinical Decision Support CDS systems** have been used since the 1970s-1980s to reduce variation and improve adherence to guidelines.
- **Precision/Personalized Medicine** aims to use an individual's genetic make-up to determine the correct choice and dose of treatment.
- **Image Analysis** has been particularly important in reducing variability in the interpretation of image data and has recently been shown to be on a par with expert analysis in such areas as retinal imaging and mammography.
- **Internet of Things** - The widespread adoption of smart devices, combined with advances in sensor technologies, has yielded new opportunities to apply AI not just in traditional medical settings, but wherever a patient may be [22].

CONCLUSION

The benefits of AI applications to healthcare have been well documented, and such systems may become virtually indispensable as ever more precise and detailed data continues to be amassed about every aspect of health. AI can help to reduce variability, improve precision, accelerate discovery and reduce disparities. It can empower patients and potentially allow nurses and other clinicians to focus more on their patients than their data. This will allow all healthcare professionals to fully relate to their patients not just as caring healers, but as healers supported by the combined wisdom of the best of medical research and analytic technology combined. some of the challenges ahead relate to understanding AI's optimal uses, addressing the technological, systemic and regulatory roadblocks for successful implementation and finally, integrating such systems appropriately into the fabric of health care and society. As with all new technologies, an appropriate balance will evolve, but we will need both visionaries moving us forward, to assure that the greatest possible benefits of AI in healthcare are achieved.

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FACE RECOGNITION BASED PERSON IDENTIFICATION USING HYBRID CLASSIFIER

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ABSTRACT
Nowadays, Bio metric verification is playing a very important role in finding the criminals within short interval of time. It is helping the police in solving the crime case by giving the accurate identification of criminal using his Finger print and Face Image. Police will find the criminals with fake passport using Bio-metric Identity (Face Image) capture and compare it with biometric identities of existing users. If match is found then we can get to know who is criminal and can arrest that criminal easily. This method works very efficiently because biometric features of a person will not change. It is better than other identification methods like hair color or style, weight or eye color which can be changed by the criminal and trap the police. So in this project we design application for air forces to predict the fake passport and persons using face classification. User can register their details for passport with their unique identification factor. These details are stored in database for further validation. This process uses the algorithm of Haar-Cascade for face recognition. The proposed approach leverages the Haar Cascade, a mathematical representation of the space of linear subspaces, to model and extract intrinsic features from facial images. The Haar Cascade classifier is a machine learning- based algorithm that uses a cascade of weak classifiers to detect specific patterns or objects in an image. It will check face image of the passport holder with available records of face images. It will show an alert message to airport security if face image matching is not found. At the time of verification, admin can check whether he is authorized person or not. Air Force Security System is developed to help the airport security in detecting the valid passport holders by using their face bio-metric. If match found, then this system is forward this details to airport management system.

Index Terms—Air force Security, Face Registration, Add Passport Details, Face Recognition, Fake Passport Detection, Verify Travel Details.

I. INTRODUCTION
Video surveillance is becoming more and more essential nowadays as society relies on video surveillance to improve security and safety. For security, such systems are usually installed in areas where crime can occur such as banks and car parks. For safety, the systems are installed in areas where there is the possibility of accidents such as on roads or motorways and at construction sites. Currently, surveillance video data is used predominantly as a forensic tool, thus losing its primary benefit as a proactive real-time alerting system. The fundamental problem is that while mounting more video cameras is relatively cheap, finding and funding human resources to observe the video feeds is very expensive. Moreover, human operators for surveillance monitoring rapidly become tired and inattentive due to the dull and boring nature of the activity. There is a strong case for automated surveillance systems where powerful computers monitor the video feeds — even if they only help to keep human operators vigilant by sending relevant alarms. Smart cameras can improve video surveillance systems by making autonomous video surveillance possible. Instead of using surveillance cameras to solve a crime after the event, a smart camera could recognize suspicious activity or individual faces and give out an alert so that an unwanted event could be prevented or the damage lessened. From another perspective, smart cameras reduce the need for human operators to continually monitor all the video feeds just to detect the activities of interest, thus reducing operating costs and increasing effectiveness.

Person re-identification is the task of matching individuals across different cameras in a multi-camera surveillance system. It is a challenging problem due to the large variations in appearance caused by factors such as pose, illumination, occlusion, and camera viewpoint. The goal of person re-identification is to associate the same person's identity across different cameras, which can be used for various applications such as video surveillance, crowd analysis, and tracking individuals in public spaces. Recent advances in deep learning and computer vision have led to significant progress in person re-identification, making it a promising area of research for real-world applications.

CLOUD COMPUTING
Cloud computing technology consists of the use of computing resources that are delivered as a service over a network. In cloud computing model users have to give access to their data for storing and performing the desired business operations. Hence cloud service provider must provide the trust and security, as there is

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valuable and sensitive data in huge amount stored on the clouds. There are concerns about flexible, scalable and fine grained access control in the cloud computing. Cloud computing is consistently growing and there are many main cloud computing providers including Amazon, Google, Microsoft, Yahoo and many others who are offering solutions including Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS), Storage-as-a- Service and Infrastructure-as-a-Service (IaaS). In addition, considering the possibility to substantially minimizing expenses by optimization and also maximizing operating as well as economic effectiveness, cloud computing is an excellent technology. Furthermore, cloud computing can tremendously boost its cooperation, speed, and also range, thus empowering a totally worldwide computing model on the internet infrastructure. On top of that, the cloud computing has advantages in delivering additional scalable, fault tolerant services.

Cloud computing handles resource management in a better way since the user no longer needs to be responsible for identifying resources for storage. If a user wants to store more data they request it from the cloud provider and once they are finished they can either release the storage by simply stopping the use of it, or move the data to a long- term lower-cost storage resource. This further allows the user to effectively use more dynamic resources because they no longer need to concern themselves with storage and cost that accompany new and old resources.

Cloud computing service models are all inside in the cloud sing and laptops, desktops, phones and tablets are acts like clients to get services from the cloud. Servers provide services to clients according to their request or pay base. Cloud computing provides a shared pool of configurable IT resources on demand, in which needs minimal effort of management to get better services. Services are based on various agreements SLA (Service Level Agreement) between service providers and consumers.

NETWORK SECURITY

Network security starts with authenticating, commonly with a username and a password. Since this requires just one detail authenticating the user name—i.e., the password—this is sometimes termed one-factor authentication. With two-factor authentication, something the user 'has' is also used (e.g., a security token or 'dongle', an ATM card, or a mobile phone); and with three-factor authentication, something the user 'is' is also used (e.g., a fingerprint or retinal scan).

Once authenticated, a firewall enforces access policies such as what services are allowed to be accessed by the network users. Though effective to prevent unauthorized access, this component may fail to check potentially harmful content such as computer worms or Trojans being transmitted over the network. Anti-virus software or an intrusion prevention system (IPS) helps detect and inhibit the action of such malware. An anomaly-based intrusion detection system may also monitor the network like wire shark traffic and may be logged for audit purposes and for later high-level analysis. Newer systems combining unsupervised machine learning with full network traffic analysis can detect active network attackers from malicious insiders or targeted external attackers that have compromised a user machine or account. Communication between two hosts using a network may be encrypted to maintain privacy.

Honeypots, essentially decoy network-accessible resources, may be deployed in a network as surveillance and early-warning tools, as the honeypots are not normally accessed for legitimate purposes. Techniques used by the attackers that attempt to compromise these decoy resources are studied during and after an attack to keep an eye on new exploitation techniques. Such analysis may be used to further tighten security of the actual network being protected by the honeypot. A honeypot can also direct an attacker's attention away from legitimate servers. A honeypot encourages attackers to spend their time and energy on the decoy server while distracting their attention from the data on the real server. Similar to a honeypot, a honey net is a network set up with intentional vulnerabilities. Its purpose is also to invite attacks so that the attacker's methods can be studied and that information can be used to increase network security. A honey net typically contains one or more honeypots.

II. RELATED WORK

Tang, et.al,…[1] Propose an image domain to domain translation approach with the aid of keeping pedestrian's identity records and pulling closer the domains' distributions for unsupervised person re-ID obligations. Proposed system exploits the CycleGAN to switch the existing labeled photo area to the unlabelled image domain. Specially, a Self- categorized Triplet Net is proposed to preserve the pedestrian identity facts, and most imply discrepancy is brought to pull the domain distribution closer. As mentioned above, there are two constraints necessary to be considered during domain transferring, i.e., preservation of pedestrian's identity information and distribution pulling of different image domains. Under the framework of CycleGAN, propose two schemes to realize these two constraints, i.e., a Self-labeled Triplet Net and a maximum mean discrepancy.

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Firstly, the pair of real images is inputted into the CycleGAN for generating two fake domain images. Secondly, the pair of real images and fake images is fed into Self-labeled Triplet Net, which takes image itself as label. Proposed Self-labeled Triplet Net is able to pull images with the same identity closer and push images with different identity away, thus commendably preserving the pedestrian's identity information. Subsequently, maximum mean discrepancy based distribution pulling is conducted. This approach is inspired by the unsupervised domain adaption where source domain is labeled while target domain is unlabeled. To empower the domain adaption the ability of pulling and pushing domain distributions, further introduce the maximum mean discrepancy into the CycleGAN. During the translation process, the value of maximum mean discrepancy between fake image and target image will be computed for pulling domain distribution closer.

Jiang, et.al,…[2] Propose an end-to-end Self-supervised Agent Learning (SAL) algorithm for unsupervised person Re-ID by jointly modeling the class label information in source domain, the similarity consistency in target domain, and the self-supervised constraint in cross domain in a unified deep model. To align domain distributions robustly, here design supervised learning mechanisms inclusive of supervised label mastering in supply domain, similarity consistency learning in target domain, and self-supervised getting to know in go domain, which play vital roles in reducing the domain discrepancy for unsupervised person Re-ID. In the supervised label learning module, the original and reconstructed features of source domain are used to train a classification network to obtain the discriminative feature embedding for source domain and establish a relationship between the source domain and the agents. In the similarity consistency learning module, explore an agent guided difficult bad mining, which focuses on the pairs of visually comparable however extraordinary people in target area and objectives to distinguish them with the steering in their similarity coefficients to sellers. In the self-supervised learning module, considering that it is an open set problem for unsupervised person re-identification, here design a triplet loss to model the self-supervised constraint of data samples from two domains. Because of the triplet loss, the proposed Al models the relationship between data samples from different domains. By modeling the three modules of proposed method, domain invariant yet discriminative features are seemingly obtainable through the principled lens of agent learning by reducing domain gaps adaptively. Lin, Yutian, et.al,…[3] Propose an iterative framework which overcomes the camera variance and achieves during- digicam similarity exploration. Specifically, here practice an unmanaged style transfer model to generate style-transferred design photographs with exceptional digicam patterns. Then iteratively exploit the similarity in the same identity from each the unique and the fashion-transferred data. Here start with thinking about each training picture as a exceptional elegance to initialize the Convolutional Neural Network (CNN) model. Then measure the similarity and steadily group comparable samples into single magnificence, which increases similarity within every identification. Here additionally introduce a variety regularization term inside the clustering to balance the cluster distribution. The proposed framework with some specific design: (i) first adopt repelled loss to optimize the CNN model without labels. In the beginning, the repelled loss directly learns to discriminate between individual images that maximize the diversity among training images. As the images are merged into clusters, the repelled loss learns to minimize total intra-cluster variance and maximize the inter-cluster variance. (ii) In practice, different identities should have a similar probability to be captured by cameras, and thus the image number for different clusters should be balanced. Without the manual annotation, here aim to exploit the cross camera similarity from the training data as the supervision information. However, the same identity could look totally different under different cameras. To tackle the camera invariance, here propose to generate style- transferred images that preserve the person identity and reflect the style of another camera. It jointly optimizes a CNN model and the relationship among the cross-camera individual samples. Specifically, apply an unsupervised style transfer model on the training images to get style- transferred images under different camera style. Then the network training starts by treating each individual image as an identity. Then, bottom-up clustering is applied to the feature embedding extracted from the community to lessen the range of classes. During the entire manner, the community regularly exploits similarity from across-camera unlabeled pictures.

Lin, Shan, et.al,…[4] Propose a multi-dataset feature generalization network (MMFA-AAE) that is capable of studying an established area-invariant characteristic illustration from more than one categorised datasets and generalizing it to 'unseen' digicam systems. The network is based on an antagonistic vehicle-encoder to analyze a generalized area-invariant latent function representation with the Maximum Mean Discrepancy (MMD) degree to align the distributions throughout more than one domain. Here proposed a singular framework for domain generalization, which ambitions to learn a prevalent illustration via area-based fully adversarial getting to know while aligning the distribution of mid-stage capabilities between them. This proposed framework may be taken into consideration as an extension of Multitask Mid-degree Feature Alignment (MMFA) network in a couple of domain mastering placing. Proposed MMFA-AAE can simultaneously limit the losses of

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data reconstruction, identification, and triplet loss. It alleviates the domain difference through adversarial education and also matches the distribution of midlevel features across multiple datasets. Similar to existing work, the baseline version is skilled on labeled images aggregated from a couple of supply domain names. Let X = [x1,..., xn] be the extracted feature vectors (feature embeddings) from the backbone community with batch length n and Y = y1,..., yn the corresponding person identity label set of X. The mini-batch includes samples randomly decided on from all source domain names. The baseline model is pre-educated on ImageNet and mutually optimized with the pass entropy loss Lid for identity classification and the triplet loss Ltri for people verification. Pid (xi, yi) denotes the predicted possibility that function vector xi belongs to person identification yi. Proposed MMFAAAE community allows a Person Re-ID model to be deployed out-of-the-field for brand spanking new digital camera networks. The major goal of proposed MMFA structure is to research a website-invariant function illustration by way of mutually optimizing an antagonistic vehicle-encoder with MMD distance regularization.

Feng, et.al,…[5] Propose a joint learning framework to research better characteristic embedding's via high precision neighbor pseudo labels and high remember group pseudo labels. The institution pseudo labels are generated with the aid of transitively merging pals of different samples into a set to attain better remember. However, the merging operation may motive subgroups in the organization because of imperfect neighbor predictions. To make use of those organization pseudo labels properly, here suggest the usage of a similarity-aggregating loss to mitigate the effect of these subgroups by using pulling the enter sample in the direction of the most similar embedding's. The predicted acquaintances are not best and may contain some poor samples with a one of a kind identification due to comparable backgrounds or common pedestrian occlusions. Merging the associates of those bad samples into one institution makes the institution noisy. Thus a set might also comprise a couple of subgroups corresponding to a couple of identities. This inherent structure of the merged institution is the primary difference with clusters generated by using DBSCAN. Considering subgroups in the merged institution, hope the enter sample to be in the direction of the maximum comparable subgroup than other subgroups to mitigate their affect. Hence here introduce a similarity- aggregating loss based on the belief that with an amazing embedding feature, the embeddings which share the identical identification have to be closer than the embeddings with distinctive identities. Here use two complementary pseudo labels, i.e. Excessive precision neighbor pseudo labels and excessive consider organization pseudo labels to optimize the embedding community. With the assist of group pseudo labels, the version can study greater discriminative statistics of the goal domain. Furthermore, examine the inherent shape of the merged corporations and introduce a similarity-aggregating loss to mitigate the have an effect on of the noisy samples within the organization.

III. BACKGROUND OF THE WORK

Existing work explains a novel group sampling for pseudo-label-based unsupervised person re-ID, which utilizes the grouping operation and solves the shortcomings in triplet sampling. Grouping samples helps to optimize the model in a direction consistent with the trend of the whole class and to reduce the impact of a single sample, which facilitates similarity structure maintenance within each class. At the same time, using the overall trend of the class also helps to maintain discrimination between classes, thereby preventing many classes from being merged, which inhibit the model from deteriorated over-fitting. In this way, the model has access to exploit more subtle differences from the existing similarity structure so as to extract the unique identity similarity.

Traditional methods of attendance tracking such as manual entry, paper-based attendance sheets, barcode readers, and biometric scanners are time-consuming and error-prone. A manual student attendance system involves physically taking attendance by calling out each student's name and recording their presence or absence in a register or sheet of paper. To overcome these limitations, face recognition-based attendance systems have emerged as a viable alternative.

IV. AIRFORCE SECURITY USING FACE RECOGNITION BASED PERSON IDENTIFICATION

Passport verification is a critical aspect of security measures in air force installations. To ensure the safety and security of personnel and facilities, it is necessary to implement robust and reliable systems for passport verification. Biometric recognition technologies, such as fingerprint and facial recognition, have been increasingly used in recent years to enhance the accuracy and efficiency of passport verification systems. Facial recognition uses algorithms to analyze and compare various facial features of an individual to confirm their identity. The facial recognition provides a more accurate and reliable system for passport verification. It will check face image of the passport holder with available records of face image. Face Verification method utilizing the process of Haar-Cascade Algorithm for extracting facial features and classification approach. Using the biometric verification factor, here predict fake passport creation. This approach ensures that the individual

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presenting the passport is the actual passport holder and not someone trying to impersonate them. By implementing a robust passport verification system using biometric recognition technologies, air force security personnel can effectively prevent unauthorized access to air force installations and ensure the safety and security of personnel and facilities.

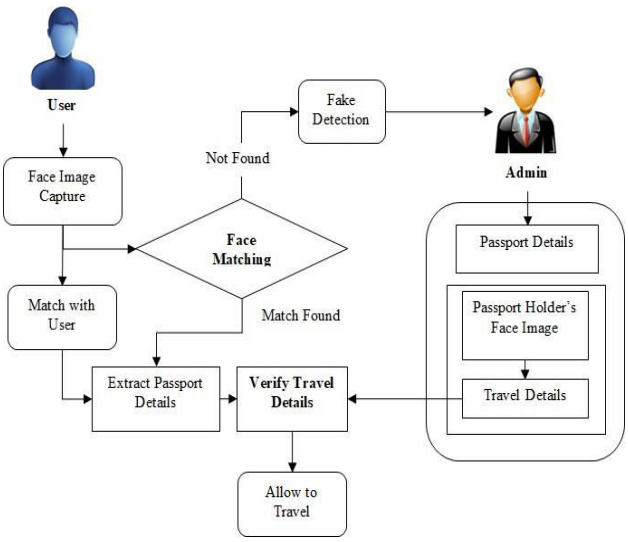

Fig 1: Proposed Framework

The proposed Air force security using face recognition based person identification method has the following modules,

User Enrolment

The User enrollment manages the user registration and login process with the help of web server. Registration process collects the user details and stored on the data base. The details are contains the name, address, email, contact no, passport details, passport verification number and face image etc. The registration phase also called as account creation. The login phase verifies the username, password and face image.

Face Registration

Face registration is the process of transforming different sets of data into one coordinate system. Facial features are stored with labels. Image registration or image alignment algorithms can be classified into intensity-based and feature-based. Face recognition systems identify people by their face images. To eliminate duplicates in a nationwide voter registration system because there are cases where the same person was assigned more than one identification number. The face recognition system directly compares the face images of the voters and does not use ID numbers to differentiate one from the others. When the top two matched faces are highly similar to the query face image, manual review is required to make sure they are indeed different persons so as to eliminate duplicates. Facial features are extracted and constructed as feature vectors. Facial features includes nose part, eye parts and lip part and these values are stored is in the form of matrix. Haar Cascade algorithm is used in this process.

Add Travel Details

This module explains about user travel details. Here user's passport and ticket details are registered by admin for further verification process. Travel details contain details about arrival details and dispatch details. The details such as flight time, date, flight no, passenger name, etc,.

Face Classification:

Human's face is a prominent feature in machine learning and computer vision system. A face conveys various information including gender, age, ethnicity etc. Face information is applicable in many sectors like biometric authentication and intelligent human-computer interface. Face identification is a one-to-many matching process that compares a query face image against all the template images in a face database to determine the identity of the query face. The identification of the test image is done by locating the image in the database that has the highest similarity with the test image. The identification process is a "closed" test, which means the sensor takes an observation of an individual that is known to be in the database. This module is known as login phase or testing phase. Input is in the form of real time video capturing. Video images are splited into still images. Face detection is done in the process of Haar Cascade based face classification. This is applied in the network training procedure, which was a kind of knowledge migration between source and target domain. The network

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was trained in three steps: initialization, form a general face recognition model, and knowledge transfer to face condition identification.

Fake Passport Prediction
This module explains about fake passport prediction process. During passport enquiry admin can check user details like arrival and dispatch details. If user has fake passport means that will analysed using face classification process. Using this passport verification process, authorized users are only allowed to make travel.

METHODOLOGY

Haar Cascade Algorithm
Haar Cascade algorithm is a popular machine learning-based approach for object detection in images or video streams. Here are the main steps involved in the Haar Cascade algorithm:

Feature Extraction: Haar-like features are used to represent the object being detected. These features are computed at different scales and positions on the image.

Training the Classifier: The next step involves training a classifier that can distinguish between the positive samples (images containing the object of interest) and negative samples (images without the object of interest). The most commonly used classifier is the Viola-Jones algorithm, which uses the AdaBoost algorithm to select the best features that can classify the images accurately.

Creating the Cascade Classifier: In this step, the classifier is divided into stages, where each stage consists of a set of weak classifiers. Each weak classifier is a simple classifier that uses a single Haar-like feature to make a decision. The cascade classifier is designed to reject non-object regions of the image quickly, reducing the amount of computation needed.

Detection: Once the cascade classifier is trained, it can be used to detect the object in the new image or video stream. The image is scanned with a sliding window at different scales, and the Haar-like features are computed at each location. The cascade classifier is then applied to each window, and if the object is detected, a bounding box is drawn around it.

V. CONCLUSION

Air Force Security System is developed to help the airport security in detecting the valid passport holders by using their face image. Air Force Security System is developed to help the airport security in detecting the valid passport holders by using their face images and finger print. It will check face image and finger print of the passport holder with available records of face images and finger prints. It will show an alert message to airport security if bio-metric matching is not found. If match found, then this system will check the passport holder's behavior. It will play the emergency alarm if the behavior of passport holder is not good. Also detect the crime repost using face recognition approach. If the captured image match with any criminals face image that could be detected automatically. If he committed any crime or offense then system will reject him.

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ROLE OF ARTIFICIAL INTELIGENCE AND MACHINE LEARNING IN DIAGNOSIS OF CANCER

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ABSTRACT
The fields of artificial intelligence (AI) play a key role in achieving precision medicine's objective of creating individualised treatment plans for each cancer patient. gathering of patient data and enhanced nanomaterial design for targeted cancer treatment. A patient-specific disease profile is assembled using diagnostic nanomaterials, and a suite of therapeutic nanotechnologies is then employed to improve the course of treatment. High intratumor and interpatient heterogeneities, however, pose significant challenges to the analytical and diagnostic platforms' sensible design. This gap can be filled by integrating AI techniques, which can use pattern recognition and classification algorithms to improve the accuracy of diagnosis and treatment. In order to handle complex and large data sets, AI is now a tool used by researchers for routine statistical analyses as well as for obtaining complementary results. AI helps to specify estimation outcomes and improves the precision of treatment impact prediction in cancer patients. A brand-new area of research called nanoinformatics is brought about by the application of AI to nanotechnology. Additionally, targeting drug delivery systems can be developed by combining AI with nanorobots, an emerging technology. Additionally, AI-based combination therapy can help with cancer patient diagnosis and treatment comprehension thanks to developments in the field of nanomedicine. This review's primary goals are to go over the latest advancements, potential applications, and long-term plans for artificial intelligence in the delivery of successful cancer care.

Keywords: Artificial intelligence, Nanomaterials, Nanoinformatics ,Diagnosis, Interpatient heterogeneities

1. INTRODUCTION
According to estimates from Global Cancer Statistics, approximately 10 million deaths worldwide were attributable to cancer in 2020.One Cancer treatment is still a difficuapeutic indices, and low bioavailability.Recentdevelopments in nanotechnology have made it possible to design drug formulations based on nanoparticles (NPs) that have better qualities than conventional small molecule chemotherapy. These properties include high drug loading, targeted delivery, and controlled or sustained release of the anticancer drug.Cancer therapy is still an arduous task. Some of the drawbacks of traditional small molecule-based chemotherapy include high dosage requirements, lack of specificity, low bioavailability, low therapeutic indices, negative side effects, and the emergence of multi-drug resistance.In comparison to conventional small molecule chemotherapy, nanoparticle (NP)-based drug formulations can be designed with better properties, such as high drug loading, targeted delivery, and controlled or sustained release of the anticancer drug. This is made possible by recent developments in nanotechnology. Across all medical stages, nanomaterials have played a role in the development of precision medicine. Fast and sensitive single-molecule detection combined with longer sequence read lengths is made possible by new omics collection technologies like single-molecule nanopore sequencing, which preserves genetic context. Nanosensor-based diagnostic assays enable the simultaneous scanning of liquid biopsies (blood, urine, saliva) and cell cultures for multiple disease biomarkers, as well as the detection of biomarkers at femtomolar concentrations. Over the past few decades, nanomedicine-based cancer treatments have changed. From a population-wide treatment approach that focused primarily on enhancing efficacy and minimising side effects, to targeted systems that provide information about drug activity inside the patient's body. Although machine learning is a subset of AI, artificial intelligence (AI) is a term that is frequently used synonymously with machine learning. Arguably, machine learning refers to the technologies and algorithms that allow systems to recognise patterns, make decisions, and develop themselves through experience and data, whereas artificial intelligence refers to the general capacity of computers to mimic human thought and carry out tasks in real-world environments. In this article, we address the application of nanomaterials, cancer diagnosis, and treatment technologies, highlighting the role that AI plays in precision data analysis.

2. AI AND MACHINE LEARNING IN DIAGNOSIS OF CANCER

2.1 ARTIFICIAL INTELLIGENCE
The study of creating computers and robots with the ability to behave in ways that both imitate and surpass those of humans is known as artificial intelligence. Programmes with AI capabilities can automatically initiate actions or provide information by analysing and contextualising data without the need for human intervention. Many of the technologies we use today, such as smart devices and voice assistants like Siri on Apple products,

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are powered by artificial intelligence. Businesses are using methods like computer vision and natural language processing, which allow computers to understand images and speak to people, to automate processes, speed up decision-making, and facilitate chatbot interactions with customers.

2.2 MACHINE LEARNING

An avenue towards artificial intelligence is machine learning. In order to make increasingly better decisions, this subcategory of artificial intelligence (AI) uses algorithms to automatically extract patterns and insights from data. Programmers explore the boundaries of their ability to enhance a computer system's perception, thought process, and behaviour through the study and application of machine learning. A more sophisticated approach to machine learning is called deep learning. Deep learning models learn complex patterns and generate predictions without the need for human input by using large neural networks, which operate logically and similarly to a human brain when analysing data.

2.3 CANCER DIAGNOSIS

Doctors use cancer imaging tests to answer a range of questions, like: Is it cancer or a harmless lump? If it is cancer, how fast is it growing? How far has it spread? Is it growing back after treatment? Studies suggest that AI has the potential to improve the speed, accuracy, and reliability with which doctors answer those questions. But what scientists are most excited about is the potential for AI to go beyond what humans can currently do themselves. AI can “see” things that we humans can’t, and can find complex patterns and relationships between very different kinds of data.

“AI is great at doing this—at going beyond human performance for a lot of tasks,” But, in this case, it is often unclear how the AI reaches its conclusion, so it’s difficult for doctors and researchers to check if the tool is performing correctly.

2.4 FINDING CANCER EARLY

People are routinely screened for precancerous cells, which have the potential to develop into cancer, or for signs of cancer using tests like Pap tests and mammograms. Early detection and treatment of cancer is the aim, ideally before it spreads or even develops. AI tools have been developed by scientists to support various cancer screening tests, including those for breast cancer. Though research in this field is rapidly changing, AI-based computer programmes have been used to assist doctors in the interpretation of mammograms for more than 20 years. An AI algorithm developed by one group can assist in determining the frequency of breast cancer screenings. The model predicts a person's chance of getting breast cancer in the next five years based on the images from their mammogram. Many deep learning artificial intelligence (AI) models have been created to assist physicians in identifying lung cancer on CT scans. A significant number of false-positive test results—which suggest a person has lung cancer when they actually don't—are caused by noncancerous abnormalities in the lungs that can mimic cancer on CT scans. Clinical trials on colon cancer have demonstrated that a number of AI techniques can enhance the identification of adenomas, which are precancerous growths. But since adenomas rarely develop into cancer, some experts worry that these AI tools may cause many patients to undergo pointless treatments and additional testing.

3. SYNOPSIS OF ARTIFICIAL INTELLIGENCE IN ONCOLOGY

Artificial Intelligence (AI) is a general term for computers that mimic human intelligence. Under artificial intelligence (AI), machine learning (ML) is the process of teaching computer algorithms to make predictions based on past performance. ML can be broadly classified into two categories: supervised learning, which allows the computer to see outcome data, and unsupervised learning, which does not provide outcome data. In order to predict outcomes, such as the existence or absence of cancer, survival rates, or risk groups, both strategies search for patterns in the data. Natural language processing (NLP) is a technique that is frequently employed in oncology and other fields for the analysis of unstructured clinical data. NLP converts unstructured free-text into a format that can be analysed by computers, which makes resource-intensive tasks automatable. In machine learning, partitioning data into subsets is a standard procedure for developing and optimising models on training and validation subsets. To prevent over-optimism, these models are then evaluated on an unknown test set.

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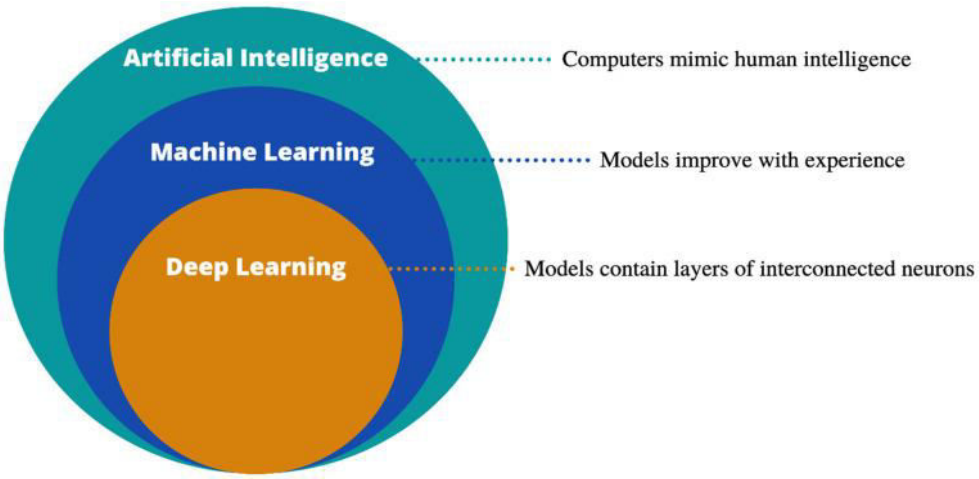
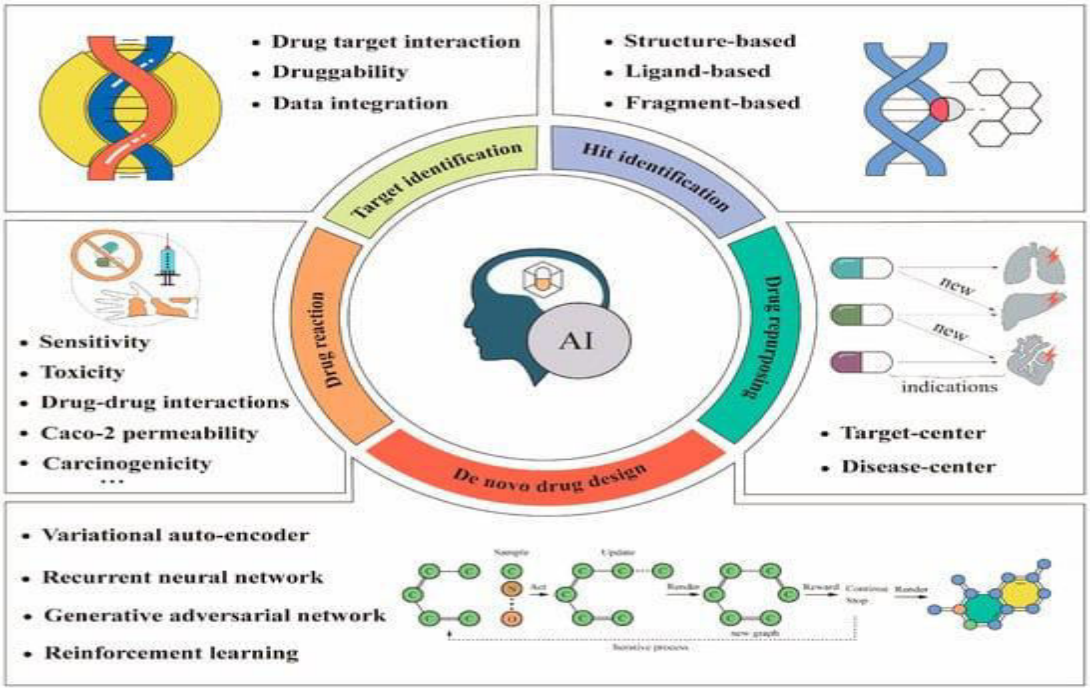


A subset of machine learning (ML) called deep learning (DL) builds complex architectures that are comparable to the interconnected neurons found in the human brain. Model development, training, and evaluation features are offered by well-known Python-based deep learning frameworks like PyTorch (Facebook) and Tensorflow (Google). Additionally, without the need for local software installation, Google offers a free online notebook environment called Google Colaboratory that enables cloud-based Python usage and GPU access.

4. AI IN ANTI- CANCER DRUG DESIGN

The procedure for designing and discovering anti-cancer drugs includes preclinical drug candidate identification, target recognition, hit exploration, hit-to-lead development, lead optimisation, and preclinical and clinical research. Developing new and effective anti-cancer drugs from scratch is still a difficult, costly, and time-consuming process that will necessitate close multidisciplinary collaborations between medicinal chemistry, computational chemistry, biology, pharmacology, and clinical research. This is true even with advancements in tumour biotechnology and understanding cancer mechanisms. A new drug's introduction into clinical practise can, on average, take between 10 and 17 years and nearly 2.8 billion dollars. In addition, only 10% of the substances evaluated in clinical trials are released onto the market. Anti-cancer drug design is particularly challenging because of issues like tumour heterogeneity, metastasis, chemoresistance in oncology, and undruggable targets. It may appear that the traditional methods for drug design are ineffective. The outcomes of cancer patients' treatments are really not ideal because there are still a lot of unanswered questions. Therefore, there is an urgent need for more potent anti-cancer drug design strategies.They will shorten the time needed for clinical trials and lower the cost of drug development. A few uses of AI in the development of anti-cancer medications. The models based on deep learning mentioned above are typically used to implement the bottom (de novo drug design). Reinforcement learning has been widely applied recently.



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4.1 SCREENING OF BREAST CANCER

Among women worldwide, breast cancer is one of the main causes of death. When it comes to the pathogenesis of the disease, there are many variables that can contribute to an individual's risk of developing it, including gender, heredity, genetics, environment, and occupation. Early screening techniques are the most efficient means of combating the illness. The number of deaths from breast cancer has significantly decreased. Treatment success rates are increased when AI is incorporated into screening procedures like looking through biopsy slides. The field appears to have a very promising future, and there has been an increase in interest in this area in recent years.

The field of computational radiology uses computer vision, lesion detection, or pattern recognition for lesion detection in order to classify lesions in accordance with BIRADS (Breast Imaging Reporting and Data System) and to perform systematic reporting (diagnosis) on procedures that were previously performed by experts. In order to model therapy responses based on prognostic and predictive values, it also entails extracting imaging biomarkers. Deep learning and machine learning are two of the most important AI components needed for breast cancer imaging. In order to train prediction models and decipher generalisations, machine learning is used to store a large dataset. The newest area of machine learning is called deep learning, and it uses artificial neural networks to create a system of recognition and classification. A common technique in AI systems is radiomics. A feature is an aspect of an image that is extracted quantitatively. Pattern recognition algorithms are typically responsible for this, identifying images and producing a set of numbers that correspond to a quantitative feature of the visible portion of the image.

The foundation of radiomics is the notion that disparate molecular and genetic processes are represented by features that have been extracted. Computational algorithms used in machine learning leverage features from images obtained through radiomics to provide insights into the course of individual diseases. Unsupervised machine learning and supervised machine learning are the two categories of machine learning in radiomics. Without using any previous data or data from the provided image, unsupervised machine learning classifies information. The first step in the supervised machine learning process is AI training using an already-existing data archive. Deep learning operates by using a multi-neural layer or network to process an image, turning it into a series of numbers that represent features that should be provided, similar to how supervised machine learning operates. Utilising data from biopsy slides and radiomics, artificial intelligence is used in the field of breast cancer treatment to facilitate early detection. This is corroborated by an international endeavour to produce learning algorithms that interpret mammograms by decreasing the quantity of false positives. In whole slide images of lymph node biopsies, AI has improved the likelihood of detecting metastatic breast cancer. Depending on the population, AI algorithms function differently due to variations in risk factors and predispositions.

5. CHALLENGES AND FUTURE ASPECTS OF AI IN CANCER

Artificial Intelligence has grown to be a very useful tool in the treatment of cancer. It has demonstrated remarkable results, and there's a chance that it could revolutionise all current treatment modalities. Where to draw the line between AI and human intelligence is the only question that needs to be addressed. The foundation of AI is population data. As a result, there will inevitably be a discrepancy in the data that is developed about individuals from various socioeconomic backgrounds. One specific illness whose prevalence varies depending on race is cancer. Certain predetermined results from studies on AI efficiency can be used to evaluate the standards and reliability of those studies. Image data is the foundation of AI models used in cancer management. The issue with this specific facet is the widespread underutilization in many hospitals of patient histories stored as electronic health records.

The software systems of hospitals around the world need to include easily accessible databases and user-friendly software. This is currently a challenging task that calls for the combined efforts of the medical and engineering communities . Establishing doctors' trust in AI to assist them in making decisions is another difficulty in using the technology . Doctors need to receive sufficient training on AI technology. Comparatively speaking, large prospective studies are more credible than most conducted retrospective studies, which are typically smaller in size. But in the near future, AI might take over a lot of the responsibilities held by radiologists, and even in the event that it doesn't, it will undoubtedly help them make decisions. Because it is non-intrusive, it is a viable option that could potentially harness more AI power with additional research.

6. SUMMARY AND CONCLUSION

Both patients and the medical community have found cancer to be a significant burden. Early cancer diagnosis has become simpler with the integration of AI into various screening techniques. Machine learning, deep learning, and radiomics are some of the ways artificial intelligence (AI) is used in breast cancer screening.

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These cutting-edge methods help the pathologist diagnose patients early and provide high-quality care. But there are restrictions on using AI. There are numerous laws in place to control the application of AI. AI is able to identify calcification, which helps with patient diagnosis and management. It can also detect breast mass, breast tissue segmentation, and density. These obstacles should be addressed and AI-based screening techniques become more widely used with additional research and technological advancements, thereby enhancing the general quality of life for cancer patients.

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ROLE OF ARTIFICIAL INTELIGENCE IN PHARMACEUTICALINDUSTRY- A REVIEW

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ABSTRACT
Artificial Intelligence (AI) is a field of engineering focused on making intelligent machines whichemerged as a transformative force in the pharmaceutical industry, revolutionizing drug development, clinical research, personalized medicine, disease diagnosis, and various other critical aspects. AI operates through machine learning and deep learning, enhancing drug molecule design, clinical trial optimization, and personalized treatment. Natural Language Processing (NLP) enables AI to understand and interpret language, facilitating more natural human-machine interactions. Various tools, such as robot pharmacies and AI-based robots like MEDi and TUG, have improved patient safety and healthcare efficiency. The application of AI in the pharmaceutical industry extends to drug discovery, clinical research, personalized medicine, antibiotic studies, disease diagnosis, nanomedicine, quality control, and marketing. AI streamlines drug molecule design, clinical trial processes, and quality assurance, leading to improved outcomes and reduced costs. Moreover, AI-driven nanomedicines are transforming drug delivery for complex diseases, and AI aids in detecting and diagnosing diseases more effectively. It also revolutionizes pharmaceutical marketing by enabling data-driven strategies that enhance engagement and revenue. Despite the immense potential, the adoption of AI in the pharmaceutical industry faces challenges, including the novelty of AI, insufficient IT infrastructure, and data-related issues. However, partnerships between AI companies and pharmaceutical giants, such as Roche, Sumitomo Dainippon Pharma, Astellas Pharma, Bayer Pharma, and GSK, are driving innovation and efficiency.

Keywords: Artificial intelligence, machine learning (ML), Deep learning (DL), natural language processing (NLP), Neural networks (NN), Drug discovery, Clinical research, Nanomedicine, Personalized Medicine

1. INTRODUCTION
Artificial Intelligence (AI) is a field of engineering focused on making intelligent machines particularly software for computers. It entails giving computers or robotic systems the ability to process data and produce results that are comparable to how people learn, make decisions, and solve problems. AI has revolutionized the pharmaceutical industry and is widely being used in healthcare. Thistechnological synergy transforms the industry in a number of ways by combining computer processing and human intelligence. The integration of machine and human capabilities improves healthcare procedures, diagnostics, and drug development [1].

AI is seen as a game-changer in the drug development process, and big data and machine learning are about to have a big impact on healthcare, possibly opening up a $100 billion market. Despite being two to three years away from release, experts predict that AI-developed medications will become crucial for pharmaceutical companies to remain competitive [2].

2. HOW ARTIFICIAL INTELLIGENCE OPERATES

2.1 MACHINE LEARNING (ML)
ML focuses on using software to learn from data in order to make predictions. Multimedia identification and object detection are two areas where machine learning excels. ML is separated into two categories: supervised, unsupervised learning, reinforcement learning. It provides useful insights and forecasting methods for domains such as medical research. As evidenced by its potential across scientific fields, decision-making machine learning (ML) is essential in drug design and experimental development [3].

2.2 DEEP LEARNING (DL)
As a subfield of machine learning, deep learning (DL) leverages artificial neural networks to learn from large amounts of experimental data, hence taking advantage of big data and data mining for possible drug development. Differentiating itself as a component of AI, DL uses flexible neural network topologies such as CNNs, RNNs, and feed-forward networks. Growing computational power and more readily available data are related to the growth of deep learning. Improved personalized treatment based on genetic markers, more rapid and affordable drug discovery, and streamlined clinical trials are all possible outcomes of optimizing AI techniques[4].

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2.3 NATURAL LANGUAGE PROCESSING (NLP)

The ability of a machine to read, understand, and interpret language is known as natural language processing, or NLP. With NLP, a computer can react correctly by figuring out what the user meant to say. This makes machine-human communication more natural and efficient.

2.4NEURAL NETWORKS (NN)

Neural networks (NN) use algorithms that mimic the functioning of human neurons, just as human neural cells do. These systems capture correlations between a multitude of underlying factors, facilitating intricate data processing and pattern detection [5].

3. TYPES OF AI

ARTIFICIAL NARROW INTELLIGENCE (ANI): Artificial Narrow Intelligence (ANI), commonly referred to as Weak AI, is intended for specialized applications such as traffic signaling, chess, facial recognition, and automobile steering.

ARTIFICIAL GENERAL INTELLIGENCE (AGI): Strong artificial intelligence (AI), also known as artificial general intelligence (AGI), is capable of doing tasks that are difficult for humans and cover a wide range of human intelligence.

ARTIFICIAL SUPER INTELLIGENCE (ASI): Artificial Super Intelligence (ASI) exhibits capabilities that are beyond human comprehension and outperforms human intelligence in domains such as painting, mathematics, and space-related activities.

AI can be grouped according to its current capabilities:

- **Type 1:** Without a memory system, reactive machines are limited in what they can do. One chess program from IBM that anticipates moves and recognizes checkers on the chessboard is an example.
- **Type 2:** Restricted memory systems allow for the utilization of past information, as demonstrated by automated cars that make decisions based on observations that have been recorded, albeit transiently.
- **Type 3:** Based on the "Theory of Mind," this kind of artificial intelligence involves fictitious systems that take into account personal intentions, thoughts, and desires when making decisions.
- **Type 4:** Beyond the current state of AI technology, non-existent AI systems possessing consciousness, self-awareness, and identity, signify an advanced level of development [6].

4. TOOLS OF AI

4.1ROBOT PHARMACY

To improve patient safety, UCSF Medical Center's pharmacy uses robotic technology. The robot has surpassed humans in accuracy and efficiency by successfully preparing 350,000 doses of medication without making any mistakes. The process of preparing injectable and oral medications, including hazardous chemotherapy drugs, is handled by this technology. With the help of this invention, UCSF nurses and pharmacists can better utilize their experience providing direct patient care by working together with doctors while the robot takes care of the complex task of tracking and preparing medications[7].

4.2MEDI ROBOT

The AI-based robot MEDi, which stands for Medicine and Engineering Designing Intelligence, was created at the University of Calgary in Alberta. The project, which was overseen by Community Health Sciences professor Tanya Beran, sought to develop a pain-management robot. The robot, which isn't really capable of thinking or reasoning, is made to look like artificial intelligence (AI). It was inspired by observations made in hospitals where kids frequently cry during treatments. By building a relationship with kids before describing what to anticipate during medical procedures, MEDi provides a more reassuring and educational exchange [8].

4.3 TUG ROBOTS

TUG quickly determines delivery and pickup locations thanks to its user-friendly touchscreen. For a variety of destinations, this self-governing system determines the best route automatically. TUG detects obstacles that are low to the ground using sensors that provide 180° coverage for navigation and obstacle detection. These sensors include "Light Bristle" sonar and infrared sensors. Using TUG has several advantages, including increased employee satisfaction, better patient safety overall, safer patient experiences, and increased productivity around-the-clock for healthcare providers [9].

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4.4ERICA ROBOT

Japanese professor Hiroshi Ishiguro is the creator of the innovative care robot Erica. With a face that combines European and Asian features and fluency in Japanese, Erica was created in partnership with the Japan Science and Technology Agency, Kyoto University, and the Advanced Telecommunications Research Institute International (ATR). Despite not being able to walk on her own, Erica can understand questions and respond to them with facial expressions that resemble those of a human. Ishiguro combined the features of thirty attractive women to create Erica's eyes, nose, and other facial features for her android, which was intended to be the "most beautiful and intelligent" ever. For example, Erica talks about her preferences for animated movies, traveling to Southeast Asia, and looking for a life mate [10].

5. APPLICATION OF AI IN PHARMACEUTICAL INDUSTRY

5.1AI IN DRUG DISCOVERY

AI is essential to drug discovery because it solves problems in the creation of various drug molecules. Artificial Intelligence (AI) is used to forecast various parameters, especially in quantitative structure-activity relationship modeling. This ensures biological safety, efficacy, and adverse effects. Because of the large chemical space, molecules must be delocalized. Artificial Intelligence (AI) uses in silico techniques to perform virtual screening, which speeds up analysis and sorting. AI's influence also includes bioactivity and toxicity prediction, clinical trial design optimization, patient identification, recruitment, monitoring, and endpoint detection, and the transformation of conventional clinical trial procedures for increased effectiveness, safety, and economy [11].

5.2 AI IN CLINICAL RESEARCH

Artificial Intelligence (AI) is a key component in tackling the problems that pharmaceuticals encounter during clinical trials, with the goal of increasing success rates and lowering barriers to market entry. AI promises to have a big impact on drug development, even though its use in clinical research is still purely theoretical. It speeds up time to market, lowers development costs, increases product recall rates, and affects the success or failure rate of pharmaceutical products. Clinical research on AI focuses on intervention strategies, predictive signals, and the understanding of the time-dependent impact on patients' conditions and quality of life. AI is used to screen pathological data, analyze lab results, and predict allergic or adverse drug reactions in clinical trials [12].

5.3 AI IN DRUG MOLECULE DESIGN

AI is transforming the design of drug molecules by increasing productivity, expediting workflows, and lowering expenses and chemical waste in business operations. In molecular design, recent developments in AI and ML, especially deep learning, allow machines to mimic human intelligence. Conventional experimental laboratory duties have been a bottleneck; however, artificial intelligence (AI) tools now provide more accurate, less computationally demanding simulations for chemical applications. Artificial intelligence (AI) applications that forecast molecular properties, reactivity, toxicity, and receptor binding are revolutionizing synthetic molecular design and have a big impact on chemical research. Artificial Intelligence (AI) is being used in pharmaceuticals to revolutionize medical testing by helping with disease identification, personalized treatment, drug development, and prognostic forecasting [13].

5.4 AI IN PERSONALIZED MEDICINE

Treatment plans in personalized medicine are tailored for specific patients according to their genetic make-up, medical background, and other factors. By evaluating vast volumes of patient data and identifying individualized treatment options, AI transforms this. It predicts potential side effects or interactions and assists in identifying patients who are likely to respond favorably to particular treatments, resulting in better outcomes and fewer side effects [14].

5.5 AI in ANTIBIOTIC STUDY

Resistance to antibiotics is on the rise, which makes discovery difficult. In the past, microbes were screened; however, development is currently hampered by recurring discoveries. "Halicin," which is effective against a variety of bacteria, including tuberculosis, was created by a recent study that used machine learning to predict antibacterial compounds in silico from a large molecular database. Some drugs, like those for neurological disorders or cancer, might benefit from this tactic as well [15].

5.6 AI IN DIAGNOSIS OF DISEASES

AI improves diagnostic tools such as Skout for colorectal neoplasia and helps diagnose chronic diseases. Deep learning algorithms effectively detect minute alterations in the ECG to diagnose myocardial infarction. Smartphone-based retinal imaging using the EyeArt AI algorithm demonstrates high sensitivity in the screening

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of diabetic retinopathy. Even with these developments, seeking the advice of medical experts is still essential for precise diagnosis and treatment selection [16].

5.7 AI IN NANOMEDICINE

Drug delivery for complex diseases is being revolutionized by AI-enhanced nanomedicines. Systems of nanogel particles show improved bioavailability and efficacy, making them essential for both diagnosis and treatment. The use of AI expands and changes their capacity for operation. Methotrexate nanosuspension made computationally maximizes drug particle accumulation by utilizing the energy released during drug molecule reactions [17].

5.8 AI IN QUALITY CONTROL AND QUALITY ASSURANCE

A balance of factors is essential for pharmaceutical production to be optimized. Traditionally, batch consistency and quality control are carried out by humans. However, AI provides insights into critical processes and standards under the FDA's modified cGMP through a "Quality by Design" approach, improving the quality of pharmaceutical products [18].

5.9 AI IN MARKETING

AI revolutionizes pharmaceutical marketing by enabling global life science teams to implement data-driven strategies. AI improves value proposition, streamlines resource allocation, and personalizes marketing and sales collateral. Prominent pharmaceutical companies use AI to enhance multichannel marketing, which boosts revenue and improves return on investment. The impact of AI goes beyond identifying the preferences of healthcare professionals to include promoting targeted engagement and enhancing international marketing initiatives [19].

5.10 AI IN FINANCE AND CONTROLLING

The pharmaceutical industry is starting to adopt AI trends that were first seen in control and finance. Although dynamic planning processes are in demand, the industry is unsure of AI's full potential. Automated financial tools are widely available, and new technologies have the potential to free up time for idea generation. Pharma reps predict a limited impact from AI in the next ten years, but big businesses recognize its potential for fraud prevention and early financial issue detection [20].

6. CHALLENGES TO ADOPTION OF ARTIFICIAL INTELLIGENCE IN PHARMA INDUSTRY

- **AI's Newness:** Because AI is so new and elusive, many pharmaceutical companies find it difficult to accept its existence and view it as a revolutionary discovery.
- **Insufficient IT Infrastructure:** Pharmaceutical companies had to make large financial investments for upgrades because the current IT applications were not created with artificial intelligence (AI) in mind [21].
- **Difficulties in Data:** Pharmaceutical companies face difficulties because a large amount of their data is in free text format, which necessitates extra steps in terms of collection and structuring in order to make it compatible with analysis. Notwithstanding these drawbacks, there is indisputable proof that artificial intelligence is already revolutionizing the biotech and pharmaceutical sectors [5].

7. ARTIFICIAL INTELLIGENCE (AI) AND PHARMACEUTICAL COMPANIES IN PARTNERSHIP

Roche is advancing personalized medicine by combining medical learning and large-scale genome sequencing, potentially in association with Bina. Using the power of Exscientia, Sumitomo Dainippon Pharma is committed to finding novel treatments for mental diseases. In partnership with Biovista, Astellas Pharma investigates medication repurposing. Xbird is involved in Bayer Pharma's real-time data tracking initiative, which uses wearable technology and cellphones. Exscientia and GSK work together to find innovative, targeted small molecules. With the goal of improving adherence through cutting-edge features, AbbVie presents AiCure, an AI-based patient monitoring platform [22].

8. CONCLUSION

In conclusion, the pharmaceutical industry could greatly benefit from the application of artificial intelligence (AI) in drug development, clinical research, personalized medicine, and disease diagnosis. The collaboration between AI and pharmaceutical companies contributes to innovation and efficiency, opening the door for a more advanced and successful healthcare system, despite adoption obstacles. Artificial Intelligence (AI) holds great promise for improving drug development processes and improving patient outcomes in the pharmaceutical industry.

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IMPACT OF CLOUD COMPUTING IN EDUCATION DURING PANDEMIC

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ABSTRACT
The COVID-19 epidemic has had a significant impact on society at large, including how we educate our children. Remote learning has been made more easier and educational institutions have been able to switch to using digital platforms thanks in large part to cloud computing. Students and teachers can access educational resources, work together, and communicate from any location thanks to cloud technology. Instructors have been able to continue offering top-notch training while minimising the interruption caused by the epidemic thanks to the availability of virtual classrooms and cloud-based learning management systems. The development of cloud computing in education has also opened up new doors for personalised and blended learning. Finally, cloud computing has shown to be a helpful tool for ensuring that teaching has continued during the epidemic.

Keywords: E-learning, Cloud Computing, Pandemic

I. INTRODUCTION

Global disruption has been brought on by the 2019-nCoV coronavirus illness (COVID-2019). People were reportedly experiencing fever and respiratory issues after shopping in a seafood market in Wuhan, Hubei, China, when it was detected in December 2019. Cases of 2019-nCoV infection spread to multiple nations (Thailand, Japan, Vietnam, and Singapore) in less than a month (Hong Kong, China; Taiwan, China; Macau, China). [1]

The COVID-19 epidemic has significantly changed the way we live, work, and educate ourselves. Due to the quick shift to remote learning, many students and educators worldwide now consider online education to be conventional. With this shift, the importance of technology in education, particularly the implications of cloud computing, has received much attention.

Cloud computing is the delivery of computing services such as servers, storage, databases, networking, software, analytics, and intelligence through the internet. Users may now access their data and applications from any internet-connected device without having to install any software or hardware on their local device. In the context of online education, cloud computing has shown to be a useful tool for simplifying the delivery of high-quality educational experiences, boosting collaboration and participation, and facilitating access to learning materials.

The simplicity of access to educational information is one of the main advantages of cloud computing in online education. Using the cloud, instructors, students, and anyone else with an internet connection may access readings, videos, and exams from any location. This is crucial now more than ever, as the epidemic prevents many pupils from going to school and forces them to learn at home. Moreover, cloud computing reduces the requirement for pricey gear and software, enhancing the affordability and accessibility of online learning for students from all socioeconomic levels.

The enhancement of cooperation and involvement in online learning is another advantage of cloud computing. Platforms that are hosted in the cloud, like Google Classroom, Canvas, and Microsoft Teams, give teachers and students a place to collaborate and communicate in real time. This increases students' involvement in the learning process and fosters a sense of community among them. Cloud-based solutions may be used by teachers to give feedback and support to students, ensuring that they get the support they need to excel in their studies.

Lastly, cloud computing also makes it possible to give top-notch educational experiences. With the help of the cloud, instructors may use machine learning and artificial intelligence to tailor the learning process for each student. Adaptive learning systems, for instance, may monitor student progress and modify the level of course difficulty in accordance with their performance, ensuring that they have a customised and interesting learning experience.

In conclusion, the COVID-19 pandemic has had a huge influence on online education as a result of cloud computing. It has boosted cooperation and participation, given students and instructors access to learning resources from anywhere, and made it possible to provide high-quality educational experiences. It is apparent

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that cloud computing will continue to be essential to the future of education as the globe struggles to deal with the pandemic's issues.

II. LITERATURE SURVEY:

According to the NIST Visual model, cloud computing is made up of the three elements of key features, service models, and deployment models. Users can directly access data and cloud systems thanks to the fundamental qualities' explicitly defined requirements. Online user experience is improved by the many platforms and user-friendly models that the service models offer. The cloud-based technologies may be used by both people and companies. [2]

The nature of the Internet, and more significantly, the people utilising the Internet, has started to alter as we near the midpoint of the first decade of the new century. Education is not the only industry affected by these developments; in fact, education has often trailed behind some of these trends and is just now starting to feel their effects. [3]

The functions of instructors cannot be entirely replaced by e-learning since it simply updates technology, ideas, and tools while introducing fresh information, ideas, and teaching strategies. Teachers will continue to take the lead and take part in creating and utilising the e-learning cloud. The educational process should be enhanced by the blended learning technique. Also, the virtual cooperation and engaging material provide a high retention rate. [4]

Education cloud is one of the most intriguing uses of cloud computing. By concentrating the power of thousands of computers on a single issue, educational cloud computing enables academics to explore, identify models, and make discoveries more quickly than before. For the progress of research, institutions can also make their technological infrastructures available to the public and private sectors. Universities may be able to keep up with rising energy expenditures and resource requirements thanks to the efficiency of cloud computing. Students anticipate that university services will connect to their own mobile devices for academic purposes. [5]

Due to operation and regulatory mechanisms, security and privacy issues arise in e-learning. Personal privacy is distributed, dispersed, offended, and scouted without authorization as a result of security technology failure. Network administrators were able to keep, modify, exchange, and sell personal information without being held accountable due to legal flaws. [6]

More services from their colleges are expected and needed by the students. The quality of education provided to pupils in a nation determines its potential for future success. An all-encompassing platform with simpler scalability is created via cloud computing. It will be crucial for students and educational institutions that have not yet migrated to the cloud to do so in order to benefit from better and more convenient complex applications, affordable cloud data storage, and the scalability and flexibility of an e-learning platform that supports cloud computing. [7]

III. CLOUD COMPUTING :

Instead of having to manage and maintain their own physical gear and infrastructure, users may access and use shared computing resources through the internet thanks to a technology called cloud computing. Servers, storage, databases, networking, software, analytics, and artificial intelligence are some of these resources. Several advantages come with using cloud computing services, including lower prices, more accessibility and scalability, and simpler maintenance and management. This technology has revolutionised how companies, organisations, and people utilise and store data and has grown to be an essential part of the technological landscape of today.

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3.1Cloud Computing Model:

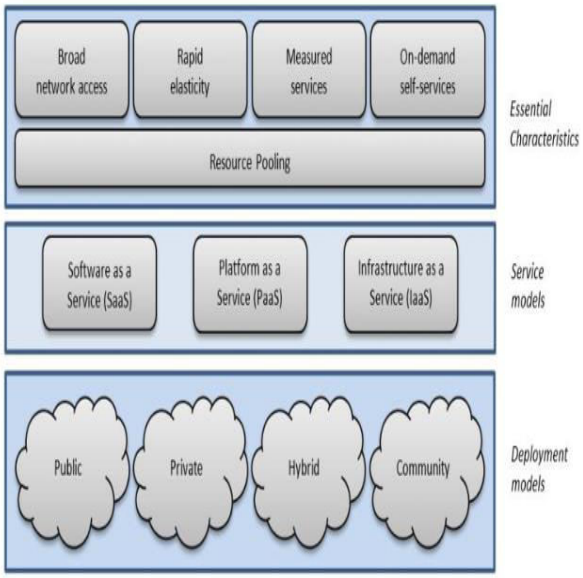

Fig 1: Visual Model for Cloud Computing

Cloud services are the deployment models; however, they have been tailored to satisfy the demands of society, a business, or a school. They enable users to access and preserve data from any technological device.

1. Broad Network Access:
Cloud computing services are accessible to many clients through various cloud platforms and are made available over a large network.

2. Rapid Elasticity:
This is a reference to "virtualization," which makes it simple to process and store data. Depending on how much storage users require, it may be expanded or compacted.

3. Measured Service:
Users and customers can access a fully organised cloud system thanks to cloud computing. Users of such systems only have to pay for the cloud services they are really utilising, which is a cost-saving strategy.
4. on-Demand Self-Service:
Users of cloud models do not need to rely on service providers, and they are user-friendly. They only need to be familiar with technology and digital gadgets.

5. Resource Pooling:
The best cloud model is provided to customers in cloud computing employing a variety of computer resources, including networks and storage systems.

In order to provide quicker innovation, adaptable resources, and scale economies, cloud computing is a paradigm for offering computing resources, including servers, storage, databases, networking, software, analytics, and intelligence over the Internet (the "cloud").

For cloud computing, there are three basic deployment models:

Public Cloud: This is the most typical deployment approach, when internet-based resources and services for cloud computing are made available to the general public. Third-party businesses own and run public clouds, which provide a range of services like infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS). Public clouds are a common option for people and small enterprises since they are affordable and simple to utilise.

Private Cloud: An exclusive cloud computing environment for a single business that uses a private network is known as a private cloud. Large businesses that need a high level of security and compliance frequently utilise private clouds because they offer more security, control, and flexibility than public clouds.

Hybrid Cloud: A hybrid cloud combines public and private clouds, enabling businesses to take use of both deployment types' advantages. Sensitive data and apps can be handled and stored on a private cloud in a hybrid cloud, while less sensitive data and applications can be processed and stored on a public cloud. With this

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strategy, businesses may benefit from the scalability and cost benefits of public clouds while retaining the privacy and security of a private cloud.

When choosing a deployment model, companies should carefully assess their requirements and goals. Each of these deployment models has advantages and disadvantages of its own. While selecting a cloud deployment option, one should take into account aspects like security, affordability, scalability, and simplicity of use.

Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service make up the three cloud service models (IaaS)

There are several different services offered by cloud computing, which may be divided into three different service models:

Infrastructure as a Service (IaaS): IaaS offers virtualized computing resources over the internet, including servers, storage, and networking. The most fundamental kind of cloud computing allows businesses to rent computer power as needed without having to make a capital expenditure on actual gear. Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform are a few IaaS providers (GCP).

Platform as a Service (PaaS): Platform as a Service (PaaS) offers a way to create, manage, and use cloud-based software and services. The underlying infrastructure is abstracted by this service paradigm, freeing developers from worrying about managing it and allowing them to concentrate on creating and distributing apps. Heroku, Google App Engine, and Microsoft Azure are some examples of PaaS vendors.

Software as a Service (SaaS): Software as a service (SaaS) offers online access to software programmes, often via a web browser. Organizations may utilise software without having to install and maintain it on their own machines thanks to this service model. Google Workspace, Salesforce, and Microsoft 365 are a few SaaS vendors.

Organizations may select the service model that best suits their needs and goals from among four options, each of which gives a different level of administration and control. SaaS offers the least amount of flexibility and control compared to IaaS. PaaS sits in the middle, offering a compromise between authority and usability.

a. Application of Cloud Computing in e-learning:

E-learning, also known as online learning or digital learning, refers to a method of instruction where students access course materials and receive instruction online as opposed to in a typical classroom environment. Since the COVID-19 pandemic, e-learning has gained appeal as a technique to impart knowledge while reducing the risk of transmission. One of the key benefits of e-learning is the increased accessibility and convenience. Because e-learning allows students to access course materials from any location with an internet connection, balancing schooling and other responsibilities is made easier. E-learning also eliminates the need for students to physically be present in a classroom, which may be highly beneficial for students who live in remote areas, have disabilities, or are otherwise unable to attend traditional classroom settings.

The capacity to customise the learning process is another benefit of online education. E-learning systems frequently provide tools that let students choose their own pace and get feedback on their development, allowing them to get an education that is customised to their particular requirements and objectives.

As it allows educational institutions and enterprises to provide scalable and affordable learning solutions, cloud computing has become a crucial component of the e-learning sector. E-learning is more accessible and practical for both students and teachers thanks to the cloud, which offers a centralised and secure platform for storing, processing, and transmitting educational information. The ability to host learning management systems (LMS) in the cloud is one of the main advantages of cloud computing in e-learning. Because LMS systems like Blackboard, Moodle, and Canvas are widely available, students and teachers may engage and communicate with one other without difficulty. A lot of homework, course materials, and other educational resources may be saved on the cloud because it has a lot of storage capacity.

The usage of virtual classrooms is a significant use of cloud computing in e-learning. Real-time engagement and cooperation between students and professors is made possible by these cloud-based platforms, enabling online classes, group projects, and debates. Virtual classrooms offer a highly engaging and dynamic learning environment with features like video conferencing, interactive whiteboards, and shared document editing. An further advantage of cloud computing is its capacity to analyse enormous volumes of data generated by e-learning systems. This data may be used to track student development, identify learning trends, and improve the overall effectiveness of online learning programmes. For institutions and businesses that provide online courses,

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this may be extremely helpful since it allows them to learn more about how students are engaging with the material and improve it.

Last but not least, the cloud enables e-learning providers to give students access to instructional information via mobile devices. Mobile learning has become a more significant component of e-learning as smartphones and tablets have gotten more popular. Students may access educational information while they are on the go thanks to the creation of learning applications, interactive e-books, and mobile-friendly websites made possible via the cloud.

b. Advantages of e-Learning using Cloud Systems for Students and Educators:
The use of cloud computing in e-learning provides numerous benefits for both students and educators. Some of the key advantages include:

Accessibility: The ability to access cloud-based e-learning from any location with an internet connection is one of its main benefits. This enables students to continue their education without being constrained by geography from the convenience of their homes.

Scalability: Large volumes of instructional information can be stored and delivered because to the cloud's limitless storage capacity. This is especially helpful for universities and businesses that provide online courses since it enables them to accept more students without worrying about storage space.

Cost-effectiveness: By hosting e-learning solutions in the cloud, costly hardware and IT infrastructure are not required. This lowers not just the initial outlay but also the ongoing maintenance expenses, making online learning more affordable for both students and teachers.

Improved Collaboration: Learning management systems and virtual classrooms based in the cloud give students and teachers a platform for interaction and collaboration. These includes tools that improve learning, such video conferencing, interactive whiteboards, and shared document editing.

Data Analytics: With the analysis of massive volumes of data produced by e-learning systems, the cloud offers insightful data on the development of students and their learning habits. By using this data, e-learning programmes may be made more successful and each student's learning experience can be made more tailored.

Mobile Learning: Mobile device delivery of educational information to students is made feasible via the cloud, enabling them to continue their education while on the road. Students with hectic schedules or little access to conventional academic settings can especially benefit from this.

Ultimately, there are several advantages to using cloud computing in e-learning for both students and teachers. The cloud has had a significant impact on the e-learning business and has the potential to continue changing how we learn in the future, from increased accessibility and scalability to cost-effectiveness and greater collaboration.

Challenges of Cloud Computing in e-Learning:
While cloud computing has numerous advantages for e-learning, there are also a number of difficulties that must be overcome. Among the principal difficulties are:

Security: While using cloud computing for e-learning, it is extremely important to safeguard sensitive and private educational data. To guard against unapproved access, data breaches, and other security risks, the cloud service provider must implement strong security measures.

Reliability: Any e-learning program's success depends on the availability of cloud-based e-learning technologies. Service interruptions or outages might hinder students' learning and aggravate teachers. The reliability of their systems and the implementation of sufficient safeguards against downtime are requirements for service providers.

Integration: For firms already utilising conventional e-learning technologies, integration with current IT systems might be difficult. In order to effectively utilise the advantages of cloud computing in e-learning, companies may need to update or replace their current systems, which might result in increased expenses.

Internet connectivity: An efficient and reliable internet connection is necessary for cloud computing. It may be challenging to obtain cloud-based e-learning solutions for students and instructors in isolated or rural places because they lack access to the required internet speeds.

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Cost: Although the use of the cloud can save initial expenses, enterprises must pay a membership fee to use cloud-based e-learning systems, which can result in recurring expenditures. Because of this, it may be challenging for businesses with tight resources to take full use of cloud computing's advantages in e-learning.

Vendor lock-in: Organizations may be forced to use a certain vendor's services once they have invested in a cloud-based e-learning system. If an organization's demands change in the future, it may be more difficult to move to a new supplier as a result.

IV. CONCLUSION:

In order to improve learning and promote technology-driven education, cloud adoption must be promoted in the educational sector. The greatest method to combine education with technology is to hold seminars on how the cloud can be used to enhance learning and connect with as many institutions as possible, especially those in distant locations. According to the survey's findings, students are open to using cloud computing for learning because of the many advantages it provides. Due to the introduction of technology, both modern education and education received in a classroom are changing. In summary, cloud computing has transformed how e-learning is provided, making it more approachable, practical, and efficient. Using learning management systems, online courses, data analytics, or mobile devices. The e-learning sector has been significantly influenced by the cloud, which has the potential to further alter how we learn in the future.

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BIG DATA PERFORMANCE ENHANCEMENT OF CONTENT IN FOG ENVIRONMENT

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ABSTRACT
Enhancing the performance of content in a fog computing environment, particularly when dealing with big data, necessitates a multifaceted approach. Fog computing extends cloud capabilities to the network's edge, making it crucial to optimize data processing and delivery for low latency and real-time responsiveness. Strategies for improvement include data compression and aggregation to minimize network traffic, content caching for quicker delivery, and edge analytics for local processing. Load balancing, distributed computing, and edge-based machine learning can parallelize and optimize data processing tasks. Quality of Service (QoS) management ensures data prioritization, while latency-aware routing selects optimal pathways. Robust network infrastructure and well-optimized edge devices are foundational, and continuous monitoring, security, and privacy measures are essential for a holistic solution that efficiently manages and processes big data in a fog environment.

Keywords: Big data Cloud computing, Fog computing, performance

[1]INTRODUCTION

Enhancing the performance of content in a fog computing environment, especially with big data, involves optimizing various aspects of data processing and delivery. Fog computing is an architecture that extends cloud computing capabilities to the edge of the network, which can be especially valuable for applications that require low latency and real-time processing. Here are some strategies for improving the performance of content in a fog environment, specifically when dealing with big data:

1. Data Compression and Aggregation:
- Implement data compression and aggregation techniques to reduce the amount of data transmitted over the network. This can help in conserving bandwidth and reducing latency.

2. Caching:
- Use content caching mechanisms at the edge nodes in the fog environment. Cached content can be quickly delivered to end-users, reducing the need to retrieve data from the cloud or a distant data center.

3. Edge Analytics:
- Perform real-time analytics at the edge nodes to filter and process data locally. This reduces the amount of data that needs to be sent to the cloud for processing, thus minimizing latency.

4. Load Balancing:
- Implement load balancing mechanisms to distribute data processing and content delivery tasks efficiently across fog nodes. This ensures that no single node becomes a bottleneck.

5. Distributed Computing:
- Utilize distributed computing frameworks to parallelize data processing tasks. This can significantly improve the speed and efficiency of processing big data at the edge.

6. Edge-Based Machine Learning:
- Implement machine learning models at the edge for tasks like predictive maintenance or anomaly detection. This can reduce the need to transmit data to a central cloud for analysis, improving real-time decision-making.

7. Quality of Service (QoS) Management:
- Prioritize data traffic based on QoS requirements. Ensure that critical data and content receive higher priority, while less critical data can be processed with lower priority, reducing the risk of congestion.

8. Latency-Aware Routing:
- Use routing algorithms that take into account the latency and network conditions when deciding where to process or forward data. This can help in selecting the most optimal path for content delivery.

9. Edge Device Optimization:
- Optimize the edge devices themselves by ensuring they have adequate processing power and storage capacity. This will enable them to handle big data efficiently.

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10. Network Infrastructure:
- Invest in a robust and low-latency network infrastructure, as the performance of content in a fog environment is heavily dependent on the underlying network's quality.

11. Monitoring and Optimization:
- Continuously monitor the performance of the fog environment, and use analytics to identify areas that need optimization. Implement regular updates and improvements based on the insights gained from monitoring.

12. Security and Privacy:
- Ensure that security measures are in place to protect big data in the fog environment, and implement privacy safeguards to comply with relevant regulations.

Enhancing the performance of content in a fog environment, especially with big data, is a complex task that requires a combination of technological solutions and a thorough understanding of the specific use case and requirements. It's important to design and implement a holistic approach that addresses the unique challenges of your fog computing environment and leverages the advantages of edge computing while efficiently managing and processing big data..

[2]LITERATURE REVIEW
Fog computing has been studied from several angles. We discussed some of these themes before, including the following:

S. Malkowski et al. (2012) discussed consolidation's challenges and prospects. Thus, resources are used extensively. Non-monotonic response time differences occur in n-tier applications. A comprehensive study of consolidated n-tier applications' efficacy under heavy usage has been suggested. Repeatable methods helped it overcome the difficulty [1]. P. Sareen (2013) wrote on cloud computing. He discussed several cloud computing types and architecture. Their applications and concerns were also explored. Technological innovation and inventive practises are two of the biggest determinants in a company's success. Cloud computing, a novel IT idea, lets companies and individuals spread many services correctly and cheaply. The following article explains cloud computing to younger readers. Clouds and their numerous forms are covered in this article. Additionally, it compares and contrasts cloud and grid computing usage. [2]. E. Gorelik (2013) examined many cloud computing models. Most companies' IT departments struggle with cost and administration. Thus, the IT industry has seen substantial turmoil. Agile IT has transformed the creation of new technology and business models. Cloud computing provides organisations more possibilities [3]. P. Pazowski (2013) examined the most progressive cloud computing IS/IT presentation concepts. The inquiry aims to illustrate cloud computing using examples. It also defines the word and outlines its fundamental presentation and service types. The authors compare cloud computing to traditional methods for organising and presenting information systems and technology in projects. [4]. A 2013 study by M.Georgescu and colleagues examined the commercial value of cloud computing. They proved that cloud computing is a major trend in every sector, not just IT companies. [5]. B.H. Bhavani (2014) studied cloud computing resource provisioning. Cloud computing has been considered as a paradigm. This creates a network that can be accessed easily and whenever needed. We want access to the central pool of programmable computer devices to execute our objectives. Computer networks, servers, software, and service providers are examples. [6]. Mohamed Firdhous (2014) debated cloud computing. They predicted it will become the standard for cloud computing soon. In this research [7], fog was added together with cloud-based technologies. K.Shenoy (2015) explained fog computing. The biggest challenge for cloud service providers is user-provided information security concerns. This is because information theft has been rising for years. [8]. M.Verma (2016) discussed load-balancing device structural design in fog computing. This study examined the advantages of load balancing in cloud systems for high availability and zero downtime [9]. Bushra Zaheer Abbasi (2017) discussed security challenges, remedies, and fog computing best practises. Fog computing has expanded cloud computing services. Due to its ancestry, it has certain cloud computing traits. They stated fog computing had many advantages over other forms of computing. [10]. Nabil Abubaker (2017) presented a cloud computing privacy paradigm. Temporary cloud computing. In modern times, fog computing is quite useful. Fog computing was created to solve cloud computing's problems. Many individuals discovered that avoiding really heavy traffic is advantageous. Most of this bandwidth is generated by too many IOT systems. These gadgets have a constant network connection. [11]. Jiyuan Zhou (2017) linked Hierarchic Secure Cloud Storage Scheme to Fog Computing. because cloud computing is getting increasingly popular. The use of cloud computing supported an assumption. Since the beginning, it has been the major controller. Many strategies may be used for cloud computing. Cloud computing can provide such effect [12]. K. Dolui (2017) compares mobile edge computing, fog computing, and cloudlet computing [13]. Fog computing may compromise users' privacy and security, according to Yunguo Guan et al. (2018). They underlined the

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possibility of a fog-based system in the cloud [14]. Deepika Mahal Yashpal 2018 examined ways to increase security in networked systems to prevent brute force and timing attacks and proposes solutions. It strengthens its security system to better defend against application layer threats. [15]. F. Pallas and colleagues studied fog computing scientifically in 2018. Modern applications were often hosted on the cloud due to its supposedly endless processing capability, versatility, and low cost. This will take a long time for end users, but developers will like it. Low latency access is needed for future applications like the Internet of Things, autonomous driving, and 5G mobile apps. To achieve this, computing is often pushed to the network perimeter. Fog computing—the natural transition from the cloud to the network edge—has garnered attention recently.Fog Computing may be a valuable deployment platform, however it is not yet widely accepted. They think this move would be simpler if fog infrastructure services were uniformly service-oriented. This work generates new research ideas, describes fog computing based on this motivation, addresses common fog computing adoption issues, and offers background information [16]. A 2020 research by Ayesha Unnisa and colleagues examines cloud, fog, and edge computing. Cloud and fog computing will be covered in this article. This article thoroughly compares cloud and fog computing for data storage and processing. This lets us choose which computer platform gives the most thorough service delivery analysis quickly and easily. Cloud computing, however, relies on the internet and is more vulnerable [17]. The authors H. R. Abdulqadir and colleagues (2021) introduced cloud-to-edge transition. An investigation. The rapid growth of Internet of Things (IoT) technologies threatens centralized cloud computing. The issues include high latency, limited capacity, and network failure. Cloud computing and fog computing move IoT devices closer to the cloud to solve these issues. Internet of Things devices may process and store data locally using cloud and fog computing instead of transmitting it to the cloud [18]. A broker management system for fog, cloud, and IoT was extensively studied by M. A. Masarweh and colleagues (2022). A solution to these issues is "fog computing," which brings the cloud closer to IoT devices [19].

[3] PROBLEM STATEMENT

Enhancing the performance of content in a fog environment, particularly with big data, can be challenging due to various problems and issues. Here are some common challenges and concerns associated with this process:

1. Network Congestion: Fog environments often involve a large number of edge devices, which can lead to network congestion when transmitting large volumes of data. This congestion can result in increased latency and reduced data transfer speeds.

2. Data Security: Handling big data at the edge introduces security concerns, as sensitive data may be vulnerable to breaches or unauthorized access. It's essential to implement robust security measures to protect data in the fog environment.

3. Data Privacy: Maintaining data privacy, especially when dealing with sensitive or personal information, is a significant concern. Compliance with privacy regulations like GDPR and HIPAA can be complex in a fog environment.

4. Data Quality: Ensuring data quality is crucial for accurate analysis and decision-making. Inconsistent or unreliable data from edge devices can lead to incorrect insights and actions.

5. Resource Constraints: Edge devices often have limited processing power and storage capacity. Handling big data at the edge can strain these resources, potentially affecting performance and causing bottlenecks.

6. Scalability: The fog environment must be scalable to accommodate increasing data volumes and the addition of new edge devices.

7. Data Synchronization: Keeping data synchronized across edge devices and with the central cloud can be difficult. Inconsistencies in data can lead to incorrect decisions and actions.

8. Algorithm Complexity: Implementing advanced analytics and machine learning models at the edge requires significant computing power and may be impractical for resource-constrained devices.

9. Fault Tolerance: Fog environments must be designed to be fault-tolerant to handle device failures or network interruptions gracefully. Ensuring continuous operation in the event of failures is essential for reliability.

10. Interoperability: Integrating various edge devices, sensors, and platforms can be challenging due to the lack of standardized protocols and data formats. Ensuring interoperability and seamless data flow is crucial.

11. Latency Control: While fog computing aims to reduce latency, it's not always straightforward to achieve low latency consistently, especially in scenarios with a large number of edge devices and high data volumes.

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12. Monitoring and Management: Monitoring and managing a distributed fog environment can be complex. Tools and strategies are needed to gain visibility into system performance, troubleshoot issues, and implement optimizations effectively.

13. Regulatory Compliance: Complying with industry-specific regulations and standards while handling big data in a fog environment is a critical concern, as violations can lead to legal and financial consequences.

14. Energy Efficiency: Many edge devices in fog computing environments are powered by batteries or have limited power sources. Optimizing energy usage while maintaining performance is essential to prolong device lifespan.

15. Cost Management: Implementing and maintaining a fog computing environment with big data capabilities can be costly. Balancing performance enhancements with budget constraints is a challenge.

Addressing these problems and issues requires careful planning, technology selection, and a holistic approach to designing and managing fog environments for big data. Organizations must invest in research, development, and continuous improvement to overcome these challenges and reap the benefits of improved content performance in fog computing settings.

[4]PROPOSED MODEL

The process flow for enhancing the performance of content in a fog computing environment with a focus on big data involves several key steps and considerations. Below is a high-level process flow for this purpose:

1. Data Collection at Edge Devices:
- Data originates from various sources, such as IoT sensors, devices, or user interactions, and is collected at the edge devices within the fog environment.

2. Data Preprocessing:
- Data preprocessing includes data cleaning, transformation, and filtering to ensure that only relevant and high-quality data is processed further. This step helps reduce the volume of data and improves data quality.

3. Data Compression and Aggregation:
- Implement data compression and aggregation techniques to reduce the size of data before transmission to minimize the load on the network and reduce latency.

4. Edge Analytics:
- Perform real-time analytics at the edge nodes to process data locally. This may involve running analytics models, making decisions, or performing data enrichment at the edge to reduce the need to transmit data to a central cloud.

5. Load Balancing and Distributed Computing:
- Distribute data processing tasks across edge nodes to balance the workload and optimize resource utilization. This can be achieved through load balancing algorithms and distributed computing frameworks.

6. Edge-Based Machine Learning:
- Implement machine learning models at the edge to perform tasks like predictive maintenance, anomaly detection, or content recommendations. This reduces the need to transmit data to a central cloud for analysis.

7. Quality of Service (QoS) Management:
- Prioritize data traffic based on QoS requirements, ensuring that critical data receives higher priority for processing and delivery while lower-priority data is handled accordingly.

8. Latency-Aware Routing:
- Utilize routing algorithms that take into account latency and network conditions to choose the optimal path for data transmission, ensuring minimal delays.

9. Content Caching:
- Cache frequently accessed content at edge nodes to reduce the need to fetch data from distant data centers. Cached content can be quickly delivered to end-users, enhancing performance.

10. Network Infrastructure Optimization:
- Ensure that the underlying network infrastructure is robust, low-latency, and scalable to support the demands of big data in a fog environment.

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11. Monitoring and Optimization:
- Continuously monitor the performance of the fog environment, collecting data on latency, bandwidth usage, and resource utilization. Use analytics to identify areas in need of optimization and implement improvements as necessary.

12. Security and Privacy Measures:
- Implement security measures to protect data in transit and at rest within the fog environment. Ensure compliance with privacy regulations and standards to safeguard sensitive data.

13. Content Delivery:
- Once data is processed and optimized, deliver the content to end-users or other downstream applications with low latency and high performance.

14. Feedback Loop:
- Establish a feedback loop to collect user feedback and system performance data, which can inform further improvements and optimizations in the fog environment.

This process flow is iterative and adaptive, as fog environments and data requirements may evolve over time. By implementing these steps and continually monitoring and optimizing the fog environment, you can enhance the performance of content, especially when dealing with big data, in a fog computing setting.

[5] RESULT AND DISCUSSION

These steps are related to accepting and processing data from both the fog side and the cloud side while ensuring encryption and authentication. Here's a summary of the three distinct sections:

1. Accepting Data from the Fog:
- In this step, the end-user module is set up to receive data from the fog side. This involves opening a port that allows data to be captured from the fog. It's crucial that both the end-user module and the fog node use a shared authentication code or key to ensure secure communication. If a common authentication code is used, the data received from the fog side can be decrypted.

2. Accepting Data from the Cloud:
- This part of the process enables the end-user module to accept data from the cloud side. Similar to the fog side, a port is opened to capture and transmit data from the cloud. It's important for both the end-user module and the cloud service to share a common authentication code for secure communication. With the same authentication code, the data received from the cloud side can be decrypted.

3. Merge and Decode:
- In the final step, the end-user module combines and processes the data received from both the fog and cloud sides. The data is decoded based on the shared authentication code, which is consistent with the encryption used by both the fog and cloud sources. This ensures that the integrated data is in a usable and understandable format for further analysis or application.

These steps highlight the importance of secure communication, authentication, and encryption in a fog computing environment, where data is collected from multiple sources and needs to be processed and integrated at the end-user module. By following this process, you can ensure the reliability and security of data transmission and processing in such an environment.

Simulation result has been shown in table 1 where data preprocessing time for conventional and proposed work has been presented.

Table1: Comparative Analysis of Data pre-processing time of Traditional and Proposed Work

Packets	Traditional	Proposed
100	911.3344615	817.97472
200	1957.368413	1638.79781
300	2717.338667	2477.047542
400	3854.880813	3352.630097
500	4892.611808	4127.359338
600	5927.731631	5357.553552
700	6300.481434	5978.986822
800	7957.423475	7095.071798

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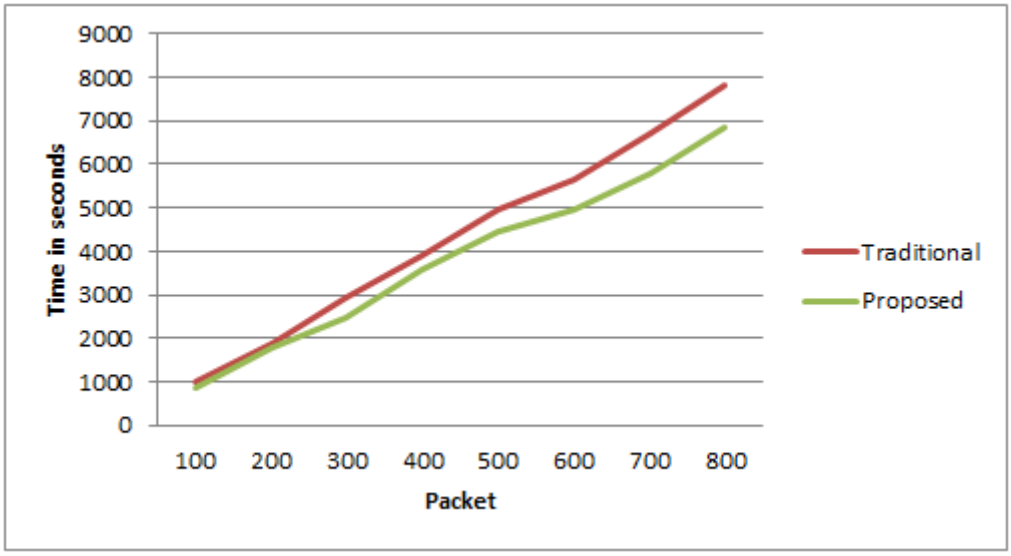

Fig 1: Comparative analysis of Data pre-processing time of traditional and proposed work

Simulation result has been shown in table 2 where data transmission time for conventional and proposed work has been presented.

Table 2: Comparative Analysis of Data transmission time of Traditional and Proposed Work

Packets	Traditional	Proposed
100	47.13217298	42.57210594
200	95.02168238	89.45018474
300	144.8239686	121.4305708
400	197.2678869	178.7961822
500	240.8365519	219.9975341
600	277.2799749	253.6699805
700	343.6099506	300.2221141
800	392.192943	343.0140772

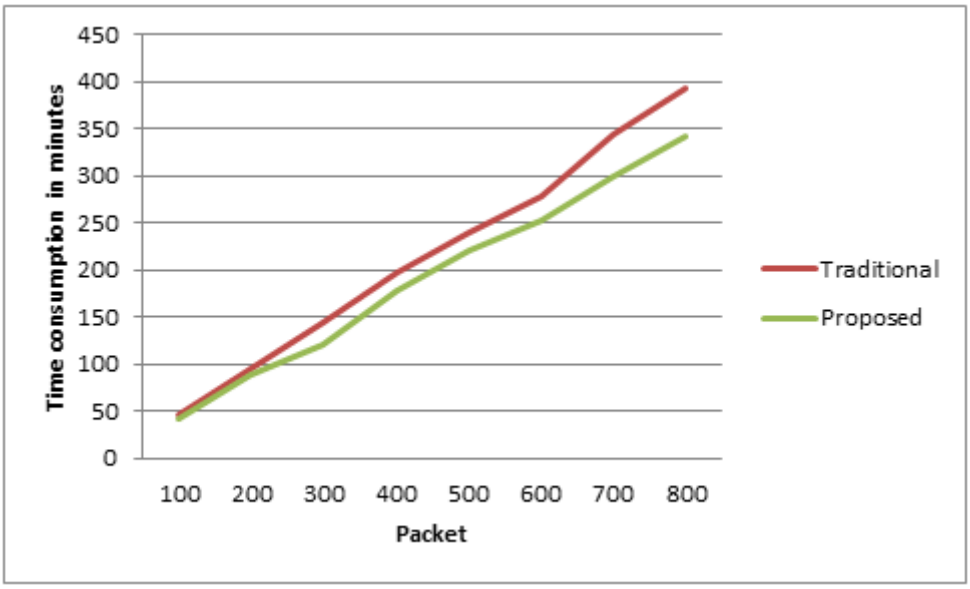

Fig 2: Comparative analysis of Data transmission time of traditional and proposed work

[6] CONCLUSION

The performance of a proposed model that splits data, consumes less preprocessing time, and reduces transmission time compared to a conventional fog-based system can offer several advantages. Here are some of the key benefits and considerations:

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1. **Reduced Latency:** By splitting data at the source and performing preprocessing at the edge (fog) devices, you can significantly reduce data transmission delays. This is especially beneficial for applications that require low-latency responses, such as real-time analytics or autonomous systems.

2. **Bandwidth Efficiency:** Splitting and preprocessing data at the edge means that only relevant and condensed information is transmitted to the cloud or central server. This reduces the amount of data that needs to traverse the network, optimizing bandwidth usage and potentially lowering operational costs.

3. **Improved Scalability:** The proposed model can be more scalable as it distributes the processing load across edge devices, reducing the burden on a central cloud infrastructure. As your system grows, you can easily add more edge devices to handle the increased workload.

4. **Enhanced Privacy and Security:** Preprocessing data at the edge helps protect sensitive information because the raw data may never leave the local network. This can enhance data privacy and security, which is particularly important in industries like healthcare and finance.

5. **Energy Efficiency:** Edge devices often have resource constraints, but by minimizing data transmission and central processing, you can reduce the energy consumption of these devices, prolonging their operational life and reducing costs.

6. **Adaptability to Network Conditions:** The proposed model can adapt to varying network conditions. When network connectivity is stable, you can offload more processing to the edge. When the network is unreliable, you can prioritize preprocessing and data splitting to minimize the reliance on the cloud.

7. **Real-time Decision-Making:** With less preprocessing time and lower latency, the proposed model enables quicker decision-making at the edge. This is crucial for applications like autonomous vehicles and industrial automation, where split-second decisions are critical.

8. **Reduced Overhead:** Central cloud resources can be freed up for more strategic and heavy-duty tasks, while routine data preprocessing and filtering are handled at the edge. This can reduce the overall overhead of cloud-based processing.

9. **Cost Savings:** The reduced data transmission and cloud processing requirements can lead to cost savings, as cloud services are often billed based on the volume of data processed or stored. This cost-effectiveness is especially relevant for organizations with constrained budgets.

10. **Customization and Flexibility:** The proposed model allows for customization and flexibility in data preprocessing and splitting logic. You can adapt the system to your specific application requirements and use cases.

While there are clear advantages to the proposed model, it's essential to consider the potential challenges, such as the need for effective edge device management, standardization of protocols, and the trade-offs involved in moving processing tasks to the edge. A well-designed and properly implemented system can harness the benefits of reduced preprocessing time and transmission time while addressing these challenges.

[7] FUTURE SCOPE

The future scope of enhancing the performance of content in a fog computing environment, particularly in the context of big data, is promising and involves several exciting trends and developments:

1. **Edge AI Advancements:** As AI and machine learning technologies continue to advance, the ability to perform complex data analytics and machine learning at the edge of the network will improve. This will lead to more efficient and real-time decision-making, reducing the need to transmit data to the cloud for processing.
2. **5G and Low-Latency Networks:** The deployment of 5G and low-latency networks will significantly enhance the capabilities of fog computing. With faster and more reliable connections, content can be delivered and processed with even lower latency, making fog computing an ideal solution for applications such as autonomous vehicles and augmented reality.
3. **IoT Integration:** The growth of the Internet of Things (IoT) will lead to an increase in data generated at the edge. Fog computing will play a crucial role in processing and analyzing this data locally, improving the efficiency of IoT applications.

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4. **Hybrid Cloud-Fog Architectures:** Hybrid architectures that combine fog and cloud computing will become more common. This will allow for dynamic resource allocation, with fog nodes handling real-time processing, and the cloud providing additional capacity for heavy batch processing and storage.
5. **Enhanced Security and Privacy:** With the increasing concern over data security and privacy, fog computing will evolve to provide improved security measures, including edge-based encryption, secure enclaves, and privacy-preserving techniques. This will ensure that sensitive data is protected at the edge.
6. **Standardization and Interoperability:** Efforts to standardize protocols, data formats, and interoperability in fog computing will simplify the integration of diverse devices and platforms. This will reduce complexity and enable a more seamless implementation of fog environments.
7. **Energy-Efficient Edge Devices:** Advances in energy-efficient hardware and devices will enable longer battery life and reduced energy consumption for edge devices. This is crucial for remote and resource-constrained deployments.
8. **Autonomous Fog Management:** Automated fog management systems using AI and machine learning will optimize resource allocation, load balancing, and performance enhancements, reducing the need for manual intervention.
9. **Data-Centric Edge Computing:** A focus on data-centric computing will emerge, where data management, processing, and analytics will be central to fog computing design, resulting in more efficient and effective use of data.
10. **Industry-Specific Solutions:** Various industries, including healthcare, manufacturing, and transportation, will continue to adopt fog computing for domain-specific applications. Customized solutions will drive innovation and performance improvements in these sectors.
11. **Regulatory Compliance:** The evolving regulatory landscape will influence fog computing design. Ensuring compliance with data protection and privacy regulations will remain a critical consideration.
12. **Research and Development:** Ongoing research and development efforts will lead to the creation of new algorithms, tools, and techniques for optimizing big data performance in fog environments.

The future of enhancing big data performance in fog computing environments holds significant potential for addressing the growing demand for low-latency, real-time, and resource-efficient data processing. As technology continues to advance and new challenges arise, fog computing will play a vital role in meeting these demands and unlocking new opportunities across various industries.

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SECURE AND HIGH PERFORMANCE ENHANCEMENT FOR CLOUD ENVIRONMENT FOR REAL WORD APPLICATION

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ABSTRACT
Cloud-based services are increasingly being utilised to transfer data across locations and cloud-based applications are becoming the norm. After a digital file has been shared, the possibility of unwanted access still exists. The performance of cloud systems might suffer when extra security measures are implemented. Researchers conducted significant analysis to enhance cloud safety and functionality. The recommended approach ought to improve security without diminishing effectiveness. The published study is being examined to see whether there are any limitations in regards to cloud-based software security concerns. Transmission delay, error probability, and packet loss probability may all be reduced by employing an encrypted hybrid approach in cloud systems and socket-based high-performance mechanisms. We are evaluating the proposed model against state-of-the-art methods in the industry to determine its superiority in these areas. The purpose of this research is to learn more about the motivations for and any obstacles to the planned action. After reviewing the issue statement, this investigation will analyse the practical implementation of the planned task. The algorithm and mechanism of the Endeavour would explain the research methods that were used. The findings of the simulation would be provided, along with an explanation of the study's advantages over similar ones. We'll go through the many methods you may use to conduct this study in further detail below. The results of preliminary research may suggest interesting new avenues to investigate. In order to better secure the hybrid socket based strategy, researchers investigated the hybrid approach in order to categorise various forms of assaults.

Keywords: Cloud computing, Distance learning, security, performance

[1] INTRODUCTION

1.1 Distance Learning

The term "Distance Learning" is used to describe a method of education in which students are not physically present in a classroom with a teacher. The phrase "distance learning" refers to any method of acquiring knowledge or education that does not include personal contact with the teacher or professor. This may be done in a number of ways, one of which is by establishing satellite campuses in areas where the primary provider does not have a presence. A degree earned via one of these distant learning institutions is still only recognised as having been granted by the original source.

1.2 Two Types of Distance Learning

The two main types of e-learning are synchronous and asynchronous.

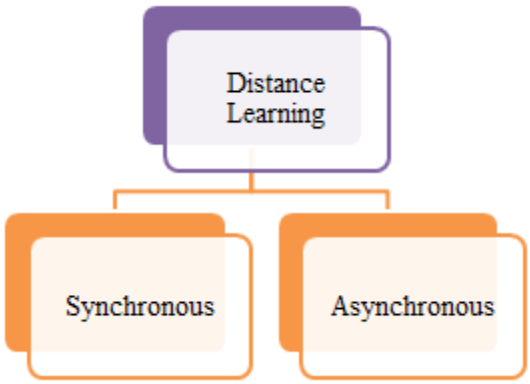

Fig: 1 Distance Learning

- **Synchronous**

Real-time lecture delivery is what we mean when we talk about synchronous remote learning. Real-time interaction with your instructors is guaranteed. Teleconferencing and related technologies are essential to the success of this educational approach.In synchronous distant learning, students and teachers may interact live online. However, it lacks the adaptability that some students would like since you must meet with your instructors and classmates at their designated meeting times.

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- **Asynchronous**

Asynchronous distant learning allows students to go through courses at their own speed. You'll have weekly due dates to work towards, so you may go at your own pace. The material of the course may be accessed whenever it is needed. However, you may engage in chat, quizzes, and video comments.

1.3 Cloud Computing

The term "cloud computing" refers to the practise of providing various services through the Internet. Data storage, servers, databases, networks, and software are all examples of tools and applications that fall under this category. With cloud computing, data may be stored in a distant database rather than on a private hard drive or other local storage device. If a computer or other electronic device can connect to the internet, it can have access to the information and applications it needs to function.Cost savings, enhanced productivity, speed and efficiency, performance, and security are just few of the many reasons why cloud computing is a popular choice for individuals and organisations alike.

1.4 The types of cloud computing services

Depending on your organization's requirements for security, scalability, and ease of administration, you may choose from one of three primary kinds of cloud computing service:

- **Infrastructure as a Service (Iaas)**

Computing, storage, networking, and virtualization capabilities are just some of the IT infrastructure services that may be accessed on demand via IaaS. It's the most like using conventional, on-premises IT in that it gives you complete command over all of your systems.

- **Platform as a Service (Paas)**

To create applications in the cloud, Platform as a Service (PaaS) provides all the necessary tools and infrastructure. With PaaS, businesses no longer have to worry about the administration and upkeep of the underlying infrastructure, freeing them from focusing on application development.

- **Software as a Service (Saas)**

SaaS, or software as a service, provides everything needed to run an application, from the underlying infrastructure to regular software upgrades. End-user applications are a common kind of SaaS solution, in which the cloud provider handles both the service and the underlying infrastructure.

1.5 Security and Performance of Cloud Environment

Securing and enhancing the performance of a cloud environment for real-world applications is crucial for ensuring the reliability, scalability, and availability of your services. Here are some key strategies and best practices to achieve these goals:

- **Identity and Access Management (IAM):** Implement robust IAM policies to control access to your cloud resources. Use the principle of least privilege (PoLP) to ensure that users and services have only the permissions they need. Enable multi-factor authentication (MFA) for all user accounts to add an extra layer of security.
- **Data Encryption:** Encrypt data both in transit and at rest using industry-standard encryption protocols and key management practices. Utilize services like AWS Key Management Service (KMS) or Azure Key Vault to manage encryption keys securely.
- **Network Security:** Implement a VPC or Virtual Network (VNet) to isolate and segment your resources. Utilize network security groups, firewalls, and intrusion detection systems to protect against unauthorized access and attacks.
- **Security Monitoring and Logging:** Set up comprehensive logging and monitoring using tools like AWS CloudWatch, Azure Monitor, or Google Cloud Monitoring. Implement anomaly detection and alerting to quickly respond to security incidents.
- **Patch Management:** Regularly update and patch your cloud resources and virtual machines to address vulnerabilities. Utilize automation tools to streamline the patch management process.
- **Application-Level Security:** Follow secure coding practices to prevent common application vulnerabilities such as SQL injection, cross-site scripting (XSS), and cross-site request forgery (CSRF). Implement web application firewalls (WAFs) to protect against web-based attacks.

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- **Load Balancing and Autoscaling:** Use load balancers to distribute traffic evenly across multiple instances for better performance and availability. Implement autoscaling to automatically adjust resources based on demand, ensuring optimal performance during traffic spikes.
- **Content Delivery Network (CDN):** Utilize a CDN to cache and deliver static content closer to end-users, reducing latency and improving application performance.
- **Database Optimization:** Choose the appropriate database service and configuration for your application's needs (e.g., relational databases, NoSQL databases). Implement caching mechanisms and query optimization to improve database performance.
- **Backup and Disaster Recovery:** Implement regular backups and disaster recovery plans to ensure data availability in case of outages or data loss.
- **Compliance and Governance:** Ensure compliance with industry-specific regulations (e.g., GDPR, HIPAA) by configuring your cloud environment accordingly.Use compliance monitoring tools to assess and maintain compliance.
- **Third-party Security Tools:** Consider using third-party security tools and services that specialize in cloud security, such as intrusion detection systems and vulnerability scanners.
- **Employee Training:** Continuously educate your team about cloud security best practices and ensure that they are aware of the latest threats and vulnerabilities.
- **Regular Security Audits and Penetration Testing:** Conduct regular security audits and penetration testing to identify and remediate vulnerabilities proactively.

[2] LITERATURE REVIEW

Several studies have been conducted to enhance the safety and performance of cloud storage.

The term "cloud computing" was used by M. Armbrust et al. [1] in their 2009 research to define the infrastructure behind providing software and applications through the internet. These services have been referred to as "SaaS" for some time. The "Cloud" in this sense refers to both the actual and theoretical resources housed inside a data centre. Utility Computing refers to the kind of service provided by Public Clouds, which are clouds that allow users to pay for their use on a minute-by-minute basis. When referring to the internal datacenters of a corporation or other organisation that are not available to the general public, the term "Private Cloud" was often used. This led to the term "Cloud Computing" being used to describe anything outside of private clouds, including SaaS and Utility Computing. Both SaaS users and providers, as well as Utility Computing users and suppliers, were theoretically viable. Our key target audiences were SaaS vendors (Cloud consumers) and Cloud infrastructure vendors. Cloud computing was distinguished by three hardware aspects.

Data about online education in the cloud was gathered in 2011 by Kumar, G. [2]. The researchers used theoretical and empirical methods in their investigation. E-learning solution providers' cloud-hosted websites were analyzed to gather data. Cloud security research has reached a theoretical conclusion. A number of comparison methods have been created by academics to help them evaluate the accuracy of theoretical predictions against empirical facts.

Consolidation potential and dangers at high resource utilization: N-tier application response time non-monotonicity was published in 2012 by S. Malkowski et al.[3]. Using an enterprise-level computer virtualization environment, they directly evaluate and assess resource utilizations, request rates, and performance using two consolidated n-tier application benchmark systems (RUBBoS). They find that an n-tier application system's increasing workload might unexpectedly raise the overall response time of a separate co-located system by as much as 300 percent, despite the fact that throughput remains constant. Based on their findings, we determined that the most effective strategy for mitigating the effects of non-monotonic variations in response time was to increase the total number of threads processing requests across all levels.

The advantages of cloud computing for businesses were detailed in a 2013 article by M.Georgescu [4] and colleagues in the Journal of Economics and Public Policy at the University of the Virgin Islands. In the cloud computing model, access was prioritised above storage and maintenance. The way business was conducted, both on a personal and a societal level, was impacted by this.

Models for Cloud Computing were proposed by E.Gorelik [5] in 2013.Cloud computing has given organizations more discretion in terms of managing their infrastructure, saving money, and shifting risk to service providers.

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Its centrality to both technology progress and business operations today has prompted innovative strategies from corporate IT departments.

In 2013, Meslhy [6] developed a data security paradigm for use with cloud applications. This study concludes that the implementation of a unified default gateway across public and private cloud apps is the best strategy to ensure the security of user data. To prevent a cloud service from failing, it is possible to encrypt data at the gateway platform before sending it to the cloud. Following extensive study, a fast encryption technique was developed to safeguard data. Furthermore, it contains anti-malware, firewall, and tokenization features. A 7% performance hit may be attributed to the security approach, since it slows down several application threads for firewall and malware detection.

Provided Computing Resources in the Cloud: Methods, was published in 2014 by B.H. Bhavani et al.[7] Cloud computing was a way to provide on-demand access to a shared pool of configurable computer resources and services across a network such as the Internet.

I. Bandara et al. [8] raised concerns regarding online education's vulnerability to cyber attacks in 2014. They illustrate several approaches to cyber security assessment, monitoring, and administration in virtual classrooms.

Cloud-based Intelligent Healthcare Monitoring System, developed by K. A. Parane et al. [9] in 2014.For this reason, they provide a CIHMS that may deliver medical feedback/assistance to the patient through cloud or hospital.

The Importance of Cloud Computing in the Classroom was published in 2014 by A. Bouyer et al. [10] and colleagues at. They talk about why companies and nations need cloud-based educational systems.

Asgarali Bouyer et al. [11] emphasised the value of cloud computing in 2014 for distance learning. A key take away from their investigation was that cloud computing is a dynamically scalable technology. Internet-based service delivery is a viable solution. Because of recent technological advancements, virtual technologies are playing an increasingly significant role in online education. The benefits of online education to the academic community are many. Online learning is undergoing both quantitative and qualitative developments. Institutions of higher learning and STEM students alike gain from cutting-edge scientific and technological investigation. In this research, cloud-based online learning infrastructure was the primary focus.

S. Sharma et al. [12] published a comprehensive look into the use of e-learning platforms and cloud storage for distance education in 2014.This study provides e-learning methods that make advantage of cloud computing services, with an emphasis on the benefits to the e-learners.

For 2016, Singh, S. K., produced insights on how RSA was used to protect cloud data, which were published as part of a larger work [13]. The performance of the RSA Algorithm is affected by three variables, according the author's analysis: The three most important metrics are throughput, space complexity, and the length of time it takes to complete the task. Results indicated that only genuine individuals would be able to decrypt the data using the RSA method. Before being sent to the cloud, information is encrypted. In order to ensure the safety of the requested information, Cloud services must first confirm the requester's identity before handing over any requested files. Encrypting data has taken 15 percent longer than intended, which has slowed down processing times.

E-learning in Distant Learning with the Help of Cloud Computing was published in 2015 by Arshad Ali [14] and co-authors. The article begins with an overview of modern E-Learning, moves on to an examination of the notion of cloud computing, and concludes by described the design of a cloud computing platform that makes use of the properties of E-Learning.

Future of Cloud Computing was published by K. Shenoy et al. [16] in 2015.Putted data closer to the end user was a primary goal of fog computing. This paper addresses the security concerns.

Comparing Fog and Clouds was published in 2015 by K. P. Saharan et al. [17]. They talk about the Fog's primary features, which include its mobility, 2.Spatial cognition 3. Minimal delay they examine the benefits and motivation of Fog computing, as well as its applications for IoT, and discuss its characteristics, which include: 4.a large number of nodes; 5.a wide geographical dispersion; and 6.a variety of real-time applications.

In 2016, K. Jakimoski et al.[18] published Security Methods for Information Safety in the Cloud.The goal of this study was to examine and rate the state-of-the-art approaches to data safety in cloud computing.

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The 2016 research study on fog computing for secure data security by N.M. murthy et al. [19] in this study, they explored topics such as fog computing's utility. The difficulty of fog computing, Fog computing vs. cloud computing: benefits, limitations, and a comparison of Fog Computing Services

X. Ouyang, et al. [20] published Spotlight: A Cloud-Based Information Service in 2016.A "probe" was a request for a certain kind of server, and they suggest deliberately probing cloud platforms to directly discover such information.

The Cloud Systems in Education was published by A. T. lKorucu et al. [21] in 2016.This research was dedicated to learning more about cloud computing and its potential applications in the classroom. Research had been conducted using a survey design.

A Study on E-Learning in Distance Education using Cloud Computing was published in 2015 by Dr. Pranav Patil and colleagues [22]. This article provides an overview of current E-Learning practises, an examination of the cloud computing concept, and a description of the architecture of a cloud computing platform that leverages E-Learning's flexible configuration choices.

Fog computing security: a survey of exist uses and countermeasures was published in 2017 by Saad Khan et al. [23]. In order to identify common security flaws, this research conducts a literature review of Fog computing applications. In order to offer a comprehensive evaluation, related technologies such as Edge computing, Cloudlets, and Micro-data centres had also been considered.

P.Dhiman et al. [24] published Fog Computing: Moving Beyond the Cloud in 2017.This study explores the architecture, policy manager, and potential applications of this modern computing technology.

Christian Esposito et al. [25] published Difficulties in Integrating Edge and Cloud Computing in 2017.The ability to accomplish high-throughput under high concurrent accesses, mobility support, real-time processing assurances, and data persistency were all advantages of integrating edge and cloud computing.

[3] PROBLEM STATEMENT

There have been several discoveries in the field of cloud computing security, but all of them have resulted in a decrease in performance due to the security measures taken. What's more, previous studies have only looked at a subset of the information. It's important to remember that inadequate speeds and substantial packet loss meant that previous trials had very low throughput. The integrity of text and images must be maintained without diminishing their use. In addition, there is a deficiency of intelligent methods for removing the packets, which is problematic given the available data. In order to ensure the safety of cloud services, the proposed work proposes to implement a number of measures.

[4] PROPOSED RESEARCH METHODOLOGY

When it comes to cloud security, several studies have been conducted. Provide findings from your study that address the safety of both textual and visual information. A hybrid method has been used to bolster safety concerns. A system like this may prevent malicious material from spreading over a network and filter out unwanted packets. The proposed study takes into account performance difficulties with security and dependability concerns. The proposed effort centers on a hybrid technique that would be able to categories types of assaults, taking into account the aspects that impact cloud security and performance.

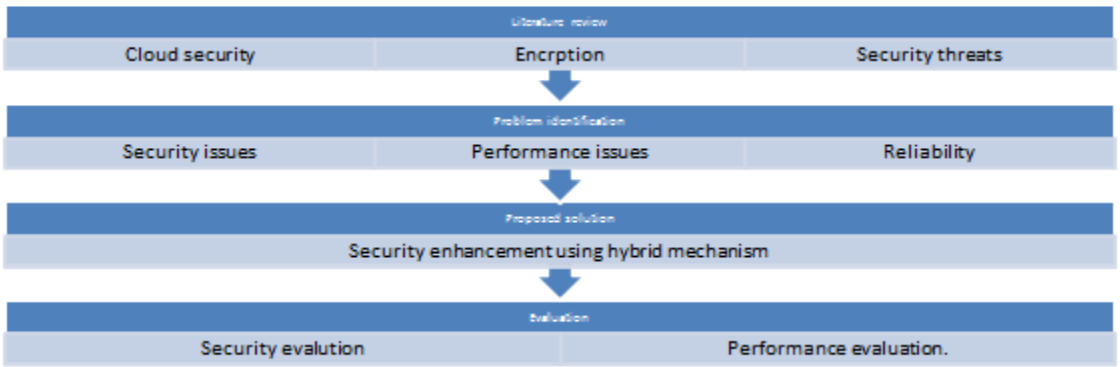

Fig 1: Research Methodology

The hybrid methodology used by the proposed model is shown in the following flowchart. There is security for both graphs and text in the present study. To tighten up its security, developers opted to use a machine-learning technique. Data packet filtering prevents erroneous data from being sent across a network. The suggested study

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intends to tackle the problems of speed, safety, and dependability all at once. In order to better understand how various elements influence cloud security and performance, the proposed study focuses on machine learning algorithms that can categories various forms of attack.

[5] RESULT AND DISCUSSION

5.1 Platform used to implement the Proposed Model

Java was used as the programming tool during the development of the transmitter and receiver module, which was built on the Netbean platform. During the simulation, the amount of time needed to complete the previous work and the work that is being suggested is measured and compared based on the number of packets that are involved. MATLAB has been used as the platform for the simulation work that has been done.

5.2 Simulation for Time/Error/Packet Size

It is important to remember that the length of time needed for a data packet to go from the transmitter module to the reception module is factored in.

5.2.1 Time Consumption

Figure 2 depicts the results of simulations conducted with regard to the amount of time spent working with the proposed system in contrast to earlier cryptography-based research including RSA, DES, AES and DNA. The work that has been proposed makes use of exclusive order while encrypting data and the data that has been compressed has also been encrypted. However, prior studies made use of the RSA and AES mechanisms, which caused the encryption process to take a longer amount of time. In addition, the data have not been compressed prior to being sent in the previous study. As a result of the reduced size of the data packets, the amount of time required to complete the process is noticeably lower when compared to that of other methods.

Table 1: Comparative analysis of Time consumption

Number of attack	DES	RSA	AES	DNA	Proposed work
10	0.95	0.93	0.88	0.85	0.82
20	1.67	1.59	1.51	1.39	1.22
30	2.32	2.29	2.20	1.94	1.67
40	3.09	2.99	2.87	2.51	2.35
50	3.91	3.57	2.93	2.78	2.65
60	4.62	4.58	4.35	3.99	3.42

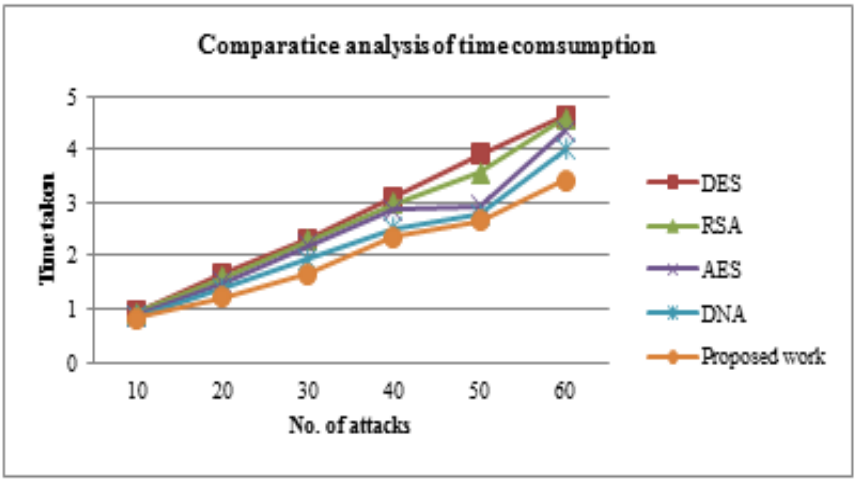

Fig 2: Comparison of time taken during transmission RSA, DES, AES and DNA cryptography with proposed work

5.2.2 Error Rate

There is always a possibility of mistakes occurring when data is being sent. However, the error rate may be brought down to a more acceptable level by reducing the size of the packets and the amount of time they spend on the network. Because of the replacement process, the length of the string may be cut down, which lowers the likelihood of errors occurring. However, the RSA and AES cryptographic mechanisms that were utilised in the earlier study did not result in a reduction in the size of the packets. As a result, the current study has the potential to reduce the mistake rate. A comparative examination of the error rate for earlier works using RSA, DES, AES and DNA encryption, as well as the proposed work, is shown in Figure 3.

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Table 2: Comparative analysis of Error rate

Number of attack	DES	RSA	AES	DNA	Proposed work
10	0.83	0.78	0.67	0.61	0.59
20	1.36	1.29	1.16	1.01	0.89
30	2.33	2.30	2.20	1.98	1.69
40	2.55	2.35	2.24	2.0	1.82
50	3.94	3.53	3.00	2.87	2.46
60	4.20	3.92	3.76	3.64	3.51

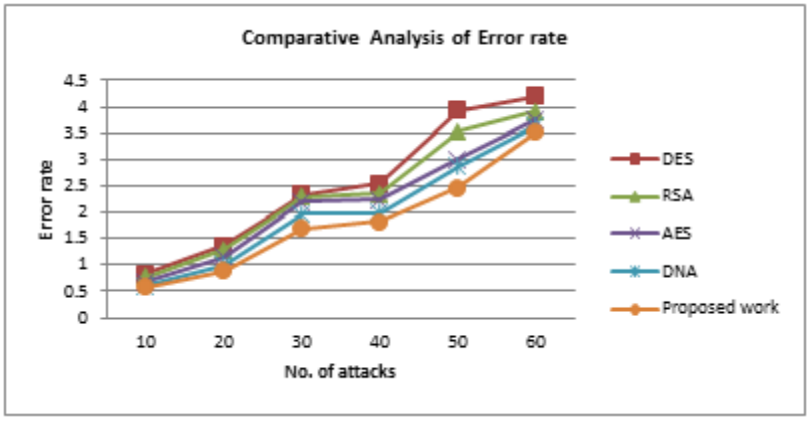

Fig 3: Comparison of error rates for RSA, DES, AES and DNA cryptography with proposed

5.3 Matlab Simulation for Comparative Analysis of Security

In this part, we'll examine how the proposed changes would affect security. In case of the proposed work, the number of packets affected is less as the number of attacks increases. From previous researches, it has been found that AES cryptography is better as compare to RSA, DES and DNA. But proposed work is better than AES cryptography. From the following figures, it is concluded that the affected packets are less in the case of proposed work as compared to RSA and AES-based cryptography approaches.

5.3.1 Man-in-the-Middle

The influence that it has on the packet in the context of RSA, DES, AES and DNA encryption, as well as the work that has been recommended to counteract these attacks, is outlined below.

Table 3: Comparative analysis of Man in middle attack

Number of attack	DES	RSA	AES	DNA	Proposed work
10	9	8	7	6	4
20	13	11	9	8	6
30	20	13	11	10	9
40	25	17	15	13	11
50	29	25	19	16	14
60	32	31	27	21	17

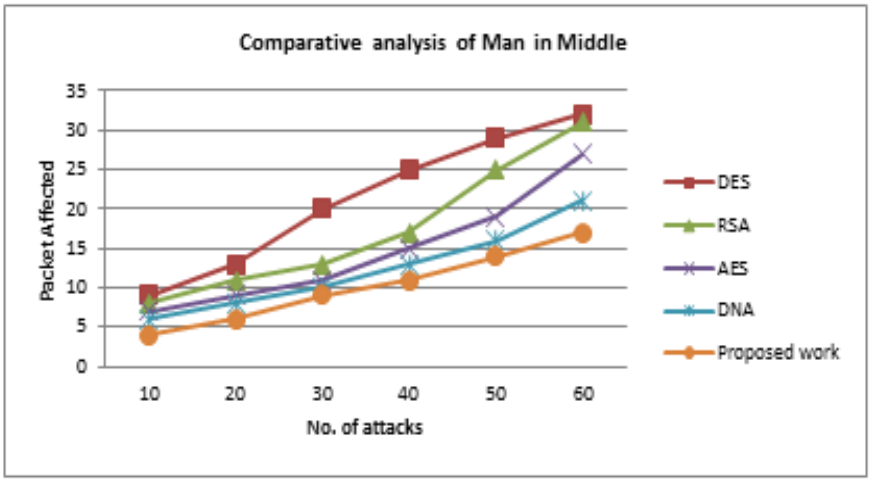

Fig 4 Comparative analysis in case of attack Man-In-The-Middle

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5.3.2 Brute Force Attack

An attack that employs trial and error to attempt to find out a user's login data is called a brute force assault. In addition, encryption keys and a secret website page are used. The comparative analysis of this assault is shown in the following table.

Table 4: Comparative analysis of Brute force attack

Number of attack	DES	RSA	AES	DNA	Proposed work
10	8	7	6	5	3
20	12	10	8	6	5
30	20	15	11	9	7
40	26	15	13	11	10
50	31	24	19	17	14
60	33	32	27	25	21

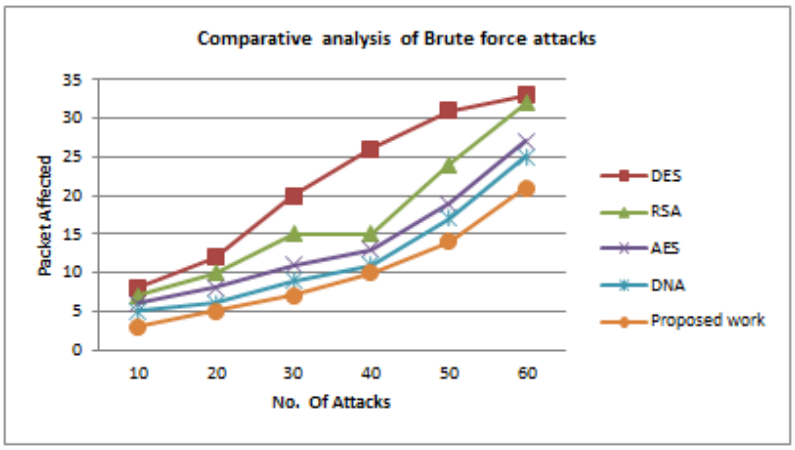

Fig 5: Comparative analysis in case of Brute force attack

5.3.3 DENIAL-OF-SERVICE

An effort to prohibit users from accessing a computer or network resource is an example of a kind of cyber attack known as a denial of service attack (DoS). The chance of a denial of service attack is decreased when both the size of the packet and the amount of time spent transmitting it across the network are lowered. Therefore, there is less of an effect caused by the denial of service in the event of suggested work. A comparative comparison of denial-of-service attacks may be found in the following figure.

Table 5: Comparative analysis of Denial of Service

Number of attack	DES	RSA	AES	DNA	Proposed work
10	9	8	7	6	4
20	13	11	9	8	6
30	21	16	12	10	8
40	27	16	14	13	11
50	32	25	20	18	15
60	34	33	28	24	22

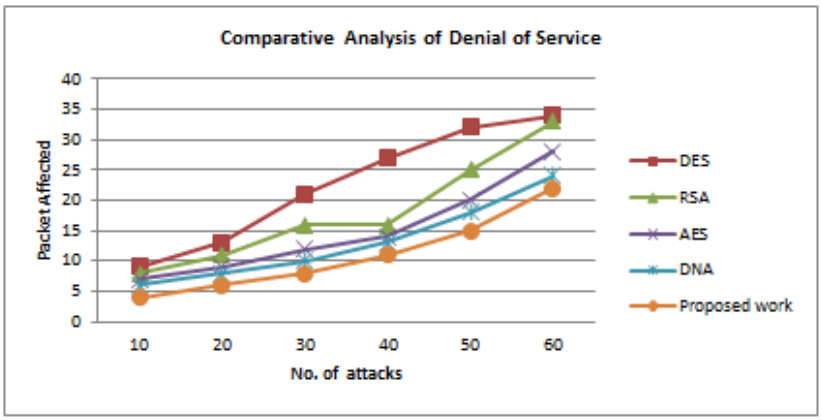

Fig 6: Comparative analysis in case of Denial-of-Service

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5.3.5 ACCESS VIOLATION

The work that is being proposed involves using a user-defined port and a security key for exclusive usage, either of which may be altered at any given moment throughout various sessions. As a result, concerns about access violations have been addressed and resolved in the proposed work. The comparative study of access violation for RSA, DES, AES and DNA encryption, as well as the suggested work, is shown in Figure 7.

Table 6: Comparative analysis of Access violation

Number of attack	DES	RSA	AES	DNA	Proposed work
10	8	7	6	5	4
20	13	11	9	8	7
30	20	15	12	10	9
40	26	18	16	15	13
50	29	24	21	18	15
60	33	32	28	22	16

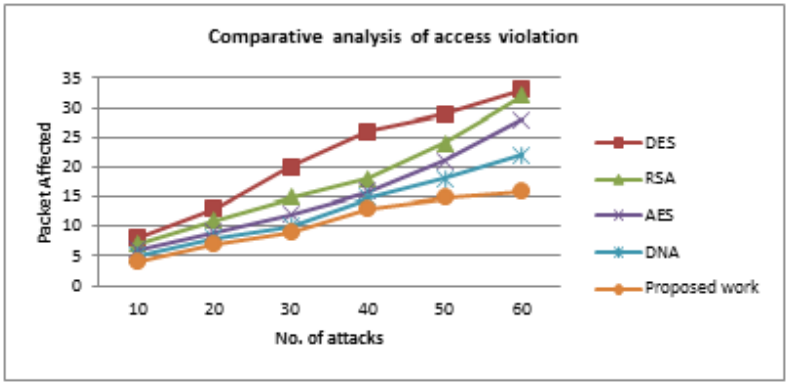

Fig 7: Comparative analysis in case of access violation

5.3.8 ATTACK ON CLOUD SERVICES

Utilization of exclusive or after data compression, in addition to user-defined port numbers, has helped to limit the likelihood of various attacks on cloud services. The comparative study of an attack on a cloud service using RSA, DES, AES and DNA encryption, as well as the suggested work, is shown in Figure 8.

Table 7: Comparative analysis of Attack on cloud services

Number of attack	DES	RSA	AES	DNA	Proposed work
10	14	10	9	8	7
20	19	13	11	10	9
30	27	22	19	17	15
40	29	25	23	19	16
50	39	31	24	20	15
60	43	38	31	25	18

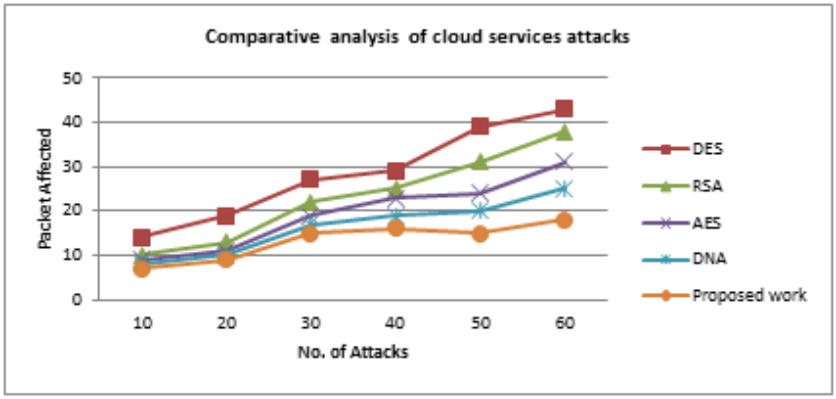

Fig 8: Attack on cloud services

[7] CONCLUSION

The advent of cloud computing has made it feasible for individuals to test out novel concepts. The administration of digital resources and content calls are for the creation of an environment that is supportive.

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The currently available research has uncovered a few potential security models that may be used. A number of different technologies, including RSA, AES, DES, and DNA protection, have made it possible to safeguard data stored on the cloud. Investigations have been conducted with the goal of better understanding cloud-based educational content. The effectiveness of clouds has only been the subject of a limited number of studies. Researchers carried out an exhaustive investigation with the goal of enhancing the cloud's performance and level of security. The suggested solution's end objective is to increase levels of safety without sacrificing operational efficacy in any way. The performance and safety of cloud computing must be taken into account throughout the execution of prior operations that have already been assessed. The advent of cloud computing has made it feasible for individuals to test out novel concepts. The administration of digital resources and content calls are for the creation of an environment that is supportive. The currently available research has uncovered a few potential security models that may be used. A number of different technologies, including RSA, AES, DES, and DNA protection, have made it possible to safeguard data stored on the cloud. Investigations have been conducted with the goal of better understanding cloud-based educational content. The effectiveness of clouds has only been the subject of a limited number of studies. Researchers carried out an exhaustive investigation with the goal of enhancing the cloud's performance and level of security. The suggested solution's end objective is to increase levels of safety without sacrificing operational efficacy in any way. The performance and safety of cloud computing must be taken into account throughout the execution of prior operations that have already been assessed.

[8] FUTURE SCOPE

A cloud-based approach like this may be valuable in the real world. Common need in cloud computing include a data compression and encryption system based on machine learning. The transmission speed, reliability, and error rate of this hybrid system are all superior than those of conventional techniques. All parties involved have a lot to gain from this sort of work.

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FINGERPRINT-BASED VOTING SYSTEM

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ABSTRACT
This paper introduces an online voting system that utilizes fingerprint technology, focusing on security and efficiency. Accurate fingerprint recognition is achieved through the implementation of the SecuGen Hamster Pro H20 device. The system incorporates a two-step verification process, including inputting the Aadhar number and conducting biometric checks against a voter details table. Once verified, voters can select their preferred candidate, and the system displays the winner once voting concludes. The project successfully ensures fair and transparent elections by emphasizing secure authentication, precise result computation, and transparent procedures. By providing a reliable platform for citizens to exercise their voting rights, this proposed system has the potential to strengthen democracy.

Keywords: KNN, Blockchain, Biometric, ATM, e-voting.

1. INTRODUCTION

The traditional voting systems used in many countries face significant challenges that undermine the integrity and fairness of elections. Issues such as voter fraud, impersonation, and multiple voting attempts continue to pose serious concerns. These problems not only compromise the accuracy of election results but also erode public trust in the democratic process.

Addressing these challenges and ensuring secure and transparent elections is of the utmost importance in maintaining the democratic principles of representation and citizen participation. Thus, there is a need for an innovative and reliable voting system that can overcome these limitations and provide a more secure and efficient electoral process.

The various objectives that were identified for the present study can be summarized as below.

- Enhance the efficiency and accuracy of the voting process by implementing a secure andreliable biometric identification system.
- Eliminate the possibility of voter fraud and impersonation by utilizing the unique characteristics of individuals' fingerprints
- Ensure that each eligible voter can only cast one vote, thereby maintaining the integrity of the electoral system.
- Simplify the voting process for voters by reducing the need for physical identification documents and streamlining the registration process
- Increase voter turnout by providing a convenient and accessible voting method that is inclusive to individuals without traditional identification documents.

The fingerprint-based online voting system represents an innovative solution that aims to transform the electoral process by leveraging biometric technology and secure online platforms. Through the integration of the SecuGen Hamster Pro H20 device for fingerprint recognition and a two-step verification process involving Aadhar numbers, the system ensures a high level of security and accuracy in voter authentication. With a user-friendly interface, voters can easily make their candidate selection, while the system efficiently computes and presents the results based on the collected votes. The primary objective of this paper is to establish a transparent, dependable, and inclusive online voting system that effectively addresses voter fraud concerns and enhances the credibility of elections in the digital age.

2. Existing System & Preliminaries

Traditional voting systems have been widely used across the world for conducting elections. These systems have evolved over time, reflecting the social, technological, and legal contexts of different countries. However, they often face several challenges that can impact the integrity, efficiency, and accessibility of the electoral process [8]. Previous voting systems have faced issues such as voter fraud, impersonation, counting errors, logistical challenges, and limited accessibility [1]. Counting errors and logistical challenges are also common issues in traditional voting systems. The manual counting of paper ballots is prone to human error and can be time-consuming, leading to delays in declaring election results [3]. Additionally, the transportation and storage

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of physical ballot boxes present logistical challenges, particularly in large-scale elections with geographically dispersed voting centers [2]. Moreover, traditional voting systems often struggle with limited accessibility, especially for individuals with disabilities, those living in remote areas, or those who are unable to physically visit polling stations. These barriers prevent certain segments of the population from exercising their democratic rights and participating in the electoral process [4]. By leveraging biometric technology, such as fingerprint recognition, these systems aim to enhance the security and accuracy of voter authentication while streamlining the votingprocess [7]. Fingerprint-based voting systems offer the potential to eliminate voter fraud and impersonation by ensuring that each vote is linked to a unique biometric identifier [6]. Furthermore, these systems can improve efficiency by automating the authentication and vote-counting processes, reducing human error and expediting the declaration of results [5]. Theuse of fingerprint biometrics also enhances accessibility as it allows eligible voters to cast their ballots securely and conveniently, regardless of physical location or mobility constraints.

In recent years, the widely accepted voting equipment can be divided into five categories:

1. **Paper-Based Voting:** Paper-based voting involves providing voters with a blank ballot and allowing them to use a marker to indicate the Chosen candidate. However, this method can be time-consuming when it comes to hand-counting the ballots. Additionally, disputes often arise during the review process, with endless debates over whether the marker adequately crosses the square or circle representing the candidate.
2. **Lever Voting Machine**: The lever voting machine is a distinctive device where each lever is designated for a specific candidate. Voters express their preference by pulling the lever associated with their chosen candidate. These machines have the advantage of automatically tallying the votes. However, due to their less intuitive interface, it is essential to provide some instruction or training to voters for effective use.
3. **Punch Card:** In the process of using a metal hole-punch, voters insert a hole into a blank ballot to indicate their choice. While this method allows for automatic vote counting, there is a risk of incorrect results if the casting is incomplete or inaccurate.
4. **Optical Voting Machine:** Following each voter's completion of a circle corresponding to their preferred candidate on a blank ballot, the machine identifies the darkest mark on each ballot and generates the final result. This type of machine enables swift vote calculation. However, if the circle is fully filled during voting, it can lead to an optical scan error.
5. **Direct Recording Electronic (Dre) Voting Machine:** When a Direct Recording Electronic (DRE) system incorporates a keyboard, touch screen, or buttons for voter input, the vote count is expedited. However, DREs tend to be costly and lack the ability to provide verifiable evidence that the vote stored within the machine accurately represents what the voter observed and confirmed on the screen.

The convenience of cash withdrawals through ATM terminals has made ATM cards issued by financial institutions highly sought after by people worldwide. The global ATM system is renowned for its ability to provide customers with instant cash. To initiate a transaction, customers are required to insert their financial institution's ATM card into the ATM terminal. An authentication process is conducted using a personal identification number (PIN) associated with each ATM card. Once the authentication is successfully completed, customers are granted access to a range of transaction options, including balance inquiries, instant cash withdrawals, and other available banking services.

With transactions now taking place within a private network of bank servers, the likelihood of intrusion during the exchange between ATM terminals and the bank server becomes nearly impossible. However, the inclusion of non-financial transactions may introduce additional routing overhead on the National Financial Switch (NFS) since all transactions must pass through it, given that ATM networks reside within the private bank server network. Therefore, there is a need to minimize overhead and expand the utilization of ATMs for non-financial transactions. The implementation of an electronic voting system gained traction with the introduction of an e-voting system for local elections in Gujarat [2]. Unfortunately, this initiative faced significant challenges as citizens were burdened with the requirement to register their laptops or personal computers prior to casting their votes, ultimately resulting in its failure.

3. This is an example of a robust e-voting system designed to minimize the costs associated with conducting cost-effective and fair elections in democratic countries. The system demonstrates a comprehensive understanding of the entire voting process and addresses concerns related to potential misconduct by political parties. By providing an authentic and secure method of casting votes that are untraceable, this e-voting model aims to reduce the financial burden on the government during elections. However, the

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assumption that every individual has internet access at home attracts a significant number of people to the e-voting booths.

3.SYSTEM DESIGN & METHODOLOGY

The system design described below provides a framework for the development and implementation of the fingerprint-based online voting system. It encompasses the client-side interface, server-side infrastructure, database management, voter verification, candidate selection, result calculation, integration and communication, security measures, scalability, performance, and user experience considerations.

The ER diagram (as shown in figure 1) consists of four entities: Voter, Candidate, Vote, and Election. Voters are identified by their VoterID and authenticated through their fingerprints.

Candidates have a CandidateID, Name, and Party affiliation. Votes are recorded with a timestamp and linked to a specific Voter and Candidate.

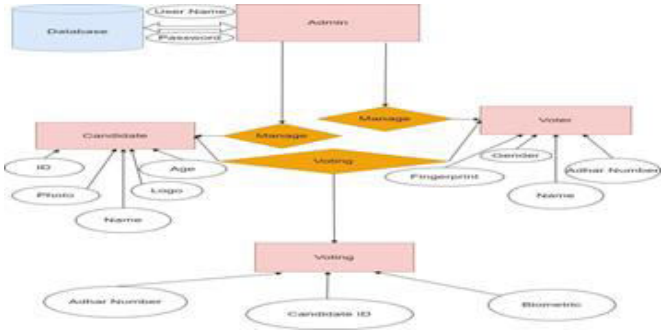

Fig1: ER Diagram

METHODOLOGY

1. **Fingerprint Capture:** The initial stage of the fingerprint-based voting system involves acquiring the fingerprints of eligible voters. This can be accomplished through the utilization of fingerprint scanning devices or sensors that capture the distinct ridge patterns and individual characteristics present in a person's fingerprint.
2. **Fingerprint Recognition:** The collected fingerprints undergo processing through fingerprint recognition algorithms. These algorithms examine the minutiae points, ridge patterns, and other distinctive elements of the fingerprint to generate a digital representation or template. This template serves as a basis for comparison and authentication purposes.
3. **Voter Enrollment:** In the enrollment phase, the fingerprints of eligible voters are gathered and associated with their voter information, including their name, identification number, and other pertinent details. This procedure guarantees that each voter possesses a distinct fingerprint template that is connected to their voter profile.
4. **Voter Authentication:** Upon a voter's arrival at the polling station, their fingerprint is scanned or captured to initiate the authentication process. The captured fingerprint is then compared to the stored templates in the voter database to authenticate the voter's identity. If a match is detected, the voter is successfully authenticated and granted permission to proceed with casting their vote.
5. **Vote Casting:** Once the voter's identity is verified, they are given a ballot or guided to an electronic voting machine. Following the established voting procedures for the specific election, the voter can proceed to cast their vote. It's important to note that the fingerprint-based voting system does not directly determine the vote itself; instead, it functions as a method for verifying the individual's identity.
6. **Data Management and Security:** For the fingerprint-based voting system to operate effectively, a resilient data management infrastructure is essential to handle the storage, retrieval, and processing of fingerprint templates and voter information. It is crucial to implement stringent security measures to safeguard the confidentiality and integrity of the data. These measures should include encryption, access controls, and secure storage mechanisms, ensuring the protection of sensitive information.
7. **Audit Trail and Verification:** The system should maintain an audit trail to track the activities related to the voting process. This includes recording the timestamps of voter authentication, vote casting, and any relevant system events. The audit trail can be used for post-election verification and to address any discrepancies or disputes.

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8. **System Testing and Verification:** Before the deployment of the fingerprint-based voting system, rigorous testing and verification procedures should be conducted. This includes testing the accuracy and reliability of the fingerprint recognition algorithms, evaluating the system's performance under various scenarios, and conducting pilot tests to ensure seamless integration with the voting process.
9. **Legal and Ethical Considerations:** The implementation of a fingerprint-based voting system necessitates adherence to legal and ethical considerations. These involve obtaining appropriate consent from voters regarding the collection and utilization of their biometric data, compliance with data protection and privacy regulations, and ensuring transparency in the system's functioning. It is crucial to respect these requirements to ensure the system operates in an ethical and legally compliant manner.

4. ARCHITECTURE

The architecture described below in Fig2. provides a framework for the development and implementation of a fingerprint-based online voting system. It encompasses client-side interface, server-side infrastructure, database management, voter verification, candidate selection, result calculation, integration and communication, security measures, scalability, performance, and user experience considerations.

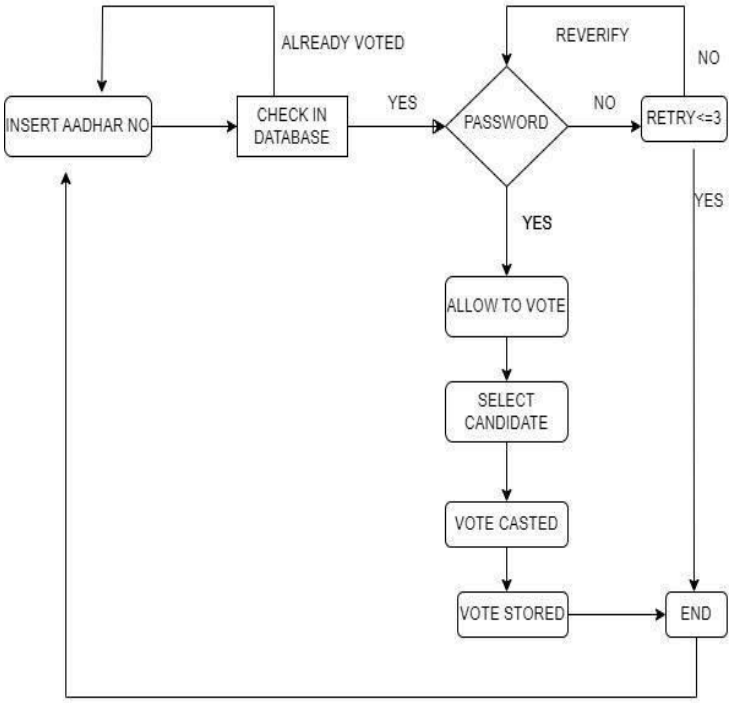

Fig2: Flow-Chart

In this paper we have proposed, a fingerprint-based voting system that leverages the K-Nearest Neighbors (KNN)algorithm for accurate and efficient voter identification. By utilizing the unique and immutable nature of fingerprints, we aim to enhance the security and integrity of the voting process while ensuring a seamless experience for voters.

By combining the strength of fingerprint biometrics and the KNN algorithm, we strive to createa fingerprint-based voting system that offers increased accuracy, efficiency, and transparency. The successful implementation of such a system holds the potential to transform the electoral landscape, ensuring fair and trustworthy elections while inspiring confidence among voters and stakeholders.

5. IMPLEMENTATION & RESULTS

The voting process begins with the voter entering a valid Aadhar/ID number. If the number is valid, the voter is directed to a page where they are required to provide their biometrics,specifically their fingerprints. This step serves to verify their unique identity while also ensuring that the voter meets all the necessary criteria for online voting.

- To enable this verification process, a dataset of registered voters' fingerprint samples and their corresponding class labels is collected. The dataset is then preprocessed, and relevant features are extracted from the fingerprint images. This allows for the differentiation and identification of individual voters.
- The dataset is further divided into a training set and a testing set. The K parameter in the KNN algorithm is

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selected, determining the number of nearest neighbors to consider during the classification process. The KNN model is then trained using the training set, calculating the distances between the test samples and the training samples.

- Based on the majority vote of the K nearest neighbors, the class labels of the test samples are determined. The performance of the KNN model is evaluated using the testing set to ensure its accuracy and effectiveness.

During the actual voting process, the trained KNN model is utilized to authenticate voters by comparing their fingerprint features with the registered templates. This comparison ensures that only authorized voters are granted access to cast their votes online.

Results of the Voting are stored in a database. The results can be accessed and calculated by running simple SQL queries by Admin and this will also reduce the Vote Counting time and resources required. These results can also be savedin a blockchain which will enhance the security of this system to optimal level.

CONCLUSION

The fingerprint-based voting system presents a promising solution to enhance the integrity, security, and efficiency of the voting process. By leveraging the unique biometric characteristics of fingerprints, this system provides a reliable means of identity verification for voters.

In conclusion, the online fingerprint-based voting system offers improved efficiency, accuracy, and security in the electoral process. By leveraging biometric data and the internet, it verifies voter identities, reduces fraud, and increases accessibility. Real-time electronic processing allows for faster results, enhancing transparency and credibility. Privacy and data security must be prioritized, while inclusivity considerations should address individuals without internet access or physical limitations.

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COMPARATIVE STUDY OF COVID PREDICTION IN CXR IMAGES USING HYBRID VGG19-SVM MODEL AND HYBRID CNN-LSTM MODEL

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ABSTRACT
COVID-19 was thought to be the most lethal and devastating disease for humans caused by the novel coronavirus currently. Accurate diagnosis may lead to earlier COVID-19 discovery and lower patient mortality, especially in instances without evident symptoms. The majority of the time, chest X-ray (CXR) images are used to diagnose this illness. Patients who are infected with coronavirus exhibit symptoms that were very similar to those of pneumonia, and the virus targets body's respiratory organs, making breathing difficult. This paper presented a Comparative study between hybrid VGG19-SVM model and Hybrid CNN-LSTM Model for identifying COVID-19 patients in CXR based on wild horse optimizer (WHO) based K-means segmentation to address these problems as well as long short term memory and convolution neural network. The proposed VGG19-SVM segmentation algorithm comprises four phases such as data gathering, pre-processing, segmentation and COVID-19 detection. In the other hand CNN-LSTM Algorithm comprises data collection, pre-processing, watershed segmentation and COVID-19 Prediction. CXR data were gathered from medical Internet of Things (IoT) devices.in the case of VGG19-SVM, Image pre-processing was performed with the assistance of image resizing, Markov random field (MRF) and adaptive gamma correction (AGC). Then, the proposed WHO based K-clustering is used to segment the affected portion of lung CXR effectively. The hybrid classification approach is introduced based on the combination of VGG19 and SVM, which is employed to classify if the patient is in normal condition either COVID-19, pneumonia or tuberculosis. Thus, various existing methods such as VGG19, AlexNet, VGG16 and GoogleNet are taken in this analysis, .On the other hand in case of Hybrid CNN-LSTM input image is pre-processed using Anisotropic diffusion filtering and Adaptive gamma correction for achieving noise removal and enhancing contrast, then the required region for prediction is segmented from the image using the watershed segmentation technique. The proposed VGG19-SVM attained 0.96 of F1_score, 0.97 of NPV, 0.07 FNR and 0.008 of FPR, when compared to the existing methods obtained better findings using DL techniques. the proposed Hybrid CNN-LSTM attained accuracy, precision, specificity and error value is 97%,96%,94%and 3%respectively. This shows the effectiveness of the proposed WHO based K-means clustering algorithm based hybrid VGG19-SVM model and hybrid CNN-LSTM model which can be useful for segment the CXR images.

Keywords: Wild horse optimizer, Support vector machine, adaptive gamma correction, Markov random field, VGG-19 and K-means clustering, anisotropic filtering, segmentation, long short term memory, convolution neural network.

INTRODUCTION
COVID-19 is latest in a string of epidemics brought on by very contagious respiratory viral diseases. More than 651,247 people have died from COVID-19 over world, making it an endemic rather than pandemic disease [1]. Since COVID-19 does not now have a specific treatment or cure, it is unavoidable to live with illness and its symptoms [2]. This fact has significantly increased load on already underfunded healthcare systems worldwide, particularly in underdeveloped countries [3]. Alternatives exist that could decrease the significant impact on already constrained healthcare institutions and the economy [4] in the absence of an effective, clinically validated antiviral approach or an authorised vaccine to halt the COVID-19 pandemic. People have already been afflicted by numerous other illnesses as a result of the global climate changes, and the COVID-19 has had an immense influence. A ventilator may be used to assist the patient in breathing during hospitalization and treatment in an intensive care unit (ICU) [5].

Due to the COVID-19's severity and simplicity of transmission, it has spread quickly around the world. The greater financial strain on healthcare organisations is mostly caused by daily increase in number of workers required to support mechanical ventilators for severely sick patients admitted to intensive care units [6]. The number of ICU beds must be significantly increased as a result. In above mentioned situation, early diagnosis is crucial to ensuring that patients receive right care while reducing strain on the healthcare system [7]. The most promising of these options makes use of non-clinical methods including machine learning (ML), data mining, deep learning (DL), and other artificial intelligence (AI) [8]. Diagnoses and prognoses for COVID-19 pandemic patients would be simpler with these alternatives [9]. In this study, epidemiological labelled datasets for positive

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and negative COVID-19 cases were used to create supervised machine learning models for COVID-19 infection [10].

Naive Bayes (NB), support vector machines (SVM), artificial neutral network (ANN), logistic regression (LR) and decision trees (DT) were among the learning techniques employed [11]. Recently, there have been widespread applications of AI and DL techniques in the areas of automatic speaker recognition (ASR) and Speech-Audio analysis that could be useful in the early detection and screening of COVID-19 [12]. In these applications, elements of coughing, breathing, and speech sound are identified through analysis utilising Recurrent Neural Network (RNN) as a classifier [13]. VGG19 outperforms other CNN models for COVID-19 classification, including VGG19, Resnet50, VGG16 and AlexNet [14]. The fractured lung regions were found using the watershed segmentation approach, which may add to the evidence that the lungs were assaulted by COVID-19. This predictive system was developed using long short-term memory (LSTM), convolutional neural network (CNN), generative adversarial network (GAN) and other DL approaches [15]. In this work aim to enhance COVID-19 detection model through hybrid VGG19-SVM model as well as hybrid CNN-LSTM Model. The main contributions of 1st research work is given as follows,

- WHO based K-means clustering and hybrid VGG19-SVM is presented for an effective COVID-19 detection model.
- The image resizing, MRF and AGC techniques are applied for enrich the quality of images and eliminate the noise content present in the CXR image.
- An adaptive gamma correction approach is utilized for improve the contrast of lung CXR image.
- In lung CXR, the optimal cluster centroids are chosen using wild horse optimizer (WHO) based K-means clustering algorithm for segmenting the affected portions.
- Hybrid VGG19-SVM is proposed by combination of VGG19 and SVM approach used to determine whether patient has COVID, pneumonia, tuberculosis, or is otherwise healthy condition.
- In the hybrid CNN-LSTM model images are resized for good quality, Improving classification performance through introducing anisotropic diffusion filtering for noise removal and adaptive gamma correction for contrast enhancement.
- The watershed segmentation technique is included for making the region of interest and solving the over segmentation problem.
- This proposed prediction achieves improved accuracy with a lesser error rate.

LITERATURE REVIEW

Multiple clustering and classification algorithms have recently been provided by various studies in order to segment CXR that appear in Lung and assess the disease's progression. Therefore k-means, FCM and K++ were the commonly used techniques for segmentation and AlexNet, VGGNet16 and MobileNetV2 were used techniques for classification. From these some of the techniques were reviewed as follows.

Cortes and Sanchez [16] had developed CXR recognition between COVID-19 and Healthy using DL transfer using AlexNet. The accurate detection of this disease may benefit from the combination of powerful artificial intelligence tools and radiological imaging. For images with a single intensity, first layer, which was used with color images, was substituted. Along from samples of sick persons, there were also samples of healthy people and samples showing the effects of COVID-19 and pneumonia. Elpeltagy and Sallam [17] had created detection of COVID-19 from CXR images was enhanced by combining hand-selected features with ResNet-50. A unique categorization system that fuses a selection of hand-picked features with data from a deep convolutional neural network. CXR images were frequently used to identify, assess, and keep track of common lung and respiratory infections. The best DL model to find the COVID-19 is ResNet50.

Loey et *al*. [18] had suggested COVID-19 detection in chest CT scan images using conventional data augmentation methods and conditional generative adversarial nets (CGAN) based on a deep transfer learning model. ResNet50, GoogleNet, VGGNet16, VGGNet19 and AlexNet are five different deep CNN based models that were used for this study's examination to identify patients who were infected with coronavirus utilizing chest CT radiographs and digital images. Horry et *al*. had presented images from three most used medical imaging modes like X-ray, ultrasound, and CT scan to show how transfer learning from DL models may be utilized to conduct COVID-19 identification. After being meticulously calibrated with correct parameters, selected VGG19 model exhibits high levels of COVID-19 detection versus pneumonia or normal for all three

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lung image modalities. In order for DL models to concentrate on identifying diseases with certain traits from them, it aims to remove unwanted noise from the images.

One of the greatest issues with CNN training was the high number of parameters needed . The main issue was that many DL models have not been tested in order to obtain the greatest performance measurement. In order to overcome these concerns, WHO based K-means segmentation and hybrid VGG19-SVM model was proposed for COVID-19 detection.

Proposed Methodology for hybrid VGG19-SVM Model Vs hybrid CNN-LSTM Model

In this study, hybrid VGG19-SVM model and K-means segmentation technique based on WHO are given for use in identifying COVID-19 patients in chest X-rays (CXR). The containment of the virus's spread still heavily depends on early detection. SARS-CoV2 virus-induced viral pneumonia affects patients in severe COVID-19 instances. It is substantially more difficult to distinguish between COVID-19 patients and Pneumonia patients than between healthy people and COVID-19 patients because of similarities between Pneumonia and COVID-19 Chest X Ray pictures. Classic DL designs like ResNet, VGG, etc., or versions of such models, have been extensively used for single-level classification, lengthening both training and validation times. So, in this research introduce a hybrid model for minimize testing and training validation.

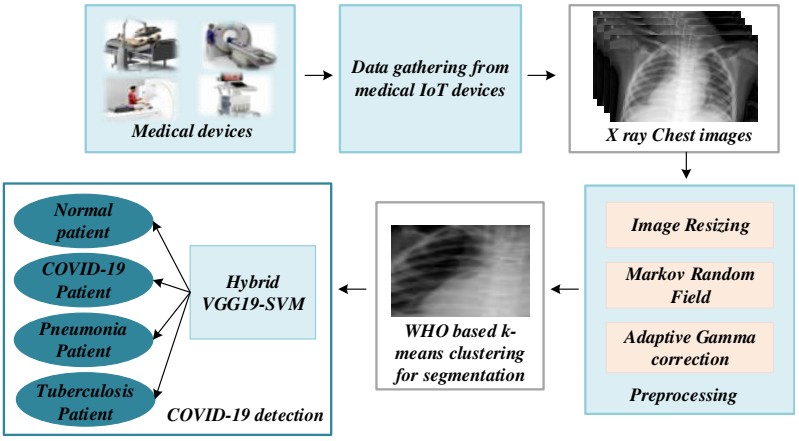

Figure 1: Architecture of the VGG19-SVM COVID-19 detection framework

The proposed COVID-19 detection framework is illustrated in Figure 1 and it consists of four phases such as, data collection from medical IoT devices, image pre-processing, segmentation using the WHO-based K-means clustering technique, and COVID-19 detection using a hybrid VGG19-SVM that has been presented. CXR images are initially collected with help of IoT-based medical devices in healthcare system to determine whether patient is infected with COVID-19 or not. After data gathering, CXR images are pre-processing to enhance quality of images by reducing noise that appears in raw images. Apply a variety of pre-processing techniques in the current framework, such as adaptive gamma correction, Markov random field, and image resizing. Following pre-processing, the segmentation step segments a specific area of chest image for accurate detection using a WHO-based K-means clustering algorithm. The segmented portion is then used as input for a pre-trained VGG19 net to extract image features, which is then used as input for an SVM classifier to do detection. Finally the hybrid VGG19-SVM categorize the Chest X-ray into normal patient COVID patient, pneumonia patient and tuberculosis.

The architecture of the hybrid CNN-LSTM Model, deep learning-based COVID prediction is illustrated in figure 1.

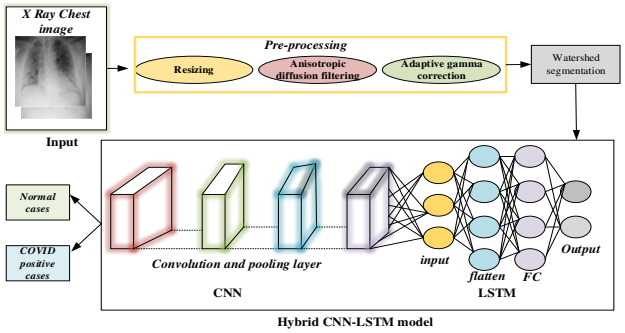

Figure 1: The architecture of the Hybrid CNN-LSTM Deep Learning Prediction Model

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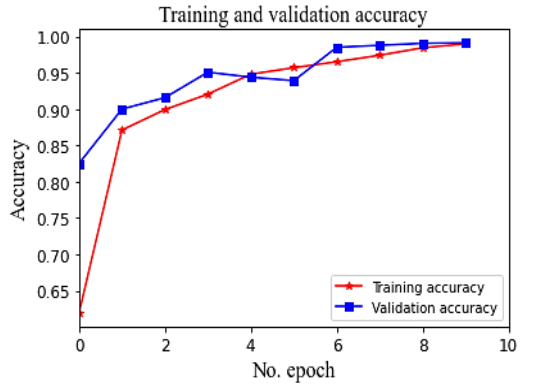
Figure 1 illustrates the proposed hybrid deep learning technique designed for the prediction of COVID infected persons. Initially, the data collection for COVID disease prediction is performed based on IoT technology. Medical IoT devices that are involved in the process of data collection are X-rays, CT scans, MRI scans and ultrasounds. The image data collected based on these IoT medical devices are considered as input. Following that, the input image is pre-processed using three pre-processing techniques: resizing, noise removal and contrast enhancement. An anisotropic diffusion filtering technique removes the image's noise, and the image's contrast is improved through the adaptive gamma correction technique. Then, the image obtained as a result of pre-processing is sent as input for watershed segmentation. The segmented image is fetched as an input into a hybrid CNN-LSTM model for prediction. Finally, the COVID positive cases are classified from normal cases using the proposed hybrid deep learning technique.

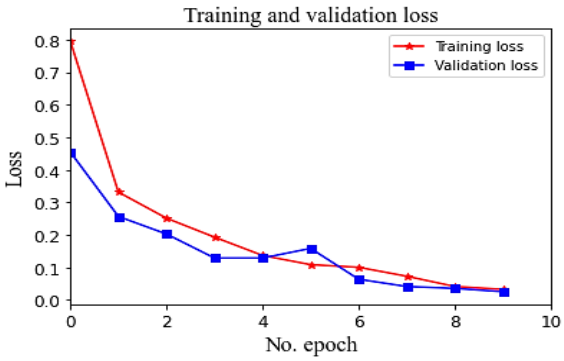
RESULT AND DISCUSSION

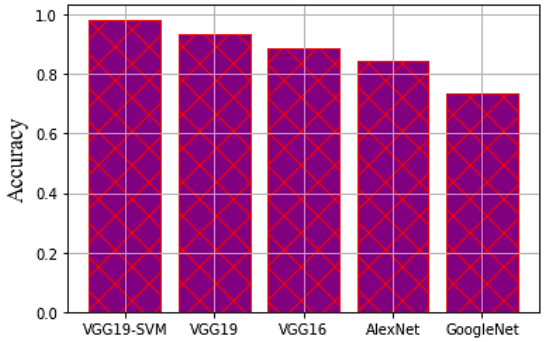
This study uses a hybrid VGG19-SVM model with WHO-based K-means segmentation to detect COVID-19 patients in CXR images and hybrid CNN-LSTM model .Both of the proposed algorithm is implemented in Python software for validate its performance.

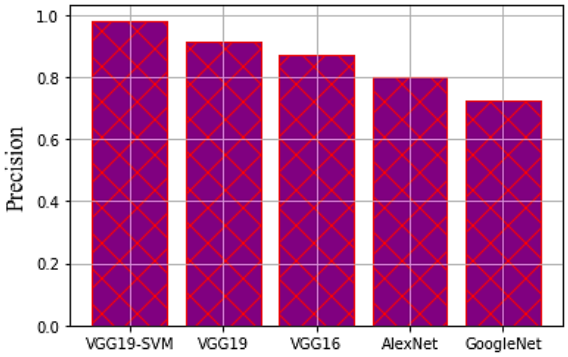
Performance Analysis of VGG19-SVM AND CNN-LSTM

VGG19-SVM

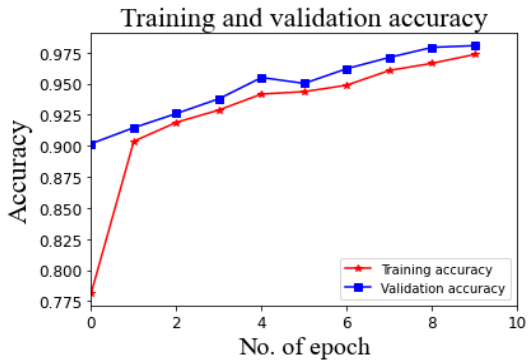


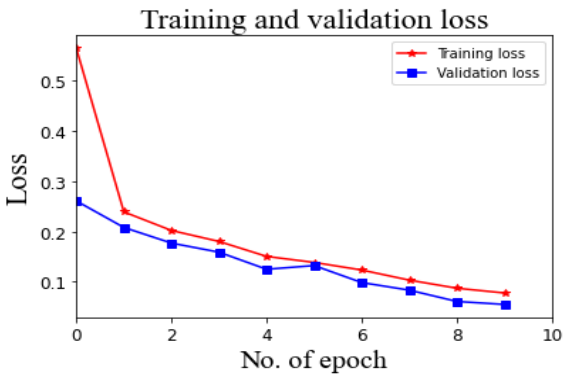






CNN-LSTM





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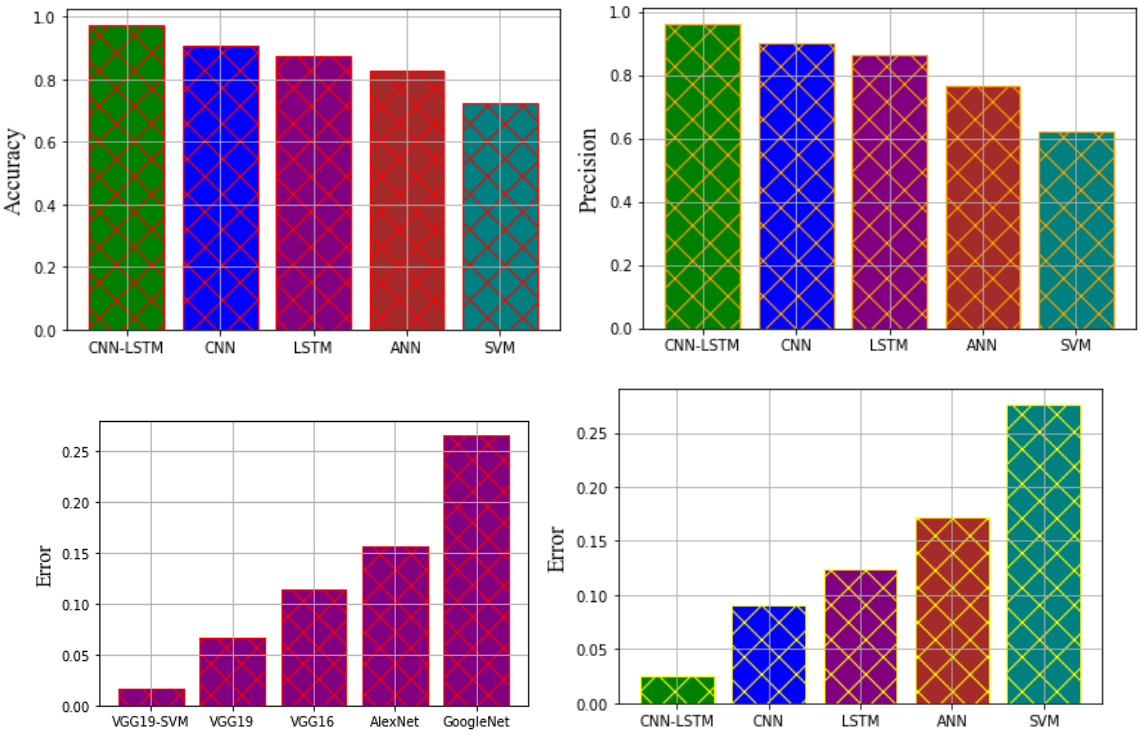

In proposed VGG19-SVM model is contrasted with the VGG19, VGG16, AlexNet, and GoogleNet current techniques. VGG19-SVM, VGG19, VGG16, AlexNet, and GoogleNet are the most accurate. Figure shows the error vs existing methods, including VGG19-SVM, VGG19, VGG16, AlexNet and GoogleNet. VGG19-SVM 's generated error metrics are 0.017, which is less than VGG19, VGG16, AlexNet and GoogleNet's respective values of 0.066, 0.114, 0.15. Above Figure displays the comparison study carried out using the proposed hybrid and conventional model for error metrics. The graph is plotted between various techniques and errors in percentage on both axes. The error value obtained for the proposed CNN-LSTM model is 0.03%, while for other existing models such as CNN, LSTM, ANN and SVM, the precision value is 0.09%, 0.13%, 0.18% and 0.28%. This also shows the value of the error metric is lesser for the proposed hybrid model compared with the rest of the existing model.

CONCLUSION

In the proposed paper we can see the comparative study of Covid-19 prediction using two different Model based on deep learning techniques applied for the case of lung infection using patient's chest x-ray images.

Both the models that is VGG19-SVM and CNN-LSTM follows few common phases like Data collection, Pre-Processing, Segmentation and finally COVID prediction. Data collection from various medical IOT Devices in both the cases. Further pre-processing has three stages namely image Resizing, Markov-random field and adaptive gamma correction respectively in case of VGG19-SVM Model, In the other hand we can see stages of CNN-LSTM Model as Image resizing, Anisotropic diffusion filtering and Adaptive gamma correction for achieving noise removal and enhancing contrast. After that both the cases has used Segmentation technique; In case of VGG19-SVM the WHO based K-clustering is used to segment the affected portion of lung CXR images whereas in case of hybrid CNN-LSTM model Watershed segmentation s used before the final stage of prediction of COVID-19. We finally can compare the results found and Performance Analysis of both Models and we can see that the Accuracy, precision, specificity and error values for hybrid VGG19-SVM Model is 98%,98%,98% and 0.017% respectively Whereas for another model CNN-LSTM these values reached is 97%,96%,94% and 3% respectively. Hence we finally come to the conclusion that hybrid VGG19-SVM model is better compared to hybrid CNN-LSTM Model with greater accuracy.

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SECURING HEALTHCARE DATA IN IOT ENVIRONMENTS: A BLOCKCHAIN-BASED APPROACH FOR IMAGE STORAGE AND INTEGRITY

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ABSTRACT
The proliferation of Internet of Things (IoT) devices in healthcare has ushered in unprecedented opportunities for efficient disease detection and patient monitoring. However, this surge in connectivity has brought to the forefront significant concerns regarding the security and integrity of sensitive healthcare data. Notably, medical imaging datasets, such as Brain MRI and Kidney stone images, are particularly vulnerable to unauthorized access and tampering, posing serious risks to patient privacy and diagnostic accuracy. This research aims to address the critical issue of data security in healthcare IoT environments, focusing on the storage of digital medical images over blockchain technology. Leveraging the decentralized and immutable nature of blockchain, this study seeks to enhance the integrity and confidentiality of healthcare data, especially high-value imaging datasets crucial for disease detection and diagnosis.

Keywords: Healthcare, IoT, Blockchain, Image Storage, Data Security, Disease Detection

[1] INTRODUCTION

1.1 Healthcare data management in IoT

In the Internet of Things (IoT), the management of healthcare data is a significant and ever-evolving concern that calls for the development of creative solutions to guarantee the accessibility, integrity, and security of patient information. The growth of linked medical devices and sensors has resulted in the generation of enormous volumes of real-time data by healthcare systems. This data includes everything from diagnostic imaging to vital signs and patient histories. Despite the fact that the Internet of Things (IoT) promises to improve patient care, clinical decision-making, and remote monitoring capabilities, it also adds data management challenges that are more complicated. Because of the decentralized nature of data gathering across a variety of devices and the need for real-time analysis, it is necessary to take a comprehensive approach to the storage, transfer, and protection of data. The importance of developing strong healthcare data management systems that are customized for Internet of Things contexts is highlighted by concerns over the integrity of data, the privacy of patients, and interoperability. Taking this into consideration, the use of blockchain technology presents itself as a potentially useful alternative. A number of the basic difficulties that are related with healthcare data in the Internet of Things are addressed by the intrinsic characteristics of blockchain, which include decentralization, immutability, and cryptographic security. The use of a framework that is based on blockchain technology allows for the storage of healthcare data in a way that is both tamper-resistant and transparent. This helps to maintain the authenticity of patient records and prevents unauthorized changes from being made. Additionally, the decentralized nature of blockchain technology reduces the likelihood of a single point of failure, which in turn increases the robustness of healthcare data systems.

Additionally, in order to effectively manage healthcare data in the Internet of Things, it is necessary to have the communication links between devices and centralized data repositories to be safe. Encryption methods and secure communication standards are very important components in the process of protecting sensitive patient information when it is being sent on the internet. Additionally, access control methods and identity management systems are vital for guaranteeing that only authorized entities, such as healthcare professionals and authenticated devices, are able to interact with and retrieve patient data. Access control mechanisms and identity management systems are required for this purpose. Interoperability is becoming an increasingly important topic as the Internet of Things ecosystem in the healthcare industry continues to grow. The efforts that are put into standardization are very necessary in order to guarantee effortless communication and integration across a wide variety of platforms and devices. Through the establishment of standard protocols for the sharing and storage of data, the creation of cohesive and linked healthcare ecosystems is facilitated, which eventually leads to improvements in patient outcomes and the delivery of healthcare solutions.

1.2 Blockchain-Based Approach for Image Storage and Integrity for healthcare

The development of blockchain technology has made it possible to guarantee the preservation and integrity of medical pictures within the healthcare sector, which has transformed the possibilities that were previously available. Due to the fact that digital health records and diagnostic imaging play a significant part in the treatment of patients in this day and age, it is of the utmost importance to guarantee the safety and inalterability

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of these sensitive data sets. An strategy that is based on blockchain technology provides a framework that is decentralized and resistant to tampering, which dramatically improves the security and confidentiality of healthcare data, especially high-resolution medical pictures that are essential for correct diagnosis. By using the cryptographic principles of blockchain, each picture is safely stored in a ledger that is both visible and immutable. This prevents any illegal changes or tampering from occurring about the image. Not only does this provide a strong barrier against data breaches and criminal activity, but it also helps to develop confidence between patients and healthcare providers. As an additional benefit, blockchain technology offers a verifiable record of each and every contact with the medical pictures, which guarantees both openness and accountability throughout the process of data management. With this strategy, the danger of a single point of failure is reduced, which in turn increases the resilience of healthcare data systems. This is accomplished by decentralizing control and creating means for reaching agreement. A blockchain-based solution for image storage and integrity provides a pioneering route for tackling the particular issues provided by healthcare data. This solution contributes to the construction of a secure and interoperable basis for the future of healthcare information management. In summary, a blockchain-based solution for image storage and integrity offers a pioneer of a solution.

When it comes to tackling the key challenges that surround the preservation and integrity of medical pictures, the use of blockchain technology in the healthcare industry presents a ground-breaking solution. Particularly in this day and age, when digital diagnostic imaging plays such an important part in the treatment of patients, it is of the utmost importance to guarantee the safety and inalterability of these sensitive datasets. An new approach to improve the security and secrecy of healthcare data, especially high-resolution medical pictures that are essential for correct diagnosis, is provided by the decentralized and cryptographic properties of blockchain technology. The creation of an immutable ledger for the storage of medical pictures is one of the most significant benefits that may be gained by using a blockchain-based method. As a result of the cryptographic connection that exists between each picture and a block in the chain, the images are resistant to any illegal changes or manipulations. It is because of this intrinsic tamper-proof character that the medical pictures are guaranteed to stay unaltered and trustworthy throughout their entire lifespan, beginning with their development and ending with their interpretation by medical specialists.

Additionally, blockchain technology makes it possible to create a paper trail that is both visible and auditable for every interaction with medical pictures. A decentralized ledger is used to safely record any data trades, as well as access logs, alterations, and other data transactions. Patients may have the peace of mind that their medical information is being managed in a safe and ethical manner thanks to this openness, which not only helps to increase accountability but also helps to develop confidence among patients. Through the implementation of consensus procedures and the decentralization of control, blockchain technology diminishes the possibility of a single point of failure. It is especially important to have this resilience in healthcare settings, where the availability of data and its integrity are of the utmost importance. On account of the distributed structure of the blockchain network, even in the event that one of the nodes in the network fails or is hacked, the data will continue to be accessible and safe via the other nodes in the network. On top of that, the implementation of access control measures is made possible via the use of smart contracts inside blockchain technology. In order to ensure that only authorized healthcare practitioners are able to see or edit certain datasets, it is possible to restrict access to medical pictures via the use of established rules and permissions that are encoded in sophisticated contracts. In order to further protect sensitive medical information, this granular control provides an additional degree of protection.

1.3 Need of Research:

1. **Enhancing Data Integrity:** Implementing a blockchain-based system to ensure the immutability and integrity of healthcare data, preventing unauthorized alterations or tampering of critical medical images.
2. **Securing IoT Devices:** Developing mechanisms to secure IoT devices in healthcare settings, establishing a trust layer through blockchain technology to authenticate and authorize devices transmitting medical images.
3. **Privacy Preservation:** Implementing privacy-enhancing features within the blockchain, such as encryption and selective data disclosure, to safeguard sensitive patient information while still allowing authorized access for medical professionals.
4. **Efficient and Accessible Data Retrieval:** Designing a streamlined and efficient method for retrieving medical images from the blockchain, ensuring accessibility for authorized healthcare providers without compromising data security.

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5. **Interoperability:** Addressing the challenge of interoperability by exploring standards and protocols that facilitate seamless integration of blockchain technology with existing healthcare systems and IoT devices.

[2] LITERATURE REVIEW

K. Anil et al (2023) proposed block chain-based secure healthcare data storage and retrieval solution for cloud computing settings that would be called as Health Block. By using the Solidity programming language, we were able to build smart contracts that included fundamental structures and functionalities for the Ethereum block chain platform. We also developed and deployed a system that we called (HToB), which stands for its acronym. The safe storing and retrieval of data based on block chain technology is supported by this algorithm, which is managed by smart contracts. Our system is examined using a client application that is web-based and has a user-friendly interface. The findings of the experiments shown that our system is capable of ensuring the integrity of data and non-repudiation, in addition to reaping all of the advantages that block chain technology has to offer[1].

[2] E. M. Adere et al (2022) discussed trends are analyzed, and the potential advantages of using block chain technology in the Internet of Things and healthcare are highlighted. As stated in the published research, block chain technology is mostly employed for data management operations in the healthcare and Internet of Things industries. More specifically, it is applied to enhance data security, which encompasses data integrity, access control, and the protection of privacy. There are six different sorts of data security preservation techniques that are used in each of these domains. Furthermore, articles emphasize the ways in which block chain technology and the Internet of Things, especially health IoT, may be used in an integrated manner. It was determined that there were three different integration techniques that may achieve this objective [2].

P. Sharma et al (2021) presented Internet of Things architecture that is built on block chain technology and uses the Identity-built Encryption (IBE) algorithm to offer increased security for healthcare data. Within this context, the smart contract is responsible for defining all of the fundamental processes of the healthcare system, which might be advantageous to all actors involved. In order to determine whether or not the planned plan is effective, a number of tests are carried out. It is clear from the findings that the suggested strategy is superior than the well-known schemes that are already in place [3].

[4] N. Bhalaji et al (2019) considered summed up as a global network of gadgets that are linked to one another. It is currently making its way into every aspect of life, with the most important use among them being the management of medical healthcare. Real-time monitoring of patient body parameters, smart wearable's, tracking vitals, and other applications are among the most important uses of the Internet of Things in the medical field. The information that is gathered from the sensors is subsequently used by a variety of third parties for the purpose of conducting research. There is a significant issue that emerges here, and that is the privacy of the individuals whose information is being obtained. There is a potential threat to the people's identities. It is essential that the data acquired from sensors be kept in its original state. Any alterations that are made to this health-related data by any unauthorized individuals may have a negative influence on the life of the individual [4].

B. Zaabar et al (2021) presented a novel architecture that avoids the problems associated with centralized storage by making use of decentralized databases. The decentralized database known as OrbitDB with (IPFS) is used for the purpose of storing electronic health records, which are associated with patients. In addition, we have implemented a block chain network that is based on Hyper ledger fabric. This network was developed using Hyper ledger composer, which allows us to record hashes of the data that is saved and regulate access when the data is retrieved. The Block chain-based architecture that has been presented is intended to have a positive impact on the robustness of healthcare management systems and to circumvent the recognized security restrictions that are present in systems that are routinely used for smart healthcare. The proposed system has been shown to be robust and superior in terms of security and privacy requirements, key features of block chain-based healthcare systems, and performance metrics including various throughput and latency [5].

K. Mohammad et al (2021) proposed an architecture (which we will refer to as BC Health) in this work that will enable data owners to specify their preferred access controls over their privacy-sensitive healthcare data. This will allow us to address the difficulty of balancing the trade-off between openness and access control. BC Health is organised across two distinct chains, each of which is responsible for recording data transactions and access controls. By using a clustering strategy, we are able to handle the real-world development concerns of BC, which include scalability, latency, and overhead. In terms of computing and processing time, our thorough experimental investigation demonstrates that BC Health is efficient, and it also demonstrates that it is resilient against a number of different security assaults [6].

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NFT culture is the name given to the way of life that was provided by 9NFTMANIA, according to the research that was carried out by Gupta, M. et al (2023). Within this society, non-fungible tokens (NFT) would be used for a variety of purposes, including but not limited to greetings, invitations, certificates, and membership cards. By doing things in this way, it would be feasible to perform a secure transfer of digital assets, and this non-fungible token would have a certain value. The sending of non-fungible tokens (NFT) to the wallet of another individual is something that should be done regardless of whether the individual desires to convey thanks to another individual or just wish them a good morning. Furthermore, there would be a restriction placed on the supply of such greeting NFT, which would imply that there is still the chance of a rise in the price of the purchase. On the other hand, when web 3.0 methods are used to verify NFT holders in Met averse, individuals who have NFT will be able to get access to premium online services. This is because the NFT holders will be verified. It is [6].

Block chain was first presented by M. Gupta et al. (2023), and non-fungible tokens (NFTs) have attracted a significant amount of attention, particularly in the field of digital assets and decentralized technology. The popularity of these two concepts has increased in tandem with their strong relationship to one another. Block chain and non-fungible tokens (NFTs) have a relationship that is mutually helpful. Block chain serves as the foundational technology that allows NFTs to function as one-of-a-kind digital assets. This link is mutually beneficial. On the other hand, non-fungible tokens, also known as NFTs, are a solution to the age-old challenge of proving ownership and validity in the digital world. These tokens make use of the technology known as block chain. Non-fungible tokens, also known as NFTs, are a solution to the problem of digital scarcity. They do this by representing one-of-a-kind assets on the blockchain where they are stored. This enables creators, such as musicians, game developers, and artists, to tokenize their digital creations and sell them as limited-edition, one-of-a-kind items [8]. Tokenization is a kind of digital asset management.

The setting of decentralized finance ecosystems was examined by R. Gupta et al. (2023), and they said that liquidity pools are a key component in the process of preserving the value of tokens. The use of arbitrage is one of the most important ways in which liquidity pools assist to the maintenance of stability. One of the most important contributing processes that liquidity pools are involved in is this one. In situations when the value of a token is low, purchasers will make purchases. When, on the other hand, the item is priced at a higher than normal level, sales are made accessible. Arbitrage is made possible by the presence of liquidity pools, which enable traders to carry out these transactions directly on decentralized exchanges. This makes arbitrage a very viable activity. This makes arbitrage a company that can be successful. Arbitrageurs apply sustained pressure, which adds to the value of the token reverting to its target peg[9]. This, in turn, tends to cultivate greater stability in the market.

In their discussion of the findings of the study that was conducted, D. Gupta and colleagues (2023) came to the conclusion that the most important aspect that impacts the value that is given to greetings is the degree of popularity that they enjoy. In addition to this, it has been found out that the Love Emogie is only accessible in a restricted quantity. The growing demand for non-fungible tokens (NFTs) has been a contributing element from the limited availability of just 43 Love Emojie. This is because of the inherent scarcity of non-fungible tokens (NFTs). On the other hand, it is important to point out that the concerns of cost and use case have a considerable influence [10].

Pi Network is a crypto currency project that was proposed by R. Issalh and colleagues in 2023. Pi Network is notable for the innovative approach it takes to mining and accessibility. Users of the site, which was launched in 2019, are provided with the opportunity to mine the network's native digital money, which is known as Pi, straight from their mobile devices. By democratizing the mining process and making participation in crypto currency more accessible to a larger variety of individuals, the platform aims to accomplish its objectives. Especially interesting is the fact that the block chain that Pi Network uses is constructed on the Stellar Consensus Protocol. This protocol puts equal priority on the concepts of security, decentralization, and transaction speed. Participation from the community is given a substantial amount of importance by Pi Network, which is still in the beginning stages of its growth. It inspires people to take an active role in the project and make contributions to it with their participation [11].

An investigation of the importance of non-fungible token avatars in the met averse was carried out by A. Duggal and colleagues (2023). The researchers focused specifically on the role that these avatars play in redefining digital ownership, self-expression, and user engagement. In addition to this, the research investigates the challenges and obstacles that are associated with the marketing of NFT avatars. It takes into account a wide range of factors, such as the dynamics of the market, the challenges posed by technology, and the adoption of the product by users. The study that is being conducted takes into account a wide range of non-fungible tokens

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(NFTs) that have been developed by a variety of various NFT Brands. It is possible that this NFT may be used in the Meta verse at some point in the future. An NFT referred to as the "Sizzling monster" has been the subject of a case study that has been developed at the end of the research paper. A number of non-fungible token (NFT) firms have previously acquired it from Young Parrot Platform at the beginning of its existence [12]. The availability of this NFT is very limited.

M. Gupta and others (2023) to abstain from participating in speculation in the crypto currency market during NFT transactions is a call to employ care, study, and a devotion to responsible investing. This call was created to prevent individuals from engaging in such speculation. The acceptance of these principles will contribute to the formation of an ecosystem that is more trustworthy and sustainable, which will eventually make it possible for the block chain technology that supports it to achieve its promise beyond the narrow scope of short-term market fluctuations. It is necessary to have a strategy that is both cautious and well-informed while participating in speculation in the crypto currency market, particularly when dealing with transactions that use non-fungible tokens (NFT). There is a significant amount of intrinsic volatility in the crypto currency market, which is exacerbated by the non-fiat currency region. This is one of the most noticeable aspects of the crypto currency market. It is vital for investors to exercise prudence and resist from giving in to the temptation of speculating since prices are prone to unexpected and unpredictable changes. This is because of the fact that prices are prone to movements that are not predictable [13].

[3] PROBLEM STATEMENT

Securing healthcare data in the ever-changing environment of the Internet of Things (IoT) provides a multitude of issues that call for a strategy that is both strong and inventive. This is especially true when taking into consideration a blockchain-based solution for picture storage and integrity. One of the most significant problems is the susceptibility of Internet of Things devices to cyberattacks. It is of the utmost importance to guarantee the safety of the information that is conveyed from medical sensors and imaging equipment as these devices become more integrated into the infrastructure of healthcare. Cyberattacks that target Internet of Things devices have the potential to undermine the confidentiality and integrity of medical pictures, which poses significant dangers to the privacy of patients and the accuracy of diagnostics. Interoperability of various Internet of Things devices within healthcare ecosystems is another significant challenge that has to be addressed. The seamless integration of these components is made more difficult by the variety of the devices and data types that comprise them. The blockchain-based method that has been presented must face the problem of defining standards and protocols that promote interoperability. This will ensure that a cohesive and linked network is created that is capable of securely transmitting and storing medical pictures across a variety of devices and systems.

The protection of one's privacy has become an important concern, particularly in the field of healthcare, where maintaining patient confidentiality is of the utmost importance. When considering the use of blockchain technology for the storing of images, it is necessary to give serious thought to privacy-enhancing aspects such as encryption and selective data sharing. It is a difficult job that requires careful attention to be paid to the task of striking a balance between protecting sensitive patient information and allowing authorized access to medical experts. In light of the fact that the amount of data created by Internet of Things devices in the healthcare industry continues to increase, scalability is an additional worry. When it comes to managing the vast volume of medical photos and the data that goes along with them, traditional blockchain networks could have some limits. It is essential to address scalability challenges in order to guarantee that the blockchain-based solution that has been offered is capable of properly managing the growing number of high-resolution photographs without sacrificing either performance or the integrity of the data. Additionally, regulatory compliance adds an additional degree of complexity to the handling of healthcare data. In order to deploy blockchain technology while adhering to data protection legislation and healthcare standards, it is necessary to have a full awareness of the legal environment. In order to successfully achieve broad adoption and acceptance within the healthcare business, it is vital to make certain that the suggested solution is in accordance with regulatory frameworks.

[4] PROPOSED WORK

With particular focus on the use of a blockchain-based solution for image storage and integrity, the work that is being suggested has the objective of addressing the growing difficulties associated with the protection of healthcare data in settings that are connected to the Internet of Things (IoT). Because of the proliferation of Internet of Things devices in modern healthcare systems, there are now options for remote patient monitoring and improved diagnostics that have the potential to revolutionize the industry. However, this increasing connectedness also exposes healthcare data to risks, which necessitates the development of creative solutions to maintain the confidentiality, integrity, and accessibility of essential medical information. The fundamental

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purpose of the study that has been presented is to create and implement a strong framework that makes use of blockchain technology in order to improve the security and integrity of healthcare data, particularly medical pictures that are essential for the identification and diagnosis of diseases. The blockchain technology offers a perfect solution for protecting the integrity of medical pictures during their entire lifespan. This is accomplished via the use of a distributed and tamper-resistant ledger. For the purpose of limiting the risks associated with illegal access, manipulation, or data breaches, each picture is securely stored in a blockchain that is both visible and immutable.

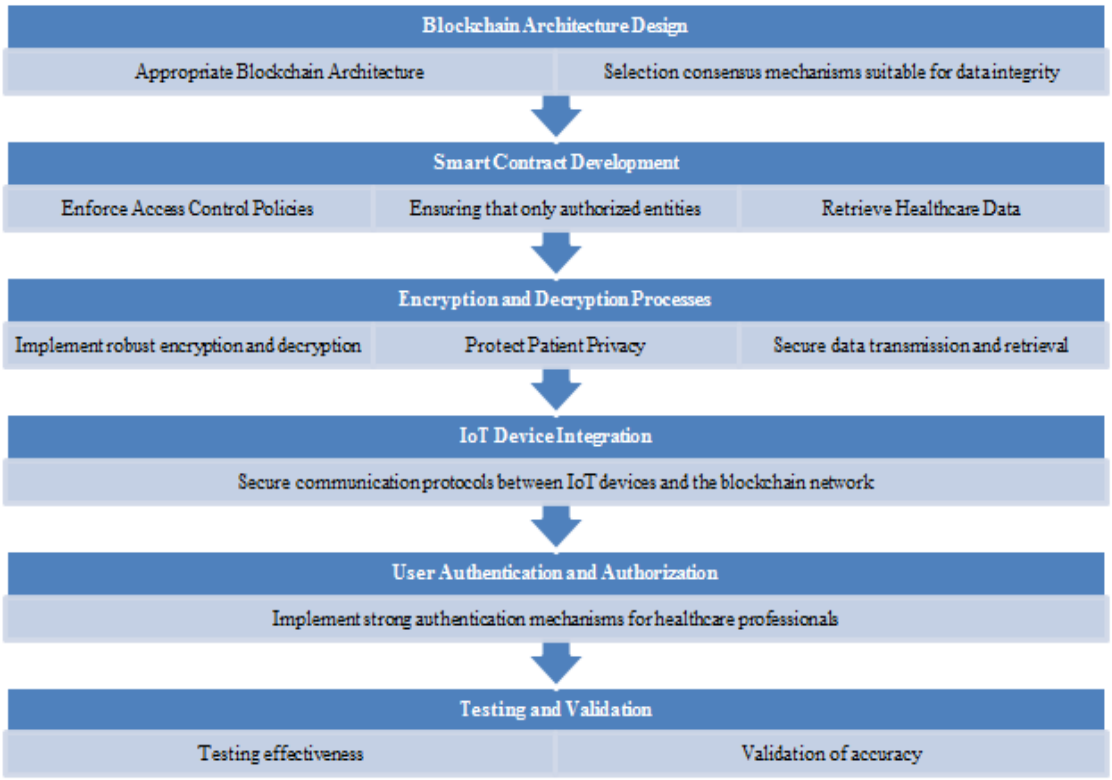

Fig 1: Process Flow of research work

The project will investigate the complexities involved in integrating Internet of Things devices into healthcare settings, with a particular emphasis on the establishment of a trust layer via the use of blockchain technology. In order to do this, processes must be developed to authenticate and authorize Internet of Things devices that send medical pictures. This will ensure that the data produced by these devices is both safe and trustworthy. Due to the fact that blockchain technology is decentralized, it provides an extra layer of protection, which in turn reduces the risk of a single point of failure and increases the overall resilience of the healthcare data system. Furthermore, the study that is being suggested will investigate the characteristics of the blockchain architecture that are designed to protect users' privacy. These characteristics include encryption and selective data disclosure. These precautions are important in order to safeguard sensitive patient information while still preserving the transparency and accessibility that are crucial for the professionals working in the healthcare industry. The purpose of this project is to safeguard the transmission and storage of medical pictures by applying modern encryption algorithms. This will help to mitigate the dangers that are connected with data interception or illegal access. The process includes the design and implementation of smart contracts for the purpose of enforcing access control restrictions. This ensures that only authorized entities, such as healthcare professionals and authenticated Internet of Things devices, are able to interact with and receive patient data. An exhaustive testing and validation procedure will be carried out in order to evaluate the efficiency of the blockchain-based system that has been presented with regard to the preservation of data integrity, the protection of privacy, and the accessibility of the system.

4.1 Proposed Research Methodology

The purpose of this study is to make a contribution to the paradigm change that is occurring in the management of healthcare data. This shift will occur when blockchain technology is used, which will provide a foundation that is secure, transparent, and interoperable for the storage and protection of medical pictures in Internet of Things settings. It is predicted that the results of this effort will have far-reaching ramifications for the treatment of patients, the protection of data, and the general progression of healthcare systems into the digital age.

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1. **Blockchain Architecture Design:** It determines the appropriate blockchain architecture for healthcare data storage and selects consensus mechanisms suitable for ensuring data integrity in a healthcare context.
2. **Smart Contract Development:** Develop smart contracts to enforce access control policies, ensuring that only authorized entities can interact with and retrieve healthcare data.
3. **Encryption and Decryption Processes:** Implement robust encryption and decryption processes to protect patient privacy while allowing for secure data transmission and retrieval.
4. **IoT Device Integration:** Establish secure communication protocols between IoT devices and the blockchain network, ensuring data integrity during transmission.
5. **User Authentication and Authorization:** Implement strong authentication mechanisms for healthcare professionals accessing patient data, with a focus on user-friendly yet secure access controls.
6. **Testing and Validation:** Conduct rigorous testing to validate the effectiveness of the proposed blockchain-based system in terms of data integrity, privacy preservation, and accessibility.

4.2 Expected Outcomes

1. **Improved Data Security:** A blockchain-based solution that significantly enhances the security and integrity of healthcare data, particularly medical images, in IoT environments.
2. **Privacy-Preserving Access:** Mechanisms to balance data accessibility for healthcare professionals while prioritizing patient privacy through encryption and selective data disclosure.
3. **Interoperability Standards:** Recommendations for interoperability standards that facilitate the seamless integration of blockchain technology with existing healthcare systems and IoT devices.

This research endeavors to contribute to the growing field of secure healthcare data management in IoT environments, providing a robust framework for the storage and retrieval of digital medical images over blockchain. The outcomes are anticipated to have far-reaching implications for patient care, medical research, and the overall integrity of healthcare data ecosystems.

[5] RESULT AND DISCUSSION

The research proposal included a number of different areas of study that were investigated, including blockchain, identity management, and security research. After some time had passed, the problem surfaced. Inaccuracy, performance, and security are all areas that are experiencing issues. Compression and encryption procedures are two methodologies that have been suggested as potential approaches to reduce the size of the content. In contrast, the use of cryptography resulted in improvements to both the performance and the security of the system. Both the recommended model and the traditional model have been subjected to comparative research in order to evaluate their different levels of performance, error rate, and immunity to external attachment influences.

1.5.1 Comparative Analysis of Performance

This section provides a simulation of the amount of time required to process a block. When the number of blocks is studied at a 10-block interval, it has been shown that the processing time of a block is less than the processing time that is often used.

Table 2: Comparative Analysis of Performance

Number of blocks	Conventional processing time	Proposed processing time
10	0.77	0.64
20	1.95	1.37
30	2.67	1.94
40	3.77	2.55
50	4.87	3.19
60	5.68	3.91
70	6.90	4.43
80	7.65	5.39
90	8.49	5.79
100	9.73	6.69

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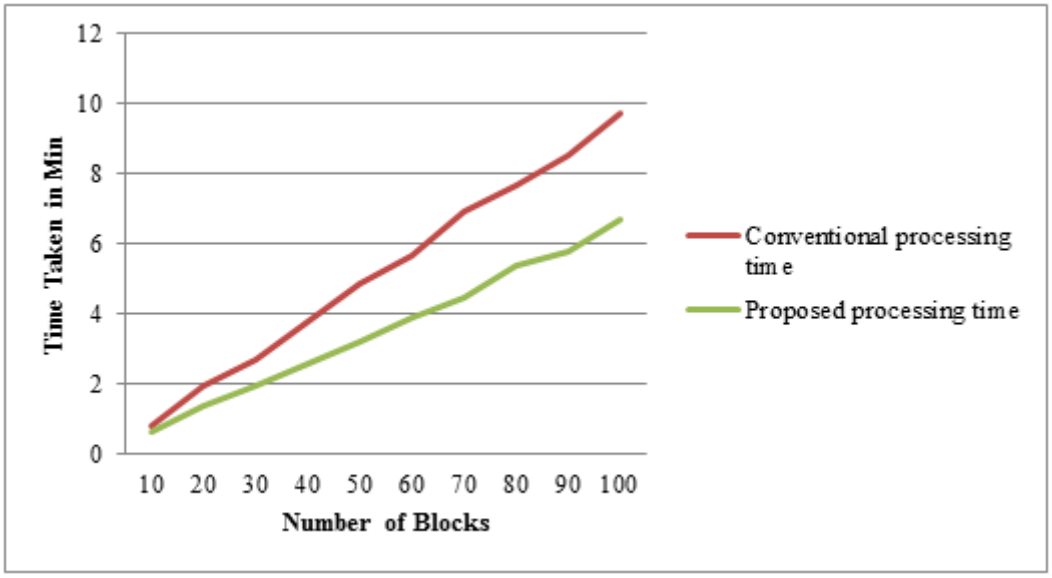

Fig 4: Comparative Analysis of Performance

1.5.2 Comparative Analysis of Error Rate

Within the scope of this section, simulated mistakes have been taken into consideration. While taking into consideration the block numbers every ten blocks, there have been less errors than there would have been with the conventional approach.

Table 3: Comparative analysis of Error Rate

Number of Packet	Conventional Scheme	Proposed scheme
1	4	2
2	6	3
3	9	4
4	11	6
5	14	8
6	16	9
7	17	11
8	21	14
9	24	16
10	26	19

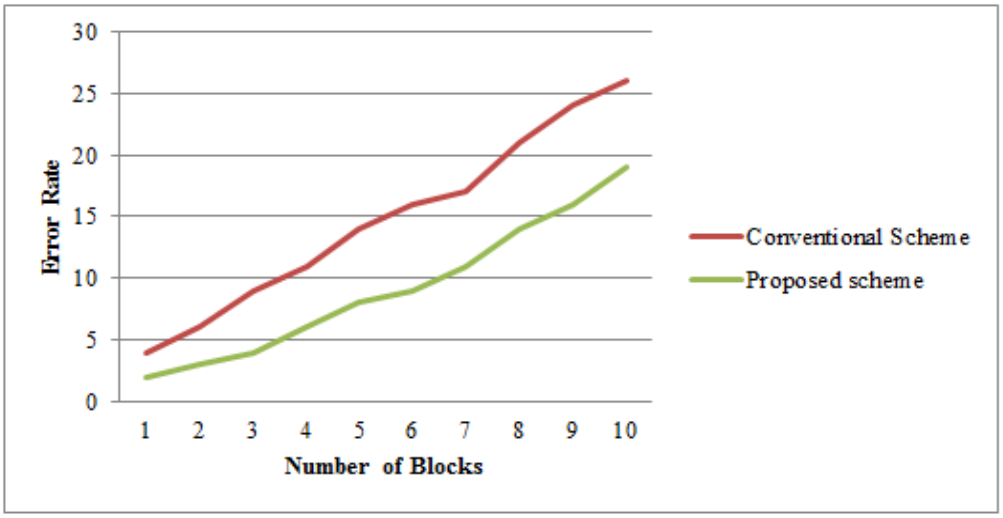

Fig 5: Comparative analysis of Error Rate

1.5.3 Comparative Analysis of Blocks Affected by External Attacks

A simulation of an external attack was carried out. In a common system, the number of blocks that are susceptible to an attack from the outside is higher than the number of blocks that are vulnerable when the blocks are counted in increments of 10. This has been shown.

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Table 4: Comparative analysis of Blocks affected by external attacks

Number of blocks	Conventional Scheme	Proposed scheme
1	4	2
2	6	3
3	7	5
4	10	7
5	10	7
6	14	10
7	14	11
8	16	13
9	18	14
10	21	16

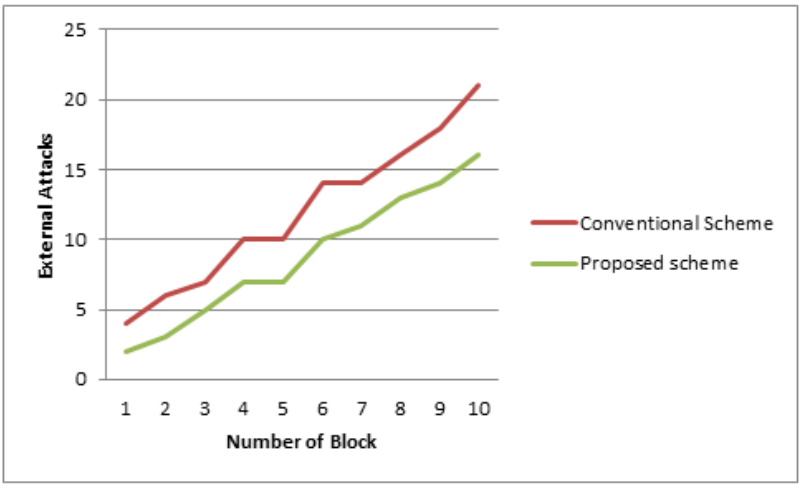

Fig 6: Comparative analysis of Blocks affected by external attacks

[6] CONCLUSION

In conclusion, the strategy built on blockchain technology for the preservation and integrity of images in the healthcare industry marks a paradigm change in the management of data. This novel approach solves the one-of-a-kind difficulties that are presented by medical imaging data. It does so by using decentralization, cryptography, and transparency. It also provides a foundation that is both safe and interoperable for the future of healthcare information management. Blockchain stands out as a promising technology that has the potential to raise data security, integrity, and patient confidence to levels that have never been seen before in the healthcare business, which is continuing to actively embrace digital transformation. To effectively manage healthcare data in Internet of Things contexts, a comprehensive strategy that takes into account data integrity, security, privacy, and interoperability is required. Because of its decentralized and secure nature, blockchain technology has the potential to revolutionize the way in which healthcare data is kept and maintained. This would result in the development of a foundation that is both trustworthy and robust for the future of linked healthcare systems. Using a blockchain-based method for image storage and integrity is a multidimensional endeavor that must address difficulties relating to device security, interoperability, privacy, scalability, and regulatory compliance. In conclusion, safeguarding healthcare data in Internet of Things contexts is a complicated enterprise. One of the most important things that must be done in order to successfully deploy a healthcare data management system that is both safe and robust and that makes use of the revolutionary potential of blockchain technology is to confront these difficulties head-on.

[7] FUTURE SCOPE

The potential future of safeguarding healthcare data in Internet of Things settings by using a blockchain-based solution for image storage and integrity holds a great deal of promise and is poised to alter the landscape of healthcare information management. There are a number of significant areas that provide chances for additional investigation and development as technology continues to evolve towards its full potential. In the first place, the combination of more sophisticated artificial intelligence (AI) methods with blockchain technology has the potential to improve the capabilities of healthcare data security. Anomaly detection and predictive analysis are two applications of artificial intelligence algorithms that may be used to provide an extra layer of protection against possible threats to computer data integrity. The development of more advanced and preventative

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security measures is anticipated to be facilitated by collaborative research projects that investigate the synergies that exist between artificial intelligence and blockchain technology. Interoperability will continue to be an essential component for the development of healthcare data management in the years to come. A crucial part will be played by the efforts that are made to build industry-wide standards and protocols that will allow blockchain technology to be smoothly integrated with a variety of Internet of Things devices and healthcare systems. It is possible that the creation of a single framework that permits safe and standardized communication across the many components of the healthcare ecosystem has the potential to improve the accessibility of data and the level of cooperation among healthcare providers. The development of quantum computing presents both obstacles and possibilities for the protection of patient data in the healthcare market. Despite the fact that quantum computing has the capability of breaking conventional encryption systems, it also offers up opportunities for the creation of cryptographic algorithms that are resistant to quantum computing. Research projects that investigate the convergence of blockchain technology with quantum-resistant encryption in the context of healthcare data management will be of great assistance in strengthening the protection of sensitive medical information. In addition, the scalability of blockchain networks will be a primary focus of study in the years to come. Innovative approaches to scalability, such as sharding and layer-2 solutions, will be essential to ensure that blockchain technology can effectively handle the increasing volume of medical images without compromising performance. This is because the amount of healthcare data generated by Internet of Things devices is growing at an exponential rate. Among the many fascinating possibilities for the future is the investigation of decentralized identification systems. It is possible to empower patients with more control over their healthcare data by integrating blockchain technology with self-sovereign identification models. This may be accomplished while ensuring that access is offered in a safe and transparent manner. This strategy is in line with the larger push toward patient-centered healthcare and control of data within the healthcare industry. The future scope of safeguarding healthcare data in Internet of Things settings using a blockchain-based method is distinguished by developments in artificial intelligence integration, initiatives towards interoperability, quantum-resistant encryption, scalability solutions, and decentralized identification. By addressing these frontiers, researchers and industry professionals can make a contribution to the establishment of a paradigm for healthcare data management that is resilient, patient-centric, and technologically advanced. This paradigm will ensure the integrity, security, and accessibility of medical images in a healthcare landscape that is becoming increasingly connected.

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SECURITY ENHANCEMENT BY MAKING USE OF BLOCKCHAIN DURING BIG DATA PROCESSING

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ABSTRACT
Due to the vast number, diversity, and velocity of transactions and accompanying information, digital assets, including Non-Fungible Tokens (NFTs), may be regarded a kind of big data when evaluated collectively. This is because of the fact that NFTs belong to the category of digital assets. When it comes to the processing of such data, the use of blockchain technology might potentially increase security in a variety of different ways. Blockchain, which is a distributed and decentralized ledger, provides a record of transactions that is both accessible and immutable. Blockchain is a distributed record of transactions. When it is used to the processing of large amounts of data in the form of NFT, it is feasible to manage a wide range of security issues. This paper is focused on security enhancement of big data that is form of NFT over blockchain.

Keywords: Big data, Security, Blockchain, Decentralization, NFT

[1] INTRODUCTION

There are several ways in which the use of blockchain technology into the processing of large data might improve security. Blockchain, which is a distributed and decentralized ledger, offers a record of transactions that is both visible and unchangeable. It is possible to handle a variety of security problems when it is used to the processing of large data. Blockchain technology has the potential to improve data processing security in a number of ways. Blockchain technology maintains the integrity of data by generating a ledger that is difficult to alter and completely visible. Each block in the chain includes a hash of the block that came before it, which results in the formation of a chain of blocks that are connected to one another. It would be very difficult, if not impossible, to manipulate historical data since any effort to change the data in a single block would need changing all blocks that subsequently followed it. Traditional big data systems often depend on centralized designs, which leaves them susceptible to assaults and single points of failure. Decentralization is a solution to this vulnerability. Each member in a blockchain blockchain possesses a copy of the complete blockchain.

Blockchain is a decentralized network that runs on this network. Due to the absence of a single target for malicious attacks, this effectively lowers the likelihood of data loss or modification occurring. Smart contracts, which are contracts that automatically execute themselves and have the conditions of the agreement put into code, may be used to automate access control and data permissions. By ensuring that only authorized parties are able to access, alter, or distribute certain data, this reduces the likelihood that unauthorized individuals may get access to the data. Blockchain technology enables a thorough traceability of data, which is the fourth benefit of blockchain technology. A record of every transaction and instance of data alteration is stored in the blockchain, which serves as an audit trail. Organizations are able to monitor the flow of data throughout the processing lifetime thanks to this capability, which is essential for regulatory considerations. Blockchain is dependent on consensus methods (such as Proof of Work and Proof of Stake) in order to confirm transactions and ensure the network's safety. Due to the fact that any fraudulent transaction would need agreement from the majority of the network users, this makes it impossible for hostile actors to modify data. Because blockchain is immutable, once data is entered to the ledger, it cannot be changed or removed. This assures that the data cannot be altered or destroyed. In this way, a record of all transactions is created that is both visible and auditable, which makes forensic analysis and accountability much easier to do.

Blockchain technology has the potential to facilitate the exchange of data in a way that is both secure and transparent among many parties. Through the use of cryptographic keys and smart contracts, participants are able to exchange data while still keeping control over their own information. This ensures that data is only available to authorized organizations without any unauthorized access. Blockchain technology decreases the risk that is associated with vulnerabilities that are caused by third parties since it does away with the need for central authority or intermediaries. This is of particular importance in situations where there are several parties involved in the collection of large data and trust is an essential component. Despite the fact that combining blockchain technology with big data processing offers a number of security advantages, it is essential to thoroughly evaluate the particular use case, scalability, and costs associated with the integration. Furthermore, the continuous improvements in blockchain technology may provide new features and capabilities that further strengthen its compliance with the needs for the security of large data.

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1.1 Big data on Blockchain

Digital assets, including Non-Fungible Tokens (NFTs), can be considered a form of big data when analyzed collectively due to the large volume, variety, and velocity of transactions and associated metadata. Here are some perspectives on how digital assets, particularly NFTs, can be viewed through the lens of big data:

1. **Volume of Transactions:** NFTs represent unique digital assets that are often bought, sold, and transferred on blockchain platforms. The sheer volume of transactions involving NFTs contributes to the big data characteristics. Analyzing patterns, trends, and transaction histories becomes essential to understand the dynamics of the digital asset market.
2. **Metadata and Attributes:** Each NFT comes with a set of metadata and attributes that describe its characteristics, ownership, and transaction history. This metadata can include information about the creator, timestamp of creation, ownership transfers, and more. Managing and analyzing this metadata across a large number of NFTs contribute to the complexity of handling big data.
3. **Decentralized and Distributed Nature:** NFT transactions typically occur on blockchain networks, which are decentralized and distributed. This adds a layer of complexity in terms of data storage, retrieval, and analysis. Blockchain's distributed ledger technology contributes to the overall decentralized nature of the NFT ecosystem.
4. **Smart Contracts and Programmability:** NFT transactions often involve the use of smart contracts, which are self-executing contracts with predefined rules. These contracts automate various aspects of the transaction process, and the programmability of smart contracts adds another dimension to the complexity of managing and analyzing big data in the NFT space.
5. **Marketplace Dynamics:** NFT marketplaces host a large number of digital assets, and the dynamics of these marketplaces can be analyzed as big data. Understanding price trends, popularity, and the overall behavior of participants in NFT marketplaces requires processing and analyzing significant amounts of data.
6. **Cultural and Social Insights:** NFTs often represent digital art, collectibles, or other forms of creative expression. Analyzing the cultural and social impact of these digital assets involves considering a wide range of data, including user-generated content, interactions, and community engagement. This adds a qualitative aspect to the big data analysis.
7. **Security and Privacy Considerations:** The security and privacy of NFT transactions are critical considerations. The decentralized and transparent nature of blockchain provides a level of security, but ensuring the privacy of individuals and their transactions remains an ongoing challenge, especially when dealing with big data sets.
8. **Marketplace Efficiency and Liquidity:** Understanding the efficiency and liquidity of NFT marketplaces involves analyzing data related to transaction times, bid-ask spreads, and overall market activity. This information is crucial for participants, including creators, buyers, and sellers, in making informed decisions.

NFTs and other digital assets contribute to the big data landscape due to the vast amounts of transactional, metadata, and contextual information associated with them. Analyzing this data provides insights into market trends, user behavior, and the overall dynamics of the evolving digital asset ecosystem.

1.2 NFT DATASET

In this research endeavor, the focus centers on the exploration and analysis of a distinctive dataset derived from the 9NFTMANIA collection, specifically sourced from the OpenSea market. The collection's uniqueness lies in its representation of digital assets, and the chosen marketplace, OpenSea, is renowned as one of the foremost platforms for trading Non-Fungible Tokens (NFTs). Notably, the management of these digital assets is facilitated through the Matic blockchain, contributing a layer of decentralization and efficiency to the overall ecosystem. The utilization of the Matic blockchain introduces a set of characteristics and considerations unique to this blockchain, such as its use of sidechains to enhance scalability and reduce transaction costs. This research delves into the intricacies of the dataset, incorporating metadata, transaction history, and ownership details, to harness insights into the security aspects and clustering patterns of NFTs within the context of the 9NFTMANIA collection on the OpenSea market over the Matic blockchain. The integration of these specific elements adds depth and specificity to the study, contributing to a nuanced understanding of the intersection between NFTs, OpenSea, and the Matic blockchain.

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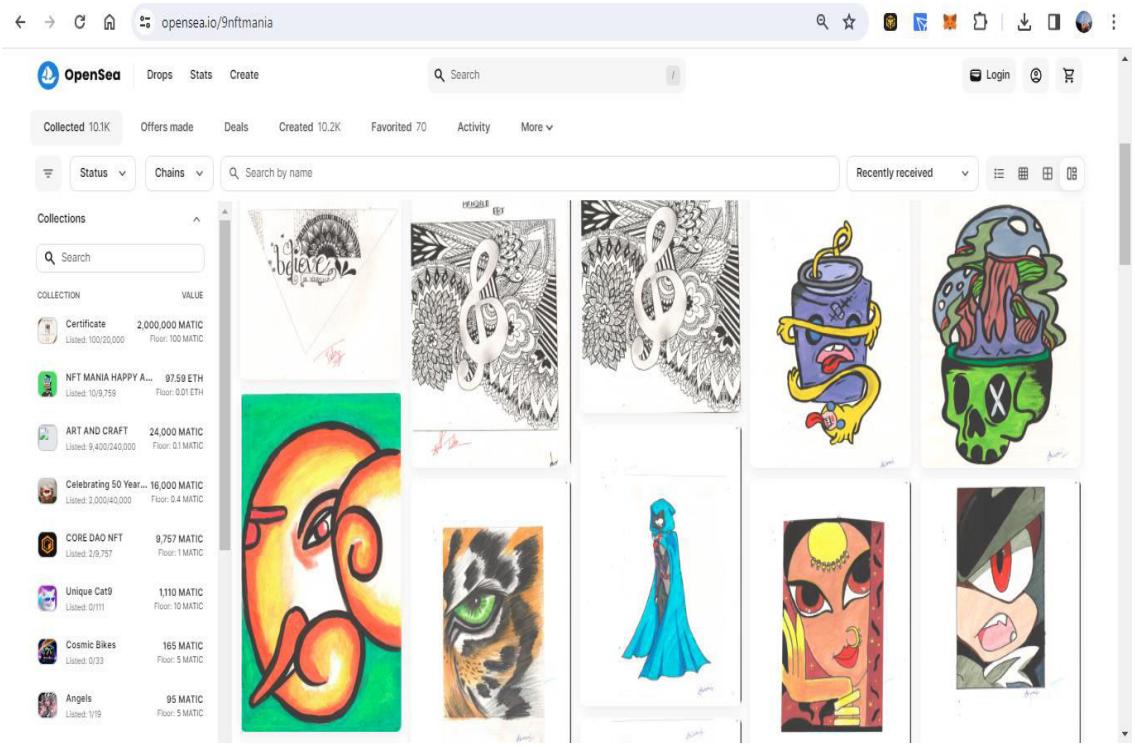

Fig 1 NFT listed on Opensea market place

[2] LITERATURE REVIEW

There are different researches in area of Big data and Blockchain in existence that are discussed in present section. Naveen Rishishwar et al (2017) discussed day and age, data is of utmost importance for each and every company, organization, and enterprise, even those who are just getting started. Data is helpful to everyone in making vital choices that are relevant to their development. When there is a growth in the size of the data that exceeds the limit.When the size of the database grows to the point where it is very challenging to administer using the conventional database software. Next, we referred to it as "Big Data." Large amounts of data provide a number of distinct issues in terms of compute, scalability, storage, and processing. Large amounts of data are managed, stored, and processed in a highly effective way by Big Data. Big Data also manages the enormous volume of data. in order to have the ability to extract useful information from such a large amount of data in order to make any choice. The fact remains that a great number of firms are not using Big Data due to the fact that there are a number of problems and difficulties that need to be resolved. The primary problems and difficulties that are now being faced with Big Data were highlighted in this study. We also spoke about several different approaches to dealing with them [1]. J. Xiong et al (2019) presented order to improve the selection of the initial center points and the technique for calculating the distance from other locations to the center point, you should suggest a privacy and availability data clustering (PADC) scheme that is based on the k-means algorithm and differential privacy. Furthermore, PADC makes an effort to lessen the impact of the outlier effect by identifying outliers throughout the clustering process. The results of the security analysis reveal that our plan is successful in achieving the objective of differentiated privacy and in preventing the leakage of personal information. The performance assessment, on the other hand, demonstrates that our scheme, while maintaining the same degree of privacy, enhances the availability of clustering results in comparison to the differential privacy k-means algorithms that are already in use. This indicates that our proposed PADC scheme is superior to other schemes for providing intelligent electrical service using the Iot [2]. V. R. Niveditha et al (2020) presented frame work of big data is proposed as a means by which approaches of static and dynamic malware detection may be effectively combined in order to reliably classify and identify zero-day malware. The framework that is being offered has been tested and estimated on a sample file set of 0.1 million, which includes clean files of 0.03 million and contains a broad range of malware families comprising 0.13 million harmful binaries. Through the use of 10-fold cross validation, the findings indicate that SVM achieved the highest level of accuracy, which was 93.03%, when it came to identifying malware and benign kinds [3]. Abdulbaset Salem et al (2021) discussed big data refers to a new technology paradigm that encompasses data that is produced at a rapid pace, in large quantities, and with a wide range of characteristics. Massive amounts of data are being hailed as a revolution that has the potential to completely transform the way businesses function across a wide range of sectors. This article provides an introduction to big data as well as the many dimensions of data quality. It also discusses the issues that are associated with the quality components of big data, as well as the lifespan of

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big data analytics [4]. J. Jung et al (2019) provided a framework for the analysis of huge data concerning (IoT) home devices. These devices are distributed to consumers via a variety of distribution channels, are utilized by house users in smart homes, and are serviced in A/S centers, often understood as repair shops. The distribution stage, the customer-usage stage, and the A/S stage are the three primary phases at which we gather large amounts of data and do an analysis thereof. The ultimate goal of the framework that has been described is to provide assistance to small and medium-sized businesses in the process of developing an elastic strategy for the new product. Because of this, they are able to arrive at a conclusion that is more successful at three important phases. As an example, they are able to lessen the amount of duplication that exists regarding a distribution route, as well as modify the quantity of warehousing, release, and stock [5]. Gupta, M. et al (2023) conducted NFT culture is the moniker given to the lifestyle that was offered by 9NFTMANIA. In this society, greetings, invites, certifications, and membership cards would all be formed in the form of non-fungible tokens (NFT). In this manner, it would be possible to make a safe transfer of digital assets, and this non-fungible token would have a specific value. Even if a person wishes to express gratitude to another person or would want to wish them a good morning, they should still send NFT to the wallet of the other person. Additionally, the supply of such greeting NFT would be restricted, which means that there is still the possibility of an increase in purchase price. When web 3.0 procedures are used to verify NFT holders in Meta verse, on the other hand, those who have NFT would be able to get access to premium online services [6]. M. Gupta et al (2023) introduced blockchain and NFTs (Non-Fungible Tokens) have garnered a large amount of interest, especially in the domain of digital assets and decentralized technology. These two ideas are closely tied to one another and have risen in popularity. There is a mutually beneficial connection between blockchain and NFTs (Non-Fungible Tokens), with blockchain acting as the underpinning technology that enables NFTs to operate as one-of-a-kind digital assets. On the other side, non-fungible tokens (NFTs) make use of blockchain technology in order to solve the age-old problem of demonstrating ownership and validity in the digital environment. The issue of digital scarcity is solved by non-fungible tokens (NFTs), which do this by representing unique assets on the blockchain. This makes it possible for producers, such as musicians, game developers, and painters, to tokenize their digital works and sell them as limited-edition, one-of-a-kind things [7]. R. Gupta et al (2023) discussed context of DeFi ecosystems, liquidity pools are an essential component in the process of maintaining the value of tokens. Arbitrage is one of the key methods that liquidity pools contribute to stability via. This is one of the primary processes that liquidity pools contribute to. When a token's value is low, buyers will make purchases. On the other side, sales are made available when the item is overpriced. Arbitrage is made feasible by the availability of liquidity pools, which allow traders to carry out these transactions directly on decentralized exchanges. This makes arbitrage a viable business. The persistent pressure exerted by arbitrageurs contributes to the token's value returning to its target peg, which in turn serves to nurture more stability [8]. D. Gupta et al (2023) discussed conclusion from the research that was carried out that the degree of popularity of greetings is the key factor that determines the value that is ascribed to them. In addition, it has been discovered that the Love Emogie is only available in limited quantities. Due to the intrinsic scarcity of non-fungible tokens (NFTs), the increased demand for NFTs has been a contributing factor from the restricted supply of just 43 Love Emojie. On the other hand, it should be mentioned that cost and use case considerations have a significant impact [9]. R. Issalh et al (2023) introduced crypto currency project known as Pi Network is the creative approach it takes to mining and accessibility. The platform, which was introduced in 2019, gives users the ability to mine its native digital currency, Pi, directly from their mobile devices. The goals of the platform are to democratize the mining process and make involvement in crypto currencies more accessible to a wider range of people. Particularly noteworthy is the fact that Pi Network's block chain is built on the Stellar Consensus Protocol, which places equal importance on the principles of security, decentralization, and transaction speed. Pi Network, which is still in its early phases of development, lays a significant focus on community participation. It encourages users to actively participate in the project and contribute to it [10]. A. Duggal et al (2023) explored relevance of non-fungible token avatars in the meta verse is investigated, with a particular focus on the role that these avatars play in redefining digital ownership, self-expression, and user engagement. In addition, the study dives into the problems and difficulties that are involved with the marketing of NFT avatars. It takes into consideration a variety of elements, including market dynamics, technical hurdles, and user acceptance. This research takes into consideration a variety of NFTs that have been created by a number of different NFT Brands. Possibly in the future, this NFT will be used in the Meta verse. There is a case study of the "Sizzling monster" NFT that has been created at the conclusion of the research article. The availability of this NFT is very restricted, and a number of NFT companies have already purchased it from Young Parrot Platform at the beginning of its existence [11]. M. Gupta et al (2023) introduced to refrain from engaging in speculation in the crypto currency market during NFT transactions is a call to use caution, research, and a dedication to responsible investment. The adoption of these principles will help to the creation of an ecosystem that is more credible and sustainable,

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which will enable the block chain technology that underpins it to realize its promise beyond the limited scope of short-term market swings. An strategy that is careful and well-informed is required while engaging in speculation in the crypto currency market, especially during deals using (NFT). One of the most notable characteristics of the crypto currency market is its inherent volatility, which is magnified by the non-fiat currency area. Due to the fact that prices are prone to unexpected and unforeseeable shifts, it is essential for investors to exercise caution and refrain from giving in to the temptation of speculating. Instead than being based on conventional fundamentals, the value of (NFTs) is determined by variables such as perceived scarcity, demand, and cultural significance [12].

[3] PROBLEM STATEMENT

While blockchain and NFTs bring unique features to the digital asset space, they also present specific challenges to the security of big data. Here are some challenges associated with the security of NFTs over blockchain:

1. **Smart Contract Vulnerabilities:** NFTs often rely on smart contracts for their functionality. Vulnerabilities in smart contracts, such as coding errors or loopholes, can be exploited by attackers to compromise the security of the NFT and its associated data.
2. **Ownership and Identity Management:** Ensuring the secure and accurate representation of ownership is crucial for NFTs. If private keys or access credentials are compromised, it could lead to unauthorized transfers and manipulations. Identity management challenges may arise, especially when dealing with decentralized systems.
3. **Privacy Concerns:** Blockchain is designed to be transparent and immutable, but this transparency may conflict with privacy requirements. If personal or sensitive information is included in the metadata of NFTs, it may become publicly accessible. Striking a balance between transparency and privacy is a significant challenge.
4. **Scalability Issues:** As the number of NFT transactions and users increases, scalability becomes a concern. Blockchain networks may face congestion, delays, and increased transaction costs during periods of high demand, affecting the overall security and efficiency of the system.
5. **Interoperability Challenges:** NFTs may be issued and traded on different blockchain networks, leading to interoperability challenges. Transferring assets between different blockchains requires secure mechanisms to prevent fraud and ensure the accurate representation of ownership.
6. **Marketplace Security:** NFT marketplaces serve as platforms for buying and selling digital assets. Security challenges may include vulnerabilities in the marketplace's infrastructure, potential for fraudulent listings, and the need for secure payment and transaction processing.
7. **Regulatory Compliance:** The regulatory landscape for NFTs is evolving, and compliance with various regulations is a challenge. Ensuring that NFT platforms adhere to legal requirements, such as anti-money laundering (AML) and know your customer (KYC) regulations, is crucial for security and legitimacy.
8. **Network Consensus Risks:** Blockchain networks rely on consensus mechanisms to validate transactions. If a significant portion of the network is compromised or if there is a flaw in the consensus algorithm, it could lead to security risks, such as double-spending attacks or unauthorized modifications to the blockchain.
9. **Environmental Concerns:** Some blockchain networks use energy-intensive consensus mechanisms like Proof of Work. The environmental impact of these mechanisms is a concern. Security measures, such as transitioning to more eco-friendly consensus mechanisms, need to be balanced with environmental considerations.
10. **Lack of Standardization:** The lack of standardized protocols for NFTs and their metadata can lead to inconsistencies in how data is represented and interpreted. Standardization efforts are essential to ensure interoperability and consistency across different platforms.

Addressing these challenges requires a combination of technological innovations, regulatory frameworks, and industry collaboration. As the NFT space continues to evolve, stakeholders need to remain vigilant in addressing security concerns to foster trust and widespread adoption.

[4] Process flow of Clustering of big data in form of NFT for Security using Deep Learning

The clustering of big data in the form of NFTs (Non-Fungible Tokens) for security using deep learning involves several steps. This process flow outlines the major stages of this task:

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1. **Data Collection:** Gather a large dataset of NFTs, including their metadata, transaction history, ownership details, and any other relevant information. Ensure that the dataset is representative and diverse, covering various types of digital assets.
2. **Data Preprocessing:** Clean and preprocess the collected data. This may involve handling missing values, normalizing numerical features, encoding categorical variables, and addressing any other data quality issues. Prepare the data for further analysis.
3. **Feature Extraction:** Extract relevant features from the NFT dataset. This can include metadata attributes, transaction patterns, ownership changes, and other characteristics that are important for clustering. Feature extraction is crucial for feeding meaningful input into the deep learning model.
4. **Deep Learning Model Selection:** Choose an appropriate deep learning model for clustering. Autoencoders or variants of autoencoders, such as Variational Autoencoders (VAEs), are commonly used for unsupervised feature learning and clustering tasks. These models are well-suited for capturing complex patterns in high-dimensional data.
5. **Model Training:** Train the selected deep learning model using the preprocessed NFT data. Use unsupervised learning techniques to allow the model to learn patterns and representations in the data without explicit labels. The model should be trained to encode the input data in a lower-dimensional space.
6. **Dimensionality Reduction:** Apply dimensionality reduction techniques to reduce the complexity of the learned features. This step is essential for visualizing and interpreting the clusters effectively. Techniques like t-Distributed Stochastic Neighbor Embedding (t-SNE) can be useful for this purpose.
7. **Clustering Algorithm:** Implement a clustering algorithm on the lower-dimensional representations obtained from the deep learning model. K-means, hierarchical clustering, or DBSCAN (Density-Based Spatial Clustering of Applications with Noise) are commonly used algorithms for clustering.
8. **Evaluation of Clusters:** Evaluate the quality of the obtained clusters using appropriate metrics. Internal validation metrics (e.g., silhouette score) and external validation metrics (if ground truth labels are available) can help assess the effectiveness of the clustering.
9. **Security Analysis:** Perform a security analysis of the clusters. Examine the characteristics of each cluster to identify patterns, anomalies, or potential security threats. This may involve looking for unusual transaction patterns, ownership changes, or other behaviors that could indicate security risks.

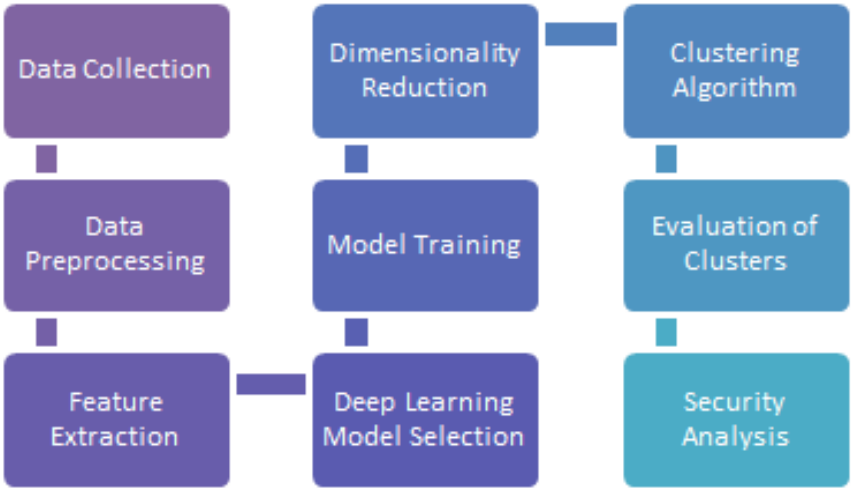

Fig 2: Process flow of clustering of big data in form of NFT for security using deep learning

Remember that the success of this process relies on the quality of the data, the choice of deep learning model, and the effectiveness of the clustering algorithm. Additionally, staying informed about the latest developments in the NFT space and adapting the clustering model accordingly is crucial for maintaining security in dynamic environments.

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[5] RESULT AND DISCUSSION

In simulation part, different attributes of NFT are considered such as total supply, Creator, name, Rate, Description, Contract address, Transaction details. Clustering has been made for 4 groups using deep learning for security of NFT.

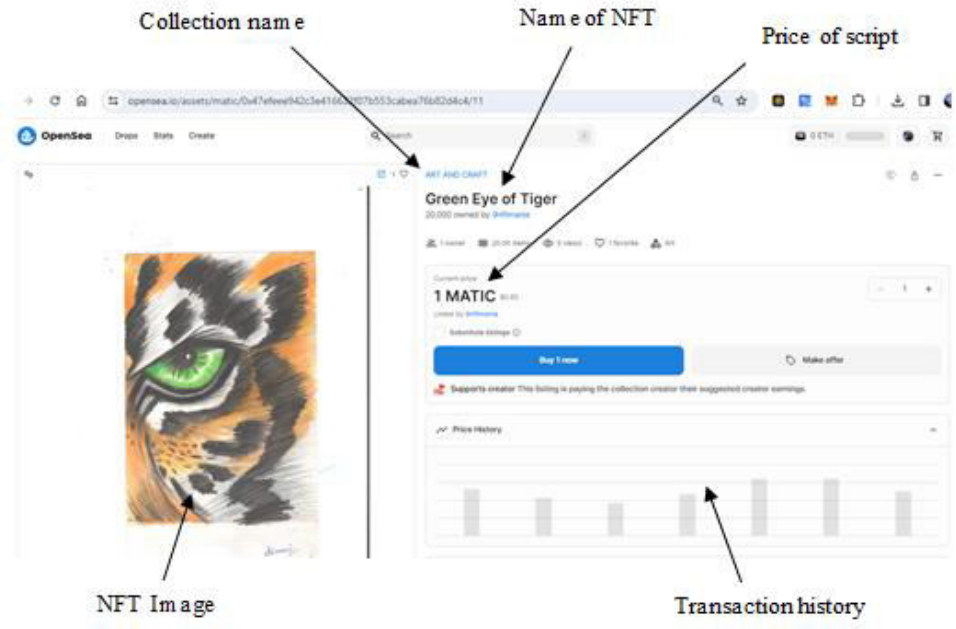

Fig: Different component of NFT

5.1 Simulation of Proposed Deep Learning

There are 4 categories for simulation of proposed deep learning model. The generation of a confusion matrix after training a clustering model on big data associated with Non-Fungible Tokens (NFTs) in the context of security involves a comprehensive evaluation process. Firstly, the clustering model is trained using large-scale datasets containing information related to NFTs, such as transaction records, ownership details, and other relevant attributes. The objective is to uncover inherent patterns, associations, or anomalies within the NFT data that may indicate security-related concerns or potential threats. Following the model training, the next step involves establishing a ground truth for evaluation purposes. This ground truth could be derived from known clusters or classifications that are available in the dataset, or it might be determined through domain expertise and external evaluation methods. In the absence of explicit ground truth labels, the evaluation process may involve qualitative assessments by subject matter experts. Once the ground truth is established, the trained clustering model is applied to the NFT dataset, assigning each data point to a predicted cluster. The confusion matrix is then constructed, providing a tabular representation of the model's performance by comparing predicted clusters against actual cluster assignments. In the context of security, this matrix allows for the assessment of the model's ability to accurately identify patterns or groupings that may indicate anomalous behavior, potential fraud, or security threats. The confusion matrix serves as the foundation for deriving various evaluation metrics, each offering unique insights into the clustering model's performance. Metrics such as precision, recall, F1 score, accuracy are commonly calculated. Precision quantifies the accuracy of positive predictions, recall measures the ability to capture all positive instances, and the F1 score combines precision and recall into a single metric. The iterative nature of the clustering evaluation process allows for refinement and improvement of the model. Based on the insights gained from the confusion matrix and associated metrics, adjustments can be made to hyperparameters, algorithms, or the overall model architecture. Continuous monitoring and periodic reassessment are crucial to ensuring the model's effectiveness in identifying security-related patterns within the dynamic landscape of NFT-associated big data. Overall, this approach facilitates a systematic and data-driven evaluation of the clustering model's performance in enhancing security within the realm of Non-Fungible Tokens.

Table 1: Confusion matrix of Proposed Deep learning model

	Group A	Group B	Group C	Group D
Group A	957	15	9	13
Group B	11	962	8	6
Group C	19	7	974	8
Group D	13	16	9	973

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RESULTS
TP: 3866

Overall Accuracy: 96.65%

Table 2: Accuracy parameters for proposed deep learning model

Class	n (truth)	n (classified)	Accuracy	Precision	Recall	F1 Score
1	1000	994	98%	0.96	0.96	0.96
2	1000	987	98.43%	0.97	0.96	0.97
3	1000	1008	98.5%	0.97	0.97	0.97
4	1000	1011	98.38%	0.96	0.97	0.97

5.2 Comparative analysis of accuracy and error rate
During training phase the comparison of accuracy for corresponding epoch in case of conventional and proposed work is shown in table 3

Table 3: Comparison of accuracy for conventional and proposed

Epoch	Conventional	Proposed work
1	81.09142783	83.54704
2	82.87559143	84.13152
3	82.55703331	84.92037
4	82.91659372	85.30751
5	83.79394272	85.47048
6	84.18221624	86.37652
7	85.28143912	86.94083
8	86.66331998	86.97996
9	85.30044935	87.51609
10	87.49547661	87.83881
11	86.10375836	87.90564
12	88.24033319	88.85938
13	85.89363471	89.55004
14	87.33513742	90.53285
15	90.86906364	91.47248
16	90.49860274	92.36559
17	90.01521458	92.80424
18	91.57379811	93.22322
19	91.09180431	93.69256
20	91.27909585	94.14602
21	93.56512317	94.60223
22	92.61531222	95.10072
23	92.94656587	95.60287
24	92.84933256	96.19601
25	96.64895378	96.7812

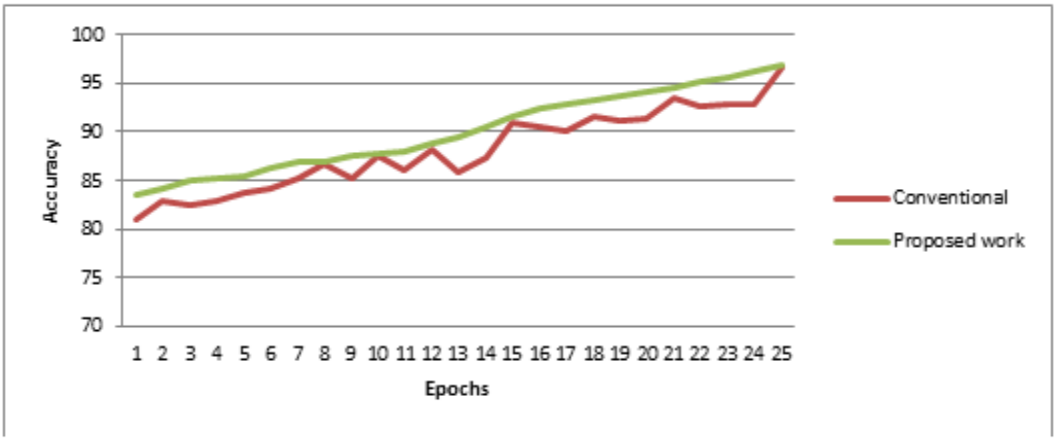

Fig: Comparison of accuracy for different epochs

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Table 4: Comparison of Error rate

Epoch	Conventional	Proposed work
1	18.90857217	16.45296
2	17.12440857	15.86848
3	17.44296669	15.07963
4	17.08340628	14.69249
5	16.20605728	14.52952
6	15.81778376	13.62348
7	14.71856088	13.05917
8	13.33668002	13.02004
9	14.69955065	12.48391
10	12.50452339	12.16119
11	13.89624164	12.09436
12	11.75966681	11.14062
13	14.10636529	10.44996
14	12.66486258	9.467151
15	9.130936357	8.527517
16	9.501397261	7.634407
17	9.984785422	7.195756
18	8.426201889	6.776784
19	8.908195691	6.30744
20	8.720904153	5.853985
21	6.43487683	5.397773
22	7.384687777	4.899281
23	7.05343413	4.39713
24	7.150667443	3.803994
25	3.35104622	3.218797

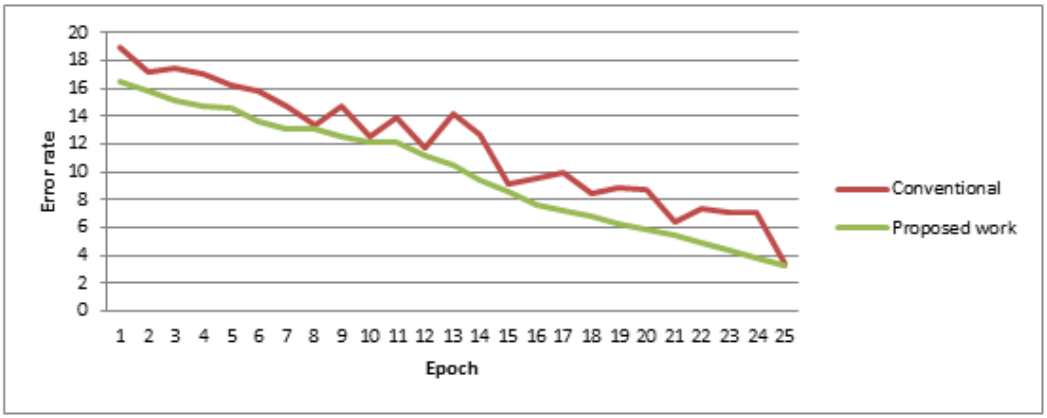

Fig: Comparison of error rate for different epochs

[6] CONCLUSION

In conclusion, the clustering big data in the form of NFTs for security using deep learning encompasses a wide array of applications and challenges. This research area is instrumental in fostering a secure and resilient environment for the burgeoning NFT ecosystem, benefiting creators, collectors, and platforms alike. It is concluded that error rate of proposed work is less than conventional work where as accuracy of proposed work is more than conventional work.

[7] FUTURE SCOPE

The scope of clustering big data in the form of NFTs (Non-Fungible Tokens) for security using deep learning is broad and multifaceted. This research area holds significant potential for addressing various challenges and enhancing the security of digital assets. Here are several aspects that define the scope of this research:

1. **Security Threat Detection:** Clustering NFT data using deep learning can help identify patterns associated with security threats. This includes detecting anomalous transactions, suspicious ownership changes, or any patterns indicative of fraudulent activities within the NFT ecosystem.

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2. **Fraud Prevention and Mitigation:** By applying clustering techniques, researchers can develop models that distinguish between legitimate and potentially fraudulent NFT transactions. This can contribute to fraud prevention and provide insights into the evolving tactics of malicious actors.
3. **User Authentication and Authorization:** Deep learning-based clustering can be employed to establish user behavior profiles. This enables the identification of unusual or unauthorized activities, strengthening user authentication and authorization processes within NFT platforms.
4. **Privacy Preservation:** The clustering of NFT data can be designed to respect privacy concerns. By grouping similar transactions or behaviors without exposing individual user details, it's possible to enhance privacy while still deriving meaningful security insights.
5. **Marketplace Integrity:** Clustering helps in maintaining the integrity of NFT marketplaces. Detecting and mitigating any attempts to manipulate or disrupt the market, such as pump-and-dump schemes, can contribute to a more secure and trustworthy environment for both creators and collectors.
6. **Adaptability to Evolving Threats:** Deep learning models are capable of learning and adapting to new patterns and emerging threats. This adaptability is crucial in the dynamic landscape of NFTs, where novel security challenges may continuously arise.
7. **Comprehensive Data Analysis:** The clustering of big data allows for a comprehensive analysis of various aspects of NFTs, including metadata, transaction history, and ownership details. This holistic approach provides a deeper understanding of security issues and patterns within the entire NFT dataset.
8. **Collaborative Security Measures:** Clustering models can facilitate collaborative security measures by identifying common threats faced by different NFT creators, platforms, or marketplaces. This collective insight can contribute to the development of industry-wide security standards.
9. **Regulatory Compliance:** Deep learning-based clustering can aid in ensuring compliance with regulatory requirements within the NFT space. By identifying and monitoring transactions that may violate regulatory standards, this approach helps platforms adhere to legal and compliance frameworks.
10. **Visual Representation of Clusters:** Visualization of clusters provides a tangible and interpretable representation of security patterns. This not only aids researchers in understanding the results but also enables communication of security insights to non-technical stakeholders.
11. **Scalability Considerations:** Considering the vast scale of NFT data, the research scope extends to addressing scalability challenges associated with clustering big data. Efficient algorithms and distributed computing approaches become essential for handling large datasets.
12. **Interdisciplinary Collaboration:** The scope of this research encourages interdisciplinary collaboration, involving experts in blockchain technology, deep learning, cybersecurity, and data privacy. Such collaboration is vital for developing holistic solutions that address the diverse challenges in securing NFTs.

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IOT IN SOCIAL SCIENCE EDUCATION: BRIDGING THEORY AND PRACTICE FOR INTERDISCIPLINARY CONNECTIONS.

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ABSTRACT

In this extensive paper, we delve into the profound impact of the Internet of Things (IoT) on the intersection of theoretical frameworks in social science and their practical manifestations. The focus of this study is to explore the potential of incorporating IoT technologies into social science education, emphasising the bridging of the gap between theoretical concepts and practical applications. Through IoT devices and platforms, educators in social science can establish interdisciplinary connections, providing students with real-world experiences that deepen their comprehension of intricate social phenomena. The paper thoroughly discusses the advantages and challenges associated with integrating IoT in social science education, offering concrete examples of successful implementations and proposing strategies for educators to incorporate IoT into their curriculum seamlessly. Overall, this paper contends that IoT can revolutionise social science education, equipping students for the increasingly interconnected world they will navigate post-graduation. The article scrutinises educators' perceptions regarding integrating IoT into social science education. Their insights highlight the potential of IoT to stimulate student engagement, critical thinking, and problem-solving skills, all while acknowledging challenges such as data privacy concerns and financial constraints. The paper also unravels the interdisciplinary landscape of IoT-enhanced learning experiences by examining real-world examples. These IoT-infused experiences cultivate a holistic understanding of social science concepts across diverse academic disciplines by immersing students in hands-on, experiential learning. The conclusion positions the IoT ecosystem as a powerful catalyst, propelling education and social science research into an era of innovation, collaboration, and profound interdisciplinary connections. The narrative consistently underscores the transformative role of IoT, shaping the future trajectory of education and social science research.

Keywords: IoT, Education, Social Science.

INTRODUCTION

The IoT, an expansive network interconnecting devices and software, stands on the brink of reshaping education through the integration of cutting-edge technologies. This discussion will delve into how IoT technologies can enhance learning outcomes. It particularly emphasizes the creation of interdisciplinary environments conducive to innovation and creativity. The infusion of IoT technologies into education has garnered significant popularity, holding the promise of redefining the educational landscape. These technologies harbor the potential to revolutionize the learning process, injecting interactivity, engagement, and efficiency into the educational experience. Establishing an intelligent learning environment through IoT allows for real-time monitoring of student progress and the delivery of personalized feedback. This dynamic interaction between educators and students fosters targeted improvements in areas that demand attention.

Many studies focus on the importance of the use and application of IoT in education. Among these, it explains the challenges[1], perception and readiness of students[1], benefits[2], application of IoT in various fields[3] and the

[1] According to Kassab et al. (2019), the myriad benefits and challenges of infusing IoT into educational settings are brought to the forefront. This underscores the crucial necessity to navigate the intricacies associated with IoT implementation, especially in the ever-evolving landscape of education, as Rodríguez et al. (2020) emphasised in the context of Spanish universities amidst the COVID-19 pandemic. A spotlight on digital inequalities in the IoT landscape underscores the importance of ensuring user-friendly and accessible IoT interfaces. Deursen et al.'s (2019) study accentuates the significance of clear terms of use and user-friendly IoT devices, a crucial step toward ensuring inclusivity. Furthermore, considerations of varying skills in operating smart home devices in the IoT context (Boer et al. 2022), underscore the imperative of addressing skill disparities to utilise IoT in educational environments effectively. The challenges faced by higher institutions utilising IoT in social science education span social, educational, and technological aspects. Addressing these challenges requires a comprehensive understanding of the social implications, stakeholder readiness, interdisciplinary collaboration, and the dynamic nature of educational institutions in the era of IoT. While adopting IoT has the potential to revolutionize the learning experience, it also

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transformative potential of IoT[4]. Explaining the seamless integration of the IoT into educational frameworks is paramount for addressing a spectrum of challenges and elevating the overall learning experience. The reason is mainly because the influence of IoT transcends the realm of education, extending its impact across various domains. It is one of the rapidly evolving innovative technologies digitizing and interconnecting numerous fields, as observed by Kimbugwe et al. (2021).

Universities worldwide are increasingly adopting IoT across diverse educational domains, with a specific emphasis on social science education[5]. Global attention towards incorporating IoT in social science education is

introduces several obstacles. A primary challenge lies in the social implications of IoT, notably concerning issues such as social distancing and reduced personal communication. Additionally, IoT's comprehensive, ubiquitous, and interconnected nature may pose difficulties in student understanding and acceptance. Further consideration is needed regarding IoT's impact on educational institutions' social sustainability, as it can influence the quality of life and social stability of the surrounding community.

[1] Negm (2022), stress the need for elucidating students' readiness and acceptance of IoT technologies for online education. A comprehensive review of IoT curriculum, pedagogy, and assessment for STEM education by Abichandani et al. (2022) accentuates the significance of developing remote laboratories, particularly in the face of challenges such as the COVID-19 pandemic, to ensure the continuity of practical training. The study by Evwiekpaefe and Amrevuawho (2023) underscores factors influencing the acceptance and use of IoT technology for educational purposes in tertiary institutions, emphasising performance expectancy, effort expectancy, and facilitating conditions. Furthermore, the impact of IoT on the learning process and the development of game based learning for IoT in the classroom require careful consideration.

[2] Furthermore, Jang and Song (2022) shed light on the importance of incorporating IoT technologies into healthcare education, particularly in information sharing in nursing education. The broader acceptance of IoT technology among students and staff in tertiary institutions, as noted by Evwiekpaefe and Amrevuawho (2023), is positioned as a potential catalyst for enhanced productivity across various economic sectors, underscoring the societal impact of IoT implementation.

[3] The applicability of IoT extends across various fields, including social sciences, healthcare, food supply chain, and transportation, underscoring its relevance and impact on diverse domains (Caesarendra et al., 2018). The integration of IoT in education is associated with providing a rich and interactive learning environment, fostering active learning through collaborative participation beyond the traditional classroom setting (Shahin, 2020).

[4] The transformative potential of IoT is acknowledged as a technology poised to revolutionize our way of life and communication, influencing our social and natural world (Milivojevic & Radulski, 2020). Moreover, the complexity of IoT in agriculture represents a multidisciplinary field in education, incorporating earth sciences, measurement and control technologies, telecommunication systems, and data processing (Medvedev & Molodyakov, 2019).

[5] The recognition of IoT's significance in delivering electronic lectures, especially during health crises such as the Coronavirus pandemic, has been underscored in the literature (Al-Taai et al., 2023). Moreover, research investigating the acceptance of IoT learning among university students lays a foundation for the widespread adoption and utilisation of IoT technologies in higher education, benefitting both students and faculty ("Acceptance of IoT Learning Among University Students at Pakistan," 2021). In addition, IoT awareness training has been revealed to positively influence students' perspectives on the use of IoT applications in education, emphasising the role of education in shaping attitudes towards this technology (Uspabayeva et al., 2022). Notably, the growing trend of incorporating IoT into computer science and software engineering education is highlighted, emphasising the importance of IoT competencies in first-year university students (Mora et al., 2018; Hynninen & Knutas, 2022). This research also underscores the multifaceted nature of IoT in education, serving both as a technological tool to enhance academic infrastructure and as a subject for teaching fundamental concepts of computer science (DeFranco & Kassab, 2019).

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evident in various studies. For example, a study in Saudi Arabia by Almetere (2020) delves into factors influencing the adoption of IoT technologies in education among undergraduate students. Similarly, a Nigerian study explores the acceptance of IoT technology among students and staff in tertiary institutions, indicating a growing interest in integrating IoT in educational settings (Evwiekpaefe & Amrevuawho, 2023). Additional research in Indonesia, Spain, Pakistan, and beyond sheds light on the transformative role of IoT in learning infrastructure and development, emphasizing the need for further exploration, especially in the context of the COVID-19 pandemic.

However, as explainedngs by the literature, there exist research gaps in integrating IoT into social science education. Addressing these gaps is crucial to unlocking the full potential of IoT in enhancing and transforming the learning experience in this field. Almetere et al. (2020) identified three significant research gaps in IoT acceptance in public universities, emphasizing the need for further investigation. Negm (2022) offers insights into the intention to use IoT in online higher education, providing perspectives for institutions seeking trends and practices for skills and work-based learning developments. Leong et al. (2021) stress the insufficient analysis of IoT from a social science perspective, indicating a gap in understanding the social implications of IoT in education. Notably, research findings are concentrated in the northern and eastern hemispheres, with a noticeable dearth in the southern and western hemispheres (Dai et al., 2021). Furthermore, the social ramifications of IoT have received limited academic scrutiny within the social sciences, resulting in a lack of consolidated and coherent perspectives on this subject (Zeeuw et al., 2019; Kassab et al., 2019). Evwiekpaefe and Amrevuawho (2023) highlighted the factors that influence the acceptance and use of IoT technology in tertiary institutions. They emphasized the need for more comprehensive research in this area. Zainuddin et al. (2021) pointed out the scarcity of successful IoT implementations in education, indicating a gap in the practical application of IoT in educational settings. To address these research gaps, this paper aims to explore the benefits of integrating IoT into social science education. It will examine the collaboration between social science and its role in translating theoretical concepts into the real world. Additionally, it will explore the challenges and opportunities posed by IoT to educators. The subsequent sections will delve into the various applications of IoT in education, shedding light on its multifaceted role in shaping the future of learning.

The Diverse Application of IoT

IoT technologies present a myriad of opportunities to enhance education across diverse fields, ranging from sociology and psychology to environmental science, inquiry science instruction, health monitoring, and disease management. The application of IoT devices in education is versatile, adapting seamlessly to the unique nuances of each subject.

In the realm of psychology, Harari et al. (2016) delves into the potential of smartphones for collecting behavioral data, highlighting the inference of studying behavior through the amalgamation of sensor data. Similarly, Saeb et al. (2015) explores the correlates of depressive symptom severity, utilizing mobile phone sensor data to unveil daily life behavior patterns among individuals dealing with depression. Mohr et al. (2017) advocates for personal sensing, emphasizing the potential of sensors to capture authentic human behaviors, thoughts, feelings, and traits in daily life settings.

Shifting our focus to inquiry science instruction, Chakarov et al. (2021) accentuates the role of a physical computing system, the Data Sensor Hub, in supporting middle school science instruction, showcasing the pivotal role of sensors in enriching students' comprehension of consequential decisions in data collection. Meyerhoff et al. (2021) contribute to the discourse by evaluating changes in mental health using smartphone sensor features, demonstrating the capacity of sensor data to capture longitudinal behavioral patterns related to mental health.

In sociology, the utilization of sensors for gathering data on social behavior is transformative. Liu et al. (2017) explore the feasibility of an autism-focused augmented reality smart glasses system, underlining the potential of sensor-rich systems in enabling digital phenotyping and refining constructs related to social communication. Bähr et al. (2020) delve into using geolocation sensor data in social science research, providing insights into urban behavioral patterns and city dynamics. Struminskaya et al. (2020) explore the augmentation of surveys with data from sensors and apps, unlocking opportunities to gain a deeper understanding of individual and group behavior in social sciences.

In the health science field, wearable IoT devices monitor physiological and physical activities, including mental behavior. Haghi et al. (2021) conduct a comprehensive survey on wearable devices in health monitoring, emphasizing their capacity to observe environmental, behavioral, physiological, and psychological parameters. Callihan et al. (2023) compare safety wearable devices, ingestible pills, and wearable heart rate monitors,

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showcasing the potential to simultaneously monitor body temperature and heart rate for early detection of heat stress effects. Cilli et al. (2022) highlight the role of intelligent wearable technology in continuous physiological data for disease management in chronic diseases.

IoT devices, including brainwave sensors for cognitive training and GPS trackers for mapping land use patterns, offer tangible, real-world data. Bridging the gap between theoretical concepts and practical applications, these devices contribute to a holistic educational experience. In the subsequent section, we will delve into the integration of IoT into social science education and explore the manifold benefits it brings to this academic domain.

Benefits of Using IoT in Social Science Education

IoT technologies usher in adaptive learning, tailoring the pace and difficulty of learning materials to suit students' abilities and interests. This allows for individualized learning journeys, enabling students to explore their interests and unlock their full potential. The integration of IoT into education fosters personalized and adaptive learning experiences (Negm, 2022), offering a platform for contextual, personalized, and transparent education that promotes effective collaboration. Incorporating IoT technologies into education heralds a transformative shift, paving the way for personalized learning experiences tailored to meet the distinct needs and learning styles of individual students. By collecting and analyzing student data, educators can discern areas where students may face challenges, enabling targeted support for optimal academic achievement. This personalized educational approach transcends disciplinary boundaries, extending its benefits across diverse subjects, ultimately elevating the quality of teaching and equipping students with essential skills for success in the 21st century. This becomes particularly relevant in the context of blended learning models, gaining significance during the ongoing COVID-19 pandemic (Siripongdee et al., 2020). The idea of creative education, which includes contextual and individualised learning, fits in perfectly with the enormous potential of the IoTin education (Zhu et al., 2016).

Moreover, the incorporation of IoT facilitates the development of IoT-based educational games, promoting a dynamic and interactive learning environment (Petrović et al., 2017). The development of science education games that seamlessly blend real and virtual environments, meeting the needs of individual students and improving the learning process, is made possible by IoT technology (Husnanda & Ikhsan, 2021). Developing realistic and interactive educational games that combine real and virtual environments is made possible by the IoT. Benefits from these games include enhanced engagement, individualised education, and real-time feedback. To create dynamic, captivating learning experiences, they integrate digital components with real locations. Giving students immediate feedback on their educational games is a key benefit of the Internet of Things. Teachers may collect real-time data on student performance by integrating sensors and other IoT devices. This data enables customised education and focused interventions to maintain students' motivation and engagement. IoT-enabled educational games can also creatively use real locations. For instance, a student's movement within a physical area can be tracked by sensors and IoTdevices, which can then be used to modify the gaming environment. As a result, an extremely immersive experience is produced that promotes experimentation, exploration, and discovery.

The creation of collaborative learning experiences that span both physical and virtual places is another advantage of IoT in educational games. Students may work together to overcome obstacles or solve problems by integrating IoT devices, regardless of where they are physically located. Students benefit from this by feeling more connected to one another and being more cooperative in teams. IoT plays a big part in creating educational games that combine real and virtual worlds, providing advantages that improve learning and produce interesting, interactive experiences. We should expect more inventive applications of IoT in educational settings as it develops further. To effectively capitalise on the Internet of Things' incorporation into the academic realm, it is imperative to ensure that students understand its all-encompassing, ubiquitous, and interconnected character (Hynninen & Knutas, 2022).

The potential to create individualised, adaptive, and captivating learning experiences by incorporating IoT into social science teaching is compelling. Teachers may create creative learning environments that meet the needs of a wide range of students, encourage active learning, and improve collaborative learning by utilising the potential of IoT devices. By giving students practical experience and allowing them to apply theoretical concepts to real-world circumstances, IoT proves to be a significant tool in bridging the theoretical-practical divide in social science teaching. In the field of sociology, for instance, students can gather data on social behaviour using IoTdevices, resulting in a dynamic learning environment that increases relevance and engagement. The integration of IoT in social science education has the capacity to enhance learning outcomes, promote skill development, and raise student engagement. By utilising IoT-driven educational activities, game-

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based learning, and complete IoT technologies strategically, educators may effectively close the knowledge gap between theory and practise, giving students precious possibilities for skill development and hands-on experience. IoT applications are being positively received in educational contexts, as evidenced by recent research like Glaroudis et al. (2018), which emphasise high school students' tolerance and involvement with IoT-driven instructional activities. Additionally, studies conducted by Rong-Jun et al. (2020) demonstrate noteworthy improvements in students' emotional, knowledge, and innovative levels after taking an IoT-based maker course, highlighting the beneficial effects of real-world IoT applications on student learning outcomes.

The ability of IoT to make learning more dynamic and interesting serves as an example of the significant influence it has had on educational practises. Students can use sensors to gather information on social behaviour, test out new technologies, and examine real-world data by integrating IoT devices. This allows for practical learning experiences that are hands-on and real-world. The integration of IoT technology in education has gained significant traction, offering the potential to transform the learning process through improved interactivity, engagement, and effectiveness. The potential of IoT to address a range of issues and enhance the overall learning experience is another significant impact on educational practises. IoT technologies have the potential to completely transform education, promoting efficacy, inclusion, and accessibility. Despite obstacles like the COVID-19 pandemic, remote laboratories created with the use of IoT technologies have successfully allowed students to continue their practical instruction. These technologies help students get a comprehensive understanding of social science issues across a variety of academic fields by immersing them in IoT-enhanced learning experiences. Students may develop critical thinking and problem-solving abilities in this multidisciplinary environment of IoT-enhanced learning experiences, which is essential for success in the quickly evolving world of today.

IoT technology integration has made it easier recently to establish new partnerships in academic settings across social science disciplines and technology-related fields. By combining different viewpoints and areas of knowledge, this integration creates opportunities for investigating research questions and resolving challenging issues. We'll look at how IoT technologies help social science disciplines and tech-related fields work together in educational settings in the next section. We'll look at the advantages and difficulties of this integration and how it's changing the way we think about research and teaching.

To What Extent Does Integrating IoT Technologies Facilitate Collaboration Between Social Science Disciplines and Technology-related Fields in Educational Settings?

Collaboration across technology-related domains in education and social science disciplines is facilitated by the integration of IoT technologies. Numerous studies highlight the revolutionary potential of IoT, highlighting how it can help eliminate academic divides and promote multidisciplinary collaboration in educational settings. In order to solve complicated societal issues and prepare students for the complexities of the modern workforce, teamwork is essential. According to research by Petrović et al. (2021), game-based learning and interdisciplinary collaboration within educational settings are promoted when instructional games are integrated into the IoT curriculum (Petrović et al., 2021). In order to reinforce the case for IoT's role in promoting collaboration between social science and technology-related sectors in education, Maksimović (2018) looks into the power of people, technology, and collaboration in modernising education through IoT-supported practises.

Numerous investigations have examined how IoT might foster multidisciplinary cooperation in educational settings and close the gap between various disciplines. In order to tackle difficult societal issues and successfully traverse the multifaceted character of the modern workforce, students must collaborate with one another. The following studies demonstrate how IoT technologies can help these professions work together more easily. There is a chance for improved collaboration between these fields, as seen by the growing interconnection of research, the development of new services and applications, and the enhancement of teaching methods using IoT principles. Liston et al. (2022) have conducted groundbreaking experiments that demonstrate the revolutionary potential of integrating IoT into STEAM education. This integration fosters creativity and redefines perspectives in data science (Liston et al., 2022). Ma (2022) emphasises even more how IoT might improve language instruction, drawing in language lovers and raising academic standards in social science fields (Ma, 2022). The growing global network for research collaboration in higher education, according to Fu et al. (2022), emphasises the subject and geographical advancements in co-authored research. This illustrates how research from different disciplines and geographical areas is becoming more integrated, with social science and technology-related domains working together. In their discussion of the intersection of social networks and the Internet of Things, Ortiz et al. (2014) emphasised the potential of the latter to develop new services and applications that encourage cooperation among various intranets of things. This demonstrates the ability of IoT

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to establish an ecosystem that promotes cooperation between social science disciplines and technology-related sectors.

Additionally, Jung (2022) highlighted the swift expansion of global research cooperation in the social and natural sciences, encompassing educational technology. This demonstrates how, in the framework of scholarly research, technology-related fields and social science disciplines are increasingly collaborating. Furthermore, Maksimović (2018) talked about how IoT concepts are applied in the educational sector, highlighting how collaboration between students, faculty, administrative staff, and teachers significantly improves teaching practise and the learning experience. This emphasises how the IoTmay foster collaboration in learning environments by bridging the gaps between technology-related subjects and social science disciplines.

IoT's interdisciplinary nature has created new avenues for social science and other academic disciplines to collaborate. The study of several multidisciplinary links, notably in the fields of agriculture, healthcare, and environmental science, has been made easier by the integration of IoT devices into social science teaching. Real-time data collection and analysis made possible by IoTdevices has contributed to bridging the knowledge gap between theoretical ideas and practical applications, offering a more comprehensive grasp of intricate social concerns. The study of Hung (2019), which highlights how IoT alters numerous sectors, including education, demonstrates the multidisciplinary nature of IoT and further supports IoT's function in promoting collaboration between social science and technology-related fields in educational settings (Hung, 2019). The creation of novel educational strategies has also been aided by the interdisciplinary character of social science education. IoT-infused activities have fostered a more thorough knowledge of social science issues across a variety of academic fields by immersing students in hands-on, experiential learning. Using concepts from social science, ecology, and environmental science, for example, the integration of IoT devices into environmental science education has aided students in investigating the complex ways that human activity affects the natural world.

In their emphasis on the value of multidisciplinary cooperation across the scientific and social sciences, Barthel & Seidl highlighted the relevance of cooperation in addressing the complex difficulties that face humanity, especially in the field of groundwater research (2017). This emphasises how the IoTmight facilitate multidisciplinary cooperation by bridging the gap between various scientific fields (Barthel & Seidl, 2017). Gilbert (2014) also highlighted the collaboration between social work and engineering, highlighting the distinct role that social work plays in science and technology, especially when it comes to solving complicated social issues. This is an example of how IoT can promote cooperation across social science and technology-related domains, resulting in creative solutions to societal problems (Gilbert, 2014). A social science viewpoint on IoT research was also offered by Leong et al. (2021), who emphasised the necessity for multidisciplinary feedback to supplement technical studies and hasten the widespread use of IoT technologies. This demonstrates how IoT may incorporate social scientific viewpoints, encouraging interdisciplinary cooperation and enhancing the advancement of IoT technologies (Leong et al., 2021).

The potential of IoT to foster creativity and innovation across diverse domains is underlined by its integration with other technologies, exerting a profound influence on the learning process. The amalgamation of IoT with various technologies holds significant promise, particularly in shaping creativity and innovation, as exemplified by its positive impact on the learning process. According to Rehman et al. (2021), industrial IoT technology has proven to enhance innovation performance. Moreover, the pivotal role played by IoT technologies extends to improving real-life innovative applications, positively affecting the quality of life (Al-Garadi et al., 2020). In education, the deployment of IoT systems has been proven to enhance student attendance and positively influence the learning process in higher education, as evidenced by Tan et al. (2018). Additionally, the integration of IoT in educational environments has been acknowledged to positively influence teaching and learning performance (Al-Abdullatif et al., 2022). The emerging paradigm of educational applications and innovative technology is credited to IoT, as Madni et al. (2022) noted. Furthermore, the continuous development of IoT has spurred numerous innovations across all facets of education, shifting the focus towards blended, mobile, ubiquitous, and active learning, as articulated by Petrović et al. (2021).

The integration of IoT technology into social science classrooms is seen as a transformative influence, creating interactive and experiential learning environments (Supriadi et al., 2022). A successful integration of IoT into social science education demands a strategic approach, including seamless integration into the curriculum, collaboration between social science educators and IoT experts, access to diverse IoT devices, and ongoing training and support for educators. The achievement of success in IoT integration entails active learning experiences, forging interdisciplinary connections, placing emphasis on critical thinking, and ethical considerations. All of these factors work together to make IoT integration in social science teaching successful. In an era where the IoTis king, integrating technology into educational experiences has the ability to transform

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learning and provide students a thorough comprehension of social science principles from a variety of academic disciplines (Theodosi & Nicolaidou, 2021). By utilising IoT devices and systems, students actively participate in hands-on learning, which successfully closes the knowledge gap between theory and practise. These experiences make it easier to gather data in real time, analyse social events, and investigate intricate correlations between different factors. Multidisciplinary approaches are also supported by IoT-enhanced learning opportunities. Additionally, by fostering critical thinking, improving problem-solving abilities, and giving students a sense of ownership over the research process, these experiences address difficulties in social scientific research. Teachers are able to emphasise appropriate data gathering and use while teaching students about the ethical implications of IoT technologies in social science research.

The ability of the IoT to enhance the learning process by promoting interaction, engagement, and efficiency is clear evidence of its transformative impact on educational practise. The IoT allows for focused improvements in areas that need attention through real-time monitoring of student progress and individualised feedback. Additionally, IoT technologies enable students to improve critical thinking and problem-solving skills by creating interdisciplinary environments that promote creativity and innovation. The way that IoT is being used in education is going to change how social science research and education are conducted in the future. The IoThas revolutionised how we interact with our environment, and its impact extends beyond the domains of engineering and technology. Social sciences are currently investigating how IoT might be used to put theoretical ideas into real-world educational contexts. We can gain a deeper comprehension of intricate social concerns by integrating IoT into academic areas.The future of education and social science research lies in the innovative and collaborative opportunities the IoT ecosystem presents. In the next section, we will focus on how IoT can bridge the gap between theoretical concepts from social science disciplines and their practical implementation in real-world educational settings.

The Role IoT Plays in Translating Theoretical Concepts from Social Science Disciplines into Practical, Real-world Applications within Educational Contexts.

The burgeoning recognition of the IoT stems from its unique capability to bridge theoretical concepts from social science disciplines with tangible applications within educational settings. Despite being in its nascent stages, the integration of IoT in education showcases significant potential to elevate the global standard of education. This application triggers a paradigm shift, especially within systems thinking, providing an insightful framework for scrutinizing IoT in education (Rodney, 2020). Rodney underscores the necessity of adopting a systems model to analyze education, redefining notions of achievement, problems, and solutions—a clear departure from traditional approaches. This shift gains further traction with insights from Abichandani et al. (2022), asserting that the evolving IoT paradigm places fresh demands on educational institutions to equip students with skills relevant to IoT.

The IoT is emerging as a transformational tool in social science research, serving as a link between theoretical ideas and real-world implementations. The IoTsuccessfully bridges the knowledge gap between theory and practical implementation. A paradigm shift in social science education is brought about by the integration of IoT technologies, which enable students to apply theoretical knowledge in real-world situations. Students can gather information on social behaviour through the use of IoT devices like sensors, which makes it easier to analyse and identify patterns in human behaviour. Social scientists can now gather data in real time, beyond the constraints of conventional research methodologies, thanks to the smooth integration of IoT devices and sensors (S & Godhavari, 2022; Uppal et al., 2022). This methodology has shown benefits in a number of social scientific fields, including sociology and psychology, giving researchers a deep insight of how people behave in real-world situations. The IoT ecosystem is changing social science research by making large datasets previously inaccessible to scholars available. They can investigate complex social processes and come up with creative solutions to pressing issues because to this access. IoT plays a critical role in changing the landscape of social science research by enabling a more thorough and practical approach to comprehending and resolving societal issues.

The ability to apply theoretical principles in real-world settings gives social scientists a deeper understanding of social dynamics, human behaviour, and larger societal trends. Social scientists investigate the complex web of social phenomena using a data-driven methodology, which promotes the creation of more precise and fact-based hypotheses and solutions. Notably, by enabling large-scale, continuous, and objective data collecting, the IoT offers a remedy to the drawbacks associated with conventional data collection techniques, such surveys and interviews. The IoT has the ability to completely transform research methodology by giving academics new tools and techniques to investigate intricate phenomena and provide original ideas. We anticipate seeing even

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more creative applications of IoT technology in research as they advance, opening up new avenues for scientific investigation and discovery.

Massive data collection is made possible by the Internet of Things, which also makes it easier to track and assess the effects of social interventions and policies in real time. Additionally, the IoTprovides a regulated setting in which to carry out studies and interventions, allowing for accurate variable adjustments and observations. Consequently, this improves the validity of the results and allows social scientists to investigate hitherto undiscovered patterns, trends, and correlations. Additionally, using IoT devices in research can save costs, as data can be collected more efficiently and with less human intervention. Overall, using IoT technologies in social science research can transform the field, enabling researchers to pose new questions and uncover previously inaccessible insights.

Additionally, Zeeshan and Neittaanmäki (2021) provide a comprehensive overview of crucial IoT applications in education, emphasizing the role of IoT in realizing the concept of a smart school. Together, these references underscore the transformative influence of IoT on education, particularly in promoting a systems-thinking approach and addressing the evolving needs of educational institutions to integrate IoT-relevant skills into their curricula. Synthesizing these perspectives reveals that the infusion of IoT into education has instigated a paradigm shift, accentuating the significance of systems thinking and compelling educational institutions to adapt to a changing landscape by incorporating IoT-related skills into their programs. This shift signifies a transition toward a more interconnected and technology-driven approach to education, aligning seamlessly with the transformative potential of IoT in educational contexts.

The integration of artificial intelligence and IoT, although a novel concept (Imran et al., 2021), introduces many possibilities. Additionally, IoT processes contribute significantly to transforming data into a consistent format for learning machine languages, particularly in the context of sustainable energy technologies (Kumar, 2022). Integrating deep learning into IoT enhances security analytics, providing an advanced processing system capable of effectively and accurately detecting threats, as elucidated by Alsoufi et al. (2021). The interplay of machine learning and data analytics within the IoT framework enables adaptive learning from other IoT applications, exemplifying practical applications in the literature, as Adi et al. (2020) discussed. The continuous evolution of technology, as evidenced by the growing scale of IoT systems with the addition of more devices, positions machine learning as a key player in processing and learning from the vast data generated by IoT devices (Luo et al., 2020). Overall, integrating IoT with other technologies is a catalyst for fostering creativity and innovation across diverse fields, significantly influencing the learning process in education and beyond. The synthesis of IoT with machine learning, deep learning, artificial intelligence, and other technologies presents unprecedented opportunities for enhancing performance, security, and sustainability.

The infusion of the IoT into social science education brings forth a myriad of unresolved questions. Addressing the spatial, political, and cultural specifics of global IoT development and mitigating privacy risks and security vulnerabilities associated with IoT applications are pivotal facets requiring attention. The subsequent section will delve into the challenges of integrating IoT in social science education and the integration of IoT technologies into the social science educational curriculum.

Challenges of Integrating IoT in Social Science Education.

The integration of IoT into social science education presents a set of challenges that necessitate careful consideration, encompassing social, educational, and technological aspects, often overlapping. One crucial concern revolves around the potential for unequal access to technology, where not all students may possess the required devices or Internet connectivity. This could limit the efficacy of IoT-based learning experiences by raising the possibility of a digital divide. Furthermore, legitimate worries regarding data security and privacy surface, especially when sensitive data pertaining to social science themes is gathered and analysed. In order to resolve these problems, educators and administrators need to put strong security measures in place to preserve student information and adhere to moral principles.

Additionally, there is a learning curve associated with the adoption of new IoT technologies for both teachers and students, needing time to acquire the skills and knowledge needed for successful integration into the curriculum. Despite these obstacles, the use of IoT technology can improve social science teaching by giving students additional chances for participation and learning with careful design and execution. Teachers emphasise that in order to successfully integrate IoT technology into their lessons, they must receive thorough training as well as professional development opportunities. Financial limitations, however, can make it more difficult to acquire the infrastructure and devices that are required, and worries about data security and privacy

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are still very real. Additionally, obstacles to smooth integration are created by the interoperability issues with different IoT platforms and devices (Theodosi & Nicolaidou, 2021).

IoT use in social science teaching presents a variety of difficulties that need be carefully considered. A thorough grasp of the technology and its possible effects on social science education is necessary to successfully integrate IoT technologies into the curriculum, which is a significant issue (Chweya & Ibrahim, 2021). The advantages and difficulties of IoT integration in education have been highlighted in a number of studies. The advantages and difficulties encountered in education when incorporating IoT into the curriculum and learning environments were the subject of a systematic literature review by Kassab et al. (2019), which emphasised the necessity for a thorough grasp of the related advantages and difficulties. In his discussion of the possible effects of IoT on educational systems, Rodney (2020) made the argument that these systems might be redesigned and reshaped by IoT technology to better meet the needs of students in terms of learning. This emphasises how IoT has changed the paradigm in schooling. Furthermore, research on the acceptance and adoption of IoT technologies in educational settings was conducted by Almetere et al. (2020) and Evwiekpaefe & Amrevuawho (2023). These studies emphasised the significance of comprehending affecting elements and their relationships. As a result, incorporating IoT technologies into the academic curriculum successfully necessitates a thorough grasp of the advantages, difficulties, driving forces, and possible effects on education. To fully realise the potential of IoT technology to improve social science teaching, educators need to acknowledge the paradigm shift in education and the reasons influencing its adoption.

An understanding of the pervasive, all-encompassing, and linked character of IoT among educators and students is essential for its successful adoption (Hynninen & Knutas, 2022). Understanding the ramifications of incorporating IoT into the curriculum necessitates taking into account a number of IoT-related factors, including how it might affect social science teaching. First and foremost, it's critical to understand the IoTand how ubiquitous it is. The IoT is a network of real objects, including cars, appliances, and home appliances, that are integrated with electronics, software, sensors, actuators, and connectivity to enable data sharing. IoT devices' widespread connectivity and interconnection have the potential to completely transform social science education by facilitating practical learning opportunities and gathering data for research in real-time. IoT can also be used to develop intelligent learning environments, combining data from several sources to give a more comprehensive understanding of social phenomena.

To include IoT into the curriculum, educators must have a thorough awareness of the ramifications regarding security, privacy, and ethics. Teachers and students need to understand the possible dangers and difficulties that come with gathering and using data in IoT systems. These include concerns about data privacy, security lapses, and moral applications of data provided by IoT devices. Teachers must possess the knowledge and abilities to successfully integrate IoT technologies into social science curricula. This could entail access to resources, training courses, and professional development for developing IoT-based learning activities that complement social science curricular goals.

One of the biggest obstacles to using IoT in social science education is security concerns. Strong security measures are necessary to safeguard private student and instructor information and safeguard critical educational data (Husnanda & Ikhsan, 2021). It is imperative to protect the copious amounts of data that IoT devices gather and communicate, including academic and personal data, against unauthorised access and breaches. IoT devices are more vulnerable to cyberattacks because of their interconnectedness, which might compromise the network as a whole. To maintain network performance and security, physical security measures must also be put in place to stop IoT device theft and manipulation. By giving priority to data, network, and physical security, educational institutions can reduce the dangers that come with integrating IoT in learning environments.

In order to address the dearth of suitable teaching models and provide a balanced learning approach, another difficulty is the requirement for a change in teaching models in IoT maker courses to emphasise theory alongside practical implementations (Rong-jun et al., 2020). This change is essential for incorporating IoT technologies into the curriculum for social science education (Aikenhead, 1984). A solid collection of "theories-in-use" for decision-making is created by fusing beliefs with real-world classroom knowledge, as highlighted by Aikenhead (1984) and Bybee et al. (1991). This is crucial for teaching IoT in social science education (Bybee et al., 1991). Additionally, Kassab et al. (2019) highlight the dual purpose of "IoT in Education," highlighting its use as a subject to teach basic computer science principles and as a technical tool to enhance academic infrastructure. This emphasises how crucial it is for IoT maker classes to strike a balance between theory and real-world implementations. Leong et al. (2021) also emphasise the need to incorporate new theories and models into IoT education in order to move beyond conventional models, such as the Technology Adoption

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Model and its variations. Kortuem et al. (2013) justify the necessity for a balanced approach to learning in IoT maker courses by highlighting the significance of comprehending both the technical foundation and the societal implications of IoT. Furthermore, Roy et al. (2016) highlight the difficulties associated with technology knowledge, societal acceptance, and consumer needs, stressing how critical it is to address these issues in IoT education within the framework of social science. Therefore, a change in teaching approaches is required to emphasise theory alongside practical applications in IoT maker courses in order to properly integrate IoT in social science education. This method is in line with the multidisciplinary character of IoT education, the necessity of incorporating fresh ideas and models, and the significance of addressing societal acceptance and technology awareness. A balanced learning approach is made possible by incorporating these components, which guarantees the successful integration of IoT technology into the social science curriculum.

CONCLUSION

In conclusion, the integration of IoT technology into learning experiences serves as a conduit to a holistic understanding of social science concepts. It provides real-time data for analysis, fosters interdisciplinary collaboration, promotes hands-on experiences, enhances student engagement, encourages cross-cultural understanding, addresses data convergence and ownership challenges, and supports the development of critical thinking and problem-solving skills. The IoT ecosystem, comprising devices, communication technology, the internet, and data storage, emerges as a transformative force in shaping the future of education and social science research. Incorporating the IoT into education, particularly in the context of social science education, offers a distinctive opportunity to reshape the educational landscape. As underscored in this article, the undeniable potential of IoT to enhance student engagement, tailor learning experiences, and foster interdisciplinary collaboration is evident. However, amidst the numerous advantages, embracing this transformative technology comes with significant challenges that demand meticulous consideration and strategic planning.

Despite the myriad benefits, the effective integration of IoT within social science education requires careful consideration of social, educational, and technological challenges. Tackling social implications, including potential social distancing and reduced personal communication, is imperative for safeguarding student well-being and ensuring effective collaboration. Moreover, fostering buy-in from students and staff by addressing concerns related to IoT's comprehensive and interconnected nature is paramount. The mindset of both students and instructors is pivotal for implementing IoT successfully. The research underscores the significance of factors influencing acceptance, such as performance expectancy, effort expectancy, and facilitating conditions.

Additionally, embracing continual learning through robust training and development initiatives is critical for upskilling educators and supporting their endeavours to harness and adapt to this dynamic technology. The swift evolution of global higher education demands continual adaptation and responsiveness to recent changes in social science education. Sustaining and elevating education quality, adjusting curriculum to remain pertinent and address societal needs, and incorporating interdisciplinary approaches to develop practical IoT solutions are essential for cultivating a resilient educational model.

A comprehensive understanding of existing research gaps concerning IoT integration in social science education reveals vital areas for further exploration. Delving deeper into factors influencing acceptance, exploring student intentions to use IoT in online learning, and scrutinising student and staff perspectives on incorporating IoT in curriculum development is crucial for unlocking the full potential of this technology. Despite the challenges associated with implementing IoT in social science education, recognising its potential to revolutionise learning experiences is pivotal. Integrating IoT can contribute to student success and cultivate a vibrant and dynamic learning environment by fostering interactivity, engagement, and collaboration. Embracing its ability to personalise learning journeys and create immersive, student-centred experiences is crucial as this technology continues to evolve, empowering the future generation of social scientists. Through thorough research, collaborative efforts, and strategic planning, educators can unlock the transformative power of IoT and pave the way for a more engaging and personalised social science education. By responsibly and thoughtfully embracing this innovative technology, we can envision a future where knowledge is accessible, student-centred, and filled with limitless possibilities for a brighter tomorrow.

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A STUDY TO IDENTIFY POST MENOPAUSAL WOMEN'S QUALITY OF LIFE AND SYMPTOMS THROUGH MACHINE LEARNING

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ABSTRACT
The menopause, defined as the final menstruation or climacteric, which informs the aging of a woman's reproductive system.[1]Menopause typically occurs between 49 and 52 years of age. Medical professionals often define menopause as having occurred when a woman has not had any menstrual bleeding for a year. Menopause-related hormonal changes begin several years beforethe menopause and are characterized by a gradual increase infollicle-stimulating hormone (FSH) and more rapid decline insystemic female sex steroids (estradiol and estrone) within6 months around the menopause.[2] Reproductive aging among women has a far-reaching effect on the function of differentbody systems, and also on the psychological functioning andwell-being among middle-aged and older women. Menopause is an important life transition phase and hasbeen suggested to be a time of increased vulnerability in wellbeing.[5].These severity of climacteric complaints is routinely determined by using the Kupperman Menopause Index (KMI). The Kupperman Index are widely used internationally. The Menopause Specific Quality of Life Questionnaire (MENQOL) is a validated questionnaire for the assessment of menopausal and post menopausal women's symptoms and an effective instrument (MENQOL). The Menopause Rating Scale (MRS) is a health-related quality of life scale (HRQoL) and was developed in response to the lack of standardized scales to measure the severity of aging-symptoms and their impact on the HRQoL in the early 1990s. Machine learning is a subfield of artificial intelligence, which is broadly defined as the capability of a machine to imitate intelligent human behavior. Artificial intelligence systems are used to perform complex tasks in a way that is similar to how humans solve problems. In this system the Machine learning is greatly useful for the early detection of the vasomotor problems of the women so that we can detect her menopause early to make her well being from the long term complications like osteoporosis, fractures, obesity, depression, diabetes, and cardiovascular disease, decreased functional abilityand mortality.

Keywords: Post Menopausal women, Machine Learning, Kupperman Menopause Index, MENQOL, MRS Rating Scale

NEED OF THE STUDY
In most countries, there is an increase in the aging population as a result of both longer lives Expectancy and declining fertility rates [6]. The World Health Organization has adopted a Globalstrategy and action plan on ageing and health to ensure adults live not only longer but healthier lives. Demographic data have shown that every year, 25 million women worldwide experience the menopause.This will result in 1.2 billion postmenopausal women worldwide by 2030. Symptoms that may appear during menopause and continue through post menopause include painful intercourse, vaginal dryness, atrophic vaginitis – thinning of the membranes of the vulva, the vagina, the cervix, and the outer urinary tract, along with considerable shrinking and loss in elasticity of all of the outer and inner genital areas.Other physical symptoms of menopause include lack of energy, joint soreness,stiffness, back pain, breast enlargement, breast pain, heart palpitations, headache, dizziness, dry and itchy thinning, tingling skin, weight gain, urinary incontinence, urinary urgency, interrupted sleeping patterns, heavy night sweats and hot flashes and finally Mood and memory effectsPsychological symptoms include anxiety, poor memory, inability to concentrate, depressive mood, irritability, mood swings, and less interest in sexual activity. So the early detection of the menopause and to identify her role in post menopausal stage is more important for the women to improve her well being.Machine learning and in particular deep learningmodels based upon artificial neural networks can draw upon diversedata that include clinical images and medical notes, as well as sensorgeneratedand genomic data. Such models can iteratively learn fromlarge clinical databases and bring to bear the expertise of multiplemedical specialties upon the data of individuals.

INTRODUCTION
Post Menopause is the stage after menopause and is the time in women's lives when menstrual periods stop permanently, and they are no longer able to bear children.Menopause typically occurs between 49 and 52 years of age.Medical professionals often define menopause as having occurred when a woman has not had any

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menstrual bleeding for a year. It may also be defined by a decrease in hormone production by the ovaries. In those who have had surgery to remove their uterus but still have ovaries, menopause may be considered to have occurred at the time of the surgery or when their hormone levels fell. Following the removal of the uterus, symptoms typically occur earlier, at an average of 45 years of age.

POST MENOPAUSE WOMEN

The term menopause refers to a point in time that follows one year after the last menstruation. During the menopausal transition and after menopause, women can experience a wide range of symptoms. Post-menopausal women, especially among the Indian population, can be susceptible to experiencing non-specific low back pain (NSLBP). Non-specific low back pain refers to pain or discomfort in the lower back region without a clear underlying structural cause or specific pathology. Menopause-related cognitive impairment can be confused with the mild cognitive impairment that precedes dementia. Tentative evidence has found that forgetfulness affects about half of menopausal women and is probably caused by the effects of declining estrogen levels on the brain, or perhaps by reduced blood flow to the brain during hot flashes. Menopause confers that a possible but contentious increased risk of atherosclerosis. The risk of acute myocardial infarction and other cardiovascular diseases rises sharply after menopause, but the risk can be reduced by managing risk factors, such as tobacco smoking, hypertension, increased blood lipids, body weight, increased risk of osteopenia, osteoporosis, and accelerated lung function decline. Menopause occurs because of the sharp decrease of estradiol and progesterone production by the ovaries. After menopause, estrogen continues to be produced mostly by aromatase in fat tissues and is produced in small amounts in many other tissues such as ovaries, bone, blood vessels, and the brain where it acts locally. The substantial fall in circulating estradiol levels at menopause impacts many tissues, from brain to skin. In contrast to the sudden fall in estradiol during menopause, the levels of total and free testosterone, as well as dehydroepiandrosterone sulfate (DHEAS) and androstenedione appear to decline more or less steadily with age.

Hot flashes and other vasomotor symptoms accompany the menopausal transition. While many sources continue to claim that hot flashes during the menopausal transition are caused by low estrogen levels. The exact cause of these symptoms is not yet understood, possible factors considered are higher and erratic variation of estradiol level during the cycle, elevated FSH levels which may indicate hypothalamic dysregulation perhaps caused by missing feedback by inhibin. It has been also observed that the vasomotor symptoms differ during early perimenopause and late menopausal transition and it is possible that they are caused by a different mechanism. Long-term effects of menopause may include osteoporosis, vaginal atrophy as well as changed metabolic profile resulting in cardiac risks. The term "postmenopausal" describes women who have not experienced any menstrual flow for a minimum of 12 months, assuming that they have a uterus and are not pregnant or lactating. The reason for this delay in declaring postmenopause is because periods are usually erratic at this time of life. Therefore, a reasonably long stretch of time is necessary to be sure that the cycling has ceased. At this point a woman is considered infertile; however, the possibility of becoming pregnant has usually been very low (but not quite zero) for a number of years before this point is reached.A woman's reproductive hormone levels continue to drop and fluctuate for some time into post-menopause, so hormone withdrawal effects such as hot flashes may take several years to disappear.A period-like flow during postmenopause, even spotting, may be a sign of endometrial cancer.

Menopausal women experience a number of physical changes such as loss of muscle strength and flexibility, which is considered to be a major contributor to musculoskeletal disorders (Sutton-Tyrrel et al., 2005). Yamamoto et al. (2009) identified flexibility as a determinant of arterial stiffness, which is known to be an independent risk factor for cardiovascular disorders, target organ damage (Coutinho et al., 2011), and increased mortality risk (Vlachopoulos et al., 2010). The latest clinical practice guidelines recommend that patients remain physically active, as inactivity contributes negatively to recovery. Currently, it is known that general strength, conditioning, and resistance training programs for the spinal muscles, including Pilates and aerobic exercises, are among the best treatment options for patients with chronic low back pain and it's been shown to reduce pain and disability in the short and long term. A wide variety of therapeutic interventions are available for the treatment of chronic low back pain ranging from general physical fitness or aerobic exercise to muscle strengthening as well as various types of flexibility and stretching exercises[24]. Because of the pain, self care, household, work, social and leisure activities can be affected or even impaired. Other variables involved in defining disability are anxiety, stress, and fear. In addition to households, the other time spends as energy-demanding activities like parenting, agriculture works, taking care of livestock, which is not only strenuous, but also repetitive and lead them a continuous health risk. Any backache which can be pointed with a finger, or associated with local tenderness, is usually not due to intra pelvic lesion. LBP may also have correlations with reproductive factors, like age at marriage, marriage duration, past pregnancy, number of children or abortions,

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heightened pain sensitivity among women menstrual cycle fluctuations, biologic response to stress of pregnancy, childbearing and posture during working. Female sex hormones play an important role in causing a variety of musculoskeletal disorders. Postmenopausal women are more prone to disc degeneration because of relative estrogen deficiency, which may result in narrowing of inter-vertebral disc space, increase in number of spondylolistheses, and increased facet joint osteoarthritis prevalence[25]. Menopause is a natural part of the aging process in women and is defined as occurring 12 months after the last menstrual period and marks the end of menstrual cycles.[11].Menopause is a universal and physiological event in a woman's life occurring around the age of 50 years in most developed countries. [12].It is caused by the aging of ovaries leading to a decline in the production of ovarian gonadotrophins estrogen and progesterone.[13]The deficiency of these hormones elicits various somatic, vasomotor, sexual, and psychological symptoms that impair the overall quality of life (QoL) of women.[14, 15,16]

STATISTICAL TOOL

KUPPERMAN INDEXQUESTIONAIRE

The first widely accepted attempt to measure the severity of menopausal complaints in women was the Kupperman Index. It is classified into six areas-vasomotor disorders, urinary symptoms, psycho neurological symptoms, motor symptoms, digestive symptoms, and systemic symptoms. Hot flash, weight gain, insomnia, irritability, low sex drive, depression, fatigue, muscle/joint pain, headache, heart palpitations, vaginal dryness and finally forgetfulness.

Rating is

0: No symptom

1: Slight

2: Moderate

3: Severe

Menopause Rating Scale (MRS)

Which of the following symptoms apply to you at this time?

(X ONE Box For EACH Symptom) For Symptoms That Do Not Apply, Please Mark "None").

Symptoms:	none	mild	moderate	severe	extremely severe
Score =	0	1	2	3	4
1. Hot flashes, sweating (episodes of sweating)	☐	☐	☐	☐	☐
2. Heart discomfort (unusual awareness of heart beat, heart skipping, heart racing, tightness)	☐	☐	☐	☐	☐
3. Sleep problems (difficulty in falling asleep, difficulty in sleeping through the night, waking up early)	☐	☐	☐	☐	☐
4. Depressive mood (feeling down, sad, on the verge of tears, lack of drive, mood swings)	☐	☐	☐	☐	☐
5. Irritability (feeling nervous, inner tension, feeling aggressive)	☐	☐	☐	☐	☐
6. Anxiety (inner restlessness, feeling panicky)	☐	☐	☐	☐	☐
7. Physical and mental exhaustion (general decrease in performance, impaired memory, decrease in concentration, forgetfulness)	☐	☐	☐	☐	☐
8. Sexual problems (change in sexual desire, in sexual activity and satisfaction)	☐	☐	☐	☐	☐
9. Bladder problems (difficulty in urinating, increased need to urinate, bladder incontinence)	☐	☐	☐	☐	☐
10. Dryness of vagina (sensation of dryness or burning in the vagina, difficulty with sexual intercourse)	☐	☐	☐	☐	☐
11. Joint and muscular discomfort (pain in the joints, rheumatoid complaints)	☐	☐	☐	☐	☐

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Figure – 1: The Menopause Rating Scale (Mrs)

The Menopause Rating Scale (MRS) is a health-related quality of life scale (HRQoL) shown in Figure – 1, was developed in response to the lack of standardized scales to measure the severity of aging-symptoms and their impact on the HRQoL in the early 1990[26].

The Menopause-Specific Quality of Life Questionnaire

For each of the following items, indicate whether you have experienced the problem in the **PAST MONTH**. If you have, rate how much you have been ***bothered*** by the problem.

					Not at all bothered							Extremely bothered
					0	1	2	3	4	5	6	
1.	HOT FLUSHES OR FLASHES	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
2.	NIGHT SWEATS	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
3.	SWEATING	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
4.	BEING DISSATISFIED WITH MY PERSONAL LIFE	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
5.	FEELING ANXIOUS OR NERVOUS	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
6.	EXPERIENCING POOR MEMORY	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
7.	ACCOMPLISHING LESS THAN I USED TO	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
8.	FEELING DEPRESSED, DOWN OR BLUE	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
9.	BEING IMPATIENT WITH OTHER PEOPLE	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
10.	FEELINGS OF WANTING TO BE ALONE	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
11.	FLATULENCE (WIND) OR GAS PAINS	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
12.	ACHING IN MUSCLES AND JOINTS	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
13.	FEELING TIRED OR WORN OUT	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
14.	DIFFICULTY SLEEPING	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
15.	ACHES IN BACK OF NECK OR HEAD	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
16.	DECREASE IN PHYSICAL STRENGTH	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
17.	DECREASE IN STAMINA	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
18.	FEELING A LACK OF ENERGY	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
19.	DRYING SKIN	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
20.	WEIGHT GAIN	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
21.	INCREASED FACIAL HAIR	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
22.	CHANGES IN APPEARANCE, TEXTURE, OR TONE OF YOUR SKIN	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
23.	FEELING BLOATED	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
24.	LOW BACKACHE	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
25.	FREQUENT URINATION	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
26.	INVOLUNTARY URINATION WHEN LAUGHING OR COUGHING	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
27.	CHANGE IN YOUR SEXUAL DESIRE	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
28.	VAGINAL DRYNESS DURING INTERCOURSE	❑ No	❑ Yes	→	0	1	2	3	4	5	6	
29.	AVOIDING INTIMACY	❑ No	❑ Yes	→	0	1	2	3	4	5	6	

Figure – 2: The Menopause-specific Quality of Life (MENQOL) Questionnaire.

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MENQOL

The Menopause Specific Quality of Life Questionnaire (MENQOL) as explained in Figure – 2, is a validated questionnaire for the assessment of menopausal women's symptoms and an effective instrument.[17,18].The evaluation of the Menopause-Specific Quality of Life (MENQOL) Questionnaire, a tool used by clinicians to understand women's symptoms as they progress through the menopausal and Post menopausal transition [19,20]

ARTIFICIAL INTELLIGENCE

Artificial intelligence can not only mimic but also greatly extendhuman intelligence. The medicaldecisions and personalized therapy for a single patient be informed by vast, collective experience [8].Artificial intelligence (AI) methods and algorithms are being appliedin varying ways across clinical and research domains. Machinelearning (ML) has only begun to be applied to the menopausal transition.The end of a woman's fertility is a physiological state that is part ofaging, and it is accompanied by a myriad of symptoms that include hotflashes, disrupted sleep, loss of energy, anxiety, and feelings of sadnessand loss. These can transition to pathological phenomena such as incrementalbone loss, diabetes, and cardiovascular disease and mortality.The complexity of menopause challenges general practitioners, gynecologists, and women's health practitioners to provide comprehensivecare [9]. Implementation of AI is in an early phase, conditions such as osteoporosis that are prominent during and aftermenopause are being approached with deep learning (DL) models.Machine learning also has shown promising results diagnosingmenopause symptoms. AI can also improve personalized treatment in menopause. (Barack et al.,) developed a computerized hybrid decision-making system. to assist physicians by combining a clustering algorithm with knowledge-based algorithms to recommend hormone therapy for peri- and postmenopausal women [10]. It is importantto understand that AI algorithms can assist and facilitate the work ofhealth professionals and make them better, but cannot replace them.

DISCUSSIONS

The quality of life among menopausal women has become an increasingly hottopic in recent medical and sociological research. Specifically, vasomotor andpsychological symptoms remain at the forefront of common, bothersome symptomswhich affect a woman's quality of life. 95% of Postmenopausal women may exhibit vasomotor symptoms, which may frequently disrupt work, sleep and other activities. Furthermore, psychological symptoms such as depression are common in as many as 60% of women going through the menopausal transition. The severity of climacteric complaints is routinely determined by using the Kupperman Menopause Index (KMI) and the menopause rating scale (MRS). Artificial intelligence (AI) methods and algorithms are being appliedin varying ways across clinical and research domains.In this system the Machine learning is greatly useful for the early detection of the vasomotor problems of the women so that we can detect her menopause early to make her well being from the long term complications like osteoporosis, fractures, obesity, depression, diabetes, and cardiovascular disease, decreased functional ability and mortality.Even though there has been progress in the application of AI to the study of women's health during and after the menopausal transition, there is not yet evidence of its application in clinical practice. Translating AI to clinical care will require two lines of development. First, our understanding, identification, and measurement of mechanisms underlying menopausal metabolic traits must advance to get optimal input datasets. Second, robust algorithms and systems are needed along with access to larger datasets within an ethical framework that guarantees privacy and data protection. This has special importance for the application of DL models, which allow extraction of features and patterns that expose underlying, relevant characteristics through training with a large amount of data.

CONCLUSION

Machine learning provides an invaluable decision support system for the prediction of vasomotor symptoms of the Menopausal women so that we can prevent her from all the long term problems. The problems faced by the post menopausal women can be minimized by knowing the level through Machine learning methods so that his physical and mental well being can be defined for the further progression and are free from unrealistic assumptions. Machine learning is a statistical tool that uses artificial intelligence to allow computers to perform tasks by learning from examples without being explicitly programmed [21,22,23]

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ANTIBACTERIAL EVALUATION AND CHARACTERIZATION OF COMBINED MILLETS

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ABSTRACT
The millets are the coarse grains with a proteins, fibre, vitamins and minerals. Some wellknown millets are pearl millet, little millet, proso millets, kodo millet, and barnyard millet. These millets are being used as a dietary fibre. Panicum sumtrense commonly known as little millet, Eschinchloe frumentaceae commonly known as barnyard millet and, Pasapulam scorbiculatum commonly known as kodo millet. These millets are well known for their secondary metabolites such as flavonoids, phenolics, carbohydrates. All these three millets were individually examined for their Total Phenolic Content (TPC), Total Flavonoid Content (TFC), Antioxidant property. The Echinochloa frumentaceae was checked for AntiPigmentation and Anti-Hyperglycemic activity. When these three millets are combined may exhibit higher Antibacterial, Antifungal activity against the microbial strains. The combined millets were characterized by GC-MS analysis to identify the compounds present in the sample.

Keywords: Millets, Antioxidant, Antibacterial, GC-MS characterization.

1. INTRODUCTION
By the upcoming life style, traditional and cultural changes lead people to a risky life. The increased development and modern life changed people's health conditions. These chances can cause some infectious diseases. The infectious disease is often super imposed on a background of public health problems and challenging condition. Such disease is growing resistant to the current modern medicines and treatments. One of the major consequences of industrialization and modernization in the public eye are lifestyle disease. Way of life illnesses is present day aliments that are caused or quickened by the manner in which we live our day by day lives. This incorporates what we eat and the exercises we do every day. After some time, wrong choices will negatively affect our bodies. In this new upcoming culture development people are becoming more favourable to the occurrence of infectious disease. The medicines developed has become resistant to the disease. Traditionally, these infectious diseases can be cured with the naturally available plant, crops, and millets. Infectious diseases are caused by microorganisms like bacteria, fungi, virus and some parasites. Some microorganisms are naturally present in our body doesn't causing any harmfulness. Some microorganisms present in the environment may cause certain disease. These diseases can be characterized by the invasion of pathogen into the body. More commonly known bacterial disease are tetanus, cholera etc. some of the fungal disease are ringworm, vaginal candidiasis etc. viral diseases are HIV, Ebola etc. Emerging Infectious Disease (EID) includes the currently emerging disease in the public. It is known that there are 355 infectious disease found between 1940-2004 (16). *Panicum sumtrense* is commonly known as little millet, belongs to the Poaceae family. These crops are cultivated in the India, Pakistan, and Ceylon. Which grows straight or with folded blades to a height of 30 cm to 1 m. the leaves are linear, sometimes hairy laminae and membranous hairy ligules. The panicles are from 4 to 15 cm in length with 2 to 3.5 mm long. The grain is round and smooth, 1.8 to 1.9 mm long. Little millet is high in nutritional value such as protein 9.7g, carbohydrates 67g, fat 4.7g, fibre 4.6g, calcium 17 mg, phosphorus 220 mg, iron 9.3g, energy 320 kcal. Little millet helps in preventing cardiovascular disease, cataract, diabetics, gastrointestinal problems, cancer, inflammation. Little millet plays a major role in the body's immune system. Little millet is used as a tonic, sweet, diuretic, aphrodisiac (13). Little millet having high nutritional value and can prevent cardiovascular disease, cataract, diabetics, gastrointestinal problems, cancer, and inflammation. Little millet plays a major role in the body's immune system. Little millet is used as a tonic, sweet, diuretic, and aphrodisiac. In cardiovascular disorder it can reduce cholesterol level, reduce fasting blood glucose, blood glucose and lipid parameters in diabetics. Little millets consist of dietary fibre of about 3738%, which the highest among other millets and high in their polyunsaturated fatty acids (40). Barnyard millet is grown in the tropical region of India and central Asia. It is grown in the Himalayan region in the Deccan plateau in the south. The grains of barnyard millet is cooked and consumed like rice (13). It is robust with course, hair less leaves 4–20 in long. It has a thicker stem than most millets, grows 2–4 ft tall, with a brown to purple inflorescence (55). It is a fair source of protein, which is highly digestible and is an excellent source of dietary fibre with good amounts of soluble and insoluble fractions. The carbohydrate content is low and slowly digestible. Barnyard millets show the highest concentration of iron. Barnyard millet contains low carbohydrate which are slowly digestible. It can be used as food for the patients with allergic diseases, including atopic dermatitis. Nutritional value such as proteins, omega-3, omega-6, fatty acids, and antioxidants are present in large amount in the outer layers of barnyard millet (45). Barnyard millet also consists of Anti-Pigmentation

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and Anti-Hyperglycemic property. *Paspalum scrobiculatum* is commonly known as kodo millet. Easily digestible food being rich in dietary fibre. Kodo millet is mostly cultivated in India. Paspalum scrobiculatum occurs in shady places. In olden days farmers think that kodo millets is poisonous after rain because it can produce delirium with violent tremors of the voluntary muscles (11). Grains are cooked and prepared as a bread. kodo millet is referred do be a tuffed perinnial grass. Kodo millets are useful in controlling haemorrhages, inflammation and hepatopathy (59). The ayruvedic test have proved that grains can manage diabetes (39). Kodo millet contain about 37–38% of dietary fiber content, which is the highest among the cereals, whereas, their fat contains higher amount (4.2%) of poly unsaturated fatty acids. Kodo millet after germination showing high nutritional value than raw due to increase in vitamins, fibre, trace elements, amino acids, flavonoids, as well as phenolic acids (46).

2. MATERIALS AND METHODS

Powdered millets sample (little millet, kodo millet, barnyard millet), Bacterial Strains: *Pseudomonas aeruginosa* & *Staphylococcus aureus*, Dimethyl sulphoxide(DMSO), Antibiotic, Silica gel for TLC, Nutrient agar, Mortar & pestle, Solvents (chloroform, ethyl acetate) Sterile distilled water, Phytochemical reagents.

2.1 Extraction: The newly cultivated *Panicum sumtrense, Echinchloe frumentaceae* and *Paspalum scrobiculatum* were collected from the agricultural field in Madurai district. The all the three millets were taken in a ration 1:1:1 and grinded using mortar and pestle into a fine powder. The grind samples were extracted using both the polar and non-polar solvents. The polar solvent used is Aqueous and non-polar solvent used is chloroform. The solvents are added to the sample in a ratio of 1:4. The conical flask containing the sample with solvent were incubated in orbital shaker for four hours and the sample was filtered using whattman filter paper no 1. Sample were stored for further analysis(34,33,42).

2.2 Phytochemical analysis : the phytochemical analysis was done for Tannins, Phlobatannins , Flavonoids , Glycosides, Terpenoids, Steroids, Carbohydrates, Protein.(52)

2.3 Sterility Test

Sterility test is a qualitative test that proves the extracted sample is free from viable microorganisms. It is checked for the final products by inoculation of the sample, should be performed in a sterile room under biosafety cabinet. Nutrient agar was prepared and poured into the petri plates and allowed to solidify. The combined powder sample was prepared in a concentration of 1mg/ml. 50µl of sample was spread on the plate using L rod. The plates were incubated at 37°c for 48 hours.

2.4 Characterization Study by GC-MS (out Sourced)

The Gas chromatography Mass Spectrometry is a chemical characterization method that gives the analysis and identifies the different compounds of the extracted sample. This characterization was performed at VIT Vellore, by Department of Chemistry (25)

2.5 Antibacterial Evaluation:

Antibacterial Activity was performed with extracted samples, the bacterial strains used *Pseudomonas aeruginosa* & *Staphylococcus aureus.* Purified samples were serially diluted using 5% DMSO. The 1mg/ml of sample concentration was taken and is serially diluted to 500µg/ml and 250µg/ml. Agar well diffusion method is performed as, petri plates are autoclaved and the media prepared with nutrient agar. Media was poured into the petri plates and allowed to solidify. Blank containing no sample, organisms. The control was prepared by inoculating bacteria and spread, punching is made 5%DMSO and Antibiotic was added in a separate well. The bacterial species from the mother culture were inoculated and spread using L rod. Well is punched and the serially diluted samples were added. the plates were incubated for 24 hours at 37°c.

2.6 Antioxidant Property of Aombined Millets

Antioxidant property is the ability of a compound to elute free radicals present. The antioxidant activity was performed by DPPH (2,2 diphenyl-1-picrylhydroxy) method(21). This method is simple and easy to measure the antioxidant property of any compound. The DPPH is a stable free radical with purple in colour, readily accepts the hydrogen from the antioxidants and the colour change from purple to yellow. 2,2-Diphenyl-1-picrylhydrazyl will get converted to 2,2-Diphenyl-1-picrylhydrazine when combined with the antioxidant(9). The procedure for DPPH assay, about 50µl of each concentration from each sample was added in 96 well plate and 500µl of DPPH was added to each well. After vortexing, the sample was incubated for 30 minutes in room temperature. Control blank contains DPPH and solvent without extract. Sample blank was also prepared without DPPH. After incubation absorbance was measured at 517nm.Experiment was repeated in triplicates and the % of inhibition was calculated(59).

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$$\text{Percentage of Inhibition} = \frac{\text{Absorbance of control - Absorbance of test} \times 100}{\text{Absorbance of control}}$$

The sample was diluted at various concentration 100 µg/ml, 200 µg/ml, 300 µg/ml, 400 µg/ml, and 500 µg/ml. The DPPH were added of 50µl was added kept for incubation in a dark place for about 30 mins. The colour chances were observed and OD values are calculated.

3. RESULT AND DISCUSSIONS

The millets species *Panicum sumtrense*, *Echinchloe frumentaceae* and *Paspalum scrobiculatum* are important medicinal crops that have lot of therapeutic potential like AntiHyperglycemic, Anti-pigmentation, Antibacterial, Antifungal, Antioxidant., etc against many diseases and dsorders. These millets having notable biological activities. The process of combining these millets can give an excellent opportunity to develop a drug against various diseases and disorders.

3.1 Phytochemical Analysis

The phytochemical analysis was done for qualitative analysis for the crude sample have showed significant presence of secondary metabolites. The phytochemical present in the compounds are tabulated

Phytochemical	Results
Tannins	+
Anthraquanins	-
Phlobatannins	-
Steroids	+
Terpenoids	-
Glycosides	+
Carbohydrates	+
Proteins	+
Flavonoids	+

Table 3.1: phytochemical analysis results

The phytochemical test indicates the presence of secondary metabolites such as tannins, flavonoids, carbohydrates, proteins, glycosides. This indicates that combined millets have having secondary metabolites can show higher activity against various diseases.

3.2 Sterility Test

The subjected sample were checked for any contaminations by sterility test. The sterility test is needed for testing the absence of viable forms of microorganisms in or on the subject preparation, it is a crucial step.

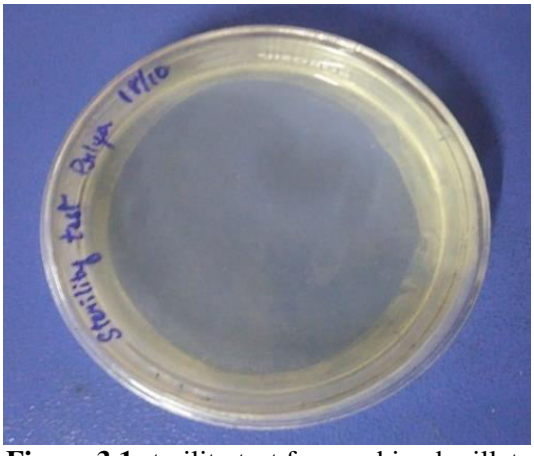

Figure 3.1 sterility test for combined millets

The sterility test performed has inferred that, the petri plates are seen without any contamination. Thus, the combined millet sample is free from viable microorganisms.

3.2. Gas Chromatography- Mass Spectrometry (GC-MS)

The gas chromatography-Mass spectrometry is a analytical method to characterize the combined millet sample. The crude extracted of combined *Panicum sumtrense*, *Echinchloe frumentaceae* and *Paspalum scrobiculatum* were given for analysis.

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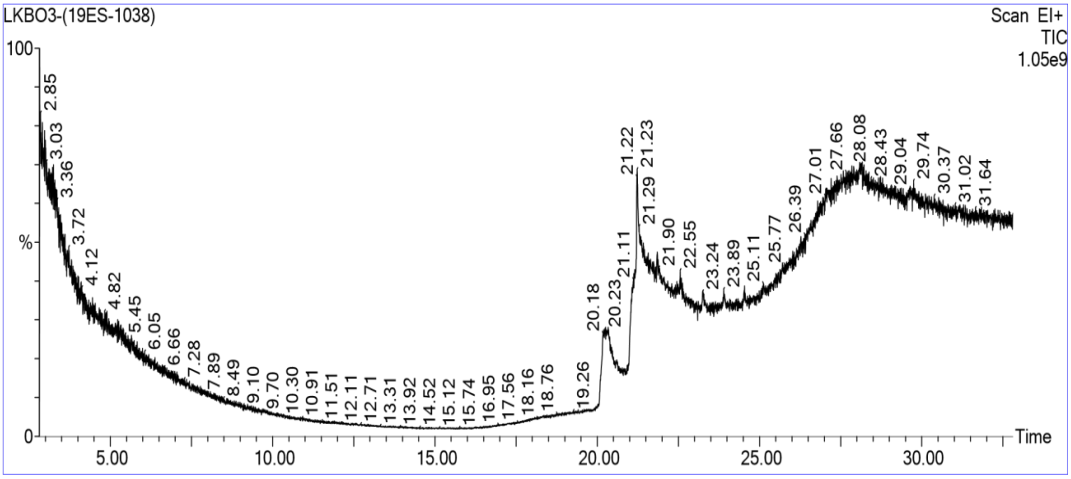

Figure 3.2 chromatogram of combined millets

All the compounds obtained by GC-MS characterization structure and molecular formula are listed below in table 5.2.1

Sl.no	Compound	Molecular formula
1	N-Hexanedecanoic acid	C6 H32O2
2	Oleic acid	C18H32O2
3	9-Ecosyne	C20 H38O2
4	Cholesta-8, 24-Dien-3- OL,4-Methyl (3 Beta.,4alpha)	C28 H46O
5	Pseduosorsasopogenin- 5,20- Dein	C27 H42O3
6	2nitrocyclohexane	C12H23O2N
7	9-Oxononanoic acid	C9 H16O3
8	1-pentadeyne	C15H30O2
9	2-methyl-z, 3,13- octadecadienol	C19H36O3
10	Methyl isolithocholate	C25H42O3
11	Diazoprogesterone	C21H30N4

Table no 3.2. Structure of compound present in combined millet

3.3 Antibacterial Activity

The antibacterial activity of combined millets against *Pseudomonas aeruginosa* and *Staphylococcus aureus* was carried out using agar well diffusion method.

Figure 3.2: Antibacterial activity of combined millets against Pesduomonas aeruginosa

3.4 Antioxidant Activity of Combined Millets

Antioxidant activity of combined millets were analysed by DPPH assay. There is no colour is observed.

Concentration of the sample (µg)	Absorbance at 517nm
100	32.03
200	41.51
300	59.65
400	78.64
500	83.64

Table 3.3: Absorbance of combined millet sample

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4. CONLUSION AND FUTURE WORK

4.1 Conclusion

The study was carried out, on various methods. The combined millets sample were extracted by both ultrasonication and maceration process. The results were seen with the maceration extraction. The secondary metabolites were analysed by phytochemical test, indicates the presence of flavonoids, tannins, carbohydrates, glycosides, steroids and proteins. The sterility test represents that the combined millets are free from viable microorganisms. The GCMS characterization was performed, components present with a high activity are Cholesta-8, 24-Dien-3-OL,4-Methyl (3 Beta.,4alpha), Methyl isolithocholate, Diazoprogesterone. The Antibacterial activity of combined millets, was performed by agar well diffusion method, results revealed, failed to inhibit the growth of *Staphylococcus aureus* and *Pseduomonas aeruginosa*. This may be due to the usage of lower concentration of sample. The Antioxidant activity performed results revealed that the combined millets inhibit less free radicals.

4.2. Future perspective

Study on millets are important, to know its medicinal value. The combined millets Panicum sumtrense, Echinchloe frumentaceae and Paspalum scrobiculatum can be further carried out for antibacterial activity, antifungal activity, Rate of killing, rate of pH, crystal violet assay and docking can be performed. The specific compound can be isolated and can be formulated as a drug.

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ASSESSMENT OF BIOCHEMICAL ANALYTES MODIFICATION IN DIABETICDISEASE AND RELATED DISORDERS

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ABSTRACT

Diabetes is characterized by hyperglycaemia and disorders of carbohydrate, fat and protein metabolism. It is associated with an absolute or relative deficiency in insulin secretion (diabetes mellitus 1 - DZ1) or with insulin resistance (diabetes mellitus 2 - DZ2). Diagnosis of diabetes mainly involves laboratory tests, which implies high quality testing in accordance with good laboratory practice. There is a wide range of tests that give us valuable information about the patient's glycaemic curve, nutritional status, insulin resistance, metabolites andlipid status. To analyse the results of analytes associated with carbohydrate metabolism and to determine the degree of dysfunction of the body in diabetic disease and related disorders. The study comprises 65 patients (38 women and 27 men, ages 43-82 years) grouped into 3 groups: patients with DZ1 (Type 1 diabetes) (n=, 27), patients with DZ2 (n=27) and non- diabetic patients (control, n=11) and was conducted over a period of 6 months, year 2022 in the Medical Analysis Laboratory of Medgidia Municipal Hospital, Constanta County, Romania, fulfilling the inclusion criteria and completing the study participation. The studied parameters change their concentration with disease progression. They can detect complications early, which may increase longevity and quality of life of diabetic patients. Multiple cellular impairments, within metabolic abnormalities in early or advanced stages of diabetes mellitus are expressed by significant statistical correlations regarding the determinedanalyses.

Keywords: Type 1 diabetes, insulin, biochemical analytes, carbohydrate metabolis

INTRODUCTION

Diabetes mellitus (DZ) is a complex and heterogeneous syndrome that induces profound changes in carbohydrate, protein, lipid, ionic and mineral metabolism, underlyingthe development of a wide spectrum of chronic complications, affecting more or less all tissues. Over the years, the prevalence of diabetes mellitus has increased globally and is classified as one of the leading causes of high morbidity and mortality and the most common cause of dialysis. According to the World Health Organization (WHO) diabetes mellitus is classified into type 1 DZ, both autoimmune and non-autoimmune forms with beta cell destruction, type 2 DZ with varying degrees of insulin resistance and insulin hyposecretion, and a separate group called other specific types of DZ, where the cause is better defined, and gestational DZ (Radu, 2022).

Type 1 diabetes mellitus (T1DM) accounts for about 5-10% of all cases of diabetes (Babes, 2021) and is the result of autoimmune destruction of the body's pancreatic beta cells, which produce the hormone insulin. Without insulin, the body cannot regulate blood glucose control (Skyler et al., 2017).

Insulin is the most important factor in regulating metabolism, but neuronal connections, metabolic signals and other hormones (e.g. glucagon) have a special significance in the integrated control of glucose intake and utilization. Glucose- and lipid-regulating organs communicate via neuronal and humoral mechanisms with fat and muscle and produce adipokines, myokines and metabolites that influence liver function (Zahiu et al., 2021).

Hypoglycaemic drugs and insulin control blood glucose levels, but cannot effectively treat the disease. One of the many remedies for treating this disease is herbal medicine. Phytotherapy highlights a trend of improving or combating diabetes, it is considered as a scientific procedure and conception in the sense of grounding on new bases the old art of healing with the help of plants (Bacalov, 2014). A few studies by Tanasa et al., 2022.a; Tanasa et al., 2022.b; Tanasa et al., 2023, on dandelion (*Taraxacum* sp.) medicinal plant, highlights its beneficial phytotherapeutic effects on the body by lowering blood glucoselevels.

The aim of this paper is to analyse the results of analytes associated with carbohydrate metabolism and to determine the degree of dysfunction of the organism in diabetic diseaseand related disorders.

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Risk Factors Involved in the Development of Chronic Complications in Diabetes Mellitus

Coronary artery disease (CAD) - the most common cause of death in European adults with diabetes. Several studies have shown that they have a two to three times higher risk than in people without diabetes. There are large differences in the prevalence of CAD in patients with type 1 or type 2 DZD and between different populations. In the EURODIAB IDDM Complication Study, which included 3250 people with type 1 diabetes from 16 European countries, the prevalence of BCV was 9% in men and 10% in women 43 increasing with age, from 6% in the 15-29 age group to 25% in the 45-59 age group, and with duration of diabetes. In patients with DZ1 the risk of BAC increases dramatically with the onset of nephropathy. Up to 29% of patients with childhood-onset DZ1 and nephropathy will have BAC after 20 years of diabetes compared to only 2-3% in patients without nephropathy (Force et al., 2019).

Diabetic Neuropathy is one of the most common complications of diabetes, being the main risk factor for leg ulcers and responsible for one lower limb amputation every twenty seconds worldwide (Sima et al., 2018). Vereșiu et al. conducted a nationwide study in 2012, according to which diabetic neuropathy was assessed to occur in 67% of all patients with diabetes. Study of Jeffcoate et al. in 2018, emphasized that 70% of all non-traumatic amputations occur in people with diabetes.

Causative factors of neuropathy are poor glycaemic control and duration of disease. Hypertension (for type 1 diabetes), age, smoking, hypoinsulinaemia and dyslipidaemia arealso implicated (Bacârea et al., 2007).

Diabetic Retinopathy is one of the most common complications and is present in both DZ1 and DZ2, especially in patients with longstanding disease and poor glycaemic control. When it culminates in vision loss, it is considered tragic and is a major morbidity factor with high economic impact, as diabetic retinopathy is the most common cause of acquired blindness. The pathophysiology of microvascular changes in retinal tissue is related to chronic hyperglycemia, which leads to circulatory changes such as loss of vascular tone, changes in blood flow, increased vascular permeability and consequently extravasation and edema, and finally vascular obstruction leading to neovascularization, with fragile vessels rupturing, leading to hemorrhage and retinal detachment (Bosco et al., 2005).

Diabetic Nephropathy is a chronic vascular complication, specific to diabetes, in which the renal microcirculation is affected and a series of functional and structural alterations originate at the glomerular level, although the renal tubules may also be affected. The clinical syndrome is characterised by persistent proteinuria, hypertension (hypertension) and progressive deterioration of renal function. The diagnosis of diabetic nephropathy is confirmed by persistent and detectable proteinuria by means of a qualitative and quantitative study performed at least 30 days apart, the latter giving a result of more than 0.5 g within 24 hours, and that it is clinically excluded that it is not caused by any cause other than diabetes and that it may or may not be accompanied by hypertension (Rodríguez et al., 2007).

Diabetic Foot is a pathological condition and not a proper diagnosis; it is rather a concept in the etiopathogenesis of which peripheral neuropathy, angiopathy and infection are involved. For diabetic foot ulceration to occur, the association of some of these causes is sufficient, and not all of these pathophysiological elements need to be present. Amputation and ulcer are the major adverse outcome of diabetic foot problems. Foot ulcers precede approximately 85% of all amputations in diabetic patients. In various studies, the proportion of patients undergoing amputation after gangrene was between 50-70%, and infection was found in 20-50% of patients (Natea, 2010).

Biochemical Analytes Involved in the Study

Diagnosis of diabetes mainly involves laboratory tests, which implies high qualitytests in accordance with good laboratory practice. There is a wide palette of tests that give us valuable information about the patient's glycemic curve, nutritional status, insulin resistance, metabolizing products, as well as the patient's lipid status (Zahiu et al., 2021).

The biochemical parameters studied were those specific to glucose metabolism: serum glucose and glycosylated hemoglobin.

Serum Glucose is the most important mono-saccharide in the blood, being the result ofcarbohydrate digestion and hepatic conversion of glycogen to glucose. The two hormones that regulate blood glucose levels are glucagon and insulin. Glucagon accelerates the conversionof glycogen and leads to increased blood glucose. Insulin increases the permeability of cell membranes to glucose and transports glucose into cells (for metabolism), stimulates glycogen formation and reduces blood glucose concentration. The inability of pancreatic beta cells to secrete insulin, reduction in the number of insulin receptors, and intestinal glucose

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malabsorption are 3 mechanisms that lead to altered glucose metabolism (Randie, 2004). Normal glucose level - 60-99 mg/dL, Altered basal glucose - 100 - 125 mg/dL, Diabetes - >= 126 (Fischbach & Dunning, 2009).

Glycosylated haemoglobin *(HbA1C)* is one of the most important markers of glycaemic control in patients diagnosed with diabetes. The HbA1C result shows the average blood glucose over the last 3 months. Determination of glycosylated haemoglobin is a means of assessing and monitoring glycaemic control in patients with diabetes. This type of test may also be recommended to avoid diabetic complications such as retinopathy and nephropathy. Normal values for glycosylated haemoglobin are between 4.8% and 5.6%. When values are between 5.6% and 6.4%, the patient may be in the pre-diabetes phase. All values above 6.5% indicate a clear diagnosis of diabetes. The therapeutic target for diabetic patients is below 7% (Song et al., 2023).

Lipid spectrum determination included: determination of total cholesterol (TC), low- density cholesterol (LDL-cholesterol), high-density cholesterol (HDL-cholesterol) andtriglycerides.

Cholesterol *(TC)* is a steroid compound that is part of the cell membranes of organs and tissues in the body and is essential for growth and development through its involvementin hormone and bile acid synthesis. In the blood, cholesterol forms, together with proteins,phospholipids and triglycerides, lipoprotein particles which, depending on their composition and density, can be VLDL cholesterol (very low density lipoproteins), LDL cholesterol (low density lipoproteins) and HDL cholesterol (high density lipoproteins). Excess cholesterol from dietary sources or defective endogenous synthesis is deposited endoluminally (on the inner surface of blood vessels) as a result of atherosclerosis, forming atheromatous plaques that cause clogging and stiffening of the arteries. The presence of atheromatous plaques, especially unstable ones, increases the risk of myocardial infarction and stroke, acute events which in some cases have a poor prognosis.

Determination of total cholesterol by summing the values obtained for each specific lipoprotein is intended to assess lipid status and quantify the risk of atherosclerosis, coronary stenosis and myocardial infarction in people diagnosed with metabolic disorders and dyslipidaemia.

Reference range values for total serum cholesterol are dependent on the age and sex of the patient: adult - optimal <200 mg/dL, upper limit - 200-240 mg/dL, elevated ≥240 mg/dL (Abbott et al., 1988).

Triglycerides (TG) in adipose tissue and other tissues are the body's most important store of energy reserves. In adipose tissue they are stored as glycerol, fatty acids and monoglycerides, which are converted in the liver to triglycerides that make up VLDL (80%) and LDL (15%). Hypertriglyceridaemia together with hypercholesterolaemia are independent risk factors for atherosclerotic disease. Triglyceride levels are also required for the calculationof LDL-C (Fischbach & Dunning, 2009). Optimal triglyceride levels in adults: <150 mg/dL.

Creatine kinase or creatine phosphokinase is an enzyme present in myocardium, muscle and brain that can be isolated in serum as 4 isoenzymes: mitochondrial, muscle (CK- MM), myocardial (CK-MB) and brain (CK-BB). The determination of CK values is diagnostically useful in the determination of acute myocardial infarction, stroke and various muscle injuries. In the presence of acute cardiac distress, CK is elevated 4-8 hours after the acute event, peaking 12-24 hours after myocardial infarction and returning to normal serum concentrations after 3-4 days (Adams et al., 1993). Reference values - < 24 U/L.

Serum urea is the end product of protein metabolism in the stomach and intestine. Urea is synthesised in the liver and eliminated in the urine. Between 50-60% is excreted back into the blood. Serum urea levels are directly related to the liver's ability to metabolise and the kidney's ability to excrete, with normal values being obtained by balancing these two functions. An increase in serum urea levels may represent severe glomerular insufficiency. Reference values for serum urea depend very much on the age of the patient and the functioning capacity of the liver as well as the kidneys.

The values considered to be reference values for serum urea are:

- < 1 year Normal serum urea value <41 mg/dL
- 1-18 years Normal serum urea value < 39 mg/dL
- 18-60 years Normal serum urea value <43 mg/dL
- 60-90 years Normal serum urea value <49 mg/dL (Ferguson et al., 1993).

Serum Creatinine is the anhydride of creatine (methylguanidyl acetic acid) and is its elimination form; it is formed in muscle tissue. Creatine is synthesised in the liver and after release is taken up by 98% in the muscle,

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where phosphorylation takes place, and in this form plays an important role in the storage of muscle energy (Lothar, 1998). When this muscle energy is required for the needs of metabolic processes, phosphocreatine is cleaved to creatinine. Creatinine is the most fixed nitrogenous constituent of blood, unaffected by most foods, exercise, circadian rhythm or other biological constants and is correlated with muscle metabolism. Once the serum creatinine value is determined, the glomerular filtration rate (eGFR), another important indicator in the diagnosis of kidney disease, can be calculated.The main use of serum creatinine determination is to diagnose renal failure. Serum creatinine is a more specific and sensitive indicator of renal function than urea (Fischbach & Dunning, 2009). Reference values: women - < 1, men - < 1.2.

Uric acid (UA) results from the degradation of nucleic acids and is the end product of purine metabolism. From the liver, it is transported by plasma to the kidneys, where it is filtered and excreted in about 70%. The remaining uric acid is eliminated and degraded in the gastrointestinal tract. Overproduction of uric acid occurs in the following situations: excessivecatabolism of nucleic acids (gout), massive production and destruction of cells (leukaemia) or inability to excrete the end product (renal failure) (Fischbach & Dunning, 2009).

Reference values for serum uric acid should be less than 7 mg/dL for men and less than 5.7 mg/dL for women.

C-reactive protein (CRP), a pentameric globulin that migrates electrophoretically in the gamma zone, is increased in tissue damage and inflammatory processes and is an acute phase reactant. CRP is a non-glycosylated protein with a pentameric structure that migrates electrophoretically near the gamma zone. It is a more sensitive and timely indicator than VSH (Laboratory Corporation of USA, 2010). CRP is a proinflammatory "trigger" in itself because it stimulates monocyte production of IL-1, IL-6 and TNF-α. Although the main source of CRPis the liver, recent data indicate that arterial tissue can produce both CRP and proteinsbelonging to the complement system (Dati & Metzmann 2005). Reference values - <0.5 mg/dL.

Potassium ion (K^+) is the main electrolyte (cation) and constituent of the buffer system in the intracellular fluid. 90% of potassium is concentrated inside the cell, with only small amounts present in bone and blood. Injured cells release potassium into the blood. The vast majority of potassium (90%) is in ionic form, the rest is bound to proteins. Potassium is essential for the normal functioning of membrane electrical phenomena. It also plays an important role in nerve conduction, muscle contraction, acid-base balance, osmotic pressure, protein anabolism and glycogen formation. Anabolic processes are accompanied by K+ fixation in the cell, and catabolic processes by its release. Potassium is preferentially concentrated in striated muscle, myocardium and liver. Together with calcium and magnesium, K^+ controls contraction and cardiac output (Fischbach & Dunning, 2009). Reference values: adults - 3.5 - 5.1.

MATERIAL AND METHODS

The present study was carried out over a period of 6 months, in the year 2022, at the Medical Analysis Laboratory of Medgidia Municipal Hospital, Constanta County, Romania.

The study includes 65 patients (38 women and 27 men, ages 43-82 years) grouped into3 groups: patients with DZ1 (n=27), patients with DZ2 (n=27) and non-diabetic patients (control, n=11), fulfilling the inclusion criteria and completing participation in the study. Eachpatient involved in the study signed informed consent with full knowledge of the facts.

Investigations were performed using the Mindray BS 800 automated analyzer with its specific reagents indicated by the manufacturer. Blood samples were collected byvenipuncture, a jéun (morning) in 5 mL tubes with separating gel without the need for decanting. Two methods were used to determine the biochemical parameters in the blood: spectrophotometric (enzyme colorimetric) and immunoturbidimetric methods.

The initial database was created using Excel, followed by statistical analysis of the data using SPSS 23. For the statistical analysis we used the data on the basis of which differences between groups were estimated using the Pearson $\chi 2$ test.

RESULTS AND DISCUSSIONS

Glycated hemoglobin % (HbA1c) and Serum glucose (mg/dL) were used to control diabetes. Reference values: serum glucose = 70 - 100 mg/dL, glycosylated haemoglobin (HbA1c) = 4.8 - 5.9 %.

Along with glycaemic control, other factors are relevant for the occurrence of complications in diabetes mellitus (DZ). Duration of diabetes, age, family history of complications, smoking, dyslipidaemia and hypertension are known to influence the development of complications (Copil, 1994).

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Table 1: Hoc Post Tests - Multiple Comparisons

Dependent Variable	Diagnosis	Diagnosis	p
Serum Glucose (mg/dL)	Type 1 diabetes	Type 2 diabetes	.000
		Healthy	.000
	Type 2 diabetes	Type 1 diabetes	.000
		Healthy	.027
	Healthy	Type 1 diabetes	.000
		Type 2 diabetes	.027
HbA1C (%)	Type 1 diabetes	Type 2 diabetes	.000
		Healthy	.000
	Type 2 diabetes	Type 1 diabetes	.000
		Healthy	.005
	Healthy	Type 1 diabetes	.000
		Type 2 diabetes	.005
Serum Urea (mg/dL)	Type 1 diabetes	Type 2 diabetes	.472
		Healthy	.162
	Type 2 diabetes	Type 1 diabetes	.472
		Healthy	.010
	Healthy	Type 1 diabetes	.162
		Type 2 diabetes	.010
TC (mg/dL)	Type 1 diabetes	Type 2 diabetes	.001
		Healthy	.194
	Type 2 diabetes	Type 1 diabetes	.001
		Healthy	.900
	Healthy	Type 1 diabetes	.194
		Type 2 diabetes	.900
HDL Cholesterol (mg/dL)	Type 1 diabetes	Type 2 diabetes	1.000
		Healthy	.004
	Type 2 diabetes	Type 1 diabetes	1.000
		Healthy	.004
	Healthy	Type 1 diabetes	.004
		Type 2 diabetes	.004
LDL Cholesterol (mg/dL)	Type 1 diabetes	Type 2 diabetes	.001
		Healthy	.511
	Type 2 diabetes	Type 1 diabetes	.001
		Healthy	.424
	Healthy	Type 1 diabetes	.511
		Type 2 diabetes	.424
TG (mg/dL)	Type 1 diabetes	Type 2 diabetes	.198
		Healthy	.006
	Type 2 diabetes	Type 1 diabetes	.198
		Healthy	.223
	Healthy	Type 1 diabetes	.006
		Type 2 diabetes	.223
Uric acid (mg/dL)	Type 1 diabetes	Type 2 diabetes	.636
		Healthy	.126
	Type 2 diabetes	Type 1 diabetes	.636
		Healthy	.011
	Healthy	Type 1 diabetes	.126
		Type 2 diabetes	.011
Weight (Kg)	Type 1 diabetes	Type 2 diabetes	.000
		Healthy	.479
	Type 2 diabetes	Type 1 diabetes	.000
		Healthy	.000
	Healthy	Type 1 diabetes	.479
		Type 2 diabetes	.000

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Note: To specify "*who from whom differs*" read the p-values from the Post Hoc Tests Multiple Comparisons table. When $p < 0.05$, significant differences are considered to exist between the mean values compared. Thus for Serum Glucose (mg/dL), there were significant differences between all groups.

The mean serum glucose values in DZ1 (276.96 ± 80.98) differed statistically significantly ($p < 0.05$) from the mean glucose values in DZ2 (155.56 ± 53.90), but also in non-diabetic patients, the mean glucose values (94.64 ± 6.92) differed significantly. Thus for serum glucose there are significant differences between all groups (Table 1).

For the DZ1 study group, the mean values of HbA1C were: 10.68 ± 1.93 which statistically significantly ($p<0.05$) differs from the mean values of the DZ2 group (7.13± 1.09)but also from the non-diabetic group (5.44 ± 0.35).

According to ANOVA analysis, for HbA1C there are statistically significant differences between all groups involved in the study (Table 1).

The risk for coronary heart disease starts as early as DZ1 or even pre-diabetes blood glucose values.

Management of dyslipidaemia in patients with DZ associated with cardiovascular protection leads to reduction of atherosclerotic cardiovascular events and coronary mortality. Chaturvedi et al. (2001) found that the association of microvascular complications is seenamong those with elevated cholesterol, triglyceride and retinopathy incidence.

Alam Verma (2015) demonstrated through epidemiological studies the role of diabetes mellitus as a risk factor for cardiovascular and cerebrovascular disease and also peripheral vascular disease. In type 2 diabetes mellitus, an input to the development of atherosclerosis is the alteration of lipids and lipoprotein profile. Changes such as increased plasma triglycerides, decreased HDL-C values with predominantly increased LDL-C, and elevated apolipoproteinB values are what is termed diabetic dyslipidaemia.

Dyslipidemia is characterized by elevated plasma cholesterol, triglycerides, one or both parameters or low HDL-C concentration and can be of two types: primary (or genetic) or secondary dyslipidemia, diagnosis is made by determining plasma cholesterol, triglycerides and individual lipoproteins (Alam et al., 2015).

The most common variant of dyslipidemia characteristic of metabolic syndrome is the lipid triad: hypertriglyceridemia accompanied by high low-density cholesterol and low high- density cholesterol (Revenco et al., 2005).

DZ-specific dyslipidaemia involves alterations in lipoprotein metabolism both exogenously, through increased dietary intake of lipids (especially triglycerides), and through endogenous changes, the main substrate of which is increased hepatic production of triglyceride-rich very low density lipoproteins (VLDL).

Table 2: Lipid spectrum changes in patients in the 3 study groups (mean values, standarddeviation and statistical significance (p-value) of groups compared by One-Way ANOVAanalysis

Determinedanalyte	Patients with DZ1 Mean ± SD	Patients with DZ2 Mean ± SD	Non-diabetic patients Mean ± SD	p-value for the 3 groups
Total cholesterol(mg/dL)	207,37 ± 60,51	151,37± 53,72	171,36 ± 26,82	<0,001
HDL cholesterol(mg/dL)	41,23 ± 11,07	41,39 ± 15,03	26,56 ± 4,69	0,002
LDL cholesterol(mg/dL)	137,60 ± 49,50	93,17 ± 41,87	116,18 ± 24,94	0,002
Triglyceride(mg/dL)	213,59 ± 106,04	167,44 ±88,48	108,60 ± 35,85	0,006
VLDL cholesterol	42,60 ± 21,18	33,49 ± 17,70	21,67 ± 7,11	0,007
Atherogenic Risk	5,23 ± 1,59	3,96 ± 1,34	6,54 ± 1,15	<0,001

Caixas et al.,1997 found that in well-controlled type 1 DZ, lipid parameter values are often close to normal. Inadequate glycaemic control may, however, be accompanied by severe hypertriglyceridaemia caused by markedLy reduced insulinemia leading to hepatic hyperproduction of VLDL and decreased clearance of VLDL and chylomicrons throughinactivation of lipoprotein lipase (LPL) (Alexa et al., 2009).

The presence of dyslipidaemia increases the risk of atherosclerotic cardiovascular disease by 2-4 times (Reaven, 2002).

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Table 3: Correlation coefficient interpretation

Coefficient value	Interpretation
0,90 ÷ 1,00 (-0,90 ÷ -1,00)	Very strong or almost perfect positive (negative) correlation
0,70 ÷ 0,90 (-0,70 ÷ -0,90)	Strong positive (negative) correlation
0,50 ÷ 0,70 (-0,50 ÷ -0,70)	Moderate positive (negative) correlation
0,30 ÷ 0,50 (-0,30 ÷ -0,50)	Weak to moderate positive (negative) correlation
0,01 ÷ 0,30 (-0,01 ÷ -0,30)	No or very weak positive (negative) correlation

In DZ1 the most advanced disorders of carbohydrate and lipid metabolism were found. After normalization of glycemia in DZ1 patients, there were trends towards normalization of lipid spectrum indices. In DZ2, after glycemic improvement, increased cholesterol,triglyceride and HDL-cholesterol values were maintained (Alexa et al., 2009).

Note: If $p < 0.05$ the two variables are considered to be correlated and the interpretation of the correlation coefficient value is according to the table below adapted from Hinkle, Wiersma and Jurs, 1988, (Table 3).

Table 4: Pearson correlation between HDL with Glucose and HbA1C for the study groups

Diagnosis		Serum Glucose		HbA1C
DZ1	**HDL**	Pearson Corellation (r)	-.022	.162
		Sig. (2-tailed) (p)	.914	.420
		N	27	27
DZ2	**HDL**	Pearson Corellation (r)	-.282	.281
		Sig. (2-tailed) (p)	.154	.156
		N	27	27
Non-diabet	**HDL**	Pearson Corellation (r)	-.312	.580
		Sig. (2-tailed) (p)	.350	.061
		N	11	11

For the DZ1 group, HDL (mg/dL) did not correlate with Glucose (mg/dL) ($r = -0.22$, $p = 0.914 > \alpha = 0.05$) nor with HbA1C ($r = 0.162$, $p = 0.420 > \alpha = 0.05$) (Table 4). For the DZ2 group, HDL (mg/dL) did not correlate with glucose (mg/dL) ($r = -0.282$, $p = 0.154 > \alpha = 0.05$) nor with HbA1C ($r = 0.281$, $p = 0.156 > \alpha = 0.05$). For the Non-diabetes group, HDL (mg/dL) did not correlate with Glucose ($r = -0312$, $p = 0.350 > \alpha = 0.05$) nor with HbA1C ($r = 0.580$, $p = 0.061 > \alpha = 0.05$) (Table 4).

Triglycerides in adipose tissue stores are broken down and free fatty acids and glycerol increase in the blood while inhibiting glucose utilization processes at different levels further accentuating hyperglycemia. Excess free fatty acids and acetyl coenzyme A lead to excess formation of ketone bodies and cholesterol in the liver.

By increasing the number of LDL receptors in the hepatocytes, patients with DZ2 have lower serum LDL-cholesterol levels than those with DZ1 (Table 5).

Cardiovascular disease is present in patients taken in the study, both in patients with DZ1 and DZ2 (CKMB mean 17.48 ± 9.80 in patients with DZ1 and mean 21.07 ± 16.76 in patients with DZ2).

Table 5: Pearson correlation between LDL with glucose and HbA1C for the study groups

Diagnosis		Serum Glucose		HbA1C
DZ1	**LDL**	Pearson Corellation (r)	.081	.302
		Sig. (2-tailed) (p)	.687	.126
		N	27	27
DZ2	**LDL**	Pearson Corellation (r)	-.416*	-.179
		Sig. (2-tailed) (p)	.031	.371
		N	27	27
Non-diabet	**LDL**	Pearson Corellation (r)	.083	.416
		Sig. (2-tailed) (p)	.808	.203
		N	11	11

*Correlation is significant at the 0.05 level (2-tailed)

The installation of renal disease in DZ2 is evidenced in our study by the statistically significant correlation between Glucose and Urea. The results obtained by EGFR estimation require regular monitoring in patients in whom diabetic kidney disease has been installed.

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The decreased uptake of amino acids in extrahepatic tissues increases the level of amino acids in the blood which are accumulated and used in the liver in gluconeogenesis. Asa result of increased degradation of amino acids, urea production increases.

Table 6: Pearson correlation between Uric Acid with Urea and Creatinine for the studygroups

Diagnosis			Serum Urea	Serum Creatinine
DZ1	**Uric acid**	Pearson Corellation (r)	.549**	.724**
		Sig. (2-tailed) (p)	.003	.000**
		N	27	27
DZ2	**Uric acid**	Pearson Corellation (r)	.761*	-.393*
		Sig. (2-tailed) (p)	.000**	.042
		N	27	27
Non-diabet	**Uric acid**	Pearson Corellation (r)	-.389	.247
		Sig. (2-tailed) (p)	.237	.464
		N	11	11

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

Preservation of renal function, in patients in our study, is demonstrated by the mean values of Urea and Creatinine (values for Urea in patients with DZ1 51.04 ± 23.55 and 62.70

±39.47 in patients with DZ2, and for Creatinine we obtained the following values: 0.90 ± 0.33for DZ1 and 1.03 ± 0.61 for DZ2) and non-affected glomerular filtration is demonstrated by EGFR means (mean values for DZ1 84.67 ± 25.86, and for DZ2 76.96 ± 27.30).

Assessment of renal function was also performed by determination of Uric Acid whichcorrelated with statistical significance with Urea and Creatinine in DZ2 patients in our study (Table 6).

For diabetic patients, uricemia may be normal or elevated, in the latter case due to reduced uric acid excretion.

C-reactive protein C, a pentameric globulin that migrates electrophoretically in the gamma zone, increases in tissue damage and inflammatory processes and is an acute phase reactant. Inflammation of the arteries of the heart can give increased levels of CRP. Possibly high levels of LDL cholesterol that has deposited on the walls of blood vessels and causes inflammation may be expressed by increased CRP levels.

Tabel 7. Pearson correlation between Potassium ion (K^+) with Glucose and HbA1C for DZ2group

Diagnosis		Serum Glucose		HbA1C (%)
DZ2	K^+ (mmol/L)	Pearson Corellation (r)	.087	.390*
		Sig. (2-tailed)	.666	.045
		N	27	27

*Correlation is significant at the 0.05 level (2-tailed).

Electrolyte imbalances in DZ2 are directly related to HbA1C values; the statistically significant correlation between K and HbA1C levels in DZ2 confirms the close relationship between electrolyte imbalances and severe disease progression in DZ2 (Table 7).

CONCLUSIONS

The mean serum glucose values in DZ1 (276.96 ± 80.98) differed statistically significantly ($p < 0.05$) from the mean glucose values in DZ2 (155.56 ± 53.90), but also in non-diabetic patients, the mean glucose values (94.64 ± 6.92) differed significantly.

According to Anova analysis, for HbA1C there are statistically significant differences between all groups involved in the study.

Hypertriglyceridemia is present at a higher frequency in patients with DZ1 comparedto DZ2, which implies that the risks of ischemic events are also higher in patients with DZ1.

By increasing the number of LDL receptors in the hepatocytes, patients with DZ2 have lower serum LDL-cholesterol levels than those with DZ1.

Lipid profile analyses (TC and LDL) correlate with statistical significance with glucose in DZ2.

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The installation of renal disease in DZ2 is evidenced in our study by the statistically significant correlation between Glucose and Urea.

The correlated increase in Urea and Creatinine is a good indicator of impaired renal function through disruption of the glomerular filtration process.

The diabetic patient is also assessed for obesity, obesity being one of the risk factors associated with impaired glucose metabolism. Weight measurement is necessary, especially inpatients with diabetes associated with heart failure and unexplained weight fluctuations.

Cardiovascular disease is present in patients taken in the study, both in patients with DZ1 and DZ2. Inflammation of the arteries of the heart can give increased levels of CRP.

Electrolyte imbalances in DZ2 are directly related to HbA1C values; the statistically significant correlation between K and HbA1C levels in DZ2 confirms the close relationship between electrolyte imbalances and severe disease progression in DZ2.

Multiple cellular impairments within metabolic abnormalities in early and advanced stages of diabetes are expressed by statistically significant correlations between determined biochemical analytes.

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DNA GYRASE AS A POTENTIAL DRUG TARGET-A REVIEW

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ABSTRACT
The remarkable enzyme DNA gyrase is responsible for catalysing the ostensibly complicated process of DNA supercoiling. Gyrase is a good target for antibacterial medicines since it is crucial to prokaryotes. These substances interact with gyrase in a variety of ways and have various chemical structures. An important bacterial enzyme called DNA gyrase is responsible for the ATP-dependent negative super-coiling of double-stranded closed-circular DNA. Gyrase is a member of the group of enzymes called topoisomerases that regulate DNA's topological transitions. From an enzymological perspective, the process by which gyrase is able to affect the topological state of DNA molecules is of inherent interest. Additionally, the intracellular target of several antibacterial drugs, DNA gyrase, has received a lot of interest as a model for additional DNA topoisomerases. In this review, we discuss a variety of elements of the study of DNA gyrase in order to provide a current summary of our understanding.

Keywords: DNA gyrB, Staphylococcus, drug target, inhibitors, etc.,

INTRODUCTION
Once thought to be a common flora found in 30% of the human population, Staphylococcus aureus has become known for being the cause of numerous serious infections in both healthy individuals and immunocompromised people (1). Recently, S. aureus infections have also been linked to a significant increase in human morbidity and mortality in both community and hospital settings (2). Moreover, S. aureus strains that mix virulent and resistant genes have emerged as a significant therapeutic challenge in the US, Europe, and developing nations like India. The creature has poisons, enzymes, surface proteins, a capsule, and a cell wall (3).

Epidemiology
Humans frequently contract staphylococcal infections, which are thought to be a natural source of S. aureus infections. Additionally, *S. pseudointermedius*, *S. epidermidis*, *S. saprophyticus*, *S. lugdunensis*, *S. schleiferi*, and *S. caprae* are among the other Staphylococcal species implicated in infections. Ten to twenty percent of the thirty adult colonised individuals are consistently colonised. Individuals who have S. aureus colonisation typically have a higher chance of contracting new infections. Patients with HIV infections, hemodialysis patients, patients with intravenous drug use, and patients with type 1 diabetes all have significant rates of staphylococcal colonisation. Young women are more likely to have toxic shock syndrome, but children are more likely to be persistent carriers of the bacterium [4].

The Causative Agent *S. Aureus*
S. aureus is a Gram-positive, catalase-positive cocci that belongs to the nonmotile, nonspore-forming Staphylococcaceae family. It is a facultative anaerobe that typically forms clusters. A wide range of bacterial products and components are available to S. aureus, which aid in the pathophysiology of infection. These elements and byproducts of the bacterium should ideally play complementary roles and be able to function both alone and in tandem. While much is known about how these bacterial factors affect the course and outcome of infections, relatively little is known about how they interact with host factors and other bacterial components and how important an impact they have on infection [5].

The organism is commensal, colonising the throat, vagina, nares, axillae, and injured skin surfaces. Because staphylococci can enter the body through a break or rupture in the skin or mucosal barrier, *S. aureus* infections have an unusually high pathogenicity factor. S. aureus virulence factors and host defence mechanisms interact intricately to determine how quickly an infection spreads, but mucin seems to be the key host surface that gets colonised. The higher susceptibility to infection is caused by multiple causes. When foreign material is present, phagocytic function is significantly compromised. The pathophysiology of nosocomial endocarditis and bacteremia is often linked to intravenous catheters. Moreover, bacterial pathogenicity is decreased by regulatory gene inactivation. Protease, hyaluronidase, and lipase are only a few of the enzymes that S. aureus produces and which break down the host tissue. An enzyme called β-lactamase inactivates penicillin, giving the organism tolerance to a variety of antibiotics [6]. More than 2,000 blood culture isolates of S. aureus were gathered between 1957 and 1966 by the Statens Serum Institute in Copenhagen. When the isolates were examined in detail to determine the source of the infection, it was found that a high percentage of penicillin-resistant strains (85% to 90%) developed from hospital isolates of *S. aureus*.

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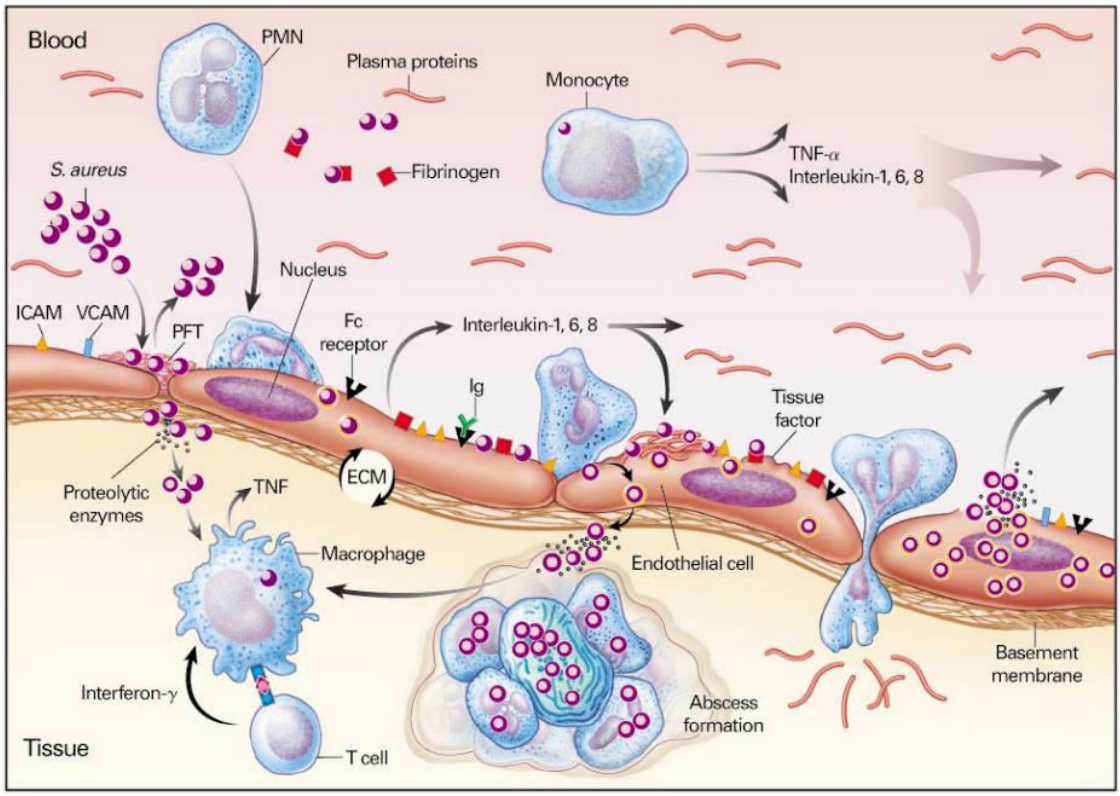

Figure 1.1: Pathogenesis of Staphylococcal Invasion of Tissue [5]

2. DNA Gyrase as a Drug Target

It has been demonstrated that topoisomerases, which are ubiquitous enzymes found in both prokaryotic and eukaryotic cells, are critical to the survival of the organism. Eukaryotic topoisomerases are targets for anticancer drugs, taking advantage of the fact that cancer cells divide more quickly than other cell types due to their crucial roles in DNA replication. Examples of antitumor medications that target eukaryotic topoisomerases for viability are camptothecin and etoposide. It has been discovered that medicinal drugs can effectively target DNA gyrase in prokaryotes [7]. Despite sharing evolutionary kinship with other topoisomerases, gyrase is unique among this group of enzymes in that it has the ability to insert supercoils into DNA, hence reducing stress on bacterial DNA [8]. There seem to be many opportunities for drug targeting in this intricate process, and a number of helpful drugs are known. We have focused on the type IIA bacterial topoisomerase, DNA Gyrase, an important enzyme involved in bacterial replication through the ATP-dependent supercoiling of DNA, in our search for novel drugs with efficacy against *S. aureus.*

3. Mechanism of the DNA Gyrase Enzyme

DNA gyrase has the ability to link the energy of ATP hydrolysis to the creation of negative supercoils in plasmid DNA, despite the fact that all type II topoisomerases require ATP hydrolysis for the effective relaxation of supercoils. Since removing this area results in an enzyme that can relax DNA but not introduce negative supercoils into the DNA, this enzyme property depends on the DNA binding region present in the C-terminal domain of the A subunit.

The DNA gyrase-catalyzed negative supercoiling reaction has two secrets. The first is that the protein has a right-handed writhe around the DNA that is coupled to the C-terminal domain. A confined positive supercoil that results is linked to about 140 base pairs of DNA. The second element of the response. DNA gyrase has the ability to link the energy of ATP hydrolysis to the creation of negative supercoils in plasmid DNA, despite the fact that all type II topoisomerases require ATP hydrolysis for the effective relaxation of supercoils. Since removing this area results in an enzyme that can relax DNA but not introduce negative supercoils into the DNA, this enzyme property depends on the DNA binding region present in the C-terminal domain of the A subunit. The DNA gyrase-catalyzed negative supercoiling reaction has two secrets. The first is that the protein has a right-handed writhe around the DNA that is coupled to the C-terminal domain. A confined positive supercoils those results is linked to about 140 base pairs of DNA. The second element of the response

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4. Inhibitors targeting Gyr B domain of the DNA Gyrase

Aminocoumarin

A well-known class of antibiotics, aminocoumarins work by inhibiting the DNA gyrase enzyme, which is necessary for bacterial cell division. The 3-amino-4,7-dihydroxycoumarin ring is the fundamental building block of an aminocoumarin. Aminocoumarins are thought of as the "Cinderellas" of the gyrase inhibitor class, in contrast to floroquinolones. The family of aminocoumarins that were isolated from Streptomyces species includes novobiocin, clorobiocin, and coumermycin A1. Nevertheless, several derivatives of aminocoumarins were produced through chemical synthesis, metabolic engineering, and genetic modification.

Cyclothialidine

Cyclothialidines include a substituted resorcinol ring with the attached pentapeptide chain (Cys, Ala, Ser, Pro, and Ala). Their mode of action is similar to the aminocoumarin drugs where the Gyr B domain is targeted and not the Gyr A. Cyclothialidines are effective competitive inhibitors to ATP and thus the supercoiling activity of the gyrase is inhibited via the inhibition of Gyr B [9]. Despite their higher potencies and better selectivity against topoisomerases as well in comparison to the coumarin class, they lack in vivo antibacterial activity due to their high lipophilicity nature. Recently, several fruitful attempts are being made to improve their water solubility and permeability characteristics and to increase their in vivo activities.

Pyrrolamides

Using HTVS screening and a structure-guided design approach, the pyrrolamide class of drugs was initially discovered at AstraZeneca to be new DNA Gyr B inhibitors with potent antibacterial activity. It was discovered, meanwhile, that the pyrrolamides target DNA gyrase, an important enzyme that is present in a wider variety of bacterial species. When DNA gyrase is inhibited, DNA synthesis is disrupted, which leads to cell death. Pyrrolamides with enhanced cellular activity and in vivo efficacy were produced as a consequence of further optimisation of biochemical activity and other drug-like qualities by different substitutions to the pyrrole, piperidine, and heterocycle sections of the parent molecule. Additionally, these compounds' broad spectrum, mode of action, and antibacterial activity highlight the potential of the pyrrolamide series as desirable candidates.

Benzimidazoles

By using high throughput screening (HTS), Vertex Pharmaceuticals created the benzimidazole, an innovative class of drugs that target both *S. aureus*'s Gyr B and topoisomerase IV. In 2012, benzimidazole ureas were assessed for their ability to inhibit Gyr B. They demonstrated an efficient IC50 in the nanomolar range and shown activity against strains resistant to fluoroquinolones as well as mouse models. [10]. The benzimidazole nucleus was substituted in a number of ways in an effort to create a structure-activity link. At the R1 position, a short alkyl chain was preferred because it made it possible for the core moiety to attach more tightly by penetrating the active site pocket deeper. Second, it was found that the ring connected to the benzimidazole R2 location could access the pocket that the ribose of ATP was occupying. These interactions were thought to be crucial for the ligand's ideal binding in Gyr B's ATP-binding pocket. The optimal enzyme inhibitory efficacy was found to be provided by coplanarity at the R3 position; one such molecule, 3-fluoropyridin-2-yl, was optimised to be the perfect substituent at this position.

Bithiazoles

A new class of 4′-methyl-N2 -phenyl-[4,5′-bithiazole]-2,2′-diamine was discovered and described as bacterial Gyr B inhibitors (11). The 2-aminothiazole moiety of this class was able to meet the general requirement for acceptor-donor interaction pattern gyrase inhibition and might be viewed as a suitable starting scaffold. Similar to what they discovered in earlier research, they discovered that the modified phenyl ring, which was able to have extra hydrophobic contacts, and the first thiazole ring seemed to be a good linker. Moreover, it was demonstrated that the phenyl ring substitution was significant, and that the hydrogen bond acceptor on the phenyl ring's para position was presumably essential for the enzyme's inhibitory function. The intensity of the binding contacts in this instance was greatly enhanced by the carboxyl group's ability to generate extra ionic connections. Moreover, the 2′-acetyl substitution of the 2′-amino group typically results in an increase in the inhibitor's activity. In the hydrophobic pocket of the ATP-binding site, the lipophilic portion of the 2′ substituent generates

CONCLUSION

Efforts since 1950’s to discover a drug against DNA Gyr B enzyme have not been fruitful as resistance, a man-made amplification of a natural phenomenon has allowed the resurgence of S. aureus in a new virulent forms of MRSA; making the presently available anti-Staphylococcal drug regime inadequate to address the inherent and

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emerging challenges of treatment. The nosocomial infections along with the development of community associated-methicillin resistant Staphylococcus aureus strains has made the the process of drug development an almost impossible mechanism. Thus the targets selected, in this thesis Staphylococcal DNA gyrase and DNA Gyr B are attractive as they are relatively less exploited targets in the field of drug discovery and hence holds an immense potential for the development of novel agents against them as they are not impacted by target mediated cross-resistance associated with previously reported drugs.

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ETHANOBOTANICAL STUDY OF MEDICINAL PLANTS USED TO TREAT ASTHMA AND COUGH IN YERCAUD HILLS, SALEM, TAMILNADU, INDIA

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ABSTRACT
India, is medically and culturally varied nations in the world, has a long history of using herbal medicines, which is still appreciated today. The present study will show us the medicinal plants which have been used to cure asthma and cough which is found in Yercaud hills. There is a total of 13 species of plants from 8 different families is used to treat asthma and the sum of 9 species of plants from 6 different species is used to treat cough. The mode of formulation will differ according to each plant species which is discussed in this article. The different parts of plants are used to cure the disease such as leaf, seed, rhizome, root, bark, fruit and flower.

INTRODUCTION
Research in the field of ethnobotany is based on the amazing plants of Indian forests, notably those in Tamil Nadu [4]. India is home to roughly 49,000 species of plants that are spread across various regions and are being related to tribe as well as medicinal information [1]. According to the World Health Organization, traditional medicines frequently include medicinal plant or their active ingredients, and 80 percent of worldwide people sets a high value on them [2]. John Harshberger, an American botanist, coined the term "ethnobotany" in 1896 to describe the studies of how humans utilize plants [4]. In the area of research, particularly for the identification of organic medications, conventional healers and ethno medicinal knowledge may offer significant hints for the choice, manufacture, and recommendations for the application of medicinal herbs [2]. The native population has cultivated extensive knowledge of medicinal plants over many centuries through risk-taking and trial-and-error tactics [7]. They were able to preserve and use plant assets efficiently due to the indigenous knowledge of herbal medicines that has been passed down through generations without even any written documents [2]. These tribal communities have a wide range of data about using medicinal plants to cure many ailments and illnesses without having any adverse affects because they live in a region with a diverse variety of plant life [2]. About 85percent of the global total, based on a WHO survey, actively relied on nature environment and its related conventional medical sector for their basic medical needs [3].

Having signs directly linked with genetic origin, ecological effects, contact with infections or foreign particles, for instance, asthma is a long-term condition defined as fluctuating breathing restriction and/or bronchial hyper-reactivity [5]. Cough is a frequent complication of bronchial ailments which can been classified into acute or persistent in origin [6]. While acute cough is among the most frequent appearances in bronchial problems, acute cough is the most frequent singular reason for appointment in patient healthcare [6]. The severity of the cough will vary according to the ages and gender of the worldwide population [6].

An wide variety of plant species can be found in the Yercaud Hills [8]. In this article medicinal plants used to treat asthma and cough will be discussed. There is a plethora of data on the history of indigenous ethnomedicinal use in Yercaud [2].

STUDY AREA
From Coromandal in West Bengal to Kanyakumari in Tamilnadu, the Indian peninsula's Eastern Ghats, a discontinuous range of hills, stretches for around 1600 kilometres in a north-south direction [3].The Yercaud hills Iain district of salem. The Salem district of Tamil Nadu contains the Yercaud mountain range, which is situated northeast of the Eastern Ghats. A substantial portion of India is blanketed in beautiful vegetation. 150 kilometres long (390 Sq. km). It is located within 11°45’56” N latitude and 78°17’55” E longitude. The temperature range is 13°C 30°C on the summits and nearly 25°C to 40°C towards the seaside. The average rainfall is approximately 1500-1750 mm [8]. Clay loamy soil dominates the region of the highest peak, while alluvial and clay loam soils dominate the valley’s bottom [1].

METHODS OF STUDY
The aim is to collect information about the medicinal plants which is used to cure asthma and diabetes which is found in Yercaud hills [2]. The information was gathered on the regional nomenclature of plants, therapeutic applications, part(s) utilized, additional components if any added, method of preparation, and administering method [4]. Collecting, identifying and preserving ethnobotanical plants following accepted practises, representative herbarium specimens of every medicinal plant species discovered [4].

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DISCUSSION AND RESULT:

(1)Asthma:
A sum of 13 medicinal plant is used to used in the treatment of asthma which will fall under 8 families which have been given in table 1 and table 2. It's botanical name, local name, parts used and mode of formulation. The families are Acanthaceae, Moraceae, Solanaceae, Alliaceae, Aroidea, Asclepiadaceae, Euphorbiaceae and Combretaceae which have been discussed in table 1 and table 2.

According to the parts used in the formulation it is classified as leaf, seed, rhizome, root, flower, bark and fruit. In the treatment of asthma leaf(56.3%) is mostly used and other parts also have been used which have been mentioned in figure 1.

Based on the mode of formulation of the plant is classified as extract, juice, paste, decoction, crushed, powdered,raw and mixed with honey. For treating the asthma decoction(30.8%) formulation is mostly used and the percentage of other formulation is given in figure 2.

(2)Cough:
A total of 9 plants have been used for treating cough which comes under 6 families. It's botanical name, local name, parts used and mode of formulation is described in table 3. The families are Acanthaceae, Lamiaceae, Piperaceae, Zingiberaceae, Nyctaginaceae and Asclepiadaceae which is mentioned in table 4.

In the treatment of cough leaves(41.7%) are majorly used other parts such as rhizome, root, flower, bark and fruit details have been discussed in figure 3.

According to the mode of formulation of the plant part extract(33.3%) is majorly used and other parts such as juice, decoction, raw, mixed with honey and powder mixed with milk percentage details have been given in figure 4.

Conclusion:
The medicinal plants since have used several years ago the modern medicinal drugs have been derived from the medicinal plants based on the local information for that medicinal plant. In this article totally 22 plants have been discussed out of which 13 medicinal plants have been used to cure asthma and 9 medicinal plants have involved in the treatment of cough. Where leaves has been commonly used and other part such as seed, rhizome, root, flower, bark and fruit. It have been formulated as extract, juice, paste, decoction, crushed, powder, raw and mixed with honey. Extract and raw part is frequently used.

Table 1: Plant species used in the treatment of asthma

S.NO	Botanical name	Family name	Local name	Parts used	Mode of application
1.	*Justicia adhatoda* L.	Acanthaceae	Adathoda	Leaf	Asthma can be cured by taking extracts of leaves orally.
2.	*Adhatoda zeylanica* Medicus.	Acanthaceae	Adathodai	Root, bark, leaves and flowers	Flowers, leaf, root, and barks are employed to treat asthma.
3.	*Artocarpus hirsutus* Lam.	Moraceae	Kattupala	Seed	To relieve asthma, seeds and honey are combined.
4.	*Solanum trilobatum* L	Solanaceae	Thoodhuvalai	Leaf	For treating asthma, extract of leaves is taken internally.
5.	*Withania somnifera* (L.) Dunal.	Solanaceae	Amakalan	Leaf	To cure asthma, leaves paste and cow's milk are combined.
6.	*Allium sativum* Linn.	Alliaceae	Pundu	Leaf	Leaves is used to cure asthma.
7.	*Acorus calamus* L.	Aroidea	Vashambu	Rhizome	To treat asthama, rhizome decoction is ingested orally.

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8.	*Adathoda vasicaNees*	Acanthaceae	Adathoda	Leaf	For treating asthama, a decoction of leaves is ingested orally.
9.	*Calotropis gigantea* (L) R.Br.	Asclepiadaceae	Erukku	Flower	To treat asthma, a flower decoction is administered directly.
10.	*Datura metal* L.	Solanaceae	Umathai	Leaf	Inhaling leaf juice treats asthma.
11.	*Euphorbia hirta* L	Euphorbiaceae	Amman-pacharisi	Leaf	Asthma is treated using goat milk mixed with crushed leaves.
12.	*Physalis minima* L.	Solanaceae	Putter thalai	Leaf	To cure asthma, a decoction of leaves is administered orally.
13.	*Terminalia chebula* Retz	Combretaceae	Kadukkai	Fruit	To cure asthma fruit powder is taken internally

Table 2: Families used for treating asthma

Families	No. of species
Acanthaceae	3
Moraceae	1
Solanaceae	4
Alliaceae	1
Aroidea	1
Asclepiadaceae	1
Euphorbiaceae	1
Combretaceae	1

Table 3: Plant parts used in the treatment of cough

S.NO	Botanical name	Family	Local name	Parts used	Mode of application
1.	*Justicia adhatoda* L.	Acanthaceae	Adathoda	Leaf	To treat cough, extract of leaves can be administered orally.
2.	*Justicia tranquebariensis* L.	Acanthaceae	Thavasi murungai	Leaf	To treat cough, extract of leaves are given orally.
3.	*Ocimum sanctum* L.	Lamiaceae	Thulasi	Leaf	Extract of leaves was ingested for treating dry cough.
4.	*Piper nigrum* L.	Piperaceae	Kurumilagu	Fruit	For treating dry cough, powdered dried fruit is taken orally with milk
5.	*Zingiber officinale* Roscoe	Zingiberaceae	Ingi	Rhizome	Honey and extract of rhizome are combined to treat coughs.
6.	*Adhatoda zeylanica* Medicus.	Acanthaceae	Adathodai	Root, bark, leaves and flowers	Root, bark, leaves and flowers used for cough.
7.	*Bougainvillaea spectabilis* Willd.	Nyctaginaceae	Kaaghithapoo	Root	Cough can be treated with root juice.

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8.	*Calotropisgigantea*	Asclepiadaceae	Erukku	Flower	To cure cough, a decoction of flower is used internally.
9.	*Ocimum basilicum* L.	Lamiaceae	Tirunitru patchi	Leaf	For healing cough, leaves are consumed internally.

Table 4: Families used for curing cough

Families	No.of species
Acanthaceae	3
Lamiaceae	2
Piperaceae	1
Zingiberaceae	1
Nyctaginaceae	1
Asclepiadaceae	1

Figure 1: Plant parts used in the treatment of asthma

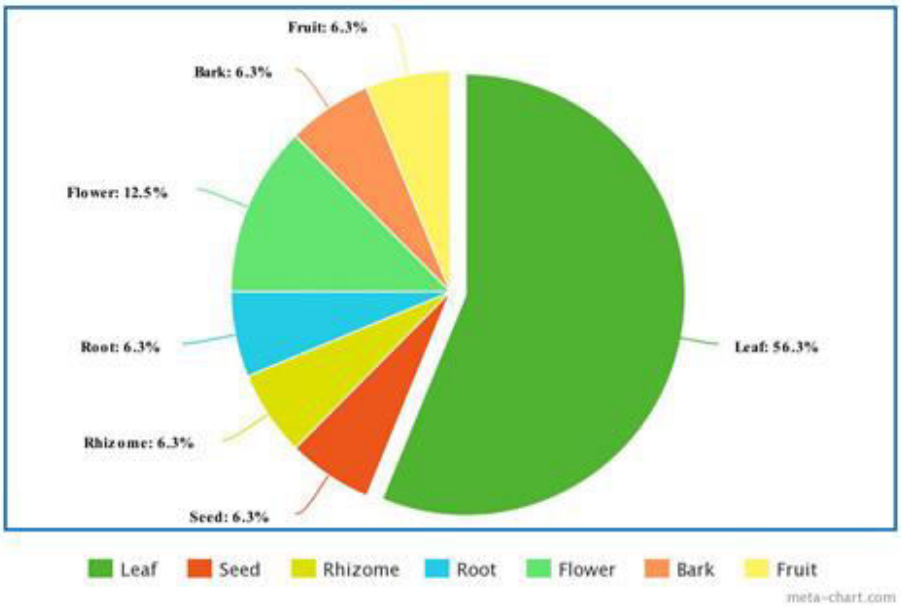

Figure 2: Mode of formulation for treating asthma

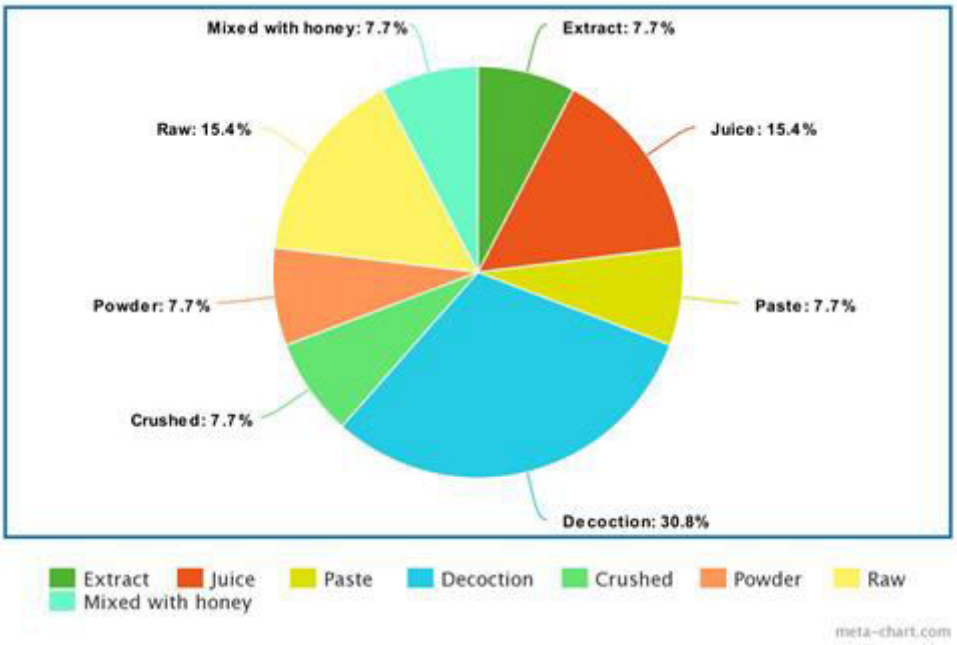

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Figure 3: Plant part used in the treatment of cough

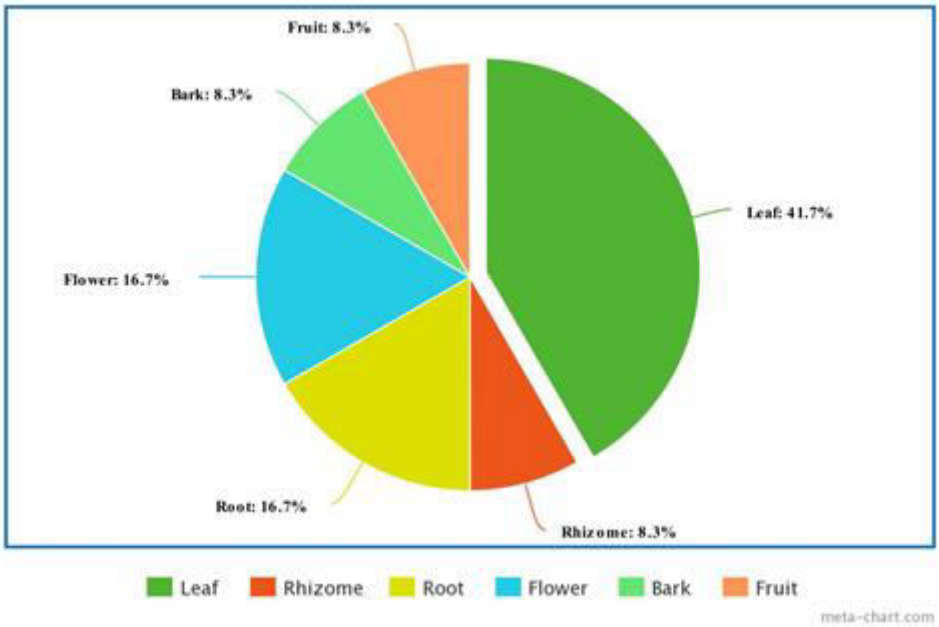
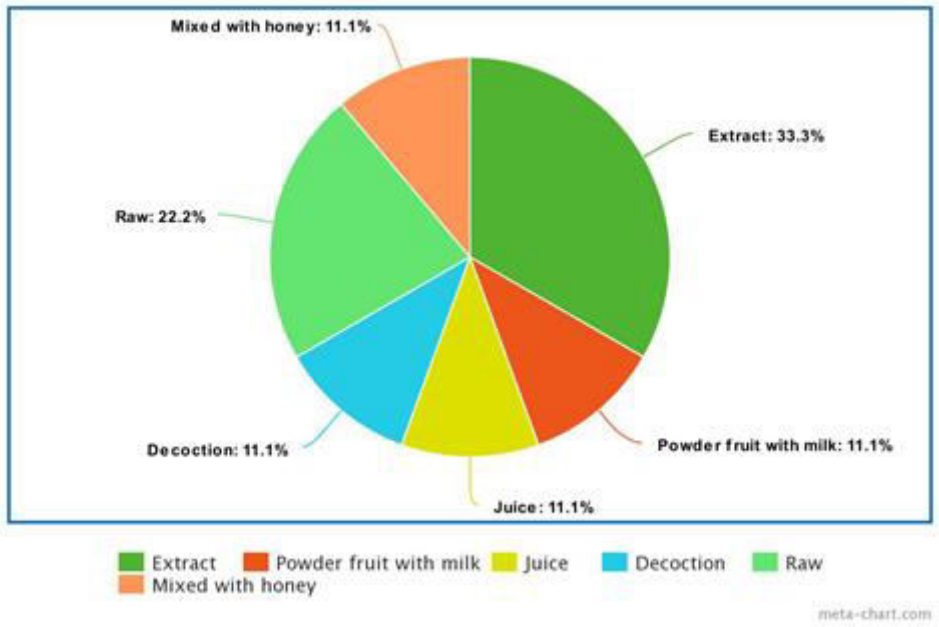


Figure 4: Mode of formulation for treating cough



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EXPLORING ESSENTIAL OIL EXTRACTION FOR DENTAL APPLICATION

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ABSTRACT
The essential oils are volatile and fragrant substance generated during the steam distillation from plant material. Depending on the particular plants from which they are originated, they frequently earn names. Essential oils can be classified in a variety of ways, such as a compound, a mixture of aromatic materials, or a combination of aromatic and non-aromatic components. Because of their potent and advantageous qualities, essential oils are used as antimicrobial, anticancer, beneficial, and antiviral medications. Often essential plant oils were used for tastes and perfumes. A complex biofilm known as dental plaque builds up over the hard connective tissue (teeth) in the dental cavity. Despite the fact that there are over 500 different bacterial species in plaque, colonization occurs in a systematic manner, starting with initial colonizers adhering onto the enamelled salivary pellicle and progressing to secondary colonization by interbacterial adhesion. Anti-infective drugs were widely used, which led to the development of germs, fungi, and viruses that were resistant to them. A range of plants for medicinal purposes have been tested for their antibacterial qualities globally in an effort to combat the pathogenic germs rising resistance. It has been observed that essential oils made from fragrant medicinal plants have outstanding antimicrobial properties against viruses, bacteria, yeasts, and filamentous fungi. In this review, exploration of different essential oils will be observed for the dental application.

Keywords: Steam distillation, essential oils, anti-oxidant technique, fragrance, Colonization.

1. INTRODUCTION
Essential oils have been utilized for a variety of purposes since the Middle Ages, including bactericidal, virucidal, fungicidal, antiparasitic, insecticidal, medicinal, and cosmetic ones. Today, this use is particularly prevalent in the pharmaceutical, sanitary, cosmetic, agricultural, and food industries. By using different solvents and steam distillation to extract low molecular weight molecules from plants, essential oils comprise complicated combinations of chemicals [1]. The main components that give essential oils their distinctive scent and biological qualities are terpenoids and phenylpropanoid. Essential oils are incredibly potent substances that are obtained from branches, leaves, foliage, plant seeds, root systems, and fruit rinds. The need for new antibacterial drugs has arisen from the emergence of microbe resistance to currently existing antibiotics [2]. Due to their extremely rapid generation times and willingness to share genetic information, across different species of bacteria, bacteria are extremely adaptable organisms. Many various extraction methods, including solvent extraction and steam distillation, are frequently used to extract essential oils. The disadvantages of these techniques include the consumption of a lot of solvents, lengthy extraction durations, and limited extraction efficiency and selectivity [3]. To obtain various oils, a variety of extraction techniques are employed, including maceration, enfleurage, cohobation, and cold pressing. Maceration is a method of extraction that imparts the fragrant and medicinal qualities of plant materials—such as flowers, herbs, and spices—to oils or other liquids. The classic process of enfleurage is used to extract the essential oils from fragile and extremely fragrant flowers, such tuberose and jasmine. When extracting essential oils from specific plant materials with minimal oil content or when a single evaporation is not enough, a specialized procedure called cohobation is employed to boost the production of essential oils. Cold pressing, sometimes referred to as cold-pressed, is a heat-free technique for removing oil from a variety of seeds, nuts, and fruits. Plaque's inclusion in the biofilm family, which includes a range of bacterial accumulations characterized by sessile development on passive or biologically active surfaces, makes clear that it is an ever-evolving, crucial ecological unit. Dental plaque, which can accumulate on tooth along the gum line, is a biofilm made up of microorganisms and their byproducts. The coating that forms on teeth is soft, sticky, colourless, or pale yellow, and it is a prevalent oral health concern. Dental plaque is caused by *Streptococcus mutans*, *Streptococcus sobrinus*, *Actinomyces* species, *Porphyromonas gingivalis*, *Treponema* species, and *Lactobacillus* species. The body experiences inflammation as a result of immune system activation [4]. Numerous factors can lead to inflammation, including infections and reactions to certain foods. When the body detects a problem, blood cells are sent to the affected region to help heal the injury and eliminate any "invaders." Antioxidant-active essential oil components make up a significant portion of all chemicals and are frequently mentioned as possible sources for the creation of novel bioactive molecules with applications in medicine, pharmacology, cosmetics, and other fields. Another

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biological characteristic of great interest is the antioxidant function of essential oils, which may protect food from oxidants' harmful effects. The primary bioactive substances found in essential oils are terpenes and terpenoids [5].

2. ESSENTIAL OIL EXTRACTION

Usually, distillation with steam or cold pressing is used to extract essential oils, which produces strong, flammable liquids that retain the medicinal properties and distinct scent of the plant. The oldest and most often used techniques include cohobation, maceration, steam distillation, the use of steam and water distillation, and enfleurage. For low oil yield distillation, maceration is flexible. Every extraction technique was appropriate for a particular plant species and its unique essential oil content [6].

2.1 TYPES OF EXTRACTION METHODS

- Steam distillation
- Cohobation
- Maceration
- Enfleurage
- Cold pressed

2.1.1 STEAM DISTILLATION

Distillation using steam is a popular technique for removing volatile components from plant material, including essential oils. The following list includes the steps that make up steam distillation.

The steam distillation system is set together. A distilling flask containing plant matter and fluid, a steam engine, a cooling device (condenser), and a flask for receipt are often included in the setup. Make sure that every piece of glass is securely attached and fastened. Water should be added to the distillation flask. The quantity of water utilized is determined by the apparatus' size and the anticipated distillation time. Make sure there is enough water, but not so much that it spills into the vessel that produces steam. In the distillation flask, add the plant material that contains the desired chemical. For instance, this could be plant material that contains essential oils. Utilizing a hotplate or heating mantle, warm the distillation flask. The flask's water will begin to boil and release steam. The volatile compounds evaporate when the steam is forced through the plant material. Steam carries the vaporized chemicals with it. The volatile compounds evaporate when the steam is forced through the plant material. Steam carries the vaporized chemicals with it. The warm steam and vaporized substances enter the cooling system, or condenser, where they revert to liquid form. In order to cool the vapor, the cooling system is usually fitted with a membrane made of water that circulates cold water. The condensed mixture gathers in the receiving flask, comprising water and the volatile chemicals. Because they are less thick than water, the volatile chemicals will float to the top. Using a separatory funnel, you can collect the upper layer, which contains the volatile component, and remove the lower layer, which is water, to separate them. When necessary, the isolated volatile chemical can be subsequently dried or purified using the proper methods, such as additional distillation processes or drying agents. The separated compound can be examined further or kept for later use in appropriate storage [7].

2.1.2 COHOBATION

A conventional technique for obtaining essential oils from botanical sources is cohobation extraction, which is very useful when creating perfumes and other aromatic compounds. A technique known as "cohobation" involves frequently distillation and redistilling a fluid in order to improve its purity. Another name for this process is "cohobation distillation." Traditionally, cohabitation begins with the plant material being steam-distilled. The essential oils are vaporized by passing steam through the plant material. Cooling causes the essential oil-containing vapor to condense into a liquid. We refer to this condensed liquid as "hydrosol" or "distillate." The plant's water-soluble chemicals and essential oil are both present in the hydrosol. The essential oil is extracted from the water by collecting and processing the hydrosol further. One popular technique is to let the hydrosol stand in a funnel for separation or other similar container. Since essential oil is fewer dense than water, it will eventually split and ascend to the top. In order to further concentrate and purify the essential oil, it is then put through one or more additional distillations after being separated. We call this procedure cohobation. Your diluted essential oil is the distillate that is left over after the cohobation procedure. Now, when compared to the original distillate, this oil is both purer and stronger. To make sure it fulfils the necessary requirements, the finished essential oil is analysed for quality and aroma profile [8].

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2.1.3 MACERATION

Maceration is a straightforward and conventional technique for removing elements such as plant-based or other materials' tastes, perfumes, or medicinal components. Please make sure to completely wash and dry any spices, herbs, or other plant components you may be utilizing. Depending on the needs of your project and your own preferences, you can utilize dried or fresh material. In order to increase surface area and facilitate the extraction process, it could be beneficial for some plant components to be somewhat chopped or crushed. But you don't have to. Choose the right solvent according to the kind of compounds you wish to extract. Put the plant material into the stainless steel or glass container. Cover the material completely with the selected solvent by pouring it over it. Plant components to solvents by weight ratios of 1:5 or 1:10 are typical starting points, though they can vary according on the particular extraction. Close the container with a lid to prevent evaporation and contamination. Keep the container for a predetermined amount of time—usually between a few a while to several weeks—in a cold, dark place. The component that is that is extracted and the needed durability of the extract determine how long it will take. It might be necessary to periodically stir and shake the mixture. Strain the liquid to extract the plant material and discard the extract after the maceration period. Any solid particles should be strained out using a fine strainer or cheesecloth. Pour the fluid into a sanitized, sealed glass jar or container using a funnel. Indicate on the container exactly what the extract is called, when it was prepared, and any other pertinent details. The extract should be kept out of direct heat and sunlight in a dark, cool area. Test the extract for its potency and aroma. If it's not strong enough, you can repeat the maceration process with fresh material, or you can concentrate it further through evaporation or other suitable methods [9].

2.1.4 ENFLEURAGE

Enfleurage is a time-honoured and labour-intensive technique used mostly to produce fine flower aromatic oils and perfumes. It is especially useful for extracting fragrant chemicals from delicate flowers. Gather fragrant and fresh flower petals. They should have the nicest aroma, be completely matured, and be free of contaminants. It might be necessary to gently remove some blooms from their stems and clean them. Arrange a wooden or glass frame on a spotless, level surface. A glass plate ought to be installed on the bottom of it. You will be pressing the flowers up against the fat on the glass plate. Make sure to uniformly distribute a thin film of fat or wax over the glass plate within the frame. The fat serves as a medium for absorption to help retain the floral scent. Cover the whole area with just one layer of petals of flowers on over of the fat. Make sure the petals are fully connected with the fat and are distributed equally. The fragrance and enfleurage pomade need to be separated next. An effective method for achieving this is "décollement," which involves washing the pomade in a solvent (like alcohol) in order to remove the essential oil. The extracted essential oil is left behind after the solution is allowed to evaporate. After that, the oil is recovered, usually with a separatory funnel or by decanting. To keep the essential oil that was extracted safe from light and air, store it in opaque, transparent glasses. Put the essential oil's name and the extraction date on the containers' labels [10].

2.1.5 COLD PRESSED

A technique for extracting oil from different seed oils or fruits without the use of heat or chemicals is called cold-pressed oil extraction. High-quality, unprocessed oils with the natural tastes and biological content of the source substance preserved are best produced using this method.

Oilseeds or fruits are cleaned and ready by eliminating any unwanted material, pits, and shells. To get the right consistency, it may break down, body, or grind the material, depending on its kind. To make a paste, for instance, olives are frequently crushed, while seeds or nuts can be broken or ground. The prepared oilseeds or fruit pulp into the hopper or feeding chamber of the cold press oil extraction machine. The amount loaded depends on the capacity of the machine and the type of oil seeds that is processed. The cold press machine removes oil from the material by applying mechanical pressure. The amount that is loaded depends on the capacity of the machine and the type of oilseed you're processing. The cold-press machine removes oil from the material by applying mechanical pressure. To release the oil, the equipment usually consists of an auger or screw that compresses the material up against a barrel or cylinder that has been perforated. Get rid of any last bits of particles or contaminants, filter the oil using cheesecloth or a fine-mesh strainer after extraction. Although optional, this procedure can make the oil cleaner. Fill clean, sealed glass bottles or receptacles with the extracted oil. To keep the oil safe from light and air, seal the containers. To keep cold-pressed oils fresh and high-quality, they must be kept in a dark, cool environment. Put the oil's name, the extraction date, and any other pertinent information on the containers' labels. You can monitor the oil's provenance and age with the use of accurate labelling [11].

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3. DENTAL PLAQUE

Plaque from dentistry is a biofilm that can develop on tooth and below the gum line. It is made up of microorganisms and their waste products [12]. It is a prevalent oral health concern and a soft, sticky, colourless or pale-yellow coating that builds up on the teeth. When saliva, food particles, and oral bacteria come together, dental plaque is created. As a result of their growth, these bacteria form a biofilm that sticks to the teeth [13]. Soon after consuming food or beverages, plaque production starts, and it can progress in a few of hours. Although bacteria make up the majority of dental plaque, other materials including as proteins and food scraps are also present. By consuming the sugars and starches found in the mouth, the microbes in plaque produce compounds that can erode the enamel and cause abscesses [14]. When it builds up on the teeth, it may appear somewhat yellowish or brown in colour, particularly if it calcifies and develops tartar, also referred to as dental calculus [15]. If plaque is not consistently eliminated by following good oral hygiene procedures, it can lead to gum disease, tooth decay, halitosis (poor breath), and the buildup of dental calculus. These abnormalities have the potential to worsen dental conditions over time [16].

3.1 MICROBES CAUSING DENTAL PLAQUE

- Streptococcus mutans
- Streptococcus sobrinus
- Lactobacillus species
- Actinomyces species
- Porphyromonas gingivalis
- Treponema species [17]

3.2 ANTI PLAQUE PROPERTIES OF ESSENTIAL OILS

- Essential oils have gained popularity in dental care for their potential therapeutic properties, which include antimicrobial, anti-inflammatory, and analgesic effects.
- Anti-inflammatory properties.
- Antibacterial Effects.

3.3 ANTI-INFLAMMATORY PROPERTIES OF ESSENTIAL OILS

Dental plaque is essentially a bacterial biofilm. The delicate tissues in the oral cavity may get irritated by this plaque if it builds up on the surfaces of the teeth and in the area around the gum line [18]. As a protective measure against the dangerous germs, the body produces inflammation as a result of this irritation inducing an immunological response. One of the main contributing factors to the emergence of gum disease, more especially gingivitis and periodontitis, is chronic inflammation brought on by dental plaque [19]. Gums that are swollen, red, and oozing are indicative of gum disease and are unmistakably inflammatory. Additionally, there is data indicating that systemic health problems may be impacted by persistent mouth inflammation, which dental plaque can either create or exacerbate. The oral-systemic link is another name for this connection. Prolonged inflammation in the oral cavity is thought to have the capacity to impact other bodily regions and could be connected to ailments such as diabetes, heart disease, and other disorders [20].

3.4 ANTIBACTERIAL EFFECTS

Essential oils have been utilized for a variety of purposes, including as all-natural remedies for bacterial infections, due to their well-known antibacterial qualities [21].

Strong antibacterial and antiseptic qualities are well known for tea tree oil. Wounds, skin diseases, and even problems with dental health are frequently treated with it. Numerous bacteria, such as *Staphylococcus* and *Escherichia coli*, can be defeated by it [22]. Lavender oil has antifungal and antibacterial qualities. It can aid in the healing of small burns and cuts and is frequently used for its calming effects on skin disorders. A number of plants, including *Rosmarinus officinalis, Eugenia caryophyllata, Baccharis dracunculifolia, Cryptomeria japonica, Achillea ligustica, and Baccharis dracunculitica*, have powerful antibacterial, anti-inflammatory, anti-oxidant, disinfectant, analgesics and gastroprotective characteristics. *S. mutans, S. sobrinus, L. casei*, and *L. lactis* are disrupted by its in vitro antibacterial activity [23].

CONCLUSION

In conclusion, studying the extraction of essential oils for use in dentistry presents a viable path toward enhancing oral health and wellbeing. Essential oils are made from different plant sources and contain substances

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that may be helpful in treating a variety of dental issues. These chemicals include compounds with possible antibacterial, anti-inflammatory, and analgesic qualities. Essential oils are a useful tool for maintaining good oral health when used sparingly and under the supervision of a dentist or other healthcare provider. Virulence variables, which are crucial in the aetiopathogenesis of dental decay, were not evaluated as thoroughly in the research as the effects of essential oils on microbial growth were. Also brought to light is the lack of chemical or botanical characterisation information provided by several studies, which raises questions regarding the veracity and consistency of their conclusions. Future studies should concentrate on translating tackles for advancing the discovery of potent anti-caries services featuring EO, given that the majority of them are regarded as GRAS by the FDA. This is because there is a disconnect between in vitro biological attributes discovered by EOs and the clinical application they have for avoiding the development of oral caries.

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FABRICATION OF EDIBLE FILM USING BETALAIN AGAINST PHARYNGITIS

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ABSTRACT
Food-grade additives and edible biopolymers are used to create edible films and coatings. Plasticizing agents and other agents are added to the biopolymers that create the films to change the edible films' physical characteristics or additional functions. Such films are especially well suited for food and packaging applications because of their renewability, degradability, and edibility. The effects of betalain, phenolic compounds from thyme, Alpinia officinarum, in combination with the properties of an edible film made of tapioca starch were investigated. dragon fruit, beets, cacti, Amaranthus, and other plants have a pigment family known as betalains. The potential health benefits of betalains, such as their anti-inflammatory, antibacterial, anticancer, and antioxidant characteristics, have attracted attention. It's commonly used to treat pharyngitis because of its possible health benefits. Thyme and Alpinia officinarum known for their soothing and anti-inflammatory properties, along with betalains, may provide an effective treatment for pharyngitis. Pharyngitis frequently includes symptoms like painful throat, trouble swallowing, and enlarged tonsils and is typically brought on by infections that are either bacterial or viral. The study aimed to ascertain betalains' ability to treat pharyngitis.

Keywords: Edible film, betalains, Thyme, Alpina officinarum, Pharyngitis, Anti-Microbial, Anti-Inflammatory.

INTRODUCTION
The order of Caryophyllales contains plant pigments called betalains. Red-violet betacyanins and yellow betaxanthins are two subgroups of betalains based on their chemical makeup. Betalains are a group of natural pigments found in certain plants like *dragon fruit, beet, cactus, Amaranthus,* etc [1]. Betalains have gained attention for their potential health benefits, including antioxidant, anti-inflammatory, antimicrobial, and anticancer properties [1,2]. They are appealing potential for the treatment of a variety of inflammatory disorders, including pharyngitis, due to their capacity to neutralize free radicals and lessen oxidative stress. Betalains have a great deal of potential to be utilized as functional food components and medicinal agents in addition to their existing application as natural colorants in the food industry, cosmetics, and pharmaceuticals [2].

Since ancient times, spices and herbs have been utilized for their flavour, as well as for their antimicrobial and therapeutic effects. Their extracts were employed in the Middle East in times BC to treat various ailments, including spasmodic gastrointestinal symptoms, cough, bronchitis, laryngitis, tonsillitis, and functioning as carminative and diuretic agents. Many plant-based products contain antioxidants like tannins, flavonoids, phenol compounds, and terpenoids [3]. Polyphenols are compounds from plant material that have been extracted using a variety of solvent systems. Thyme (*Thymus vulgaris L.*) also one of the Lamiaceae family is the most important herb from the aromatic and medicinal points of view [4].

Its rhizome contains a large number of bioactive components, including flavonoids, and essential oils, which are believed to have a variety of pharmacological potential, including 5'-reductase inhibiting agents, PGD2 inhibitors, anti-inflammatory properties, and antioxidant properties [6]. It has been claimed that the ethanolic extract of A. officinarum rhizomes has strong anti-inflammatory properties [7].

Edible films and coatings are made using edible biopolymers and food-grade additives. The biopolymers used to make the films are modified with plasticizing and other chemicals to change their physical properties or add new functionality. Due to their renewability, degradability, and edibility, these films are particularly well-suited for food applications and pharmacological effects on throat-infecting diseases [8].

Thyme, Alpinia officinarum known for its anti-inflammatory and soothing effects combined with, betalains offers potentially effective solutions for pharyngitis symptoms. They contain several bioactive compounds with antioxidant-rich [9].

This edible film is believed to help soothe irritated throats, reduce inflammation, and provide relief from pharyngitis. The study was undertaken to determine the anti-pharyngitis properties of betalains [8,9].

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Betalains and its Biological Activity

The betalains, which can be divided into yellow betaxanthins and violet betacyanins, are pigments with a betalamic acid core that contains nitrogen. In the Caryophyllales genus, these pigments can be found in the roots, fruits, and flowers. In addition to the principal edible sections of plants, such as the bracts, seeds, stems, and leaves, betalains are also found concentrated in vacuoles of reproductive and vegetative tissues [9]. Although their structural differences prevent them from coexisting in plants, betalains and anthocyanins do share some chemical characteristics, such as color spectrum or biological roles.

Several conditions (such as metal ions, an oxygen environment, pH, temperature, or light) affect the stability of betalains, albeit betalains are more resistant to pH as well as temperature than anthocyanins. Because betalains are not vulnerable to hydrolytic cleavage, they can be used in low-acidity foods (mostly frozen dairy products) [10].

Betalains are commonly extracted from whole plants via maceration in cool or room-temperature solutions. It is desirable to utilize solvents such as ethanol or methanol (20-50%, v/v), which allow for efficient pigment extraction. Furthermore, a short treatment with heat (about 70 °C, 20 minutes) deactivates enzymes involved in the breakdown of plant components, such as polyphenol oxidases [11]. Some plants have a lot of free sugars, therefore betalains extraction might be reduced.

Nuclear factors (erythroid-derived 2)-like 2-(Nrf2) based signalling pathways play a role in some of the gene-regulatory activities that betanin exhibits as a scavenge of reactive oxygen species Phase II enzymes and antioxidant defence mechanisms may be activated by betanin. Additionally, DNA and LDL oxidation may be prevented by betalain [12]. The putative blood pressure-lowering effects of red beet appear to be mostly attributable to dietary nitrate rather than betanin itself.

Various Applications of Betalains

The inclusion of Hylocereus polarizes extracts to starch/polyvinyl alcohol shrimp packaging films improved the films' antioxidant and antimicrobial properties, increased their sensitivity to ammonia, and allowed for the monitoring of shrimp freshness (referred to as "intelligent packaging" [13]).

An environmentally conscious method of colouring fibrous materials, such as fabrics or leather, has been proposed using betalains.

Pure betalains or extracts containing betalains have been employed in solar cells with dye sensitization because of their ability to transfer electrons and their capability to absorb light.

It is also used as a toxic detector infusing betalains in the film that are labelled in various Argo bio-industrial products [14].

Their colour characteristics can be used in science as biochemical indicators, protein-labelling fluorophores, & genetic transformation markers.

The numerous initiatives can be divided into three categories: (i) increasing betalain yield in beet; (ii) looking into other plant species & cell lines for betalain extraction; and (iii) creating novel betalain sources through the metabolic engineering with plants and microorganisms.

With the rising number of genetic components linked to their creation being revealed, the prospect of metabolically engineering betalain production in plants and bacteria became feasible [15].

Although their use is restricted to specific dietary supplements due to their propensity to breakdown when exposed to high temperature and light, betalains may be most commonly used as natural food colorants. [16].

Moreover, several works are mentioned that have demonstrated the potent antioxidant activity of betalains, which has been associated with protection against degenerative diseases.

Examined the red beet root's antioxidant impact in maize oil after seven days at 60 °C, noting a decline in the superoxide index with values equal to those achieved with BHT [17].

Integrated berry (Rivina humilis) betalains as a colouring agent for banana and fruit beverages, and they discovered that the stability of the betalains in fruit jam was not in excess of 60% after a six-month period of storage at 5 °C [18].

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Thyme and its Potential Benefits

The Lamiaceae family includes the principal medicinal plant known as thyme (Thymus Vulgaris L.). The primary phenolic compounds in Thymus vulgaris are carvacrol (5-isopropyl-2-methyl phenol) and thymol (5-methyl-1-2-isopropyl phenol), which together make up around 20-Review Article Summary [19]. This publication summarizes research on the physiological and medicinal uses of the thyme plant, Tyme vulgaris. Thyme's biologically active components, including flavonoids, luteolin, carvacrol, and thymol, as well as aliphatic phenols, tetra methoxylated phenols, and saponins, are discussed first in this review [20]. The reviewer addressed the major benefits of thyme, such as antioxidant, hypoglycaemia (antidiabetic), antilipidemic, anticancer, and antibacterial action. The discussion also included thyme forms and products, such as powder, extracts, or oil, and how these products are used to promote immunity.

Thyme is a significant Mediterranean aromatic plant that is used both as a traditional remedy and as a spice [21]. Worldwide, Richard et al. recognized a wide variety of thymus species. According to several studies, thyme has biological effects that are active, including germicidal, antifungal, antibacterial, antioxidant, anti-tab agism, and antispasmodic properties. A higher level of antioxidant, glutathione peroxidase, and superoxide dismutase activity was also maintained in the body when thyme oil was consumed as a dietary supplement [22].

Thymol is quickly absorbed in the upper stomach, as evidenced by the fact that rats administered an oral dose of an ethanol-based extract of Thyme (5 g/kg body wt.) had a plasma level of thymol sulphate of 8464 M one hour after intake.30 In this study, the thymol was the most significant monoterpene (44 mol/1.5 g extract), luteolin-7-O-glucoside was the primary flavonoid (22 mol/1.5 g extract), and the compound rosmarinic acid was the most significant phenolic acid (237 mol/1.5 g extract) [23]. Additionally, it was noticed that the rosmarinic acid was quickly broken down and conjugated and that no longer free rosmarinic acid was found in the plasma. Rosmarinic acid was also seen to be rapidly conjugated and broken down, leaving no longer any free rosmarinic acid in the plasma [24].

About 0.5 to 2.5% of the oil from various thyme plants is made up of 46–48% of the thymol 34–35% p-cymene, 4.5–5% carvacrol, –terpinene, linalool, and –pinene. On the other hand, as much as 60% carvacrol may be present in the oil obtained from some thyme species [25]. Two essential components with potent antibacterial effects are carvacrol and thymol (phenolic compounds).25 Al-Maqtari et al. conducted research on the essential oil from TV and found that it contains a mixture of monoterpenes, sesquiterpene hydrocarbons, and oxygenated sesquiterpenes, with a monoterpene content of 56.53%, 28.69%, and 5.04% respectively [26]. An abundance of flavonoid phenolic antioxidants, including a pigment called apigenin, lutein, luteolin, & thymine, have been found in TV essential oil, according to a report [27].

Alpina Officinarum and its Potential Benefits

The family Zingiberaceae includes *Alpina officinarum*. It is one of the perennial herbs with spectacular white racemes of flowers, lineolate, acuminate decorative leaves, and thick, spreading reddish-brown rhizomes [28]. Since very early times, it has been used customarily in Ayurveda and Chinese medicine. Since the Middle Ages, it has also been utilized in Europe [29]. In China, the rhizome has been utilized for lowering edema, treating colds, easing stomach aches, and energizing the circulatory system. Both the dry root and the rhizome part have been utilized for their antioxidant, anti-diabetic, antiulcer, anti-diarrhoea, anti-inflammatory, analgesic, and anticoagulant properties [30].

The 1,7-diphenyl heptane structure is a unique feature of the diarylheptanoid (DAH) group of chemicals, which has been discovered to have potential in the production of natural goods [31]. Many DAH compounds have been identified, and their structural characterization and biological activity have been published. Due to their capacity (ROS), polyphenols and flavonoids are a second class of substances that are of interest [32]. The decrease in 2,2-diphenyl-1-picrylhydrazyl (DPPH) radicals' absorbance at 517 nm brought on by antioxidants serves as a measure of how well they can be reduced. DPPH can cause many antioxidants to react slowly or even inertly and react rapidly with peroxyl radicals [33].

The release and/or activity of various mediators, including histamine, serotonin, & prostaglandin, are inhibited by the carrageenan paw edema test, which serves to screen anti-inflammatory medications. The antiproliferative activity of *Alpina officinarum*, which has been demonstrated to have anticancer effects on various cancer cell lines, may also be caused by its bioactive components. It was claimed that the extract of galangal may enter the bacterial cell, rupturing the bacterial membrane and killing the germs [34].

Galangal had antioxidant, anti-inflammatory, antimicrobial, immune modulating, anti-spasmodic effects and etc., in oriental medicine. Inhibitions of pancreatic lipases, -reductase, and the manufacture of prostaglandins and leukotrienes have also been documented [35].

Flavonoids, glycosides, and diarylheptanoids are three classes of significant chemical compounds found in galanga rhizomes, according to recent investigations on chemical and pharmacological aspects of the plant [36]. As researchers increasingly recognize the value of therapeutic plants, they investigate and study extracts from various plant sections for a variety of bioactivities, including antioxidants. Galanga has a variety of bioactive chemical components, including the volatile oil, phenylpropanoids, & diarylheptanoids. Alpinin, kaempferide,3-O-methyl galangin, kaempferide-3-O-d-glucoside, and cadinene sesquiterpene are some of the flavonoids that have been identified thus far [37]. Among the distinctive substances are diarylheptanoids, which can be divided into flavonol-containing diarylheptanoids, special diarylheptanoids, dimeric diarylheptanoids, and linear diarylheptanoids. Galanga did, however, contain significant amounts of galangin, a flavanol class flavonoid. The compound 3-O-methyl galangin reduced cholesterol levels [38].

Edible Film and its Application

This paper examines the potential uses of edible film in the dietary sector and sheds information on how this ground-breaking innovation is changing how we consume and present our favourite sweets [39].

Using edible ingredients like starches, proteins, or lipids, edible films are created to be extremely thin and flexible sheets. The food sector can make use of these films as coatings, wrapping, or packaging materials. Their capacity to be digested along with the food products they contain is a game-changer, providing several advantages across various applications [40].

The use of edible films for protecting single servings of a variety of goods, such as sauces, snacks, and even beverages, is growing in favour [41].

Seasonings or flavours can be preserved using edible films. These films may dissolve when added to a meal and release a flavourful zing. This ground-breaking method enables chefs and food producers to experiment with imaginative flavour pairings, improving the overall eating experience [42].

For instance, nutritional supplements such as vitamins, minerals, and others can be integrated into edible films, providing for the regulated release of these ingredients in food products.

A revolutionary product called edible film is on the verge of revolutionizing the food industry by improving food preservation, offering eco-friendly packaging options, and enriching the gastronomic experience. We should expect even more varied and intriguing uses in decades to come as academics and producers continue to improve the technology. Edible video offers a fascinating insight into the development of food technology with the potential to lessen environmental impact and enhance food quality [43].

CONCLUSION

Due to various properties like antibacterial, anti-inflammatory, antiviral antidiabetic, anticancer, etc., of betalains, phenolic extract of thyme and *Alpina officinrum* are used to treat many diseases. The biological properties of these phenolic compounds and other compounds of the various parts of plants are being studied. Infusing the phenolic compounds in the form of candy, syrup, gummies, etc., in this study these compounds are infused in the edible film made of tapioca starch is easily consumable and believed to help soothe irritated throats, reduce inflammation, provide relief from pharyngitis disease, and gives better relief.

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IN SILICO ANALYSIS OF NOVEL CHEMICAL COMPOUNDS: NATURALLY INSPIRED PRIVILEGED STRUCTURES

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ABSTRACT
The estimation of molecular properties and bioactivity score of computationally developed 2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide and 3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide derivatives of 4-(trifluoromethyl)aniline, aminohydroxybenzoic acids, aminobenzoic acids and aminophenols was carried out using Molinspiration Cheminformatics. The drug-likeness, drug score and toxicity risks of all the compounds were evaluated computationally using Osiris Property Explorer. The results were compared with the data obtained using natural compound Curcumin and a standard drug Teriflunomide. All the developed compounds obeyed Lipinski rule of five, therefore considered as drug-like and most of the compounds assessed with moderate to good bioactivity score as enzyme inhibitors, nuclear receptor ligands, kinase inhibitors, protease inhibitors, GPCR ligands and ion channel modulators. Except few, all the compounds of present investigation showed better drug-likeness, drug score and low toxicity risks. Among all the compounds, 3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide derivatives of aminophenols showed highest drug score greater than the natural compound Curcumin. Most of the compounds estimated to have good drug score greater than the standard drug Teriflunomide indicating beneficial effect of molecular hybridization, molecular manipulation or alteration.

Keywords: 2-Cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide, 3-Hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide, Aminohydroxybenzoic acids, Aminobenzoic acids, Aminophenols, Curcumin, Teriflunomide.

INTRODUCTION
Computer-Aided Drug Discovery/Design (CADD) is a part of drug discovery campaign, used to narrow down enormous chemical libraries into manageable sets of anticipated active compounds that can be tested experimentally and to direct lead compound optimization. CADD is used to design novel compounds, either by "growing" starting molecules one functional group at a time or by assembling fragments to create novel chemotypes. CADD methods are broadly classified into Structure-Based Computer-Aided Drug Design (SB-CADD) and Ligand-Based Computer-Aided Drug Design (LB-CADD). In principle, structure-based approaches are similar to high-throughput screening in that the information on the structure of the target and the ligand is crucial. Pharmacophore, ligand design, and ligand docking are examples of structure-based methodologies. LB-CADD methods use only ligand information for predicting activity depending on its similarity/dissimilarity to previously known active ligands. LB-CADD approaches in contrast to SB-CADD approaches can also be applied when the structure of the biologic target is unknown. The LB-CADD methods are applied for *in silico* screening of novel compounds possessing the biological activity of interest, hit-to-lead and lead-to drug optimization, and also for the optimization of drug metabolism and pharmacokinetic (DMPK) properties including absorption, distribution, metabolism, excretion, and toxicity (ADMET) [1]. The computational methods can significantly aid in identification, design and optimization of potential drug candidates.

Curcumin, a natural compound obtained from sacred plant rhizome turmeric (*Curcuma longa Linn.*) known to possess a diverse array of pharmacological activities. It consists of two guaiacol moieties connected to β-keto enol system through carbon-carbon double bonds. The beneficial biological activities proved to be strictly related to its electrophilic nature as Michael acceptor system [2]. Although Curcumin has some limitations like low stability and low bioavailability, extensive research has been carried out to study the application of Curcumin as a health improving agent and devise new methods to overcome the Curcumin limitations and incorporate the structural components to make multi-pharmacophore and conjugated drugs through molecular hybridization [3].

Teriflunomide, an active metabolite of Leflunomide, has anti-inflammatory and immunomodulatory properties and used to treat patients with the relapsing-remitting form of multiple sclerosis. The drug primarily acts as an inhibitor of dihydroorotate dehydrogenase and inhibits the de novo synthesis of pyrimidine in rapidly proliferating cells. It also inhibits tyrosine kinases, nuclear factor-κB, cyclooxygenase-2 and other proteins [4].

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Teriflunomide is computationally and hypothetically proposed to be a potential effective anti-COVID 19 drug [5]. Chemically, Teriflunomide is (Z)-2-cyano-3-hydroxy-N-(4-(trifluoromethyl)phenyl)but-2-enamide and consists of 2-cyano-3-hydroxybut-2-enoyl moiety connected to 4-(trifluoromethyl)aniline through amide linkage. It has been reported that the Z enolic form of Teriflunomide is more stable than other isomers. This Z enolic isomer has structural similarity to β-keto enol system of curcumin, Therefore, the present study aimed to develop novel compounds computationally by molecular hybridization and molecular manipulation or alteration to obtain 2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide and 3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide derivatives of 4-(trifluoromethyl)aniline, aminohydroxybenzoic acids, aminobenzoic acids and aminophenols. As early evaluation of ADMET is necessary in the drug development process, the present study comprises estimation of molecular properties, bioactivity score, drug-likeness, drug score and toxicity risks of newly developed compounds using free web based computational tools.

MATERIALS AND METHODS

ChemDraw Ultra 12.0, a powerful chemical drawing tool, used to develop chemical structure, nomenclature and smiles notation of novel compounds 2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide and 3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide derivatives of 4-(trifluoromethyl)aniline, aminohydroxybenzoic acids, aminobenzoic acids and aminophenols. Molinspiration Cheminformatics was used for the estimation of molecular properties and bioactivity score. The pharmacokinetic properties such as absorption, distribution, metabolism and excretion of compounds were determined using Lipinski's rule of five which states that an orally active drug has no more than one violation of the following molecular properties:

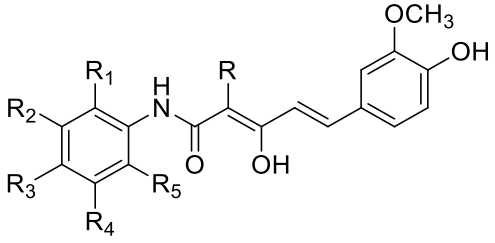
- Octanol-water partition coefficient (log P) of a molecule is not greater than 5.
- Molecular weight of a molecule is less than 500 daltons.
- Hydrogen bond acceptor (all nitrogen or oxygen atoms) in a molecule is not more than 10
- Hydrogen bond donor (the total number of nitrogen-hydrogen and oxygen-hydrogen bonds) in a molecule is not more than 5.

Other molecular properties which are important in computational prediction of druggability include number of rotatable bonds, molecular volume and topological polar surface area (TPSA). The number of rotatable bonds indicates conformational flexibility of a compound and ultimately binding with receptors or ion channels. Molecular volume determines transport characteristics of molecules, such as intestinal absorption or blood-brain barrier penetration. TPSA also recognized as a good indicator of drug absorption in intestine [TPSA < 140 angstroms squared ($Å^2$)] and its penetration through blood-brain barrier (TPSA < 60 $Å^2$). The magnitude of absorption can be expressed by percentage of absorption (% ABS), which can be calculated using equation % ABS = 109 - (0.345 × TPSA) [6]. Molinspiration Cheminformatics was also used for the calculation of bioactivity score to find ligands modulating GPCR, ion channels, nuclear receptors and to identify kinase inhibitors, protease inhibitors, and enzyme inhibitors. Osiris Property Explorer was used to determine the toxicity potential of above *in silico* developed compounds. This computational tool also used to estimate the molecular properties, drug-likeness, and drug score [7].

RESULTS AND DISCUSSION

Two sets of novel amide compounds, namely 2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide and 3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide derivatives were developed *in silico* using 4-(trifluoromethyl)aniline, aminohydroxybenzoic acids, aminobenzoic acids, aminophenols and aniline (compounds **1-17** and **19-35** respectively). Additionally, the structures of 2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide (**18**), 3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide (**36**), Curcumin (**37**) and Teriflunomide (**38**) were developed *in silico*. The general structure, nomenclature and smiles notation of the developed compounds presented in Table – 1.

Table – 1: The general structure, nomenclature and smiles notations of novel chemical compounds



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Sl. No	R	R_1	R_2	R_3	R_4	R_5
	Nomenclature					
	Smiles Notation					
1	**CN**	**H**	**H**	**CF_3**	**H**	**H**
	(2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)-N-(4-(trifluoromethyl)phenyl)penta-2,4-dienamide					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=CC=C(C(F)(F)F)C=C2					
2	**CN**	**H**	**COOH**	**OH**	**H**	**H**
	5-((2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)-2-hydroxybenzoic acid					
	OC1=C(C(O)=O)C=C(NC(/C(C#N)=C(O)/C=C/C2=CC=C(O)C(OC)=C2)=O)C=C1					
3	**CN**	**H**	**OH**	**COOH**	**H**	**H**
	4-((2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)-2-hydroxybenzoic acid					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=CC(O)=C(C(O)=O)C=C2					
4	**CN**	**OH**	**COOH**	**H**	**H**	**H**
	3-((2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)-2-hydroxybenzoic acid					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(O)C(C(O)=O)=CC=C2					
5	**CN**	**COOH**	**OH**	**H**	**H**	**H**
	2-((2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)-6-hydroxybenzoic acid					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(C(O)=O)C(O)=CC=C2					
6	**CN**	**COOH**	**H**	**OH**	**H**	**H**
	2-((2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)-5-hydroxybenzoic acid					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(C(O)=O)C=C(O)C=C2					
7	**CN**	**OH**	**H**	**COOH**	**H**	**H**
	4-((2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)-3-hydroxybenzoic acid					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(O)C=C(C(O)=O)C=C2					
8	**CN**	**COOH**	**H**	**H**	**OH**	**H**
	2-((2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)-4-hydroxybenzoic acid					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(C(O)=O)C=CC(O)=C2					
9	**CN**	**OH**	**H**	**H**	**COOH**	**H**
	3-((2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)-4-hydroxybenzoic acid					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(O)C=CC(C(O)=O)=C2					
10	**CN**	**COOH**	**H**	**H**	**H**	**OH**
	2-((2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)-3-hydroxybenzoic acid					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(C(O)=O)C=CC=C2O					
11	**CN**	**H**	**H**	**COOH**	**H**	**H**
	4-((2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=CC=C(C(O)=O)C=C2					
12	**CN**	**H**	**COOH**	**H**	**H**	**H**
	3-((2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=CC(C(O)=O)=CC=C2					
13	**CN**	**COOH**	**H**	**H**	**H**	**H**
	2-((2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(C(O)=O)C=CC=C2					

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14	**CN**	**H**	**H**	**OH**	**H**	**H**
	(2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)-N-(4-hydroxyphenyl)penta-2,4-dienamide					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=CC=C(O)C=C2					
15	**CN**	**H**	**OH**	**H**	**H**	**H**
	(2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)-N-(3-hydroxyphenyl)penta-2,4-dienamide					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=CC(O)=CC=C2					
16	**CN**	**OH**	**H**	**H**	**H**	**H**
	(2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)-N-(2-hydroxyphenyl)penta-2,4-dienamide					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(O)C=CC=C2					
17	**CN**	**H**	**H**	**H**	**H**	**H**
	(2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)-N-phenylpenta-2,4-dienamide					
	O=C(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=CC=CC=C2					
18	**CN**	**H**				
	(2Z,4E)-2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide					
	NC(/C(C#N)=C(O)/C=C/C1=CC=C(O)C(OC)=C1)=O					
19	**H**	**H**	**H**	**CF_3**	**H**	**H**
	(2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)-N-(4-(trifluoromethyl)phenyl)penta-2,4-dienamide					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=CC=C(C(F)(F)F)C=C2					
20	**H**	**H**	**COOH**	**OH**	**H**	**H**
	2-hydroxy-5-((2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	OC1=C(C(O)=O)C=C(NC(/C=C(O)/C=C/C2=CC=C(O)C(OC)=C2)=O)C=C1					
21	**H**	**H**	**OH**	**COOH**	**H**	**H**
	2-hydroxy-4-((2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=CC(O)=C(C(O)=O)C=C2					
22	**H**	**OH**	**COOH**	**H**	**H**	**H**
	2-hydroxy-3-((2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(O)C(C(O)=O)=CC=C2					
23	**H**	**COOH**	**OH**	**H**	**H**	**H**
	2-hydroxy-6-((2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(C(O)=O)C(O)=CC=C2					
24	**H**	**COOH**	**H**	**OH**	**H**	**H**
	5-hydroxy-2-((2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(C(O)=O)C=C(O)C=C2					
25	**H**	**OH**	**H**	**COOH**	**H**	**H**
	3-hydroxy-4-((2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(O)C=C(C(O)=O)C=C2					
26	**H**	**COOH**	**H**	**H**	**OH**	**H**
	4-hydroxy-2-((2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(C(O)=O)C=CC(O)=C2					
27	**H**	**OH**	**H**	**H**	**COOH**	**H**
	4-hydroxy-3-((2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(O)C=CC(C(O)=O)=C2					

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28	**H**	**COOH**	**H**	**H**	**H**	**OH**
	3-hydroxy-2-((2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(C(O)=O)C=CC=C2O					
29	**H**	**H**	**H**	**COOH**	**H**	**H**
	4-((2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=CC=C(C(O)=O)C=C2					
30	**H**	**H**	**COOH**	**H**	**H**	**H**
	3-((2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=CC(C(O)=O)=CC=C2					
31	**H**	**COOH**	**H**	**H**	**H**	**H**
	2-((2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamido)benzoic acid					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(C(O)=O)C=CC=C2					
32	**H**	**H**	**H**	**OH**	**H**	**H**
	(2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)-N-(4-hydroxyphenyl)penta-2,4-dienamide					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=CC=C(O)C=C2					
33	**H**	**H**	**OH**	**H**	**H**	**H**
	(2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)-N-(3-hydroxyphenyl)penta-2,4-dienamide					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=CC(O)=CC=C2					
34	**H**	**OH**	**H**	**H**	**H**	**H**
	(2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)-N-(2-hydroxyphenyl)penta-2,4-dienamide					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=C(O)C=CC=C2					
35	**H**	**H**	**H**	**H**	**H**	**H**
	(2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)-N-phenylpenta-2,4-dienamide					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)NC2=CC=CC=C2					
36	**H**	**H**				
	(2Z,4E)-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide					
	NC(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)=O					
37 Curcumin	(1E,4Z,6E)-5-hydroxy-1,7-bis(4-hydroxy-3-methoxyphenyl)hepta-1,4,6-trien-3-one					
	O=C(/C=C(O)/C=C/C1=CC=C(O)C(OC)=C1)/C=C/C2=CC(OC)=C(O)C=C2					
38 Teriflunomide	(Z)-2-cyano-3-hydroxy-N-(4-(trifluoromethyl)phenyl)but-2-enamide					
	O=C(/C(C#N)=C(O)/C)NC1=CC=C(C(F)(F)F)C=C1					

The molecular properties such as log P, molecular weight, number of hydrogen bond acceptor and number of hydrogen bond donor of all the *in silico* developed compounds were calculated using Molinspiration Cheminformatics. In addition, number of rotatable bonds, molecular volume, TPSA and % ABS were calculated and the data presented in Table -2. All the *in silico* developed compounds found to obey Lipinski's rule of five with zero number of violations indicating drug-likeness. Because of nitrile substitution, the milogP of first set compounds (**1-17**) was less and hydrogen bond acceptor number was more than the second set compounds (**19-35**). The milogP of 2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide (**18**) and 3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide (**36**) was very low as they don't contain N-substituted phenyl ring. The total number of rotatable bonds in the newly developed compounds was in the range of 4 to 6. The Curcumin and Teriflunomide have 7 and 3 rotatable bonds respectively. The calculated molecular volume was found between 335.13 and 210.73. TPSA was calculated as a sum of fragment contributions considering only O- and N- centered polar fragments [8]. The calculated TPSA of first set compounds was high than the second set compounds and therefore %ABS of first set compounds was less than the second set compounds. Based on the TPSA, the calculated %ABS of Curcumin and Teriflunomide was 75.80 and 83.77 respectively..

Table – 2: Molecular properties of novel chemical compounds

Compound	milogP	MW	nON	nOHNH	nViolations	nrotb	Volume	TPSA	%ABS
1	3.61	404.34	6	3	0	6	331.41	102.58	73.61

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2	2.62	396.36	9	5	0	6	335.13	160.11	53.76
3	2.62	396.36	9	5	0	6	335.13	160.11	53.76
4	2.39	396.36	9	5	0	6	335.13	160.11	53.76
5	2.18	396.36	9	5	0	6	335.13	160.11	53.76
6	2.25	396.36	9	5	0	6	335.13	160.11	53.76
7	2.33	396.36	9	5	0	6	335.13	160.11	53.76
8	2.25	396.36	9	5	0	6	335.13	160.11	53.76
9	2.33	396.36	9	5	0	6	335.13	160.11	53.76
10	2.49	396.36	9	5	0	6	335.13	160.11	53.76
11	2.62	380.36	8	4	0	6	327.11	139.88	60.74
12	2.60	380.36	8	4	0	6	327.11	139.88	60.74
13	2.76	380.36	8	4	0	6	327.11	139.88	60.74
14	2.23	352.35	7	4	0	5	308.13	122.81	66.63
15	2.21	352.35	7	4	0	5	308.13	122.81	66.63
16	2.45	352.35	7	4	0	5	308.13	122.81	66.63
17	2.71	336.35	6	3	0	5	300.11	102.58	73.61
18	0.64	260.25	6	4	0	4	227.59	116.58	68.78
19	3.89	379.33	5	3	0	6	314.55	78.79	81.82
20	2.90	371.35	8	5	0	6	318.27	136.31	61.97
21	2.90	371.35	8	5	0	6	318.27	136.31	61.97
22	2.67	371.35	8	5	0	6	318.27	136.31	61.97
23	2.46	371.35	8	5	0	6	318.27	136.31	61.97
24	2.53	371.35	8	5	0	6	318.27	136.31	61.97
25	2.61	371.35	8	5	0	6	318.27	136.31	61.97
26	2.53	371.35	8	5	0	6	318.27	136.31	61.97
27	2.61	371.35	8	5	0	6	318.27	136.31	61.97
28	2.77	371.35	8	5	0	6	318.27	136.31	61.97
29	2.90	355.35	7	4	0	6	310.25	116.09	68.95
30	2.88	355.35	7	4	0	6	310.25	116.09	68.95
31	3.04	355.35	7	4	0	6	310.25	116.09	68.95
32	2.51	327.34	6	4	0	5	291.27	99.02	74.84
33	2.49	327.34	6	4	0	5	291.27	99.02	74.84
34	2.72	327.34	6	4	0	5	291.27	99.02	74.84
35	2.99	311.34	5	3	0	5	283.25	78.79	81.82
36	0.92	235.24	5	4	0	4	210.73	92.78	76.99
Curcumin	3.05	368.38	6	3	0	7	331.83	96.22	75.80
Teriflunomide	2.30	270.21	4	2	0	3	215.58	73.12	83.77

(miLogP: Octanol-water partition coefficient, MW: Molecular weight, nON: Hydrogen bond acceptor, nOHNH: Hydrogen bond donor, n Violations: Number of violations, nrotb: Number of rotatable bonds, TPSA: Topological polar surface area, %ABS: Percentage of absorption)

Molinspiration Cheminformatics was also used to calculate the bioactivity score of newly developed compounds (**1-36**), natural compound Curcumin (**37**) and the standard drug Teriflunomide (**38**). The data presented in Table-3. A molecule having bioactivity score more than 0.00 expected to be active, while values between -0.50 and 0.00 are expected to be moderately active and if the score is less than -0.50 considered as inactive. The bioactivity score of Teriflunomide was more negative than the *in silico* developed compounds, indicating beneficial effect of guaiacol moiety connecting to 2-cyano-3-hydroxybut-2-enamide or 3-hydroxybut-2-enamide through –CH= bond at 4th position. The bioactivity data indicated compound **36** as active enzyme inhibitor and highlighted the importance of 3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide structural fragment without nitrile substitution and N-substituted phenyl ring. The bioactivity results revealed that all other compounds (**1-35**) were moderately active as enzyme inhibitors, nuclear receptor ligands, kinase inhibitors, protease inhibitors and GPCR ligands (except compound **18**). Except compounds **7**, **9**, **16** and **18**, all the compounds were moderately active as ion channel modulators. The variation in bioactivity score of

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compounds may be due to the substituent groups and their position on 2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamides and 3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamides.

On observation of previously reported bioactivity score of 2-cyano-3-hydroxybut-2-enamide derivatives of aminohydroxybenzoic acids, aminobenzoic acids and aminophenols [9], it can be inferred that converting 2-cyano-3-hydroxybut-2-enamide derivatives to 2-cyano-3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide derivatives (**1-18**) effectively modulate GPCR, ion channels, nuclear receptors and inhibit kinase and protease enzymes. Removal of nitrile group of first set compounds (**1-18**) resulted in second set compounds, 3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide derivatives (**19-36**) having improved bioactivity as enzyme inhibitors, kinase inhibitors, protease inhibitors, GPCR ligands and ion channel modulators. The improved bioactivity of second set compounds may be due to the amide linkage between the selected amines and the structural fragment of Curcumin. However, Curcumin has more intense bioactivity than all the newly developed compounds. According to bioactivity data, the first set compounds (**1-18**) identified as relatively better nuclear receptor ligands than second set compounds (**19-36**) indicating the necessity of nitrile group to productively modulate nuclear receptors.

Table – 3: Bioactivity scores of novel chemical compounds

Compound	GPCR ligand	Ion channel modulator	Kinase inhibitor	Nuclear receptor ligand	Protease inhibitor	Enzyme inhibitor
1	-0.30	-0.33	-0.18	0.00	-0.33	-0.09
2	-0.35	-0.43	-0.24	-0.05	-0.36	-0.06
3	-0.36	-0.43	-0.24	-0.07	-0.36	-0.06
4	-0.32	-0.50	-0.32	-0.16	-0.36	-0.09
5	-0.36	-0.42	-0.27	-0.02	-0.29	-0.01
6	-0.35	-0.39	-0.27	0.00	-0.40	-0.06
7	-0.37	-0.55	-0.28	-0.07	-0.44	-0.08
8	-0.35	-0.39	-0.27	-0.01	-0.41	-0.07
9	-0.37	-0.55	-0.28	-0.07	-0.44	-0.09
10	-0.33	-0.50	-0.31	-0.12	-0.38	-0.03
11	-0.37	-0.44	-0.28	-0.04	-0.38	-0.07
12	-0.38	-0.45	-0.27	-0.04	-0.38	-0.07
13	-0.38	-0.42	-0.30	-0.04	-0.42	-0.08
14	-0.37	-0.43	-0.23	-0.09	-0.39	-0.08
15	-0.38	-0.44	-0.22	-0.12	-0.40	-0.10
16	-0.40	-0.58	-0.27	-0.17	-0.47	-0.12
17	-0.40	-0.47	-0.26	-0.14	-0.41	-0.10
18	-0.55	-0.52	-0.37	-0.28	-0.55	-0.00
19	-0.09	-0.19	-0.04	-0.04	-0.17	-0.03
20	-0.15	-0.31	-0.11	-0.10	-0.19	-0.00
21	-0.15	-0.30	-0.11	-0.12	-0.20	-0.00
22	-0.11	-0.38	-0.20	-0.21	-0.20	-0.04
23	-0.15	-0.29	-0.14	-0.06	-0.12	-0.05
24	-0.14	-0.26	-0.14	-0.04	-0.24	-0.00
25	-0.17	-0.43	-0.15	-0.12	-0.28	-0.02
26	-0.15	-0.26	-0.14	-0.05	-0.25	-0.01
27	-0.17	-0.43	-0.15	-0.11	-0.28	-0.03
28	-0.12	-0.38	-0.19	-0.17	-0.22	-0.03
29	-0.16	-0.31	-0.14	-0.09	-0.21	-0.00
30	-0.17	-0.32	-0.14	-0.09	-0.22	-0.02
31	-0.17	-0.29	-0.17	-0.09	-0.25	-0.02
32	-0.14	-0.29	-0.08	-0.14	-0.22	-0.01
33	-0.15	-0.30	-0.07	-0.17	-0.23	-0.03
34	-0.17	-0.45	-0.12	-0.23	-0.30	-0.05
35	-0.17	-0.32	-0.11	-0.21	-0.25	-0.04
36	-0.37	-0.36	-0.26	-0.46	-0.47	0.09
Curcumin	-0.09	-0.39	-0.13	-0.02	-0.09	0.12

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Teriflunomide	-0.63	-0.41	-0.63	-0.46	-0.68	-0.22

Osiris Property Explorer calculates various drug-relevant properties such as cLogP, solubility, molecular weight and TPSA and toxicity risks. This tool also calculates drug-likeness using an equation summing up the score values of those fragments that are present in the molecule under investigation. The overall drug score of molecules estimated with an equation utilizing the values of molecule's drug-likeness, toxicity, clogP, solubility, and molecular weight. In the present study, the drug-relevant properties, toxicity risks, drug-likeness and drug score were predicted and presented in Table-4. The cLogP and solubility were assessed via an increment system by adding atom contributions depending on their atom types. Therefore, the values were remaining same for compounds having same substituent groups. The calculated molecular weights were rounded off to the nearest whole number. The TPSA calculated via an atom-type based increment system, published by Ertl *et al.* in 2000 [8]. The *in silico* toxicity properties predicted include mutagenicity, tumorigenicity, irritant and reproductive effects. The data indicated that compounds **4**, **18**, **22** and **31** were estimated with medium irritant and reproductive effects. All other compounds assessed as safe and non-toxic. The prediction data showed better drug-likeness and drug score for the second set compounds when compared with first set compounds. Particularly, 3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide derivatives of aminophenols (**32**-**34**), 3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide (**36**) and 3-hydroxy-5-(4-hydroxy-3-methoxyphenyl)penta-2,4-dienamide derivative of 2-amino-3-hydroxybenzoic acid (**28**) showed highest drug score, greater than the natural compound Curcumin. The prediction data also indicated that the second set compounds (except compound **19**) and few of the first set compounds (**7-11** and **13-17**) have better drug score greater than the standard drug Teriflunomide. These observations indicate overall beneficial effects of molecular hybridization and molecular manipulation or alteration.

Table-4: Drug-relevant properties, toxicity risks, drug-likeness and drug score of novel chemical compounds

Sl. No	**cLogP**	**Log S**	**MW**	**TPSA**	Toxicity Risks				**DL**	**DS**
					M	**T**	**I**	**R**		
1	3.91	-4.51	404.0	102.58	No	No	No	No	-9.22	0.31
2	2.2	-3.45	396.0	160.11	No	No	No	No	-3.53	0.4
3	2.2	-3.45	396.0	160.11	No	No	No	No	-4.34	0.4
4	2.2	-3.45	396.0	160.11	No	No	Medium	No	-2.65	0.34
5	2.2	-3.45	396.0	160.11	No	No	No	No	-2.90	0.41
6	2.2	-3.45	396.0	160.11	No	No	No	No	-2.58	0.42
7	2.2	-3.45	396.0	160.11	No	No	No	No	-2.02	0.44
8	2.2	-3.45	396.0	160.11	No	No	No	No	-3.19	0.41
9	2.2	-3.45	396.0	160.11	No	No	No	No	-1.31	0.48
10	2.2	-3.45	396.0	160.11	No	No	No	No	-0.79	0.52
11	2.55	-3.75	380.0	139.88	No	No	No	No	-1.52	0.46
12	2.55	-3.75	380.0	139.88	No	No	No	No	-4.04	0.39
13	2.55	-3.75	380.0	139.88	No	No	No	No	-0.59	0.52
14	2.72	-3.44	352.0	122.81	No	No	No	No	-0.43	0.56
15	2.72	-3.44	352.0	122.81	No	No	No	No	-0.84	0.53
16	2.72	-3.44	352.0	122.81	No	No	No	No	-0.72	0.54
17	3.06	-3.73	336.0	102.58	No	No	No	No	-2.36	0.43
18	1.0	-2.31	260.0	116.58	No	No	No	Medium	-2.36	0.41
19	4.06	-4.24	379.0	78.79	No	No	No	No	-7.39	0.33
20	2.35	-3.18	371.0	136.31	No	No	No	No	-1.74	0.47
21	2.35	-3.18	371.0	136.31	No	No	No	No	-2.54	0.44
22	2.35	-3.18	371.0	136.31	No	No	Medium	No	-0.87	0.43
23	2.35	-3.18	371.0	136.31	No	No	No	No	-1.11	0.51
24	2.35	-3.18	371.0	136.31	No	No	No	No	-0.79	0.54
25	2.35	-3.18	371.0	136.31	No	No	No	No	-0.19	0.6
26	2.35	-3.18	371.0	136.31	No	No	No	No	-1.38	0.49
27	2.35	-3.18	371.0	136.31	No	No	No	No	0.56	0.67
28	2.35	-3.18	371.0	136.31	No	No	No	No	1.02	0.71
29	2.7	-3.48	355.0	116.09	No	No	No	No	0.34	0.64
30	2.7	-3.48	355.0	116.09	No	No	No	No	-2.25	0.44
31	2.7	-3.48	355.0	116.09	No	No	Medium	Medium	1.24	0.46

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32	2.86	-3.17	327.0	99.02	No	No	No	No	1.4	0.75
33	2.86	-3.17	327.0	99.02	No	No	No	No	0.97	0.72
34	2.86	-3.17	327.0	99.02	No	No	No	No	1.08	0.73
35	3.21	-3.46	311.0	78.79	No	No	No	No	-0.58	0.55
36	1.15	-2.04	235.0	92.78	No	No	No	No	0.1	0.72
37	3.58	-3.67	368.0	96.22	No	No	No	No	1.91	0.69
38	2.55	-3.25	270.0	73.12	No	No	No	No	-10.2	0.43

(cLogP: Logarithm of Partition-Coefficient; Log S: Solubility; MW: Molecular Weight; TPSA: Total Polar Surface Area; M: Mutagenic; T: Tumorigenic; I: Irritant; R: Reproductive effect; DL: Drug Likeness; DS: Drug Score)

CONCLUSION

Teriflunomide, a metabolite of an immunosuppressive disease-modifying antirheumatic drug Leflunomide used to treat multiple sclerosis. It has been reported as a possible effective drug to the comprehensive treatment of covid 19. Curcumin, a natural phenolic pigment obtained from turmeric rhizome, has been used for centuries as a culinary spice and food dye. It has a long history of use as an ingredient for multiple medicinal preparations in Ayurveda and Chinese medicine. Considering the safety and effectiveness of Teriflunomide and Curcumin, newer analogous compounds developed *in silico* by molecular hybridization, molecular manipulation or alteration. The pharmacophoric moieties, 2-cyano-3-hydroxybut-2-enamide fragment of Teriflunomide and β-keto enol system conjugating with guaiacol through a carbon-carbon double bond in Curcumin, combined to generate new innovative hybrid compounds. The trifluoromethyl group in Teriflunomide altered with other substituents such as carboxylic acid and/or phenolic hydroxyl group to produce new compounds with improved bioactivity, drug-likeness and drug score when compared to the parent drugs.

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PHYTOCHEMICAL ANALYSIS OF TEPHROSIA VILLOSA (L.) PERS

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ABSTRACT
Present investigation was undertaken in order to analyse bioactive constituents present in Tephrosia villosa by using High Resolution- Liquid Chromatography-Mass Spectrometry (HR-LCMS).The study revealed the presence of secondary metabolites like alkaloid (Aconitine), Flavonoids(Quercetin, Mosloflavone), Coumarin (Samidin), chalcones(De-hydro-cyclo-xanthohumolhydrate), butenolide (Spiromesifen), cardenolide glycoside (diginatin), benzopyran (Piperochromanoic acid), and Phenolic compounds in the selected medicinal plants.

Keywords; Tephrosia, Alkaloid, Retinoids, Coumarin, Flavonoids, HR-LCMS.

INTRODUCTION
The genus *Tephrosia* is represented by 27 species and one variety in India (Sanjappa 1992), of which 13 species are found in Maharashtra state, while 8 species in Marathwada region. *Tephrosia villosa* (L.) Pers. is a perennial herb, characterised by compound stipulated Leaflets 13–19, oblanceolate, apex obtuse, retuse or mucronate, base cuneate. Flowers bright rosy–purple or violet. Pods linear, slightly curved, mucronate. In the Ayurveda system, is referred as *Sarwa wran vishapaha* which implies that it can heal any type of wound. It played an important role in the traditional medicine, (Akanksha *et, al*., 2014).

MATERIAL AND METHOD
The root, stem and leaves of *Tephrosia villosa* were collected from Dr. Babasaheb Ambedkar Marathwada University (B.A.M.U.), campus near Soneri Mahal Aurangabad, on 30/07/2021, and it was identified following Naik (1998) and Singh et al (2000). The Voucher specimen no. 010901 were deposited in BAMU Herbarium, Department of Botany Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. (MS).

The root stem and leaves of selected medicinal plant were finely powdered. Bioactive compounds were extracted with Ethanol using a Soxhlet's extractor for 76 hrs. The extracts were concentrated to remove the solvents completely by using Rotary evaporator. Plant extract were sent for qualitative analysis of their chemical constituent at SAIF, IIT, Bombay by HRLC-MS technique. The instrument used is Agilent technology G6550A-ifunnel, Q-TOF, LC/MS. Column type is ZORBAX RRHDSBC18, with 100 mm length, 2.1 mm diameter and 1.8 pore size. It was carried out with mass spectrometry mainly for the classes of compound which are non-volatile like higher terpenoids, phenolic compounds, alkaloids, flavonoids, lipids, sugars, and amino acid etc.

Table 1: Phytochemical compounds present in the root of *Tephrosia villosa*

Sr.no.	Compound name	Formula	Mass	R.T.	D.B. Diff. (PPM)	Group
1.	5,7,2'-Trihydroxy-6-methoxyflavone	$C_{16}H_{12}O_6$	300.0614	6.673	6.74	flavone
2.	16-Hydroxy-10-oxohexadecanoic acid	$C_{16}H_{12}0O4$	286.2137	6.976	2.34	long-chain fatty acid
3.	Aconitine	$C_{34}H_{47}NO_{11}$	645.3134	8.549	2.36	alkaloid
4	Doramapimod	C31H37N5 O3	527.2857	9.03	7.43	pyrazoles
5	Sambutoxin	C28 H39 N O4	453.2857	12.485	4.77	pyridinone
6	Dehydrocycloxanthohumol hydrate	C21 H22 O6	370.1423	11.424	-1.7	chalcones
7	Samidin	C21H22O7	386.1373	12.269	-1.88	coumarins
8	Spiromesifen	C23H30O4	370.2152	12.326	-2.04	butenolide
9	Virolongin B	C23H30O6	402.2046	10.92	-1.01	dimethoxybenzenes
10	Citreoviridin	C23H30O6	402.2048	10.295	-1.5	pyranones.
11	7,8-Diaminononanoate	C9H20N2O2	188.1529	5.375	-2	conjugate acid
12	diginatin	C41H64O15	796.4203	18.484	5.31	cardenolide

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						glycoside
13	Calenduloside G methyl ester	C43H68O14	808.4545	18.694	7.98	triterpenoid saponin
14	Withaphysacarpin	C28 H40 O7	488.2777	11.09	-0.64	withanolide

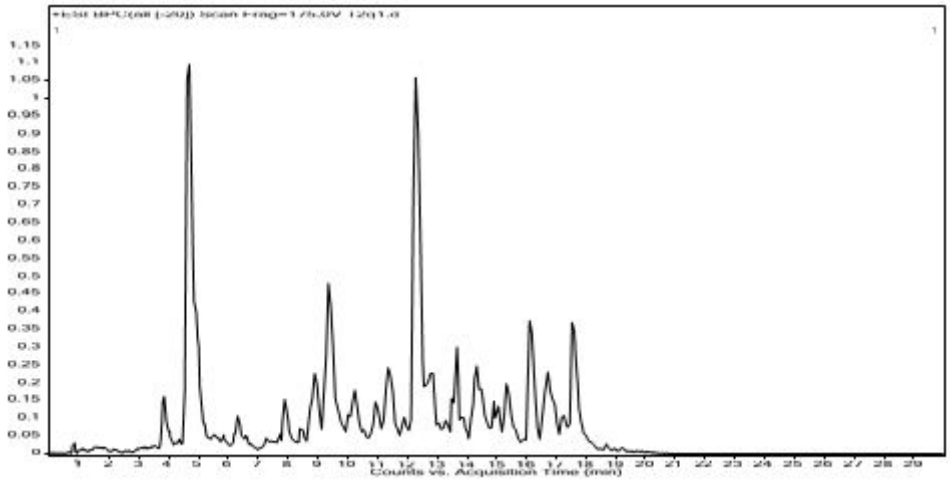

Table 2: Phytochemical compounds present in the stem of *Tephrosia villosa*

Sr.no.	Compound name	Formula	Mass	R.T.	D.B. Diff. PPM	Group
1	Ochrolifuanine A	C29 H34 N4	438.2779	17.584	0.95	alkaloid
2	14-hydroxy stearic acid	C18 H36 O3	300.2673	16.939	2.69	Fatty acid
3	Artomunoxanthentrione epoxide	C26 H22 O8	462.1333	3.079	-4.05	pyranoxanthones.
4	Americanin B	C27 H24 O9	492.144	3.596	-3.98	benzodioxine.
5	Norwogonin	C15 H10 O5	270.0517	7.875	4.33	trihydroxyflavone
6	Mosloflavone	C15 H10 O5	270.0517	7.875	4.33	flavonoids
7	Samidin	C21 H22 O7	386.1374	10.355	2.31	coumarins
8	Pratenol B	C15 H12 O7	304.0594	10.607	-3.62	benzopyran.
9	Piperochromanoic acid	C22 H28 O4	356.1995	12.793	2.07	monoterpenoid.
10	Lepidine	C21 H20 N4 O2	360.1587	11.999	0.15	aromatic ether
11	carbosulfan	C20H32N2O3S	380.212	10.196	3.51	benzofurans

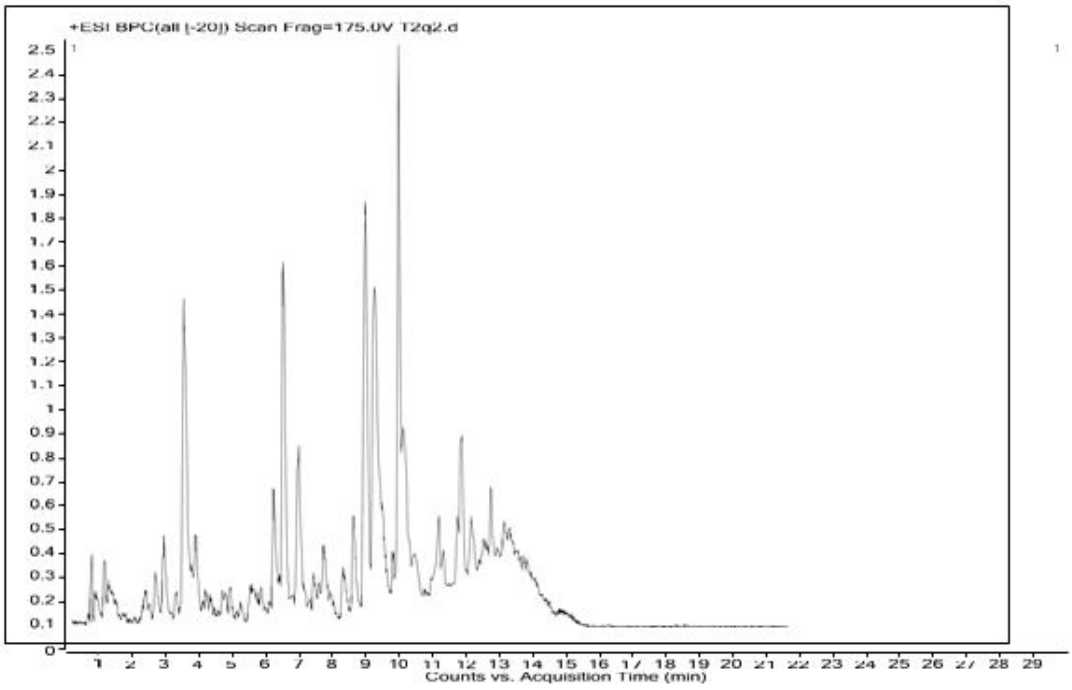

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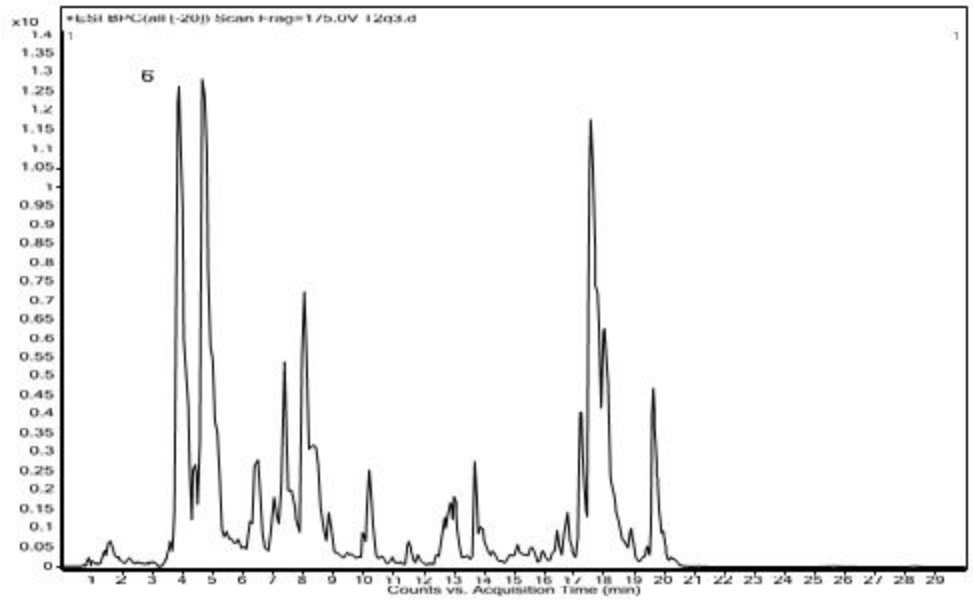
Table 3: Phytochemical compounds present in the leaves of *Tephrosia villosa*

Sr.no.	Compound name	Formula	Mass	R.T.	D.B. Diff. PPM	Group
1.	Quercetin	C_{15} H_{10} O_7	302.0404	5.668	7.49	flavonoid
2	Risperidone	C23 H27 F N4 O2	410.2117	2.999	0.19	pyridopyrimidines
3	Quinestrol	C25 H32 O2	364.2435	5.477	-8.9	steroid
4	Cetiedil	C20 H31 N O2 S	349.2104	6.061	-8.3	azepanes
7	Ascorbyl stearate	C24 H42 O7	442.2908	7.998	5.05	fatty acid ester
8	Ginsenoyne A linoleate	C35 H52 O3	520.396	9.891	-8.34	
9	Lanceotoxin A	C32H44O12	620.2831	620.2831	0.36	steroid lactone
10	Hyperforin	C35 H52 O4	536.3909	14	-8.11	terpene ketone



RESULT AND DISCUSSION

The HRLC-MS analysis of *Tephrosia villosa root* showed presence of 14 compounds as shown in table 1. compound Doramapimod has clinically relevant anti-inflammatory effects in horses, likely mediated by a decrease in leukocyte activation and decrease in the release of pro-inflammatory cytokines (Bauquier et al. 2020).

Compound Citreoviridin (CTV) in an inhibitor of mitochondrial ATPase that has been isolated from molded yellow rice and linked to the human disease Shoshin-kakke (acute cardiac beriberi). The disease results from a deficiency of thiamine, however, purified CTV can reproduce the symptoms in experimental animals (Maragos et al 2019).

Diginatin is New Cardioactive Glycoside has been found to be very similar in structure to digitoxin, digoxin, and gitoxin in that it consists of three moles of digitoxose and an aglycone, isomeric with digoxigenin and gitoxigenin, except for the presence of an extra acetylatablehydroxyl group (Okano, A.1957).

Stem showed presence of 11 compounds as shown in table 2.). Compound Americanin B decreased the level of DPPH radicals, superoxide anions, hydroxyl radicals, and intracellular reactive oxygen species. Americanin B also attenuated DNA damage induced by H2O2 treatment, as shown by the inhibition of formation of comet tails, indicative of DNA strand breakage, and prevented the oxidation of protein and peroxidation of lipid, as determined by protein carbonyls and 8-isoprostane (Zheng et al 2014).

Norwogonin flavone has been reported to exhibit anticancer effects in numerous cancer cell lines. Some authors report anticancer effects of norwogonin against human triple-negative breast cancer cells via downregulation of Nf-kB, STAT3 and TAK1 signalling pathway (Wang et al 2020).

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Samidin significantly inhibit the production of nitric oxide, as well as the gene expression levels of inducible nitric oxide synthase and cyclooxygenase-2. The results from an electrophoretic mobility shift assay illustrated that samidin significantly suppressed NF-jB and AP-1 DNAbinding affinity (Khan et al 2014).

Leaves showed presence of 10 compounds as shown in table 3. Hyperforin has been shown to inhibit, like conventional antidepressants, the neuronal uptake of serotonin, norepinephrine, and dopamine. However, hyperforin inhibits also the uptake of ã-aminobutyric acid (GABA) and L-glutamate (Madabushi et al 2006).

The cytotoxicity of cepharanthine against Vero E6 cells was measured by MTS／PMS colorimetric assay after a 48-hour incubation with 7 drug concentrations. At the concentration of 12. 50 ug／ ml, cell viability was 67(Zhang et al 2005).

CONCLUSION;

The ethanolic extract of *Tephrosia villosa* root, stem and leaves revealed the presence of important bioactive compounds like alkaloids, flavonoids, Phycoerythrobilin, flavones, stilbenoid, pheophorbide, glycoside, terpenoids, sesquiterpenoids, retinoids, Cyanoguanidine, germacranolide, coumarins, Chalcones and Steroid, using high-resolution liquid chromatography-mass spectrometry (HRLC-MS) analysis. These compounds are species specific and can be used to standardize the species.

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A HOLISTIC APPROACH TO PAEDIATRIC DENGUE MANAGEMENT: ANALYSING THE BEDSIDE SEVERITY PREDICTION SCORE AND ITS SIGNIFICANCE IN DISEASE PROGNOSIS

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ABSTRACT
Dengue fever, a prevalent arthropod-borne viral disease, poses a substantial health burden worldwide, particularly affecting paediatric populations. The unpredictable nature of the disease progression underscores the critical need for accurate severity prediction tools to facilitate timely clinical intervention and optimize patient outcomes. The "Bedside Severity Prediction Score" (BSPS) has emerged as a significant clinical tool in assessing the severity of dengue in children, amalgamating crucial clinical and laboratory parameters into a comprehensive scoring system. This review critically examines the development, validation, and potential implications of the BSPS in the context of paediatric dengue management. Through a comprehensive analysis of existing literature and studies, the review elucidates the multifaceted nature of the BSPS, emphasizing its role in risk stratification, triaging, and facilitating targeted therapeutic interventions. The review also highlights the limitations and challenges associated with the BSPS, emphasizing the need for further validation studies and the integration of novel biomarkers to enhance its predictive accuracy. Furthermore, the review underscores the potential impact of the BSPS in reducing the morbidity and mortality rates associated with severe dengue in paediatric patients. Overall, this review provides insights into the current status and future directions of the BSPS, emphasizing its significance as a pivotal tool in the holistic management of paediatric dengue cases, and underscores the necessity for continued research to refine and optimize its clinical utility.

Keywords: Dengue, BSPS, Paediatric dengue management, substantial health

1. Background Study
Dengue fever is a mosquito-borne viral infection that poses a significant global health challenge, particularly in tropical and subtropical regions. The disease affects millions of individuals each year, with children being especially vulnerable to its severe manifestations. The varying degrees of dengue severity, ranging from mild fever to life-threatening complications such as haemorrhagic fever and shock syndrome, necessitate accurate and timely risk assessment and prognostic evaluation for effective clinical management. In this context, the development of the Bedside Severity Prediction Score (BSPS) emerged as a critical step toward enhancing the clinical decision-making process and improving patient outcomes in paediatric dengue cases [1].

The BSPS is a multidimensional scoring system designed to integrate clinical parameters and laboratory findings, enabling healthcare practitioners to assess the severity of dengue in children accurately. This scoring system aims to provide a standardized and comprehensive approach to risk assessment, facilitating the early identification of high-risk patients and the timely implementation of appropriate interventions to prevent disease progression and complications [2]. The BSPS framework encompasses various clinical and laboratory indicators, including vital signs, haematological parameters, and biochemical markers, to create a holistic risk assessment model that guides clinical management strategies and treatment interventions tailored to the individual needs of paediatric dengue patients.

However, despite the BSPS's significant contributions to paediatric dengue management, there remains a need for continual research and advancements to enhance its predictive accuracy, clinical relevance, and universal applicability across diverse geographical regions and patient populations [3]. The integration of novel biomarkers, advanced diagnostic technologies, and machine learning techniques into the BSPS framework holds the potential to revolutionize paediatric dengue management, fostering a more personalized and proactive approach to patient care that prioritizes the unique needs and challenges of each paediatric dengue case. As research in this field continues to evolve, the focus remains on refining risk assessment models, optimizing treatment protocols, and improving clinical outcomes for children at risk of dengue and its potentially life-threatening complications [4].

2. INTRODUCTION
Dengue fever, a mosquito-borne viral infection prevalent in tropical and subtropical regions, continues to pose a significant public health challenge, particularly in paediatric populations. The unpredictable progression of the disease, characterized by a spectrum of clinical manifestations ranging from mild febrile illness to severe haemorrhagic complications, necessitates the development of robust clinical tools to accurately predict the

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severity of the disease in children [5]. In this context, the concept of a "Bedside Severity Prediction Score" has gained substantial attention as a potential prognostic indicator for identifying high-risk patients and enabling timely intervention strategies.

The Bedside Severity Prediction Score (BSPS) constitutes a clinical assessment tool designed to objectively evaluate various clinical and laboratory parameters to predict the progression of dengue severity in paediatric patients. This scoring system aims to provide healthcare practitioners with a standardized approach to risk stratification, facilitating prompt and appropriate management of dengue cases in children. By integrating key clinical indicators and laboratory findings, the BSPS attempts to bridge the gap in prognostic precision, thereby enhancing the capacity to triage patients effectively based on their individual risk profiles.

Several earlier studies have underscored the imperative need for reliable and efficient severity prediction tools in the context of dengue management, given the potentially rapid deterioration that can occur, especially in paediatric cases. The limitations associated with traditional clinical assessment methods and the subjective interpretation of symptoms and signs have highlighted the necessity for a quantifiable and standardized approach to risk assessment in paediatric dengue cases. This necessity has spurred the development and validation of the BSPS, which has shown promising potential in enhancing the clinical decision-making process and optimizing resource allocation in healthcare facilities [6] [7].

The complexity of dengue pathogenesis, encompassing immune-mediated responses, viral dynamics, and vascular permeability alterations, further accentuates the significance of a comprehensive scoring system that integrates both clinical and laboratory parameters. The multifactorial nature of dengue severity mandates a holistic approach to risk assessment, considering not only the immediate clinical presentation but also the underlying pathophysiological mechanisms that contribute to disease progression. Consequently, the BSPS represents an attempt to amalgamate these diverse facets into a cohesive scoring system that can provide clinicians with a comprehensive overview of the patient's condition and aid in determining the appropriate level of care and intervention [8].

As the landscape of paediatric dengue management continues to evolve, the implementation of the BSPS holds the potential to significantly mitigate the risks associated with delayed recognition of severe cases, thereby reducing the morbidity and mortality rates attributed to dengue-related complications in children. Nonetheless, the application of the BSPS in clinical practice necessitates a thorough understanding of its components, limitations, and validation in diverse patient cohorts to ensure its efficacy and reliability in different healthcare settings.

In this review, we aim to critically examine the existing literature surrounding the BSPS, elucidating its development, components, validation studies, and potential implications for paediatric dengue management. By synthesizing the findings from various studies and analyses, we seek to provide a comprehensive overview of the current status of the BSPS and its significance in the context of predicting the severity of dengue in paediatric patients.

3.0 Clinical Parameters in BSPS Development:

The development of the Bedside Severity Prediction Score (BSPS) for paediatric dengue management has entailed a comprehensive analysis of various clinical parameters to ensure the accurate prediction of disease severity and timely intervention. Several key clinical parameters have been identified and integrated into the BSPS, reflecting their critical role in assessing the progression and severity of dengue in children. Previous studies have emphasized the significance of capillary refill time as a vital clinical parameter in the BSPS development, highlighting its association with vascular permeability and the early detection of plasma leakage, which are crucial indicators of disease severity in paediatric dengue cases [9]. The incorporation of the tourniquet test in the BSPS has been supported by evidence suggesting its utility in evaluating the fragility of capillaries and the likelihood of haemorrhagic manifestations in paediatric dengue patients, contributing to the comprehensive assessment of disease severity [10]. Studies have demonstrated the significance of assessing the presence and severity of abdominal pain in children with dengue, indicating its correlation with the development of severe complications such as dengue shock syndrome and the need for immediate medical intervention [11]. The BSPS has integrated specific clinical signs associated with vascular leakage, including pleural effusion, ascites, and haemoconcentration, as crucial parameters in assessing the severity of dengue in paediatric patients, providing valuable insights into the progression of the disease and its potential complications [12]. Additionally, research has highlighted the importance of evaluating the presence of neurological symptoms, such as altered consciousness and seizures, in paediatric dengue cases, indicating their association with severe dengue and the need for immediate medical attention and close monitoring [13]. The

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incorporation of these critical clinical parameters into the BSPS has significantly enhanced the capacity to predict and manage the severity of dengue in children, emphasizing the importance of a comprehensive and systematic approach to risk assessment and clinical decision-making in paediatric dengue cases.

3.1 Laboratory Biomarkers and BSPS Accuracy

The integration of laboratory biomarkers has significantly enhanced the predictive accuracy of the Bedside Severity Prediction Score (BSPS) in paediatric dengue cases, enabling a more comprehensive assessment of disease severity and timely intervention. Various studies have highlighted the pivotal role of specific laboratory parameters in refining the BSPS and improving its prognostic capabilities. Platelet count, recognized as a crucial biomarker in the context of dengue severity, has been extensively incorporated into the BSPS, with research demonstrating its correlation with disease progression and the development of haemorrhagic manifestations in paediatric patients [14]. Additionally, haematocrit levels have been identified as essential indicators in assessing plasma leakage and the severity of vascular permeability, contributing to a more holistic evaluation of disease severity and progression in paediatric dengue cases [15]. The BSPS has also leveraged the assessment of liver enzyme levels as a key biomarker, acknowledging its association with hepatic dysfunction and the potential for severe complications in paediatric dengue cases, thereby strengthening the scoring system's capacity to identify high-risk patients and facilitate targeted clinical interventions [16]. Furthermore, research has underscored the significance of evaluating the dynamic changes in these laboratory biomarkers over time, emphasizing the need for continuous monitoring and close observation to accurately predict the trajectory of disease severity and guide appropriate management strategies in paediatric dengue cases [17] [18]. The incorporation of these critical laboratory biomarkers into the BSPS has significantly improved its accuracy in risk stratification and disease prognosis, underscoring the vital role of a comprehensive and integrated approach to clinical assessment and management in paediatric dengue cases.

3.2 Comparative Analysis with Other Scoring Systems

The comparative analysis of the Bedside Severity Prediction Score (BSPS) with other existing scoring systems has been instrumental in evaluating its efficacy and reliability in predicting the severity of dengue in paediatric patients. Studies comparing the BSPS with alternative scoring models have highlighted its superior predictive accuracy and clinical utility in risk stratification and disease prognosis. In a comprehensive study by researchers [19], the BSPS demonstrated a multidisciplinary approach that outperformed several conventional scoring systems in assessing the severity of paediatric dengue cases, emphasizing its ability to provide a more comprehensive and nuanced evaluation of disease progression. Similarly, a comparative analysis conducted by few researchers [20]. emphasized the robustness of the BSPS in identifying high-risk patients and guiding targeted interventions, highlighting its potential to surpass the limitations of other scoring systems in accurately predicting the clinical outcomes of paediatric dengue cases. Strainner et al. [21] also conducted a detailed comparative analysis, emphasizing the BSPS's ability to integrate both clinical and laboratory parameters more effectively, thereby enhancing its precision and reliability in risk stratification. These studies collectively underscore the BSPS's superiority in capturing the complex dynamics of paediatric dengue severity, providing healthcare practitioners with a more comprehensive and accurate tool for clinical decision-making and timely intervention. The findings from these comparative analyses emphasize the significance of the BSPS as a reliable and effective scoring system in the holistic management of paediatric dengue cases, underlining its potential to significantly enhance clinical outcomes and reduce the morbidity and mortality rates associated with severe dengue in children.

3.3 Clinical Implications and Treatment Outcomes

The clinical implications of the Bedside Severity Prediction Score (BSPS) in paediatric dengue cases have significantly influenced the approach to disease management, enabling healthcare practitioners to make informed decisions and implement timely interventions. Studies have emphasized the BSPS's critical role in risk stratification, enabling the identification of high-risk patients and the timely allocation of appropriate resources and medical interventions [22]. The incorporation of the BSPS into clinical practice has facilitated the early recognition of severe dengue cases, thereby reducing the risk of complications and the need for more aggressive and intensive treatment modalities. This proactive approach has resulted in improved treatment outcomes, with a notable reduction in the incidence of shock and organ failure, contributing to a decrease in the overall morbidity and mortality rates associated with paediatric dengue [23]. Furthermore, the BSPS has been instrumental in guiding targeted therapeutic interventions, optimizing the use of intravenous fluids, and ensuring timely blood component transfusions, when necessary, thereby improving patient outcomes and enhancing the overall quality of care in paediatric dengue cases [24].

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The utilization of the BSPS has streamlined the decision-making process in clinical settings, enabling healthcare practitioners to prioritize critical cases and allocate resources more efficiently, leading to improved patient management and reduced healthcare costs [25]. By facilitating a more accurate risk assessment, the BSPS has played a pivotal role in optimizing the utilization of healthcare resources, ensuring that critically ill patients receive prompt and appropriate care while minimizing unnecessary interventions for low-risk cases. This approach has contributed to a more effective and sustainable healthcare system, enabling hospitals to manage paediatric dengue cases more efficiently and allocate resources based on the severity of each patient's condition.

The implementation of the BSPS has also improved the coordination and collaboration among multidisciplinary healthcare teams, fostering a cohesive and integrated approach to paediatric dengue management [26]. The standardized risk assessment provided by the BSPS has enhanced communication and information sharing among various healthcare professionals, including physicians, nurses, and laboratory technicians, facilitating a more holistic and patient-centred approach to care. This collaborative framework has resulted in more effective treatment planning and the timely implementation of multidimensional interventions, leading to improved treatment outcomes and reduced hospital stays for paediatric dengue patients [27].

Furthermore, the integration of the BSPS into clinical practice has enhanced the monitoring and follow-up protocols for paediatric dengue cases, enabling healthcare practitioners to track disease progression and response to treatment more accurately [28]. The systematic risk assessment provided by the BSPS has facilitated regular monitoring of key clinical and laboratory parameters, allowing for the timely identification of any fluctuations or deteriorations in the patient's condition. This proactive monitoring approach has enabled healthcare teams to adjust treatment plans promptly, implement targeted interventions, and prevent the escalation of complications, thereby contributing to improved patient outcomes and a more favourable prognosis for paediatric dengue cases [29].

In addition to its direct impact on patient care, the BSPS has also contributed to the development of standardized protocols and guidelines for paediatric dengue management, fostering a more uniform and evidence-based approach to clinical practice [30]. The comprehensive risk assessment provided by the BSPS has served as a foundation for the development of standardized treatment algorithms and care pathways, ensuring consistency and uniformity in the management of paediatric dengue cases across different healthcare settings. This standardized approach has promoted the dissemination of best practices and clinical guidelines, fostering a culture of continuous improvement and quality assurance in paediatric dengue care, and enhancing the overall safety and efficacy of treatment interventions [31].

Moreover, the integration of the BSPS into clinical practice has contributed to the ongoing research and development efforts in paediatric dengue management, stimulating further investigations into novel therapeutic interventions and preventive strategies .The standardized risk assessment provided by the BSPS has facilitated the identification of key areas for research and innovation, encouraging the exploration of new treatment modalities, including antiviral therapies, immunomodulatory agents, and preventive vaccines. This collaborative approach between clinical practice and research has fostered a dynamic and progressive environment for paediatric dengue management, promoting continuous advancements in treatment outcomes and patient care [32].

Furthermore, the BSPS has significantly contributed to the education and training of healthcare professionals in the field of paediatric dengue management, enhancing their understanding of disease progression and the importance of timely risk assessment [33]. The standardized risk assessment provided by the BSPS has served as a valuable educational tool, facilitating the training of healthcare practitioners in the recognition of key clinical and laboratory parameters, the interpretation of disease severity, and the implementation of appropriate treatment interventions. This educational initiative has empowered healthcare teams to enhance their clinical decision-making skills, fostering a culture of continuous learning and professional development, and ensuring the delivery of high-quality and evidence-based care to paediatric dengue patients [34].

The integration of the BSPS into clinical practice has raised awareness among the general public and community stakeholders about the importance of early disease recognition and timely intervention in paediatric dengue cases. The standardized risk assessment provided by the BSPS has facilitated community outreach programs and educational campaigns, emphasizing the significance of preventive measures, including vector control strategies, environmental management, and public health initiatives. This community engagement has promoted a more proactive and collaborative approach to paediatric dengue prevention, fostering a sense of shared responsibility and collective action in safeguarding the health and well-being of children in dengue-endemic regions [35].

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Furthermore, the implementation of the BSPS has encouraged the development of integrated healthcare networks and partnerships, fostering collaborations between primary care providers, hospitals, and public health authorities in the management of paediatric dengue cases. The standardized risk assessment provided by the BSPS has facilitated the establishment of referral systems and communication channels, enabling seamless transitions and continuity of care for paediatric dengue patients across different healthcare settings. This integrated approach has promoted a more patient-centric and holistic continuum of care, ensuring that children receive timely and appropriate interventions at every stage of the disease, from initial diagnosis to follow-up and rehabilitation [36].

Moreover, the incorporation of the BSPS into clinical practice has promoted a culture of patient empowerment and shared decision-making in paediatric dengue management, fostering a more collaborative and inclusive approach to care. The standardized risk assessment provided by the BSPS has encouraged open communication and active engagement between healthcare providers, patients, and their families, promoting a shared understanding of disease severity, treatment options, and potential outcomes. This patient-centered approach has empowered families to actively participate in the decision-making process, fostering a sense of trust and confidence in the healthcare system and promoting a more positive and supportive care experience for paediatric dengue patients [37].

Furthermore, the integration of the BSPS into clinical practice has facilitated the development of comprehensive care plans and holistic support services for paediatric dengue patients, addressing their physical, emotional, and psychosocial needs throughout the course of the disease. The standardized risk assessment provided by the BSPS has encouraged the implementation of tailored care plans, including pain management strategies, nutritional support, and psychosocial interventions, aiming to improve the overall well-being and quality of life for children and their families. This comprehensive approach to care has fostered a more compassionate and patient-centered healthcare environment, ensuring that children receive the necessary support and resources to cope with the challenges of dengue and achieve a full recovery and optimal health outcomes [38].

Overall, the integration of the BSPS into clinical practice has revolutionized the approach to paediatric dengue management, transforming it into a comprehensive, patient-centric, and evidence-based discipline that emphasizes early risk assessment, timely intervention, and holistic support services. The BSPS has redefined the standards of care in paediatric dengue management, promoting a proactive and multidisciplinary approach that prioritizes the well-being and safety of children, fosters collaboration and innovation, and empowers healthcare practitioners, patients, and their families to make informed decisions and achieve optimal treatment outcomes.

3.4 Limited longitudinal studies assessing the long-term efficacy and reliability of the Bedside

Longitudinal studies focusing on the BSPS could also shed light on the factors influencing disease progression and severity in paediatric dengue cases, facilitating a more comprehensive understanding of the underlying mechanisms and pathophysiological changes that contribute to the evolution of the disease over time. By tracking the longitudinal trends of clinical and laboratory parameters incorporated into the BSPS, researchers can identify potential biomarkers and predictive indicators that signify disease progression and the development of severe complications in paediatric dengue patients, thereby enhancing the predictive capacity and clinical relevance of the scoring system. Furthermore, longitudinal research would enable the assessment of the BSPS's performance in diverse patient populations, considering the variations in disease dynamics, genetic predispositions, and geographical factors that might influence the severity and outcomes of paediatric dengue cases. Such comprehensive studies would contribute to the development of tailored risk assessment models that accommodate the unique needs and challenges of different patient cohorts, fostering a more personalized and precise approach to paediatric dengue management that accounts for the inherent variability and complexity of the disease [39].

Moreover, longitudinal studies would offer insights into the potential prognostic value of the BSPS in predicting long-term clinical outcomes and post-recovery sequelae in paediatric dengue cases, providing a holistic understanding of the disease's impact on the overall health and well-being of children beyond the acute phase. These studies would enable the identification of potential risk factors and predictive markers associated with prolonged complications and post-dengue syndromes, facilitating the development of comprehensive follow-up protocols and targeted interventions to mitigate the long-term health implications and improve the overall quality of life for paediatric dengue survivors. The implementation of longitudinal studies focusing on the BSPS would foster a more robust and evidence-based approach to paediatric dengue management, promoting continuous improvements in risk assessment models, treatment strategies, and patient outcomes, and ultimately advancing the standards of care and quality of life for children at risk of dengue and its complications [40].

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3.5 The incorporation of novel biomarkers and advanced diagnostic technologies into the BSPS framework

The incorporation of novel biomarkers and advanced diagnostic technologies into the Bedside Severity Prediction Score (BSPS) framework remains a relatively underexplored area in the existing literature on paediatric dengue management. Despite the recognized significance of traditional clinical and laboratory parameters, the limited research focusing on the integration of innovative biomarkers has hindered the BSPS's capacity to capture the dynamic pathophysiological changes characteristic of paediatric dengue cases. Comprehensive studies elucidating the role of novel biomarkers such as cytokines, chemokines, and specific viral markers in the BSPS have been notably scarce, impeding a comprehensive understanding of the intricate immune responses and disease progression in paediatric dengue patients. The integration of these novel biomarkers into the BSPS framework holds the potential to enhance the predictive accuracy and clinical relevance of the scoring system, providing valuable insights into the evolving pathophysiology of dengue and the underlying mechanisms driving disease severity in children. Furthermore, the limited exploration of advanced diagnostic technologies such as point-of-care testing and molecular profiling in the context of the BSPS has restricted its ability to adapt to the evolving landscape of paediatric dengue management, posing significant challenges in early disease recognition and accurate risk assessment [41]

The incorporation of novel biomarkers and advanced diagnostic technologies into the BSPS framework could facilitate a more comprehensive and nuanced risk assessment model that accounts for the diverse immunological responses and disease trajectories observed in paediatric dengue cases. The integration of specific viral RNA profiles, host genetic markers, and immune cell profiling techniques could provide valuable insights into the individualized disease susceptibility and treatment response, enabling healthcare practitioners to tailor interventions and therapeutic strategies based on the unique biomolecular signatures of each paediatric dengue patient. The incorporation of these advanced diagnostic tools into the BSPS could also foster a more proactive and preventive approach to paediatric dengue management, enabling the early detection of high-risk patients and the implementation of targeted preventive measures to mitigate the progression and complications of the disease. The integration of novel biomarkers and advanced diagnostic technologies into the BSPS framework would pave the way for the development of more precise and personalized risk assessment models that accommodate the complexity and heterogeneity of paediatric dengue cases, fostering a more tailored and effective approach to clinical decision-making and patient care [42].

Furthermore, the incorporation of novel biomarkers and advanced diagnostic technologies into the BSPS could promote the development of integrated and multidimensional risk assessment models that encompass the diverse immunological, virological, and clinical parameters associated with paediatric dengue severity. The utilization of comprehensive biomarker panels and multiplex diagnostic platforms could provide a holistic and real-time assessment of disease progression, enabling healthcare practitioners to monitor the dynamic changes in immune responses, viral load, and disease severity over the course of paediatric dengue cases [43]. Additionally, the integration of advanced diagnostic technologies could streamline the diagnostic process and expedite the identification of high-risk patients, enabling timely interventions and targeted therapeutic strategies that align with the individualized disease profiles and clinical needs of paediatric dengue cases.

Moreover, the integration of novel biomarkers and advanced diagnostic technologies into the BSPS could foster a more proactive and data-driven approach to paediatric dengue management, facilitating the implementation of evidence-based and personalized interventions that cater to the specific needs and challenges of each paediatric patient. The utilization of comprehensive biomarker panels and advanced diagnostic platforms could empower healthcare practitioners to make informed decisions and prognostic assessments, ensuring that children receive timely and targeted interventions that optimize their health outcomes and quality of life. Additionally, the incorporation of these advanced technologies into the BSPS framework could streamline the data collection and analysis process, fostering a more efficient and standardized approach to risk assessment and disease monitoring in paediatric dengue cases.

3.6 The standardization and external validation of the BSPS in paediatric dengue management

The standardization and external validation of the Bedside Severity Prediction Score (BSPS) in paediatric dengue management represent critical steps in establishing its universal applicability and reliability across diverse geographical regions and populations. While the BSPS has demonstrated promising results in certain settings, the lack of standardized protocols and external validation studies has limited its widespread implementation and adoption in various healthcare settings. The variability in disease dynamics, genetic predispositions, and environmental factors across different regions underscores the importance of standardizing the BSPS to accommodate the unique challenges and complexities of paediatric dengue management in diverse

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global contexts [44]. The development of standardized protocols for risk assessment, data collection, and scoring criteria would facilitate a more consistent and uniform approach to BSPS implementation, enabling healthcare practitioners to make accurate and reliable prognostic assessments and clinical decisions irrespective of the geographical location or patient population.

The external validation of the BSPS in diverse clinical settings and patient cohorts is imperative to evaluate its robustness and generalizability in real-world healthcare environments. Comprehensive validation studies conducted across different geographical regions would provide insights into the BSPS's performance in varied epidemiological contexts, enabling researchers to identify potential biases, limitations, and areas for improvement that could impact its predictive accuracy and clinical relevance. The external validation of the BSPS would also facilitate a comparative analysis of its performance with other existing scoring systems, fostering a more comprehensive understanding of its strengths and limitations in predicting the severity and outcomes of paediatric dengue cases [45].

The standardization of the BSPS would enable the development of a unified and evidence-based approach to paediatric dengue management that transcends geographical and cultural boundaries, fostering a global standard of care that prioritizes the well-being and safety of children at risk of dengue and its complications. The establishment of standardized protocols for risk assessment and disease monitoring would promote a more consistent and harmonized approach to clinical decision-making and treatment interventions, ensuring that all paediatric patients receive equitable and high-quality care regardless of their geographical location or socioeconomic status [46]. Moreover, the standardization of the BSPS would facilitate the collection of comparable data and the establishment of comprehensive databases that contribute to the global knowledge base on paediatric dengue management, fostering collaborative research efforts and knowledge sharing among diverse healthcare

Additionally, the external validation of the BSPS would enable researchers to assess its performance in different healthcare settings, including primary care facilities, secondary hospitals, and tertiary care centers, providing insights into its applicability and effectiveness across the continuum of paediatric healthcare services. Comprehensive validation studies conducted across diverse patient cohorts would offer valuable insights into the BSPS's performance in varying clinical environments, enabling healthcare practitioners to tailor the scoring system to the specific needs and challenges of each healthcare setting and patient population. The external validation of the BSPS would also foster a collaborative and multidisciplinary approach to paediatric dengue management, encouraging the participation of diverse healthcare professionals, researchers, and policymakers in the validation process, fostering a sense of shared responsibility and collective action in promoting the universal applicability and reliability of the BSPS [47].

Overall, the standardization and external validation of the BSPS represent crucial endeavours that contribute to the development of a comprehensive and universally applicable risk assessment model for paediatric dengue management. The establishment of standardized protocols and the validation of the BSPS in diverse clinical settings and patient populations are essential steps in ensuring its reliability, accuracy, and effectiveness in predicting disease severity and guiding clinical decision-making across different geographical regions and healthcare contexts.

3.7 The integration of the BSPS with tailored treatment protocols and therapeutic strategies

The integration of the Bedside Severity Prediction Score (BSPS) with tailored treatment protocols and therapeutic strategies represents a critical area of exploration in paediatric dengue management, necessitating comprehensive research efforts to optimize patient care and enhance overall clinical outcomes. While the BSPS has demonstrated its utility in risk assessment and disease prediction, further investigations are required to elucidate its role in guiding personalized treatment interventions and targeted therapeutic strategies that align with the specific needs and challenges of paediatric dengue cases. Tailored treatment protocols, customized based on the BSPS risk assessment, have the potential to improve the precision and efficacy of clinical interventions, ensuring that children receive timely and appropriate treatments that address the severity of their condition and mitigate the risk of complications. The integration of the BSPS with tailored treatment protocols would enable healthcare practitioners to adopt a proactive and patient-centred approach to paediatric dengue management, fostering a more personalized and effective continuum of care that caters to the unique requirements and responses of each patient [48].

The integration of the BSPS with tailored treatment protocols and therapeutic strategies could facilitate the optimization of clinical outcomes and the reduction of disease-related morbidity and mortality in paediatric dengue cases. The development of personalized treatment algorithms based on the BSPS risk assessment would

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enable healthcare practitioners to identify high-risk patients, initiate timely interventions, and monitor the response to treatment more effectively, contributing to improved patient outcomes and reduced hospital stays. Furthermore, the integration of tailored treatment protocols could streamline the delivery of healthcare services and optimize the allocation of resources, ensuring that children receive the most appropriate and timely interventions that address the specific severity and complications of their condition.

The integration of the BSPS with tailored treatment protocols and therapeutic strategies could foster the development of comprehensive and multidimensional care plans that encompass a range of clinical interventions and supportive measures tailored to the individualized needs and challenges of each paediatric dengue patient. The customization of treatment protocols based on the BSPS risk assessment would enable the implementation of targeted interventions, including fluid management strategies, nutritional support, and pain management techniques, that address the specific requirements and clinical manifestations of paediatric dengue cases. Moreover, the integration of tailored treatment protocols could facilitate the early detection and management of potential complications, ensuring that children receive prompt and effective interventions that prevent the escalation of symptoms and improve their overall quality of life [49].

The integration of the BSPS with tailored treatment protocols and therapeutic strategies could promote a more collaborative and multidisciplinary approach to paediatric dengue management, fostering the participation of diverse healthcare professionals, including physicians, nurses, pharmacists, and laboratory technicians, in the development and implementation of comprehensive care plans. The customization of treatment protocols based on the BSPS risk assessment would encourage a cohesive and integrated approach to patient care, promoting effective communication and coordination among healthcare teams and ensuring the seamless delivery of services that address the multifaceted needs and challenges of paediatric dengue cases. Additionally, the integration of tailored treatment protocols could foster a culture of continuous learning and quality improvement in paediatric dengue management, encouraging healthcare practitioners to stay abreast of the latest advancements and best practices in the field and actively participate in the development and refinement of evidence-based treatment protocols and care pathways [50].

The integration of the BSPS with tailored treatment protocols and therapeutic strategies could facilitate the development of standardized and evidence-based guidelines for paediatric dengue management, fostering a more uniform and systematic approach to clinical practice that prioritizes the well-being and safety of children at risk of dengue and its complications. The development of tailored treatment algorithms based on the BSPS risk assessment would promote the dissemination of best practices and clinical guidelines, ensuring that healthcare practitioners have access to standardized protocols and care pathways that optimize the delivery of services and improve patient outcomes. Additionally, the integration of tailored treatment protocols could enhance the training and education of healthcare professionals in the field of paediatric dengue management, empowering them to acquire the necessary knowledge and skills to implement evidence-based treatment interventions and provide high-quality care to children in need [51] [52].

Overall, the integration of the BSPS with tailored treatment protocols and therapeutic strategies represents a critical endeavour in paediatric dengue management, fostering a more personalized, proactive, and evidence-based approach to patient care that prioritizes the unique needs and challenges of each paediatric dengue case. The development of tailored treatment algorithms and care pathways based on the BSPS risk assessment has the potential to optimize clinical outcomes, improve the quality of care, and reduce the overall burden of paediatric dengue in healthcare settings worldwide.

CONCLUSIONS

From the over all studies considered for the investigation on BSPS. Few vital points have been revealed and alarmed which are mentioned below.

- The Bedside Severity Prediction Score (BSPS) serves as a crucial tool in paediatric dengue management, aiding in comprehensive risk assessment and disease prediction.
- Integrating clinical parameters, laboratory biomarkers, and advanced diagnostic technologies into the BSPS framework has significantly improved its predictive accuracy and clinical relevance.
- Comprehensive longitudinal studies are necessary to understand the BSPS's long-term efficacy in predicting disease progression and clinical outcomes in paediatric dengue cases.
- Further research focusing on the integration of novel biomarkers and advanced diagnostic technologies into the BSPS is essential to enhance its predictive capacity and adaptability to diverse patient populations.

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- Standardization and external validation of the BSPS across global healthcare settings are imperative to ensure its reliability and applicability in various clinical environments.
- The BSPS's integration with tailored treatment protocols and therapeutic strategies has the potential to optimize patient care and improve overall clinical outcomes for paediatric dengue cases.
- Continued efforts in refining the BSPS framework and promoting collaborative research initiatives are vital to advance the standards of care and improve clinical outcomes for children at risk of dengue.
- A multidisciplinary approach to paediatric dengue management, facilitated by the integration of the BSPS, fosters a comprehensive and patient-centric model of care that prioritizes individualized patient needs and challenges.
- The implementation of evidence-based guidelines and standardized protocols based on the BSPS is crucial in promoting a consistent and systematic approach to paediatric dengue management across diverse healthcare settings.
- Overall, the ongoing evolution and optimization of the BSPS framework, in conjunction with collaborative research endeavours, will contribute significantly to enhancing the quality of care and clinical outcomes for paediatric dengue patients globally.

Suggestions for Future Scope on BSPS using ML

Incorporating machine learning techniques into the Bedside Severity Prediction Score (BSPS) framework holds substantial promise for advancing paediatric dengue management. One key area for improvement is data integration and analysis, where machine learning algorithms can effectively assimilate diverse datasets, enabling the BSPS to make more accurate predictions and risk assessments by identifying complex patterns and correlations within the data. Additionally, employing machine learning models for feature selection and engineering can help identify the most informative variables, enhancing the BSPS's sensitivity to subtle changes in clinical parameters and biomarkers. To ensure the reliability and adaptability of the BSPS models, implementing advanced validation techniques such as cross-validation and bootstrapping is crucial. These methods can assess the robustness and generalizability of the machine learning-based BSPS models across various patient populations and healthcare settings. Moreover, the integration of machine learning-based systems for real-time risk monitoring can facilitate timely interventions and adjustments to treatment protocols, allowing healthcare practitioners to respond effectively to dynamic changes in a patient's condition. Personalized treatment recommendations based on individual patient profiles and BSPS risk assessments can be achieved through the integration of machine learning algorithms, ensuring tailored therapeutic strategies that optimize clinical outcomes and minimize the risk of complications. Furthermore, the use of machine learning techniques for predictive analytics can enable healthcare providers to anticipate potential long-term outcomes and post-recovery sequelae in paediatric dengue cases, leading to proactive measures and personalized follow-up protocols for improved patient care and management. Fostered through collaborative learning and knowledge sharing platforms, the integration of machine learning can facilitate data exchange and collaborative research initiatives, allowing for continuous improvement of the BSPS framework based on shared insights and collective learning within the healthcare community.

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DEVELOPMENT OF A MENTAL HEALTH ANALYZER FOR EARLY DETECTION AND INTERVENTION

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ABSTRACT
In today's world, mental health is receiving increased attention, with a growing recognition of its importance. Mental health encompasses cognitive, behavioral, and emotional well-being, and more than 700 million people worldwide are estimated to be affected by mental illness. To address this issue, there's a need to understand the consequences of mental health issues.

Healthy mental health empowers individuals to reach their full potential, handle life's stresses effectively, enhance their productivity, and contribute to their communities. Stigma and fear often deter people from seeking help for their mental health concerns, and some may not even realize they have such issues.

To address these challenges, a secure website or app can be created using machine learning and data science. This digital platform could help users detect mental health issues early. The rise of mental health apps has made such resources more accessible, but many of them lack proper features and validation.

To overcome these difficulties, a secure app or website can be developed, ensuring user privacy and offering a safe space to share their problems. Features like chatbots and questionnaires can be optimized to help users access and manage their mental stress effectively. Machine learning algorithms can analyze the collected data to aid in diagnosis and emotional support.

Keywords: Machine learning, data science, mental health, algorithms, chatbot, and questionnaire.

INTRODUCTION
People all around the world are affected by mental illness of one type or the other. Some may need professional help while others need some sort of relaxation routine to calm down and deal with the daily stress or when feeling a little depressed. The WHO (World Health Organization) asserts that "Mental health is a state of well-being in which an individual can utilize their abilities, cope with everyday stress, function productively, and contribute to the community." Examples of mental health challenges or disorders encompass excessive anxiety and stress, depression, substance abuse, bipolar disorder, and schizophrenia, among others.

The COVID-19 pandemic has led to a noticeable rise in major depressive disorders, impacting a significant portion of the population. Traditionally, individuals grappling with these issues would seek face-to-face conversations with health professionals, psychologists, and psychiatrists. Given the high number of individuals experiencing these challenges daily, it is imperative to curb the escalation of these statistics. As an alternative approach, creating an app or website offers a means for individuals to derive the benefits of face-to-face conversations to the fullest extent possible. Numerous trials and evidence highlight the positive impacts of such apps on healthcare, spanning conditions from hypertension and asthma to diabetes and mental health.

BIG DATA is very helpful in such cases. It can provide the professionals insight on patterns or any deviations that are typically challenging to identify. Data science techniques can reintroduce relevant information derived from the vast data, which can be used to assist in decision making when necessary.

Data from various resources like hospitals, internet researches, patient history and records from the pharmacies help gather a vast amount of data which can be used as datasets to perform various operations to detect patterns and can lead to detecting the exact problem and diagnosis and push for further treatment or research depending on the results.

The difficulty lies in the absence of a definitive set of tests or symptoms that can neatly categorize a mental illness. The categorization process involves a considerable amount of overlap and relies on trial and error. Individual differences contribute to delayed or inaccurate detection and diagnosis. Data science can address this challenge by leveraging large datasets and manipulating them to unveil concealed patterns and anomalies that are difficult to detect and diagnose. These findings can then be used to identify causes and symptoms, enabling a more precise and accurate diagnosis.

Data scientists are employing machine learning to gather and process datasets, aiming to identify patterns that reveal similarities and symptoms related to various mental health issues. This approach is also geared towards discovering interventions for these mental health challenges. The algorithms utilized for these tasks are

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continuously refined, and while their use may not be consistent, the widespread use of AI has led experts to recognize its potential in providing access and assistance for mental health issues. Consequently, AI tools are now employed for diagnosing mental health issues and supporting the recovery process. The appeal of AI lies in its cost-effectiveness, time efficiency, and accuracy. Individuals generally find it more convenient to open up to AI, as it offers greater anonymity and personalization, creating a safe space. However, applications or websites are constrained by the amount of data they can handle, leading to potential discontinuity. To address this limitation, it is crucial to ensure that diverse and relatable data is used.

The aim of machine learning is to construct advanced models that can improve by using probabilistic and statistical techniques. Machine learning, in general, is an important tool which helps in the prediction several mental health issues. Researchers are able to collect vast data and personalise it according to the user. This model has been tested under various algorithms. The algorithms being logistic regression, random forest, grand boosting, and decision tree, we have come to a conclusion that random forest is the best fitting algorithm. All of the said algorithms are used to predict future events.

Supervised machine learning algorithms are extensively employed for their specialized approach in research, studies, and experiments, especially within the medical field. In supervised learning, terms, values, and attributes are manifested in data instances. This classification technique relies on structured training data, offering organized information that is easily accessible and editable when needed. On the contrary, unsupervised learning lacks supervision, resulting in less accurate outcomes compared to supervised algorithms.

Natural language processing techniques, widely known as NLP techniques are used to predict symptoms in severe mental health issues like suicide or any other psychogenic symptoms. Many popular help lines all around the world use machine learning to identify people with a high risk of potential self-harm through their choice of words during phone calls.

In today's world, digitalization of mental health treatment in the preliminary level will allow users to have a clear view of them. By preparing this online chatbot/ website project that acts as a virtual therapist to the user and provides the necessary clarity regarding the next step to be taken towards the health.

LITERATURE SURVEY

The Mobile Therapeutic Attention for Patients with Treatment-Resistant Schizophrenia (m-RESIST) [1] was developed with the aim of conducting a systematic review of eccentric studies focused on mental health apps that are sensor based. The objective is to reveal connections between sensor data and symptoms of psychiatric disorders, thereby aiding the m-RESIST approach in evaluating the effectiveness of behavioral monitoring in therapy. However, a limitation exists in that while sensor data indicated associations with symptoms of depressive disorders, bipolar disorders, their practical applicability to support interventions has not been comprehensively assessed and requires further scrutiny.

The article "Smartphone-Based Tracking of Sleep in Depression, Anxiety, and Psychotic Disorders," [2] published in 2019, assessed Smartphone-based sleep evaluations and interventions. It underscores the importance of focusing on promoting sustained adherence to these Smartphone-based systems, exploring the potential of adaptive and personalized approaches to predict the risk of relapse, and evaluating the impact of sleep monitoring on enhancing patients' quality of life and achieving clinically meaningful outcomes. Although Smartphone technologies currently do not seem to provide the same level of quality or depth of sleep data as polysomnography (PSG), there is a possibility that as technology and methods advance, new opportunities for detecting the psychiatric issues will come up.

Chatbots and Conversational Agents in Mental Health: A Review of the Psychiatric Landscape, [3] released in 2019, aimed to investigate the use of conversational agents or otherwise known as chatbots in this field. The review focused on their contributions to the detection, diagnosis, and the treatment. Due to the diversity in the studies reviewed, additional research with standardized reporting of outcomes is necessary to comprehensively assess the effectiveness of conversational agents. Nevertheless, preliminary findings suggest that with appropriate approaches and further research, conversational agents could become valuable tools in psychiatric treatment within the mental health field.

The Mental Health Tracker [4] recognizes the contemporary importance of mental health. It is essential to proactively identify and address mental health issues before they significantly impact individuals. During the pandemic, people faced various challenges such as unemployment, anxiety, and depression. Understanding the mental health implications of the COVID crisis, we are developing a user-friendly app. Given the prevalent security concerns associated with such software, we are implementing the Google Authentication system to

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enhance security. This additional layer of security ensures users' confidence in the protection of their personal information.

A Mental Health Tracker Constructed with Flutter and Firebase [5]. This project is centered on creating a mental health tracker that aims to assess the user's mental state in a minimally intrusive manner. The goal is to determine if the user is experiencing any distress and then recommend appropriate measures to improve their current condition. Through a series of questions answered by the user, the system suggests tasks and keeps a record of their mental state, which is then displayed on a dashboard.

ML in Mental Health [6]: A Comprehensive Examination of techniques and Implementations. This paper aims to amalgamate the existing literature on (ML) machine learning and data science applications within the domain of mental health. It sheds light on ongoing research and practical applications, utilizing ML techniques such as vector machines (SVM), decision trees, artificial neural networks, latent Dirichlet Allocation, and various clustering methods. In general, the integration of machine learning into the field mental health has revealed a variety of advantages spanning the realms of early detection, diagnosis and treatment and support, as well as in clinical and research administration. While a substantial portion of the identified studies concentrates on detecting and diagnosing mental health conditions, it is also clear that there is potential in applying machine learning to other fields of psychology as well

Artificial Intelligence for Mental Health and Mental Illnesses [7]: A Comprehensive Exploration. Using AI has significant potential for transforming this field, accompanied by inherent challenges. This article provides a comprehensive examination of artificial intelligence (AI) and its current use in mental healthcare. It includes a review of the original research focused on AI applications in mental health, along with a discussion on the potential of AI to improve the methods used in clinical settings. It also addresses existing disadvantages, fields that need more research and ethical implications linked with AI. As AI techniques undergo continuous refinement, there exists the possibility to define the mental health issues in an objective manner than the delineated in the DSM-5, to detect the conditions at early stages for more effective interventions, and to tailor treatments based on individual characteristics. Nevertheless, exercising caution is imperative to prevent the over interpretation of preliminary results and collaborative endeavors are essential to narrow the divide between AI research in mental health and its effective implementation in clinical care.

Reviewing the data security and privacy policies of mobile apps for depression [8]. The use of mobile apps has gained popularity as a means of providing support for mental health. However, there has been limited scrutiny of the available information on data security procedures employed by developers, particularly those catering to mental health. It is imperative to assess how transparent and efficient are the practices used in the apps. Most of the examined applications did not sufficiently provide transparent information regarding data security. Although these apps have the capacity to broaden mental health resources, extending support to individuals who might face barriers or reservations in seeking traditional in-person care, or serving as a supplementary treatment tool, their effectiveness relies on ensuring safety, security, and responsible usage.

Barriers to and Facilitators of User Engagement with Digital Mental Health Interventions [9]: Systematic Review. Digital mental health interventions (DMHIs), employing technologies like mobile apps to provide mental health support, hold the potential to enhance accessibility, as numerous studies have verified their efficiencies in mitigating indications or symptoms. The aim of this systematic review is to identify key obstacles and enablers that impact user engagement with Digital Mental Health Interventions (DMHIs). Common facilitators include promoting social connectedness, heightening awareness of health, and instilling a sense of personal well-being control through the intervention. Despite previous research indicating the usefulness of DMHIs when it comes to supporting mental health factors, play a significant role in determining whether users actively participate in these interventions. This information offer valuable insights for assessing DMHIs, contributing to an Enhancing comprehension of user engagement and contributing to the design and development of novel digital interventions.

Gamification in Apps and Technologies for Improving Mental Health and Wellbeing [10]: Systematic Review. It is sought to address three research questions (RQs). RQ1: What are the most frequently utilized gamification elements in apps and technologies designed to enhance mental health and well-being? RQ2: Which domains of mental health and well-being are most commonly addressed by these gamified apps and technologies? RQ3: What rationales do researchers provide for incorporating gamification into these apps and technologies? The findings indicate that the current utilization of gamification in apps and technologies aimed at improving mental health and well-being deviates from the prevailing positive reinforcement trend criticized in the broader health and well-being literature.

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From all the above listed papers it is evident that digitalization of mental health has proven to be effective but has certain drawbacks that need to be improved by reinforcing the models to make a website for mental health a safe and effective space. A better technology or model is required to be more users friendly and to detect the emotions and perform analysis of the same to provide a proper response and also provides a secure environment for the users to help them face their mental health issues.

EXISTING METHODOLOGY

The use of technology has proven to be beneficial in complementing the assessment of diverse mental illnesses and disorders, ranging from the evaluation of sleep patterns and abnormalities to chronic conditions like schizophrenia and bipolar disorder, particularly within clinical settings.

Many investigations have delved into the application of machine learning algorithms and techniques for the analysis of datasets related to mental health. For example, Shatte et al. employed a review, examining 300 papers concentrated on machine learning and data science applications in this field. Their findings revealed that the predominant focus of this work was on mental illnesses such as Alzheimer's disease, depression disorders, bipolar disorders and schizophrenia. Furthermore, 89% of the analyzed papers employed machine learning approaches, such as support vector machine (SVM), naïve Bayes, or decision trees, which are supervised learning techniques to investigate these mental health conditions.

Logistic regression delivers a binary conclusion by predicting the probability of an outcome. Being a supervised machine learning algorithm, logistic regression is widely used because of its limited possible outcomes. The stated possible outcomes are of structured variables, making sure the result is either categorical or discrete. The outcomes could also be probabilistic values.

K nearest neighbor classifier, also known as KNN method is a non parametric, supervised learning technique. In this technique, the model predicts the outcome based on already existing data. The model makes an assumption that the outcome will be similar to already existing data that is closer to the given data points, in this case symptoms.

Decision tree classifier is a widely used supervised machine learning algorithm. This algorithm uses a model that represents a dendrogram. This dendrogram consists of nodes, roots, sub-roots and sub-trees, and are together called as a tree. This tree is a huge dataset where nodes with similar characteristics are grouped together to form a sub-tree.

PROPOSED METHODOLOGY

Most of the existing models use existing algorithms such as, logistic regression, decision tree, random forest, grand boosting algorithms. The said algorithms are pretty efficient but have their own drawbacks when creating the mental health analyzer. To explain them in detail, for

LOGISTIC REGRESSION

The accuracy rate for logistic regression was at around 75%. Therefore, using this algorithm is going to lead our model into underfit. Thus, our model would not be able to perform well in training and testing. This isn't recommended for the project to survive further.

DECISION TREE

The accuracy rate for decision tree was at around 100%. Therefore, using this algorithm is going to lead our model into overfit. Overfit would look positive on the outside but it doesn't allow our model to accept new inputs. Therefore, it isn't recommended to work on for the project.

RANDOM FOREST

The accuracy rate for random forest algorithm was at around 95%. Therefore, using this algorithm would be preferable as it is proper fit. Not only does it pass all the tests but it also allows new inputs.

GRAND BOOSTING

The accuracy rate for grand boosting was at around 100%. Therefore, using this algorithm is going to lead our model into overfit. Overfit would look positive on the outside but it doesn't allow our model to accept new inputs. Therefore, it isn't recommended to work on for the project.

DATA ACQUISITION

The data acquired for this model initially, is from Kaggle. Many datasets were taken into consideration and were analyzed, summarized before working on this project. These data sets were modified when required for more accurate results and were chosen carefully. They were structured data which comprised of the work life,

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age, gender, the amounts breaks they take a day, whether they take care of mental health affectively, was self care a part of their daily routine, etc., were taken into consideration to produce a better analysis.

```
plt.bar(Anxiety['Do you have Anxiety?'], Anxiety['count'])
plt.show()
```

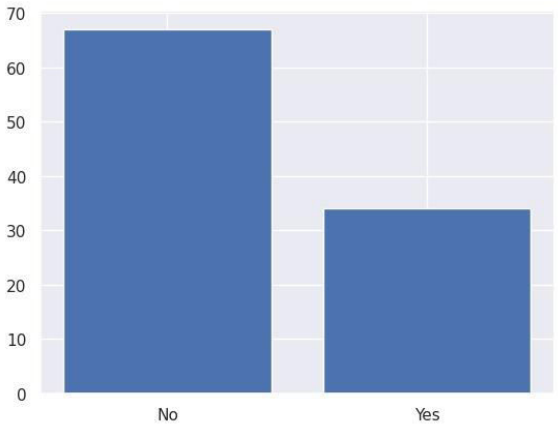

Fig. 1

The code used was designed after multiple trial and errors. The code was written based on multiple algorithms and finally was decided on random forest. The model consists of several steps while making it comfortable to the user. The steps are as follows:

- Sign up/ log in
- A small study about mental health and different types of mental health.
- A questionnaire that's provided especially for that particular type of mental health.
- An analysis based on this questionnaire
- A chatbot

SIGNUP/ LOGIN

Signing up or logging in might feel extra for a website that's about mental health for some part of the society.

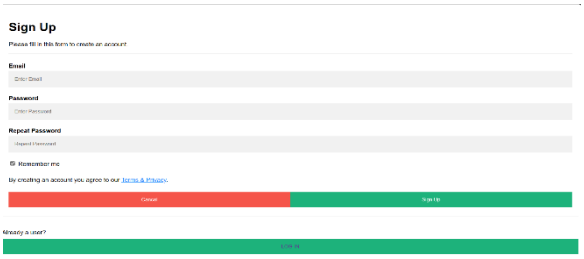

Fig 2

Fig 2 is a snippet of how the signup page looks like in our website. The snippet of the code is given in *Fig 3*.

```
<form action="/action_page.php" style="border:1px solid #ccc">
  <div class="container">
    <h1>Sign Up</h1>
    <p>Please fill in this form to create an account.</p>
    <hr>

    <label for="email"><b>Email</b></label>
    <input type="text" placeholder="Enter Email" name="email" required>

    <label for="psw"><b>Password</b></label>
    <input type="password" placeholder="Enter Password" name="psw" required>

    <label for="psw-repeat"><b>Repeat Password</b></label>
    <input type="password" placeholder="Repeat Password" name="psw-repeat" required>

    <label>
      <input type="checkbox" checked="checked" name="remember" style="margin-bottom:15px"> Remember me
    </label>

    <p>By creating an account you agree to our <a href="#" style="color:dodgerblue">Terms & Privacy</a>.</p>

    <div class="clearfix">
      <button type="button" class="cancelbtn">Cancel</button>
      <button type="submit" class="signupbtn">Sign Up</button>
    </div>
  </div>
</form>
<br><br>
Already a user? <a href="file:///C:/Users/lasya/OneDrive/Desktop/Seminar/lalalala.html">
<button>LOG-IN
</a></button>
</body>
```

Fig 3

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Our model not only provides a questionnaire but also provides a solution. Solution for mental isn't something that happens overnight. The chatbot is the only thing that will be helping you throughout your journey. The chatbot needs to have regular input of data to analyze the journey of your mental health. Which means, it needs your data to provide accurate suggestions or messages? So, keeping privacy in mind, a sign up page was created to keep track of your data and to keep it personalized.

STUDY/ INFORMATION

Mental health is heavily ignored because of the negative impression it gives off to everyone. Being mentally "unstable" isn't something that everyone would want to hear when it comes to them.

Fig 4

Fig 4 is an example of how the information is showcased in the model.

```
<!DOCTYPE html>
<html>
<head>
<title>Neurodevelopmental disorders </title>
<style>
body {
background-image:url("https://drhabibpediatricneurologist.com/wp-content/uploads/2022/03/Neurodevelopmentaldisorders.jpg");
background-repeat:no-repeat;
background-size:100%;
}

</style>
</head>
<body>
  <center>
<p><h1><u><b>NEURODEVELOPMENTAL DISORDERS</u></b></h1></p><br>
<p><h2>Neurodevelopmental disorders are disabilities associated primarily with the functioning of the
neurological system and brain.Children with neurodevelopmental disorders can experience
difficulties with language and speech, motor skills, behavior, memory, learning, or other
neurological functions. While the symptoms and behaviors of neurodevelopmental disabilities
often change or evolve as a child grows older, some disabilities are permanent. Diagnosis and
treatment of these disorders can be difficult; treatment often involves a combination of
professional therapy, pharmaceuticals, and home- and school-based programs.</h2></p></center><br><br><br>

  <p><h1>KEY FACTORS</h1></p>
<p><h2>1. Low birth weight can lead to neurodevelopmental disorders.  </h2></p>
 <p><h2>2.  Environmental contaminants, such as lead can lead to neurodevelopmental disorders.</h2></p>
<p><h2>3. Fetal exposure to smoking, alcohol, recreational drugs, or medications during pregnancy can lead to neurodevelopmental disorders.
</h2></p>
<p><h2>4. Premature birth can lead to neurodevelopmental disorders.</h2></p>
```

Fig 5

Fig 5 is the code snippet for one of the information modules. Therefore, to make mental health more comfortable for everyone, statistics and details regarding mental health and types of mental health was provided. In short, to assure people that they are not alone or abnormal and mental health is a lot more serious than it seems. Facts like mental health being affected by the kind of environment one grows up in, or the environment that they currently live in and how every single step is important as the day goes is mentioned in the website.

QUESTIONNAIRRE

As aware as it is today, mental health has simultaneously become more unserious over time. The below *Fig 6* showcases how the questionnaire looks like and the *fig 7* showcases the code snippet.

```
Depression Questionnaire
Please answer the following questions with 'yes' or 'no'.
1. Have you been feeling sad or down most of the time for the past two weeks or more
   ? (yes/no): yes
2. Have you lost interest in activities you used to enjoy? (yes/no): yes
3. Have you experienced significant changes in your appetite or weight? (yes/no): no
4. Do you have trouble falling asleep or staying asleep, or do you sleep too much?
   (yes/no): yes
5. Do you feel tired or lacking in energy most days? (yes/no): no
6. Do you feel worthless or guilty? (yes/no): no
7. Is it difficult for you to concentrate or make decisions? (yes/no): yes
8. Do you have thoughts of death or suicide? (yes/no): no
Depression Severity Score: 4
Your score indicates a lower likelihood of depression, but it's essential to monitor
   your mental health.
```

Fig 6

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```
def depression_questionnaire():
    print("Depression Questionnaire")
    print("Please answer the following questions with 'yes' or 'no'.")

    questions = [
        "1. Have you been feeling sad or down most of the time for the past two weeks or more?",
        "2. Have you lost interest in activities you used to enjoy?",
        "3. Have you experienced significant changes in your appetite or weight?",
        "4. Do you have trouble falling asleep or staying asleep, or do you sleep too much?",
        "5. Do you feel tired or lacking in energy most days?",
        "6. Do you feel worthless or guilty?",
        "7. Is it difficult for you to concentrate or make decisions?",
        "8. Do you have thoughts of death or suicide?",
    ]

    score = 0

    for i, question in enumerate(questions):
        response = input(question + " (yes/no): ").lower()
        while response not in ["yes", "no"]:
            response = input("Please answer with 'yes' or 'no': ").lower()

        if response == "yes":
            score += 1

    print("\nDepression Severity Score:", score)
    if score >= 5:
        print("It's important to seek professional help. You may be experiencing depression.")
    else:
        print("Your score indicates a lower likelihood of depression, but it's essential to monitor your mental health.")

if __name__ == "__main__":
    depression_questionnaire()
```

Fig 7

Since many people are “self-diagnosed” and are more “woke”, in today’s terms, it is so much more normalized than it should be and in the wrong way. Therefore, providing an actual analysis to dwell deep into understanding your brain is important to make the website more legal. This part of the analyzer is pretty much a necessity. As this data entered by the user is what helps the program to “analyze”.

ANALYSIS

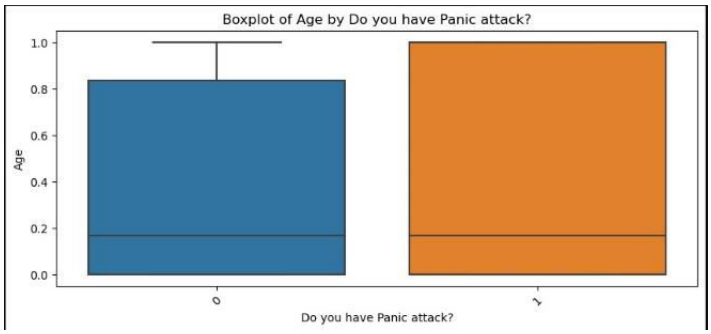

Fig. 8

The most important part of the analyzer is the analysis itself. Based on the questionnaire, the program is going to provide a proper analysis onto where your mental health is according to standards. The process of analysis is pretty simple. The code is designed such that every time the user answers the question as ‘yes’ then the code adds a “point”. The higher the points are, the more severe the mental health condition is.

CHATBOT

The chatbot in this project is the comfort people might look for. The chatbot is designed to “talk” to the user in a way such that there is continuity in the conversation. The chatbot is designed in a way such that it reacts according to the “keywords” found in the user statement. The chatbot displays multiple messages based on these keywords. Words such as sad, frustrated, happy, disturbed, bad acts as the keywords. When these words are displayed the chatbot is taught to display over 150 messages that were already given as input. These messages are hand-written, therefore giving it more “humane-touch”. The messages consists of a bunch of comfort messages, motivational messages etc., which are displayed for different keywords.

MODEL DESCRIPTION:

The Mental Health Analyzer plays a supportive role in early detection and raising awareness of mental health issues. It is not a substitute for professional diagnosis or treatment. Users are advised to consult mental health professionals for a thorough assessment.

Ethical considerations include user privacy, consent, and ensuring the information provided is secure and confidential. The analyzer does not store or share user data without consent and maintains a user-first approach to safeguarding mental well-being.

In summary, the Mental Health Analyzer is a machine learning-based model with a chatbot interface that engages users in conversation, analyzes their input, and provides preliminary insights into potential mental health concerns. It aims to promote mental health awareness and encourages users to reach out for professional help when needed. The following representation is a snippet of how this model works

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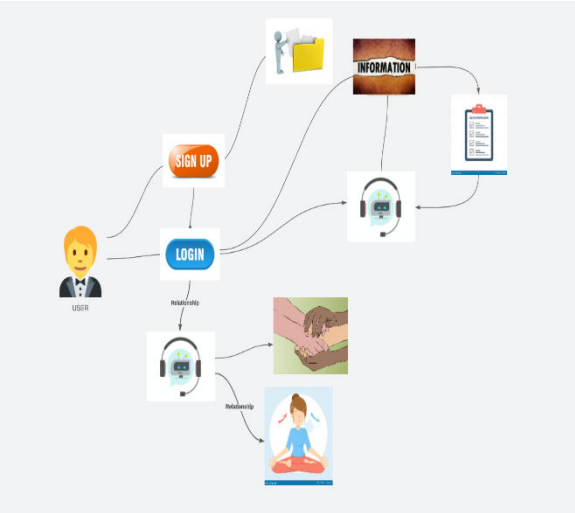

Fig. 9

THE WORK FLOW

The workflow of this project consists of a user interface that is set up with the already explained steps. The user is requested to create an account in order to secure their privacy and give them an ideal diagnosis based on their own difficulties. Once the user creates an account, they now become a client, which means that the website or the application is going to act according to the user requests or necessities. After logging in to their respective accounts, the user gets access to information about mental health and exclusive facts regarding them, therefore providing them with a safe space. The information is categorized to multiple mental health disorders. All these mental health disorders are then again explained and a questionnaire is provided to each of these mental health disorders. The website then analyses the results of this questionnaire and produces a result.

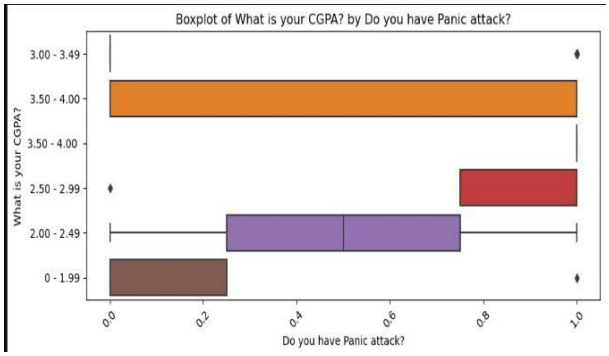

Fig. 10

Based on these results, the website determines the severity of the disorder and gives and accurate solution, as in, the website suggests professional help if needed or it will be your companion throughout journey of healing to make sure that you get better. A chat box is provided to all the users to communicate when necessary. The data received by the user when communicating with the user is saved to have continuity or a flow in the conversation when conversing the next time. This choice however is an option. The user can logout anytime and log back in with their credentials. Here is the workflow,

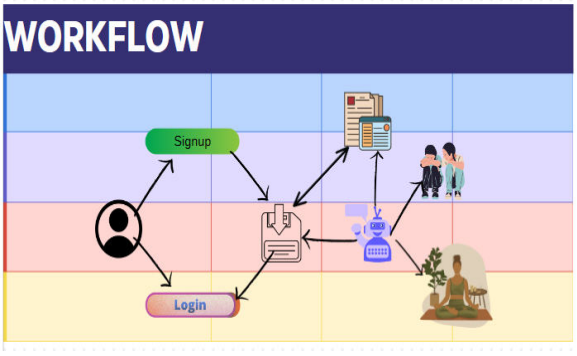

Fig. 11

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RESULT

The conclusion from this project is that, not only is this project just any other new project in the market but it is a solution for an already existing yet severely ignored problem. This project is implemented after many trails and errors of different algorithms, making it more dependable. Even if many of the graphs added are from already existing datasets, the analysis will be done truly based on user information. The examples were used to explain how the algorithm is going to adapt the data and use it to produce accurate results only. The workflow was decided after serious consideration in what kind of models already exists and what we can bring in to build a better website. Over 150 messages were handwritten for each scenario or keyword that would be entered in the chatbot to give it a more humane touch. Since there will be continuation in the conversations between the user and the chat box and since all the messages entered are by a human, it is easy for the user to communicate with the chat box and find comfort/ motivation in the user.

CONCLUSION:

The conclusion from this project is that, from testing many different algorithms, the best algorithm, which is proper fitting was identified and used exclusively. The algorithm being random forest, the process was easier and more convenient while building the model. The difference between already existing models and this model is that, not only does it provide an analysis; it also helps in finding a solution with the user during their tough times. It is a known fact that when one is feeling down mentally, they often feel lonely and out of place. Sometimes the cause of the issue could be being lonely itself. So, at times like that, our model works as a friendly companion while providing advices and solutions like a human, because it is designed to act according to the keywords, and the messages produced by the machine are handwritten.

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MARKET ANOMALIES TRANSFER MODELLING WITH AGENT BASED FRAMEWORK

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ABSTRACT
This paper presents the outcomes of market trading in a market characterized by a single security and multiple traders. The price of a security is determined by traders who employ speculative and fundamental strategies based on their performance and the broader market sentiment, with the goal of maximizing their wealth. The study involved modifying the market composition and introducing market shocks into the simulation to analyze the impact on market performance. The research focused on examining variations in the patterns of market state transitions and the behavior of different traders in response to these unexpected events. The study revealed that the market maker has a role in maintaining market stability to a certain degree and has a favorable impact on traders' profitability. Additionally, the patterns of state transitions are influenced by the types of agents and market shocks employed in the simulation.

Keywords: Agent based model, Price bifurcations, Market Recovery, Price shock, Financial trading

1. INTRODUCTION
As financial markets evolve, they encounter new risks such as unexpected liquidity shocks and the response of traders to developments. Agent-Based Modeling (ABM) gained significant popularity in the financial markets industry throughout the late 1990s and early 2000s. Palmer, Arthur, Holland, LeBaron, and Tayler were prominent innovators in the application of Agent-Based Modeling (ABM) to financial markets. The first-generation SFI (Santa Fe Institute) market was designed and became operational in the late 1980s and early 1990s [Arthur et al., 2018]. Later, their noteworthy contributions were published in 1994. The occurrence referred to as the "Flash Crash" took place on May 6, 2010, within the financial markets of the United States. This occurrence entailed a catastrophic and profound plummet in stock prices, succeeded by a prompt resurgence within a brief duration. Price declines might worsen when high-frequency liquidity providers exit the market due to market-wide acute shocks and heightened uncertainty. According to Kirilenko et al. [Andrei et al., 2017], the 2010 Flash Crash saw a significant number of high-frequency liquidity providers leaving the market, which worsened the decrease in prices. Consequently, examining the impact of market uncertainty and trading activity on significant losses can provide essential understanding of the consequences of high-frequency trading (HFT) methods, such as market making and liquidity provision, on the overall stability of the market. In order to examine the hazards described before, a simulator was created to analyze the probability of these occurrences and their outcomes. The study of processes in the market can be enhanced by modifying the initial parameters, agents, shocks, and structure of a model that represents the entire environment. This approach allows for a more detailed examination of hypotheses [Turrell, 2016]. The paper is organized into three main sections. The opening section outlines the configuration of the trading agents. The following part explores the development of the matching agent within the simulation framework. The concluding part provides and analyzes the results obtained from our set of tests [Chiarella et al., 2012] Kyle (1985).

2. MODEL STRUCTURE
In a continuous double auction stock market, a single asset is traded and diverse agents engage in trading using various strategies such as market-making, fundamental, chartist, and noise trading, all within a realistic market microstructure. The intrinsic value of a share can be approximated, as the share price is determined directly by traders who aim to enhance their financial assets. Traders have the ability to modify their strategies, either based on fundamental factors or speculation. The speculative approach is particularly influenced by the overall sentiment of other speculative traders [Lux, 1995]. The aim is to simulate sudden changes in market prices in order to analyze the resulting price divergences and assess the market's ability to recover from such shocks [Yalamova, McKelvey,2011].

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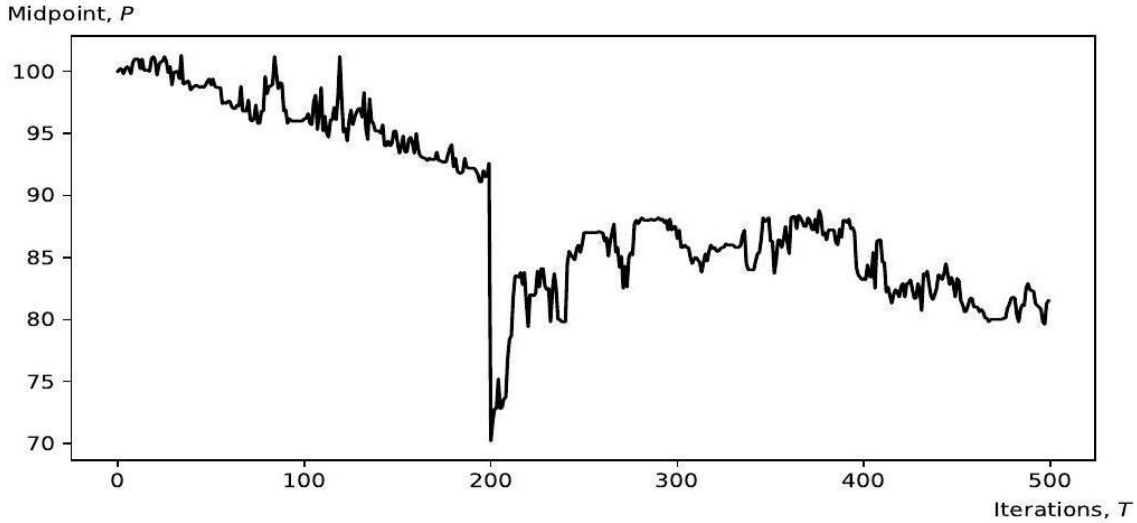

3. AGENT "RANDOM TRADER"

Random Traders aim to imitate the actions of individual investors who lack specific market information or explicit trading strategy [Clack et al., 2020]. They produce orders indiscriminately, without taking into account the special characteristics of individual stocks or the overall market conditions, resulting in what can be perceived as market noise.

In order to maintain a consistent total number of orders in the order book, we have established probabilities for various sorts of orders. This is done to create a balance between entering limit orders, which increase the number of orders in the book, and market orders, which decrease the order count. The order types are distinguished by the following probabilities: limit order -0.35, market order - 0.15, cancellation order - 0.35, and do nothing - 0.15.

The quantity associated with each order is distributed uniformly. The strategy for determining the limit order price is as follows: there is a 0.65 probability that the price is drawn from a distribution outside the spread, which is defined by an exponential deviation from the best offer (as described in Equation 1), and there is a 0.35 probability that the price is drawn from a uniform distribution between the best bid and ask prices.

$$Q_{\text{bid,ask}} \sim U(1, \ldots, 5)$$
$$P_{\text{bid}} = [\text{ best bid } \pm \Delta], \text{ where } \Delta \sim \exp(\lambda)$$
$$P_{\text{ask}} = [\text{ best ask } \pm \Delta], \text{ where } \Delta \sim \exp(\lambda)$$

4. AGENT "FUNDAMENTALIST"

The agent in our model, known as the Fundamentalist, assesses the intrinsic worth of a company and compares it to its current market price [Toth, Scalas, 2007]. When the market price is higher than the fundamental value, the Fundamentalist agent will sell the share using a market order. Alternatively, if the market price is lower than the intrinsic value, the agent acquires the share. Nevertheless, employing a strategy exclusively reliant on market orders over an extended period of time could potentially lead to a decrease in the overall volume of orders placed on the exchange. As a result, we also include a likelihood for the completion of limit orders on the other side. The chances of executing bid and ask orders are equal for the Fundamentalist agent. The price determination for these limit orders is conducted using the same procedure as that employed for the Random Trader, as depicted in Equation 1. The order volume is determined by the difference between the market price P_m and the fundamental valueP_f and is calculated accordingly.

$$Q_{bid,ask} = \min\left(\frac{1}{\gamma}\frac{|P_f - P_m|}{P_m}, 5\right)$$
$$\gamma = 5e-3$$

This relation allows the Fundamentalist to respond more quickly when there is a notable possibility of abnormal profits. The intrinsic value of a stock is obtained by evaluating the known dividend payments, which includes both the discounted known payouts and the permanently projected dividend payment calculated using the Constant Dividend Model using the most recent known dividend.

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5. AGENT "CHARTIST"

Within our paradigm, the Chartist is motivated by the purpose of capitalizing on market fluctuations by purchasing assets at low prices and selling them at high prices.Their objective is to predict future pricing trends and make decisions based on these forecasts [Samanidou et al., 2007]. When the forecasted trend is positive, they choose to buy the stock; conversely, they sell it if the trend is anticipated to be negative. The Chartist's predictions regarding stock price patterns rely on the prevailing sentiment within their group, and it adapts in accordance with changes in this mood and the trader's observations of current price fluctuations.

The Chartist primarily operates as a noise trader, where the pricing for limit orders (Equation 1) and the order volumes closely resemble those of the Random Trader. The defining feature of the Chartist is its deliberative methodology. The odds for transitioning from positive to negative sentiment are denoted as π_{+-}, whereas the probabilities for changing from negative to positive sentiment are denoted as π_{-+}.

$$\pi_{+-} = v\frac{n_c}{N}\exp(U), \pi_{-+} = v\frac{n_c}{N}\exp(-U)$$

$$U = \alpha_1 x + \frac{\alpha_2}{u}\frac{dp}{dt}\frac{1}{p}$$

Furthermore, we have parameters v representing the frequency of opinion revaluation, and n_c/N symbolizing the proportion of Chartists among all traders. The Chartist continuously reevaluates its sentiment during the trading process. The factor U influences the change in sentiment, signifying the potency of opinion propagation, with parameters α_1 and α_2 serving as weights for the current price trend and the sentiment of other traders, respectively.

6. AGENT "MARKET MAKER"

In our model, the Market Maker has a vital function in preserving market equilibrium by engaging in both purchasing and selling stocks, within specified limit parameters [Clack et al., 2020]. This agent operates entirely in a singular trading mode, either buying or selling stocks, under specific conditions characterized as "panic." In such situations, the Market Maker acquires or sells a necessary quantity to correct any lack or excess of inventory. The Market Maker acts as a stabilizing force in the market by absorbing variations in market prices. This helps to reduce price volatility and increase market liquidity.

The sizes of the orders depend on the current inventory levels. The order volumes are calculated as.

$$\begin{aligned} Q_{bid} &= \max[0, UL - 1 - \text{ assets }] \\ Q_{\text{ask}} &= \max[0, \text{assets } - LL - 1] \end{aligned}$$

The variables UL and LL denote the upper and lower inventory boundaries, respectively, for the acceptable quantity of stocks in the Market Maker's inventory. If these limits are breached, the trader is disinclined to place any volume on either side of the order book and attempts to adjust by executing market orders. This condition is referred to as a state of "panic."

$$\text{base offset } = -((\text{ best ask } - \text{ best bid }) * (\text{ assets } - \text{ softlimit }))$$

$$P_{bid} = \text{ best bid } - \text{ base of } f \text{ set, }, P_{\text{ask}} = \text{ best ask } + \text{ base of fset}$$

7. MATCHING ENGINE

To buy or sell shares, agents turn to an exchange, issuing orders $O = \{o_1, o_2, \dots, o_n\}$, each order represents pairs $o_i: (p_i, q_i, t_i)$ - price, quantity, and trader issued the order [Arthur et al., 2018]. There are two types of orders (side of the order): bid order $o_i \in B$ (buy order), ask order $o_i \in A$ (sell order). In addition to the side of the order, the orders differ in conduct: limit, market, cancel. Since market order is equivalent to limit order (Lemma 1) we denote both types as o_i. Limit and market orders resolve in $O' = O \cup \{o_i\}$ (if $\exists o_j \in O: p_i = p_j \wedge t_i = t_j$ then $q'_j = q_j + q_i$), cancel orders in $O' = O \setminus \{o_i\}$. Active orders $o_i: q_i > 0$ are stored in an order book which is defined by $O = A \cup B$, such that: $A \cap B = \emptyset, A \neq \emptyset \wedge B \neq \emptyset$. Lemma 1. With limit order l_i, market order m_i one can show that $m_i \Leftrightarrow l_i$ with the following properties:

$$m_i \Leftrightarrow l_i = \begin{cases} l_i \in A: p_i = \min(\{p_j \mid \forall o_j \in B\}) \mid m_i \in A \\ l_i \in B: p_i = \max(\{p_j \mid \forall o_j \in A\}) \mid m_i \in B \end{cases}$$

Order book management is comprised of three activities: matching the orders, maintaining the order book, sharing stock price, and spread. Matching occurs when there is an order $o_i \in A : \exists o_j \in B \mid p_i \leq p_j$, or an order $o_i \in B: \exists o_j \in A \mid p_i \geq p_j$ (by Lemma 1 this holds for market orders as well). When matching o_i, the deals are

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conducted as follows: from the best price to the worst price, until the order is not fulfilled $q_i = 0$. Maintaining the order book lies in maintaining the following order of A and B: $\text{sort}(A) = (a_1, a_2, \dots, a_n): \forall 1 \le i < j \le n \Leftrightarrow p_i \le p_j$ (sorted not descending by price) and $\text{sort}(B) = (b_1, b_2, \dots, b_n): \forall 1 \le i < j \le n \Leftrightarrow p_i \ge p_j$ (sorted not ascending by price). Such order allows matching be easier, as moving along A and B we move from best price to worst (with respect to making a deal). Therefore, stock price and spread are obtained using Lemma 2.

Lemma 2. When the order book is ordered as $\text{sort}(A), \text{sort}(B)$ one can show that the stock price $p = (p_{a,1} + p_{b,1})/2$ and the spread $s = p_{a,1} - p_{b,1}$.

To implement the order book efficiently a Linked List is used for A and B. We choose to preserve the order for A and B dynamically. With approach obtaining stock price and spread are $\text{C}(1)$ complexity (by Lemma 2), fulfilling orders $\text{C(n)} \to \text{C}(1)$ (as $q_i \to 0$), inserting orders $\text{C(n)} \to \text{C}(1)$ (as $p_i \to p$). To simplify the order management, we introduce order as a class Order, which has defined binary comparison operators by logic $\text{sort}(A), \text{sort}(B)$ are constructed. This simplifies the development addressing asymmetry of bid and ask order price comparison rule.

7. MODEL SIMULATIONS

The study investigates the effects of a market shock on the subsequent changes in market state transition patterns, trader behavior patterns, and the time it takes for the market to recover under varying proportions of agent types. We assess these changes using various agent configurations to further confirm our hypotheses. To validate the results of our experiment [Zhu et al., 2009], we collect different market measures, including volatility, returns, and volume. The simulation is conducted using a situation where there is a sudden shift in market prices. The objective is to assess how the change in the midpoint is distributed after n iterations following the shock. R - random trader, C - chartist, F - fundamentalist, M - market maker. The distribution of agents is as follows.

$$R \times C \times F \times M = \left\{ (i,j,k,l) \mid \begin{matrix} i \in R \\ j \in C \\ k \in F \\ l \in M \end{matrix} \right\}; \quad \begin{matrix} R = \{0, \dots, 10\} \\ C = \{0, \dots, 10\} \\ F = \{0, \dots, 10\} \\ M = \{0, \dots, 10\} \end{matrix}$$

The term "iterations to recover" refers to the number of iterations that occur after a shock event in order to return to normal conditions. On the other hand, "midpoint change" represents the relative difference, expressed in percentage, between market prices before and after the shock.

Figure 1.

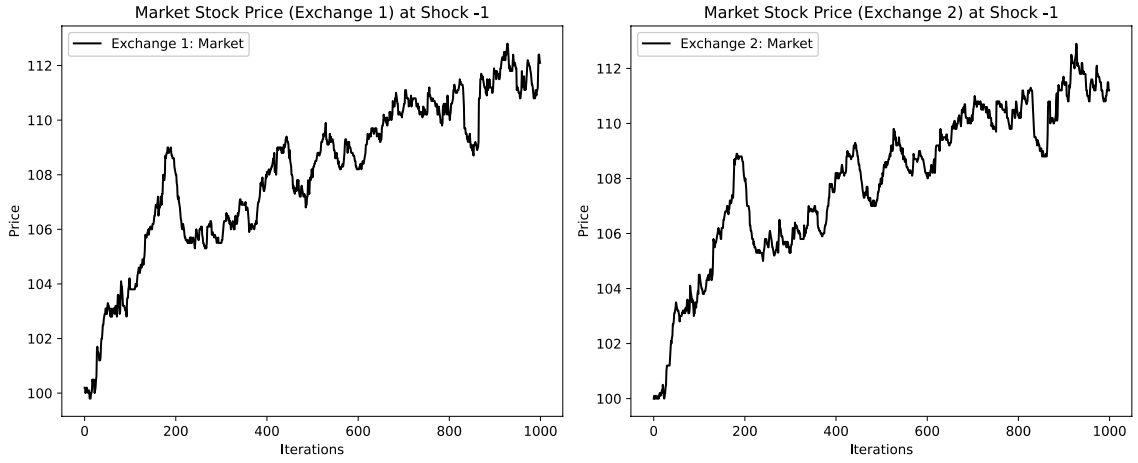

Figure 1 shows the immediate effects of a minor shock of -1 unit on Exchange 1. The market rebounded quickly, almost reaching pre-shock levels by the 300th iteration, demonstrating its resilience and recovery capacity. The swift recovery can be partially attributed to entities like the 2D MarketMakers, whose role in market stabilization is significant. A noticeable performance decline is observed during the 100th iteration, but the market's recovery mechanism shows resilience. A rapid decline is observed after a small negative

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perturbation at the 100th iteration. The rally that followed showed the market's resilience and adaptability, as the market price converged with its pre-shock level by the 300th iteration.

The spillover effect from Exchange 1 is nuanced but noticeable. Price fluctuations occur before stability is reached, emphasizing the interdependence enabled by entities like 2D Chartists who seek arbitrage opportunities. The decline in performance around the 150th iteration is likely due to the spillover effect. The price remains stable with slight fluctuations around the pre-shock level. This observation implies decreased susceptibility to shocks from Exchange 1.

Figure 2.

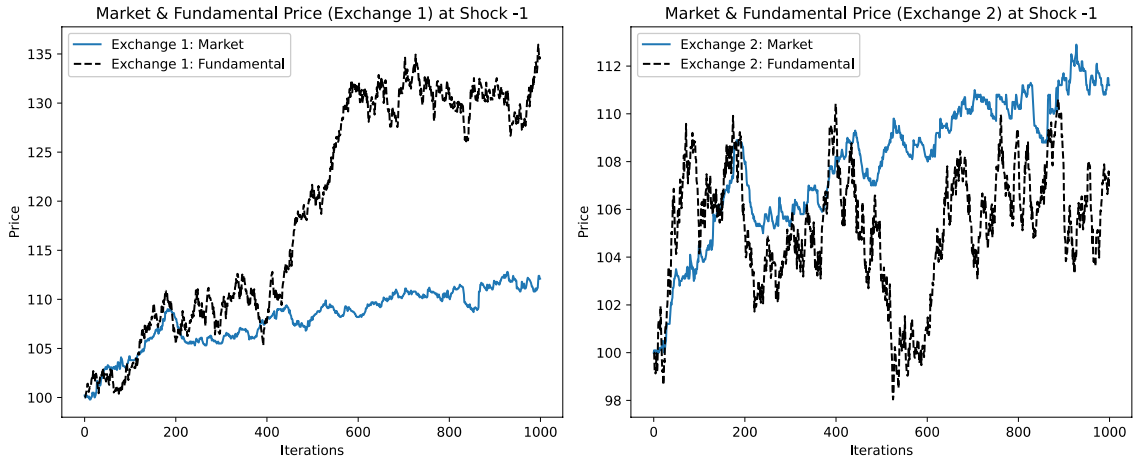
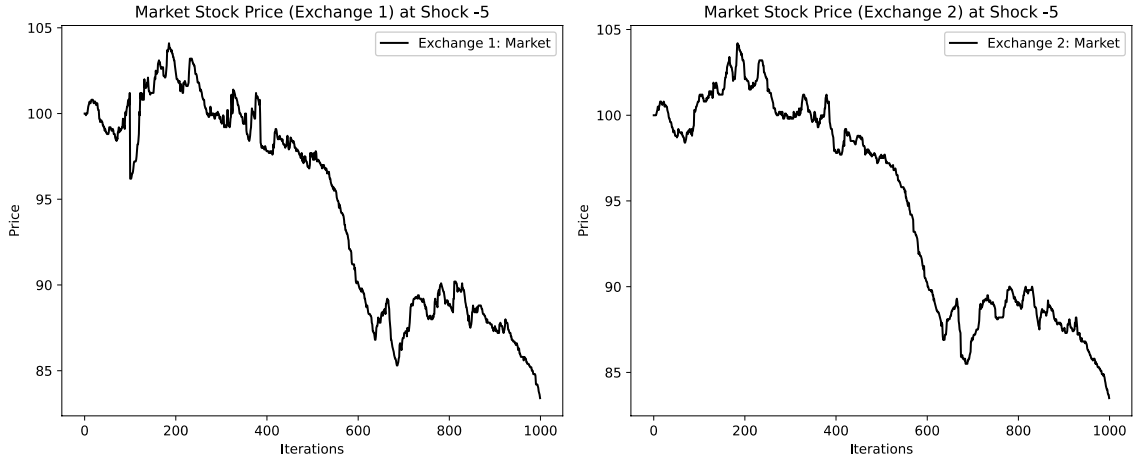


Figure 2 After the shock, the market price deviates from the fundamental price. The deviation is temporary and practically non evident as the market price quickly moves towards the fundamental price. The rapid convergence observed here suggests that Fundamentalist agents effectively maintain market equilibrium by guiding it towards its intrinsic value. The rapid convergence between market price and fundamental price after a shock suggests a dynamic market correction mechanism driven by agents using fundamental strategy. The market price quickly reaches new highs. Exchange 2, the observed price of the exchange mostly aligns with its fundamental value, indicating its stability despite disruptions in its counterpart. Following the shock, a deviation is observed in the market price, but it follows the trend of the fundamental price. This observation highlights market stability.

Figure 3.



The market has shown a notable and measurable reaction to a -5 unit shock. The market price plot in **Figure 3** clearly shows this reaction. The recovery in this scenario is slower than in scenario -1, suggesting significant challenges due to high levels of shocks. The post-shock oscillations indicate the market's attempt to stabilize after the turmoil. The decline in price becomes more evident, reaching its lowest point after a shock around the 100th iteration. The subsequent upward trajectory shows a consistent pattern and reaches the pre-shock levels within the observed timeframe.

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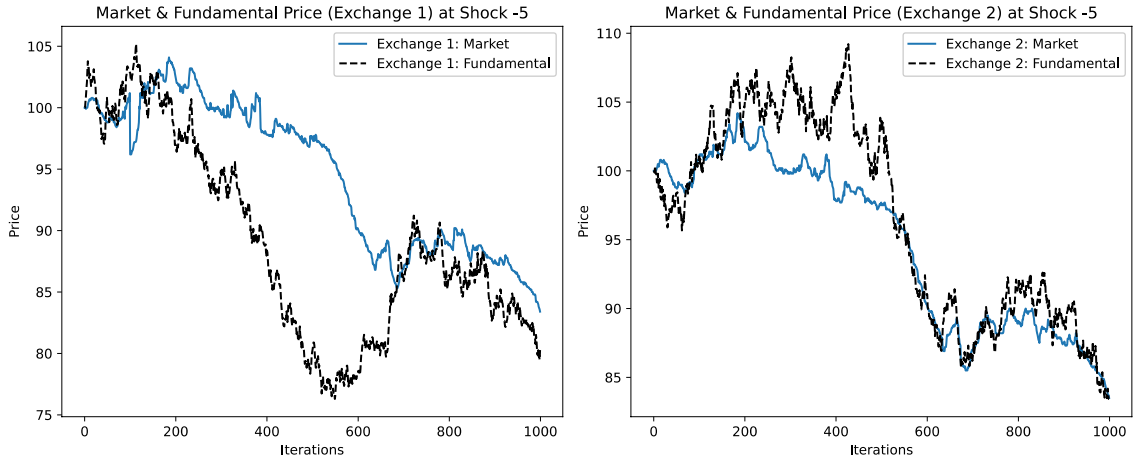
The interaction of Exchange 1 and Exchange 2 magnifies market fluctuations. The mirrored price pattern between Exchange 1 and Exchange 2 highlights the influence of agents engaging in cross-market operations. The price volatility is significantly higher after a shock compared to a -1 impact. The 250th iteration shows a trough followed by a gradual recovery, similar to the observed shock phenomena in Exchange 1, but with a time lag in response.

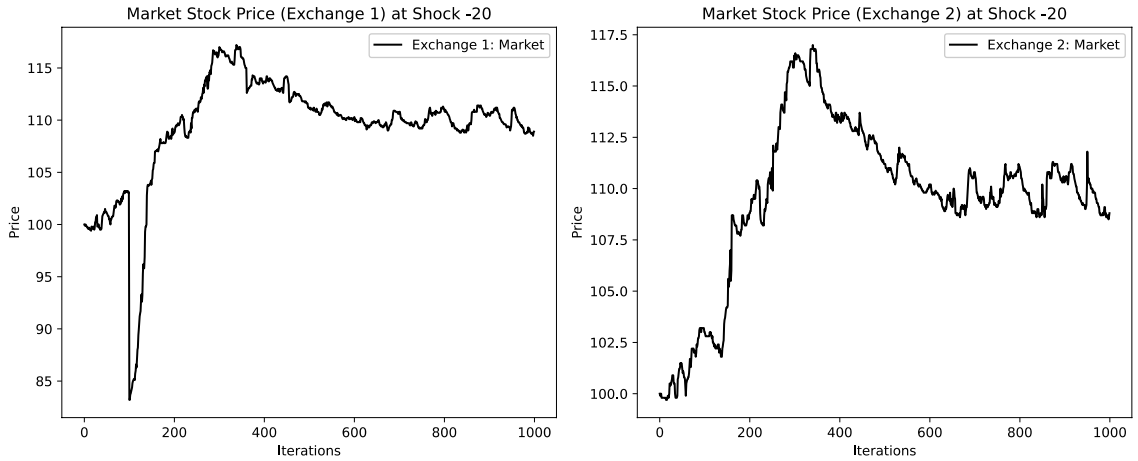
Figure 4.



In **Figure 4**, there is a significant difference between the fundamental price and the market price after a shock. The market takes time to adjust to its fundamental value. The correction phase can be influenced by 2D Chartists who exploit price discrepancies for gains. The deviation from intrinsic value after a shock is significant. The simulation shows that the market price tends to converge with the fundamental price.

Despite disruptions in Exchange 1, the market price in Exchange 2 has maintained a closer correlation with the fundamental value. This phenomenon is due to the efforts of entities like 2D MarketMakers, who have contributed to market stabilization. The asset price closely aligns with its fundamental value, indicating a strong and stable market.

Figure 5.



In **Figure 5** the plot illustrates market price fluctuations, emphasizing a significant and sudden decline in value. A negative shock of -20 leads to a substantial and noticeable decrease. The post-shock trajectory shows increased volatility with fluctuations in market conditions. The recovery period after severe shocks tends to be longer than after less severe shocks. The price trajectory after a -20 shock is highly volatile. The initial sharp decline is followed by subsequent oscillations with increasing amplitudes until around the 400th iteration, when some stability starts to emerge.

Price dynamics in Exchange 2 resemble those in Exchange 1, emphasizing the impact of inter-market transmissions. The importance of 2D Chartists in capitalizing on arbitrage opportunities is highlighted by this phenomenon. The downward trend followed by stability around the 300th iteration captures the consequential effects. The following graph shows a slight upward trend, suggesting a slow recovery.

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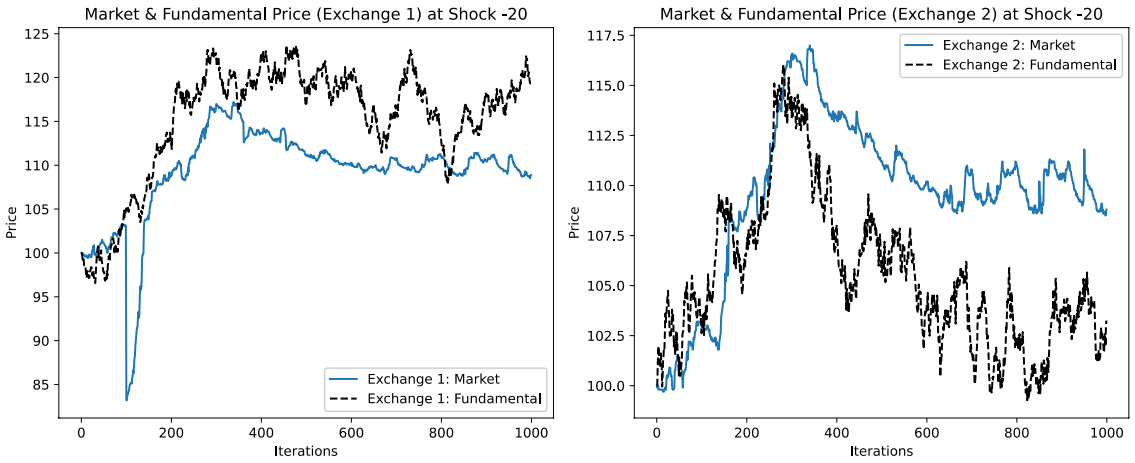
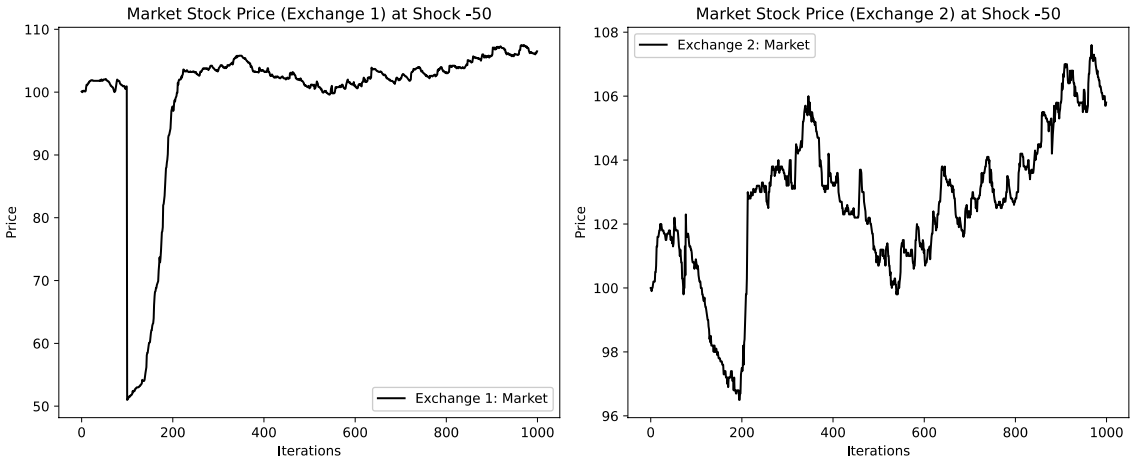
Figure 6.



In **Figure 6** the oscillatory trajectory in the relationship between market prices and fundamental prices reflects the complex interactions among various market participants. The 2D MarketMakers play a crucial role in market stabilization. The zig-zag pattern in financial markets reflects the ongoing struggle between trading agents. This pattern demonstrates the ongoing struggle between buyers and sellers to establish control and impact market results.

In the 2 exchange, the price is more stable with less sharp deviations from the fundamental value. The market environment's stability suggests equilibrium with fewer disturbances or disruptions. The graph shows increased adherence to the asset's intrinsic value. After a brief divergence, the current market price shows signs of returning to alignment with the underlying intrinsic value.

Figure 7.



In **Figure 7** there is a market shock event with a magnitude of -50. This event exhibits a substantial and sudden departure from the prevailing market conditions. The phenomenon involves a sharp decline followed by significant fluctuations, indicating the market's struggle to reach equilibrium. After the observed iterations, interestingly enough that the price has returned to its pre-shock levels, highlighting the fast recovery after a sharp decline. The post-disruptive financial environment is characterized by heightened volatility and uncertainty. The observed period exhibits significant market fluctuations with a clear path towards recovery. Which emphasizes the work of 2D Chartists which take advantage of arbitrage opportunities to increase their wealth.

The price dynamics in Exchange 2 resemble the disruptions in Exchange 1, but with a less pronounced reaction. This observation highlights the concept of market interconnectedness and emphasizes the influence of 2D Chartists on these dynamics. The shock's impact is easily noticeable. While Exchange 2's decline is less severe than Exchange 1's, the prolonged market instability emphasizes the interconnectedness of these two financial markets.

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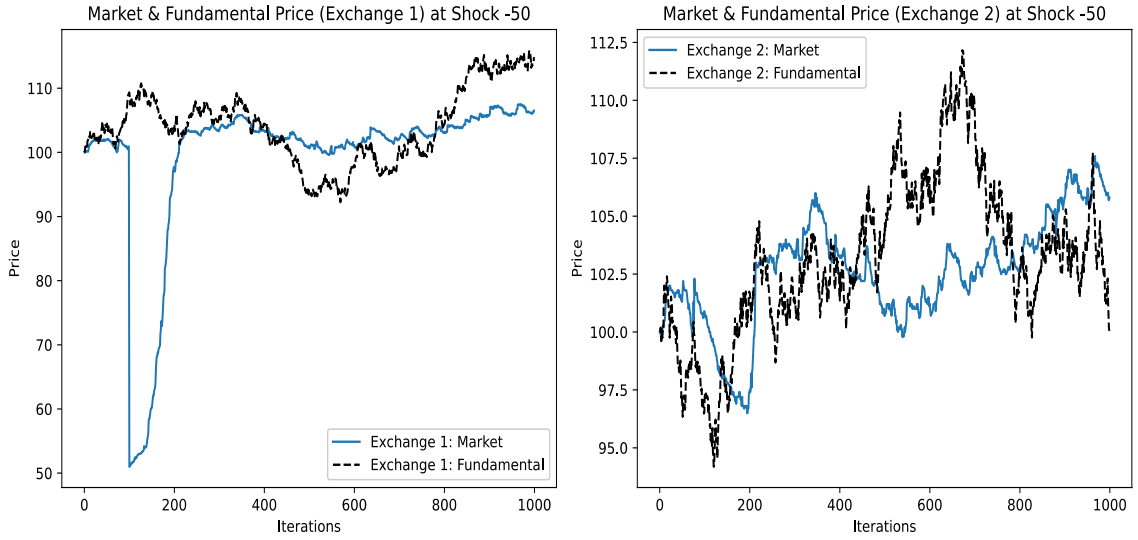
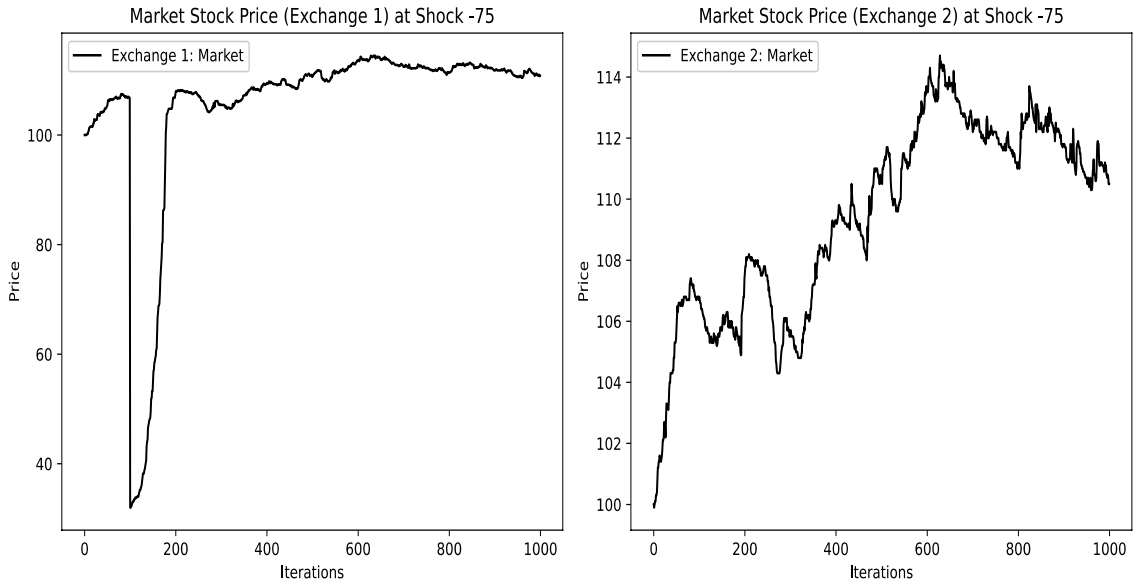
Figure 8.



In **Figure 8** there is a noticeable difference between market prices and fundamental values. The path to equilibrium is clear, but it will take time to recover. 2D Chartists strategies take advantage of this difference. The ongoing discrepancy between market prices and fundamental valuations persists, suggesting a challenging recovery path.

Exchange 2's price behavior aligns significantly with the fundamental value. This phenomenon is due to the actions of stabilizing entities like 2D MarketMakers. The market price tends to move towards equilibrium with the fundamental price over time.

Figure 9.



In **Figure 9** the -75 shock causes a sharp and substantial price decline, stabilizing around the 600th iteration. The marginal recovery following the shock is overshadowed by the significant deviation from pre-shock levels.

The increased volatility in Exchange 2 is due to the impact of the disruption in Exchange 1. The magnitude of the shock is such substantial that agents on the 2 Exchange prefer to not engage in trades as the dynamic of the market price is not clear, this results in a more stable market price without a large decline. This phenomenon emphasizes market interconnectedness and the significant impact of disturbances that spread and amplify throughout the system. The price trajectory shows a pattern similar to the shock effects seen in Exchange 1, but with a smaller amplitude. The plateau around the 600th iteration suggests the financial market's pursuit of stability.

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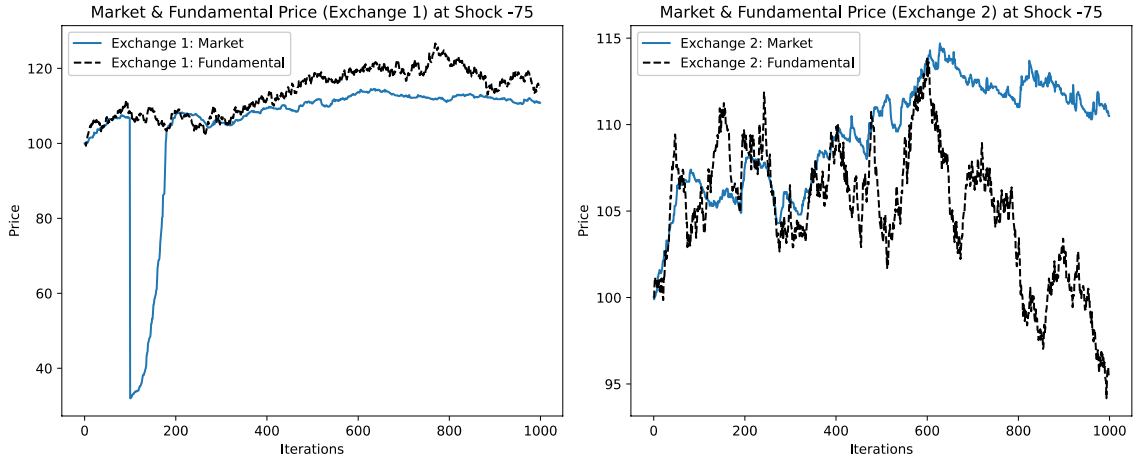
Figure 10.



In **Figure 10** the market's ongoing attempt to reach equilibrium is evident through the magnitude of the deviation, indicating a long recovery period. The simulation shows that the price consistently stays below the fundamental value, emphasizing the impact of the shock and the challenges in achieving market correction.

Exchange 2: The price dynamics indicate a stronger market with prices closer to the fundamental value, possibly due to the presence of stabilizing agents like 2D MarketMakers. Compared to Exchange 1, where there was a significant disturbance, it is worth noting that the market price in Exchange 2 shows a commendable adherence to the underlying fundamental price, with minor deviations after the shock.

Hypothesis	Test Used	Test Statistic	P-value	Significance Level	Result
Speed of recovery of the 2nd market after the shock on the 1st market	Mann–Whitney U test	156.230586	1.1120599722901342e-05	0.05	Fail to reject
Second market price rebound post-first market shock	Kruskal-Wallis H-test	181.256319	5.241244e-22	0.05	Fail to reject
Influence of MM on the speed of recovery of the 2nd market	Spearman Rank Correlation	-0.10279	8.391049e-07	0.05	Fail to reject

Further research is warranted to investigate market recovery scenarios involving a broader spectrum of agent types. Additionally, exploration of recoveries following various forms of shocks, such as information shock - characterized by lagging information dissemination among agents - and the reverse shock to a price dropdown, remains necessary. Another intriguing avenue for future research is the examination of arbitrage opportunities and shock transmission across multiple markets. This would facilitate a deeper understanding of the interconnectedness and shared vulnerabilities of diverse markets within the larger financial ecosystem.

8. CONCLUSION

Ultimately, the simulation study has yielded perceptive insights into the intricate dynamics among market participants in the aftermath of market disruptions. It has been shown that markets display different levels of resilience based on the intensity of the shock and the characteristics of market participants. Market makers are crucial in stabilizing markets after a shock. However, the involvement of chartists and fundamentalists also plays a key role in determining prices and restoring market balance. The swift rebound of market values to levels close to those prior to mild shocks indicates the underlying resilience of financial markets. Nevertheless, the extended durations of recuperation and increased instability that occur after more intense disturbances suggest that there are limitations to resilience. The interdependence of markets is an additional crucial element, as evidenced by the observed propagation of shocks between the two examined exchanges. The statistical studies performed, such as the Mann–Whitney U test and the Kruskal-Wallis H-test, have confirmed the hypotheses, offering a mathematical foundation for the qualitative observations. The findings indicate that although market dynamics are intricate, they may be anticipated to some degree, enabling the formulation of solutions to alleviate the negative impact of market disruptions.

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To enhance our understanding of market behavior, future research should explore a wider variety of agent types and shock scenarios, such as information shocks and reverse shocks. Furthermore, the examination of the effects of regulatory actions and the implementation of new market technologies may be subjects of interest for future research. The results of this study are crucial for individuals involved in the market and those responsible for making policies. They emphasize the significance of having a variety of trading agents and the necessity of strong market structures to guarantee stability and effective determination of prices, even when faced with sudden market disturbances.

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FUZZY MATHEMATICAL MODLEING AT A GLANCE AND USING WATER SUPPLY MANAGEMENT

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ABSTRACT
Mathematical modeling is the one of the bases of mathematical education. Mathematical modeling is described as conversion activity of real problem in a mathematical form. Modeling involves to formulate the real-life situations or to convert the problems is mathematical explanations to a real or believable situation. According to this approach, mathematical models are an important part of all areas of mathematical include arithmetic, algebra, geometry, or calculus. Therefore , the mathematical modelling might be offered all ages groups of higher learning, high school and primary school. When the studies recently performed about mathematics modelling are examined, it is seen how important modelling is. In this study, the importance, main features and process of mathematical modleing will be mentioned. This study is a theoretical study and is thought to be useful for other work to do.

As water has become an essential commodity, even though the vessels of the nature are almost replete with it, the alacrity in providing potable water is emerging as an exigent need of the time. There are enormous parameters which are related with each other and having direct relationship with the environment. As India being the emerging country in the third word scenario, development of a comprehensive action plan to balance the water demand with the supply would help its sustainable development. In the present water supply management system anomalies and discrepancies can be visualized in plethora. The impact of this is having intensive reflections in the region where the consumption is more with respect to the population density. The study area is the southern state of India, Kerala, which is being called the Gods own Country in consideration of its natural beauty and the potential of natural resources including the water resoures.

Keywords: *Water Supply Management, Discrete Mathematical Modeling, Weighted Digraph Model, Pulse Process, Expert Opinion Survey, Water Quality.*

INTRODUCTION: The consumption of water by an individual is required for various physiological process such as blood formation, food assimilation etc. The quantity of water that an individual of the present scenario inIndia in average of 3 liters per day.

Even though it is a very small quantity it is not essential to supply water for drinking purpose with high degree of purity. In a water supply system there are various variables those having influence in the rate of demand of water. These factors have to be carefully and properly analyzed before arriving the rate of demand. The existing water supply system is not meeting with the requirements properly because of the drstic changes happens in the environmental conditions as well as the population dynamics. The relationship between the water supply and water demand is depending upon enormous direct and indirect variables which are always exhibiting non linear changes with respect to the time factor.

While taking in the case of the state of India where the population density is changing rapidly along with the living standards. Here the functional difference between the rural and urban life pattern is very merger so that the water consumption pattern is almost similar which require equal attention. Another important feature for the water consumption is that the rainfall distribution along with the land use pattern. Apart from the drinking requirement more water is used for the irrigation and lifestyle management. The system of sanitation operating at the of India is having unique features such that apart from the other states of India the cultural ethics imparts more influence on the conventional sanitation procedure along with the personal hygiene. Hence the water supply management procedures should consider all these aspects while formulating a comprehensive system to meet the requirements. On analyzing these situations the experts working in the particular realm The inter relationship between these parameters and the analysed and the scenario can be made using the tool based on Discrete Mathematical Modeling. The significance of these parameters can be analyzed using the exert opinion and cross impact analysis which helps to formulate a comprehensive model used for representing the system.

MODEL AND MODELING:
Although the terms ‘model’ and ‘modeling’ may seem common terms, they are concepts that incorporate different meanings. Model refers to a product that comes out as a result of modeling whereas modeling refers to a process. Model means to represent the realities belonging to physical life with a number of meaningful

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symbols and to simplify what is complicated. We may come across models during our daily lives in situations where reflecting the reality is impossible or where access to reality is limited in that particular moment. For instance, an architect can exemplify the features of a building that he/she wants to sell by modeling the building that he/she will construct. By getting models to wear the clothes that they want to exhibit, fashion designers can enable other people to have an opinion on how their clothes look. Children can meet the models of reality (cars, trucks, trains, etc.) in their toys.

Many further examples can be given regarding how the models appear in our daily lives. However, there will be two common points in all the examples that will be given. The first common point is that the models are formed to be able to meet the reality or think about the reality.

The second common point is that the models are more simplified or more idealized form of some things (Lingefjärd 2007; Reported by Sağırlı, 2010). One of the most important objectives of mathematics instruction is to earn students the mathematical thinking skill. This skill is significant for students to interpret the situations and generate solutions in a problem situation.

Therefore; the models, diagrams and concepts, which exist in their minds or which will be formed by the students to interpret the problem situations that they come across and to generate a solution, are among the subjects that must be emphasized in mathematics education.

Mathematical model is a mathematical form like a formula, equation, graph or table that reflects the important features of a given situation whereas mathematical modeling is defined as the process to develop a mathematical model (The Consortium for Foundation Mathematics 2008). Mathematical modeling is the achievement in transforming a situation of the real word into a mathematical problem through the use of a mathematical model. Briefly speaking, mathematical modeling is a simplified representation of the basic characteristics of the real situation through the use of a suitable set of mathematical symbols, relations and functions (Voskoglou 2006).

According to Gravemeijer, Stephan and Cobb (2002), models emerge as a result of informal activities of the students in the classroom environment. An important development, which must be observed during learning process, is to reach mathematical models via real-life situations or problem situations. The students will be able to utilize these models in mathematical thinking processes only after these developments. Mathematical model is a concept that also incorporates mental representations and diagrams.

DISCRETE MATHEMATICAL MODEL:

We are using the discrete mathematical model digraphs such as weighted and signed digraphs for diagrammatic representation of the interrelationship between the identified variables. With the help of the pulse process it can be the possible changes that will be encountered by the system with the changes in the time factor and fluctuations in each pulse can be analyzed systematically. The signed digraph model has its many simplifications. For eg, some effects of variables on others are stronger than other effects. The signed digraph model assumes that all effects are equally strong, by placing weights of equal units magnitude on each arc (u,v), thus yielding weighted digraph. There are many constraints happened to be introduced while engaging forecasting technique and measuring the stability of the system for a particular time interval. From these constraints there is a need to find out alternative strategies which will allow to meet the constraints. If the system is a weighted digraph some of the possible changes or strategies are following.

1. Change the value of certain vertices at the specified times
2. Add at given time a new vertex (Institution) and new arcs to and from it (relations of interactions of the institutions with existing ones)
3. Change the sign of a given arc at a given time
4. Change the weight of a given arc at a given time
5. Add a new arc between existing vertices
6. Delete arc between existing vertices
7. Add a new cycle (deviation amplifying or deviation counteracting)

These methods are generally used for making strategies for meeting the constraints.

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MODELING PROCESS:

In their study, English and Watters (2004) showed that the modeling activities that they performed with elementary level students developed mathematical thinking skills and problem solving skills of students more than traditional problem-solving activities. Moreover, the results of this study that was performed with elementary school 3rd grade students signified that upper-level mathematical concepts and models can be given to even the students at this level with mathematical modeling activities.

In NTCM (1999), it was stated that mathematical modeling is quite different from problem-solving although it incorporates the features in all problem-solving definitions. It was further stated that the situations must be interpreted like problems, important factors must be selected, relationships must be defined, these relationships must be interpreted mathematically, opinions must be analyzed and solution must be achieved on the situation in mathematical modeling. Lesh and Doerr (2003) and Blum and Niss (1991) mention the following processes as problem solving activities in mathematical modeling:

a) Understanding and simplifying the problem; understanding tables, graphs and verbal information and drawing inferences from them,

b) Manipulating the problem and developing a mathematical model; identifying the variables and the relationships among them; constructing hypotheses; evaluating contextual information, and developing models,

c) Interpreting the shared solution; making decisions, analyzing the system and proposing new solutions.

d) Verifying and showing the problem; generalizing and sharing solutions; evaluating the solution from different perspectives.

We go between the reality and mathematics while performing modeling. Modeling process begins with a complicated real-life situation. A problem representation is obtained from that situation. From here, a mathematical model is obtained by means of mathematization.

The solution can be found via a mathematical study that is performed on the model. This solution is firstly interpreted, and then, its correctness is shown. If the solution or the selected process does not accord with the reality, certain stages or the entire modeling process is repeated (Doruk, 2010).

All aspects of modeling process:

 Students are given an experience regarding how mathematics can contribute in understanding, formalizing and applying the problems in different subject areas.

 Students can apply the models by defining the simple relationships in the nature, and realize the potentials and constraints of the models.

 Students can comment and discuss on the realities of the existing models.

 Students can move between the theoretical and practical aspects of modeling and problem-solving related mathematics (Blomhøj and Kjeldsen, 2006).

When the researches of mathematics educators are examined in recent years, it is observed that there is a requirement to find more efficient methods and strategies that will draw all students to meaningful mathematical learning, make them feel that mathematics is part of their lives and make them enjoy mathematics. Moreover, these methods and strategies must be able to equip the students with the rapidly advancing technology for their professional lives that they will experience throughout their existence. Furthermore, there is a necessity to make sure that they gain mathematical skills which will support them in order to find their ways efficiently in complicated situations that they will come across in their daily lives and find practical solutions to their daily problems. Modeling activities come out as a fairly efficient tool that involves the features that can meet these requirements, and they're considerably suitable to be used by mathematics instructors.

PULSE PROCESS:

To make somewhat deeper analysis of the weighted digraph model it is necessary to make some very specific assumptions about the effect that changes in value in one vertex have other vertices. It shall be called such assumptions change of value rules. The specific change of value rules assumed plays a rather subtle role in its relations to our conclusions. If we assume that the basic data (say for example initial values at each vertex and weights) are known only imprecisely, then the ultimate predictions based on specific change of values rule will be imprecise as well. Any conclusions drawn should be regarded as tentative and subjected to a sensitivity analysis.

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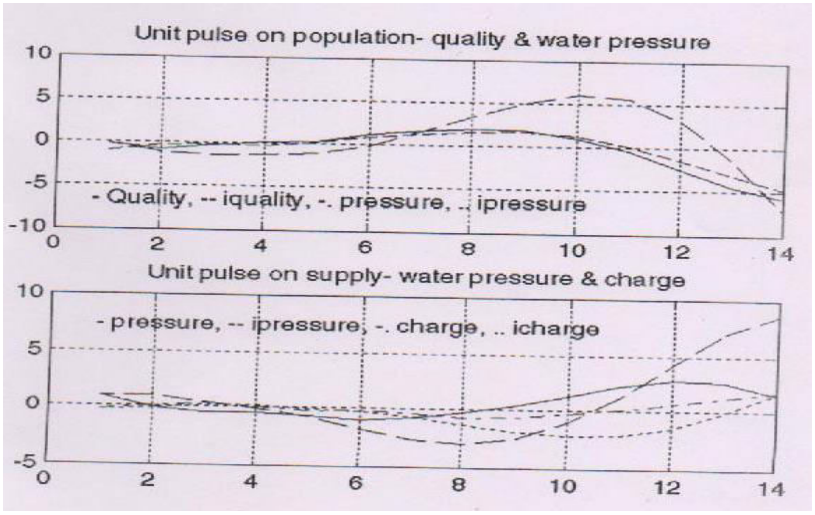
Such an analysis will involve redoing the modeling with changes in the basic data and perhaps using different changes of values. We shall present several theorems about stability of a weighted, signed digraph under pulse process.

These theorems can be applied in testing for the stability of a diagraph D reduces to asking simple questions about the Eigen-values of D. The first theorem says that we simply have to calculate the magnitudes of the Eigen- values in order to draw some interesting conclusions.

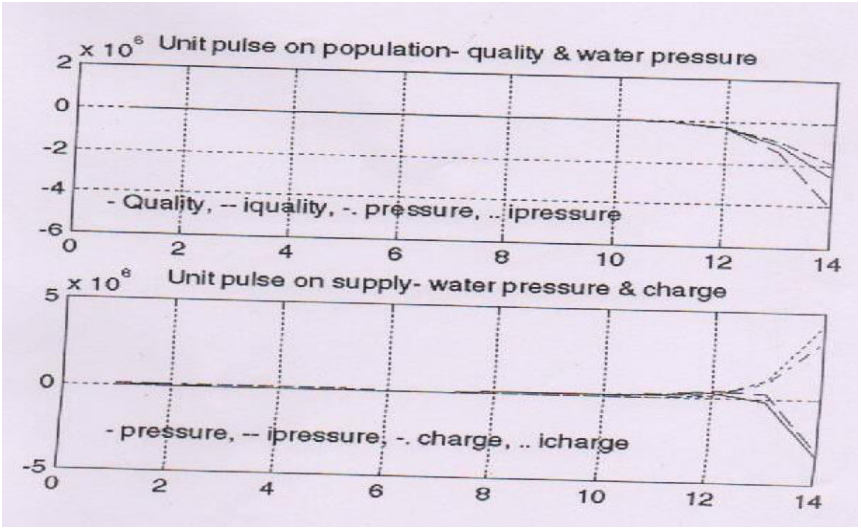
Table 1. The major variables which play a vital role in the dynamics of the water supply system.

S.No	Variables	Code of Representation
1	Population	Pp
2	Industrial Development	Id
3	Living Standard	Ls
4	Rainfall	Rf
5	Urbanization	Ur
6	System of Supply	Ss
7	Water Resources	WR
8	Quality of water	WQ
9	System of Sanitation	Sa
10	Water charge	WC
11	Water pressure in the Distribution Pipes	WP
12	Technological Advancement	TA
13	Demand	Dm
14	Land Use	LU

Diagraph 1: Unit pulse on population, Water Quality



Diagraph 2: Unit pulse on Urbanization, Sanitaion & water charge & Water



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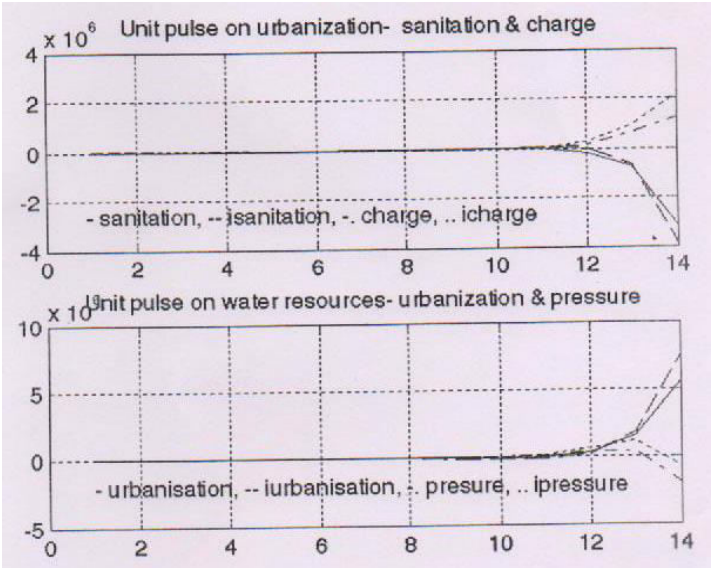
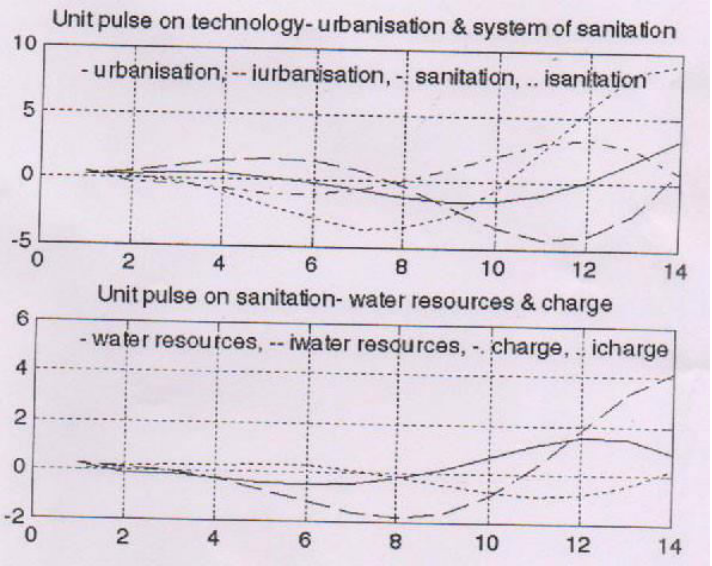
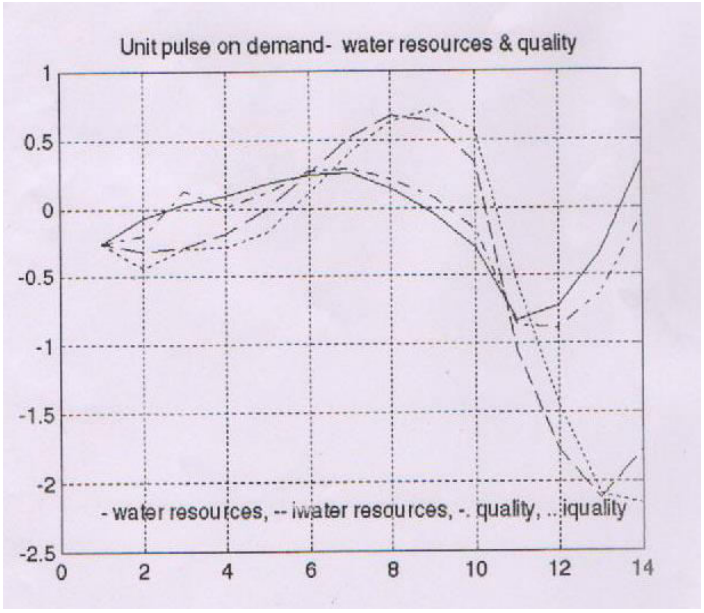
Diagraph 3: Unit pulse Urbanization, sanitation Water & water



Diagraph 4 : Unit pulse on Technology, Urbanization Water Resources & water



Diagraph 5: Unit pulse Demand, Water Resources & Water Quality



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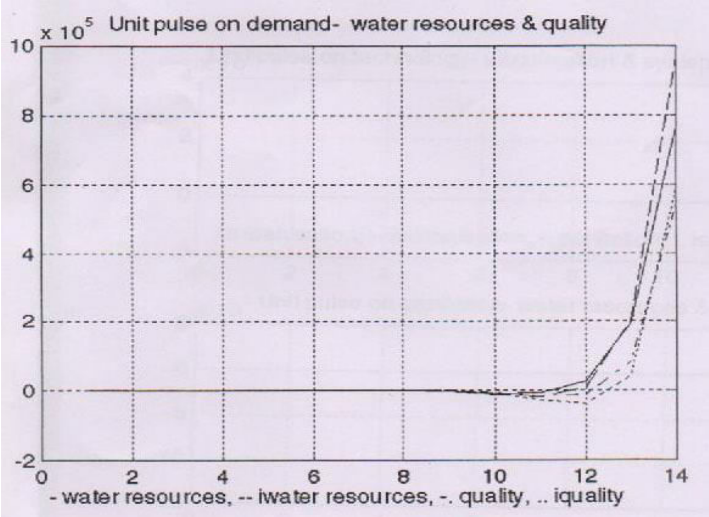
Diagraph 6: Unit pulse on Demand, water Resources & water Quality with



CONCLUSION

In this work a humble attempt has made to describe the nature and the behavior of the water supply management in the developing tropical urban net. A mathematical is formulated for the system and with the help of this we can contemplate the dynamics of the system. As the water management is a macro frame to study the interrelationship between the variables. According to Eckstern . O 1958) It is recommended that there should be a set of parameters which are having direct and indirect relationship with in the dynamics of the water supply system. Maxwell M.H made an attempt to list out variables which impart direct impact on any type of water supply management system. The model that we have developed is a discrete mathematical model the signed and weighted digraph model and the stability of the system is analyzed under the pulse process.

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FINITE ELEMENT ANALYSIS OF AIRCRAFT WING STRUCTURE USING Si_3N_4/ZrO_2 HYBRID REINFORCED WITH A 7055 METAL MATRIX COMPOSITE

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ABSTRACT
In order to create lift force during flight, aircraft wings—which are mostly made of air breathing engines—are studied in this research along with the material properties that are susceptible to wear and tear during the journey. This is where we use the study of ansys and finite element analysis, which facilitates the examination of the mechanical characteristics of the various parts that are put together to form the wing's structure. There are various parts that make up the wings, including skin, fuel tank, aileron, wing flap, ribs, stringers, front and rear brackets, Aluminium 7055 is noted to be a widely used material in the production of spars and other components. Aluminium has a lower weight, which contributes to the aircraft's overall weight composition and makes it a very cost-effective material. The prototypical gathering wing has two poles, several ribs, and a small membrane. There are two types of spars in total: primary and secondary. These spars contain aluminium 7055.

Keywords. *FEA, Modal analysis, Aircraft Wing, Rib, spars.silicon nitride, zirconium*

INTRODUCTION
Metal–matrix composites (MMCs) are most promising materials in achieving enhanced mechanical properties such as: hardness, Young's modulus, yield strength and ultimate tensile strength due to the presence of micro-sized reinforcement particles into the matrix. [1, 2]. Aluminum-matrix composites AMCs) reinforced with discontinuous reinforcements are finding increased use in automotive, military, aerospace and electricity industries because of their improved physical and mechanical properties [3].

Aluminum alloy has a series of advantages and is widely used [4,5]. The 7055 aluminum alloy is a new generation of high-strength Al-Zn-Mg-Cu series aluminum alloy and is an ultra-high-strength aluminum alloy that can be heat-treated [3,6]. The 7055 aluminum alloy has advantages such as low density, high strength to weight ratio, good toughness, and high corrosion resistance, and thus is a major material for the aerospace industry [4,7]. In the typical age-hardened alloy systems, alloying elements may exist in the form of randomly distributed solute atoms in solid solution, or in the form of constituent elements of precipitates with specific crystal structures. It has been shown that the strength of aluminum alloy mainly depends on the type, size, quantity and distribution of precipitates in the grain [8,9]. The size and distribution of the precipitated phase of the aluminum alloy have an effect on the recrystallization of the aluminum alloy [10,11]. The fine precipitation phase produces age strengthening, prevents the migration of dislocations, and thus increases the strength of the alloy, which is one of the ways to improve the properties of the alloy [12,13]. Many researchers have studied the relationship between the size of the precipitated phase and its mechanical properties [14]. Aluminium 7055 exhibits comparatively lower strength such as young's modulus, whose value pertains to 69-71 GPA

Silicon nitride: Silicon nitride, Due to its unique combination of cutting-edge properties, such as Excellent fracture resistance, higher flexural strength, good creep resistance, good wear and corrosion resistance, and a moderately high hardness Si3N4 is among the most important structural ceramics [15]

Zirconium oxide: Zirconium oxide is a highly ductile, malleable, and strong substance. Products made of zirconium oxide (also known as zirconia) exhibit good mechanical characteristics and stability at high temperatures. Additionally, zirconium oxides exhibit good chemical inertness and corrosion resistance.

Zirconium oxide nanoparticles are among the functional nanoparticles used in tooth coating, cosmetic products, and many other industrial applications [16]. The addition of zirconium oxide nanoparticles has been reported to improve the mechanical properties and expand the application of recycled aluminium chips [17]. Aluminum is one of the lightest engineering materials, having wt. ratio superior to steel [18]. It's having advantageous mechanical properties such as lightweight and heat reflectivity, nontoxic, corrosion resistance, recyclability, and formability also used in thin packaging foils.

Zirconium oxide is the type of metallic reinforcement having superior- properties. It occurs in the natural form with the structure having mono- lithic crystalline. It appears in the white form having a density is

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5.68g/cm3. One of the most important things that it is available at less cost as compare to SiC & TiC and having the same properties as compare to both ceramics reinforcements. It has also a lesser density as compare to sic and tic and has a high same- thermal resistance.[19].

LITERATURE SURVEY

The process of designing an aircraft's wings is iterative and aimed at improving both the aircraft's performance and fuel efficiency. To minimise effort and maintain consistency in the task, the wing must be designed using the given details. The survey is conducted in the following order: basic demands, loads, and forces operating on the wing provide the basis for wing design. To best meet the needs, a second set of materials will be chosen, first from conventional materials like titanium, aluminium, etc., and then from composite materials. The wing's design and analysis included two spars: the front spar, which is close to the wing's leading edge, and the rear spar, which is situated roughly two thirds of the way towards the wing's trailing edge. The bones that give wings their chambered shape and transfer load from skin to spars through stringers are called ribs. Based on the design of aircraft with swept back wings, Hamadan et al. conclude that employing swept wings can decrease flight efficiency and increase fuel. In order to prevent rigid modes displacement, it is necessary to constrain all six degrees of freedom at the root while analysing an aircraft's wing. In addition to producing lift and decreasing drag, an aircraft's wings are required to transport fuel in the wing box and heavy mounted engines, therefore they must be designed with adequate strength. According to Jones et al., a 15% increase in wing span for a fixed bending moment or a rise in the bending moment created in the spar tip can both reduce induced drag. expanding the wing's span length or decreasing its weight can improve both the aircraft's performance and fuel efficiency. However, expanding the wing's span length using isotropic material will result in an increase in the aircraft's weight. Use of composite materials Following the discovery of carbon fibre in 1964 at the Royal Aircraft Establishment at Farnborough, UK, composite materials have become an integral part of aircraft structures. Composite materials are lighter than other materials and offer greater strengths (high strength to weight ratios), high

It was noted that the Al6063 matrix material's reinforcement was distributed uniformly. In the composite sample with the reinforcing mixture of 4 weight percent ZrSiO4 plus 4 weight percent Al2O3, the composite's hardness and tensile strength was higher.

1. Materials and Methods

In this study, trainer aircraft wing structure with skin, spars and ribs is considered for the detailed analysis. The wing structure consists of 15 ribs and two spars with skin. Front spar having “I” section and rear spar having “C” section [11]

Table 1. As per Cessna 172 Sky hawk Specifications

Height (m)	2.72
Length (m)	8.28
Range with Max. Payload (km)	1185
Max. Cruise Speed (km/h)	230
Maximum Take Off Weight (kg)	1157
Wing Span (m)	11
Wing Area (m^2)	16.17
Aspect Ratio	7.5
Taper Ratio	0.69
Root Chord (m)	1.63
Tip Chord (m)	1.12
Maximum Load Factor	4.4

1.1 Design and construction.

Lift force is calculated in order to calculate the pressure.

The maximum load factor of the Cessna 172 aircraft, which the design analysis is based on, is4.4[a1] We will consider the 150% maximum take off flaps up load condition to ensure structure meets design loads[a1]. Therefore, the lift force is:

W=mg=1157×9.8066656.1.Maximum Loading Condition

Uniform pressure load has been applied in an upward direction to the wing’s lower surface in the statistic = 11346.311405≈11346.4 N

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L=nW=4.4×11346.4=49922.4

Design Load=L×1.5=49922.4×1.5=74883.6

As the calculation is done for whole wing, the result should be divided by 2 to find the force acting on only one side. Once that is done, the load is multiplied by the factor of safety whichis 2 in our case

Design Load

F= _____ ×Factor of safety2

When values are inserted we end up with the following equation:

$$\frac{74883.6}{2} \times 2 = 74883.6\text{N}$$

Load is distributed in a linear fashion. For instance, in preliminary design, we have 14 ribs.

Preliminary designfor Force acting on one rib= Rib amount

$$\frac{74883.6}{14} = 5348.828571428571\ \text{N}$$

Force Acting On one Rib = 5348 N

2. structural analysis

It is critical that a suitable material meeting all requirements is chosen during the design process. In this study Aluminum 7055 is used as a common material when constructing aircraft components.

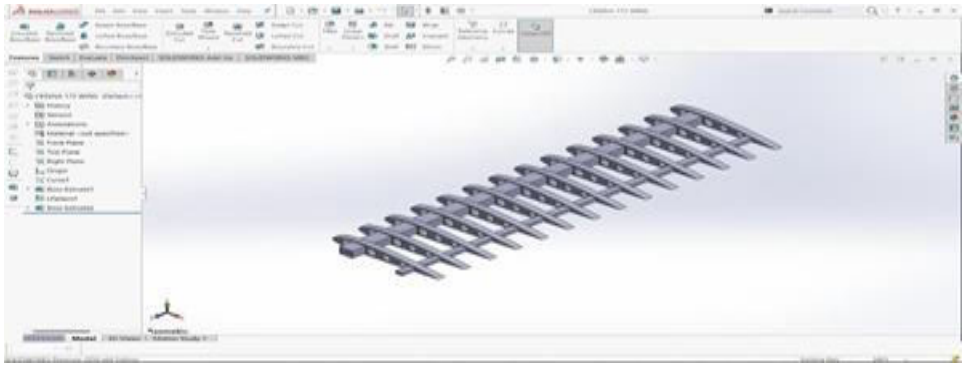

Fig1. CAD design of wing Internal Structure.

The airfoil has 14 sections, each having a thickness of 100 mm, spaced equally apart from the reference plane [13]. Holes, rear spar, and front spar are made based on the presumptions. The wing structure's entire design is formed. The file has been converted to IGS format before to being imported into the Ansys workbench.

The coordinates were imported into SOLIDWORKS using a tab-separated text file after being found in the literature. The unit cord length is fully limited and scaled up to the original Cessna

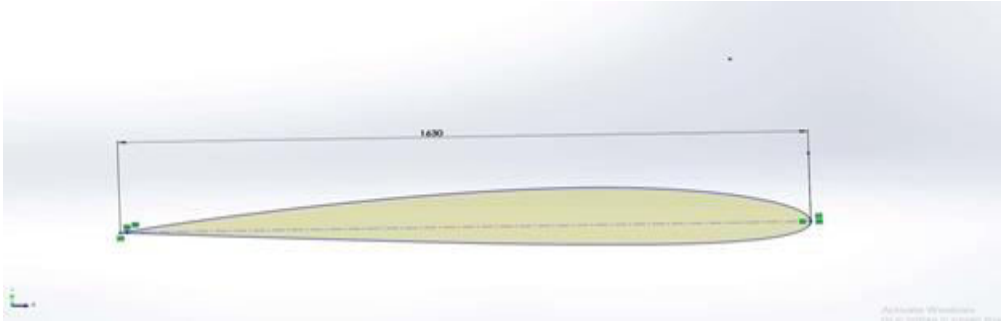

Figure 2. Airfoil Co-ordinates

Holes required for assembly and to minimize structure's weight are placed in the ribs are designated in a with the following parameters The front spar's axis is located at 0.25 times the chord length and the rear spar's axis is located at 0.75 times the chord length from the leading edge. For additional weight reduction 5 equidistant located at 0.17 times starting from the leading edge.

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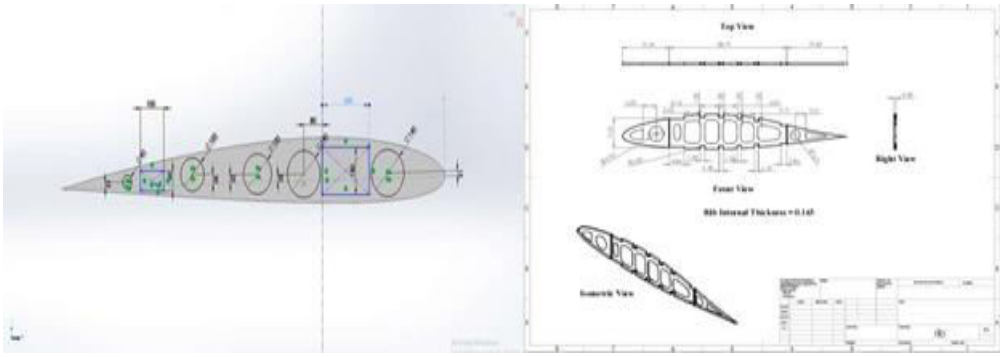

Fig .3 Dimension

Table 2. Thicknesses and diameters of design entities.

Ribs	10 cm
Front spar	20x14 cm
Rear spar	10x6 cm
1st hole diameter	14 cm
2nd hole diameter	14 cm
3rd hole diameter	12 cm
4th hole diameter	10 cm
5th hole diameter	4 cm

The ribs are readjusted as 10 cm and the inner thicknesses are distributed randomly on spars.Final thicknesses can be seen on the preliminary design's drafting:

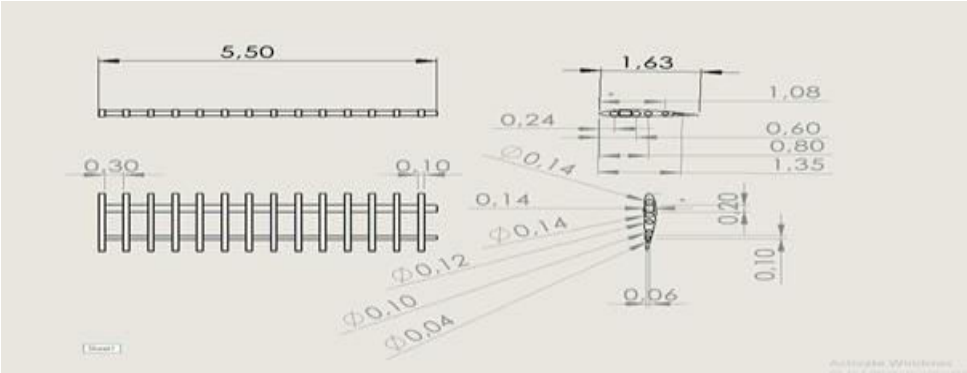

Figure 4. Drafting of Preliminary Design

The material properties are taken from different research papers [4, 7, 8, 10, 14, and 17] and matched with Ansys library.

Table 4. Material Properties

Materials	Al 7055	Si3N4	Zirconium oxide
Ultimate Tensile Strength in MPa	593 MPa	525	115
Poission Ratio	0.33	0.25	0.4
Young's Modulus in GPa	70	297	200
ρ in g/cm3	2.86 g/cm3	2.2 to 3.5 g/cm3	5.8 g/cm3

The loads and boundary conditions along with finite element model are shown in figure 3 below. One end of the wing is fixed because it is embedded inside the fuselage and other end is left free with 6 degree of freedom. Pressure force of 500Pa is applied at the bottom surface of the wing at center of pressure

[16]. Center of pressure is a point at which total pressure is assumed to be act [2].

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2.1 structural analysis of AL7055

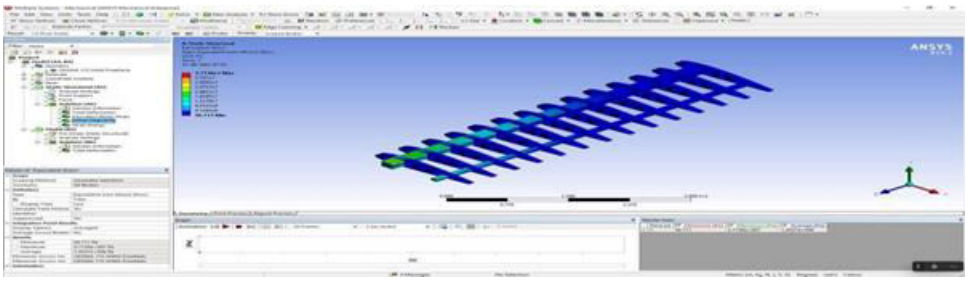

Figure 3. Equivalent Von Mises Stress result

Maximum stress value is observed near the root as seen on the figure. This is because loading affects the root section more than any other section. Total deformation is expected to be on the tip section as can be noted on the figure below

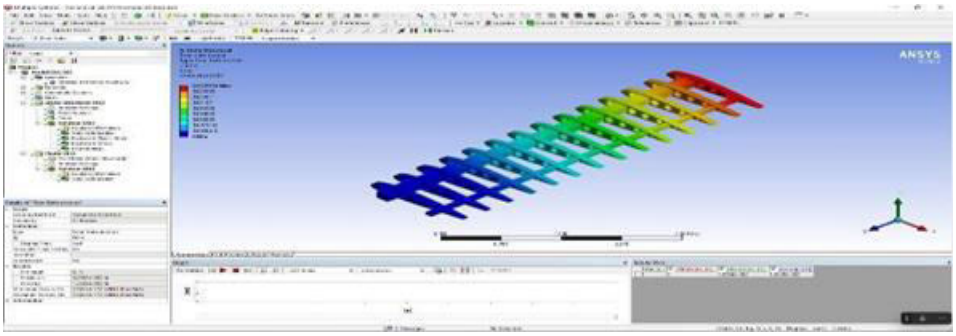

Figure 4. Total deformation result

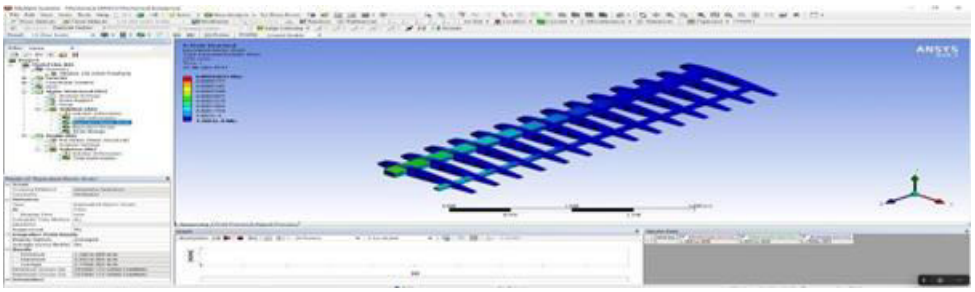

Figure 5 Equivalent Elastic Strain result

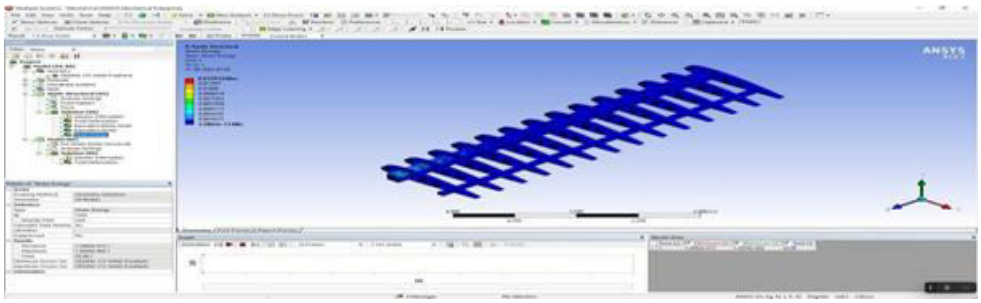

Figure 6 Equivalent Elastic Strain result

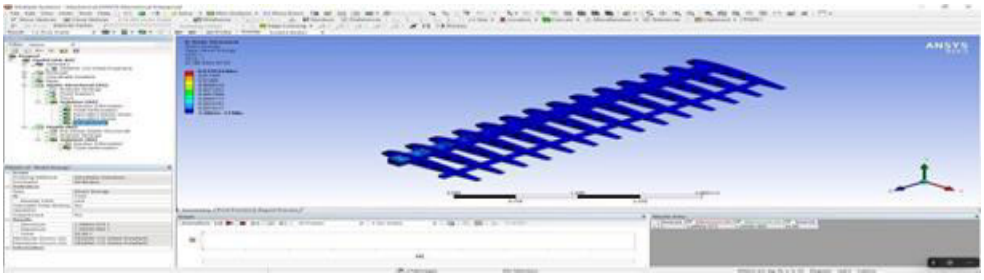

Figure 7 Strain Energy result

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Table 5 Static Structural Analysis Report

Properties	Minimum	Maximum	Average/Total
Equivalent Von Mises Stress	56.71 pa	$3.7136*10^{7}$ pa	$1.4537*10^{6}$ pa
Equivalent Elastic Strain result	$1.881*10^{-9}$	$5.3051*10^{-4}$	$2.1706*10^{-5}$
Strain Energy	$1.2862*10^{-13}$ j	$1.2934*10^{-2}$ j	35.96 j
Total deformation	0	$3.2954*10^{-2}$ m	$1.3228*10^{-2}$ m

2.2 Modal Analysis Results for Aluminum 7055

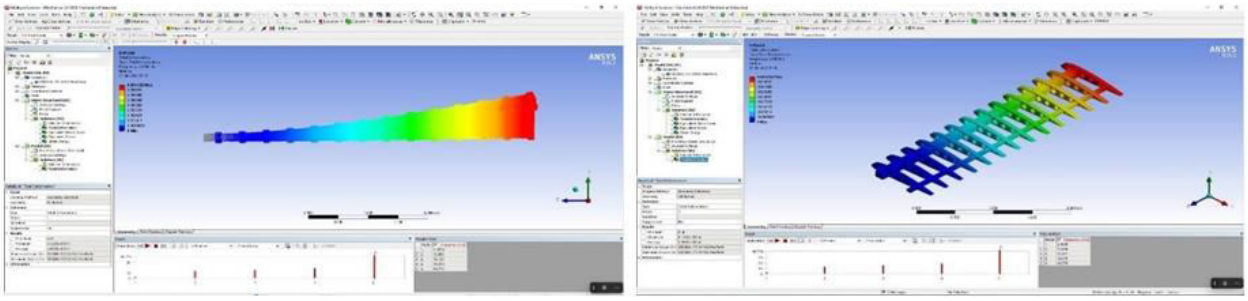

Figure 8 Mode-1 Analysis for Aluminium 7055

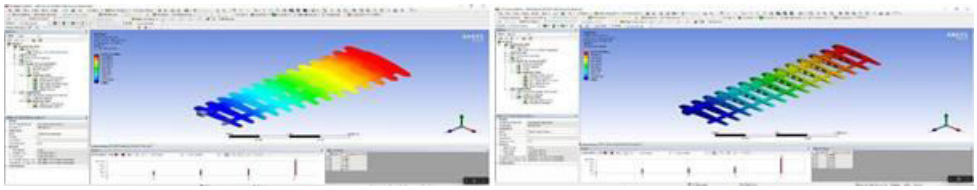

Figure 9 Mode-2 Analysis for Aluminium 7055

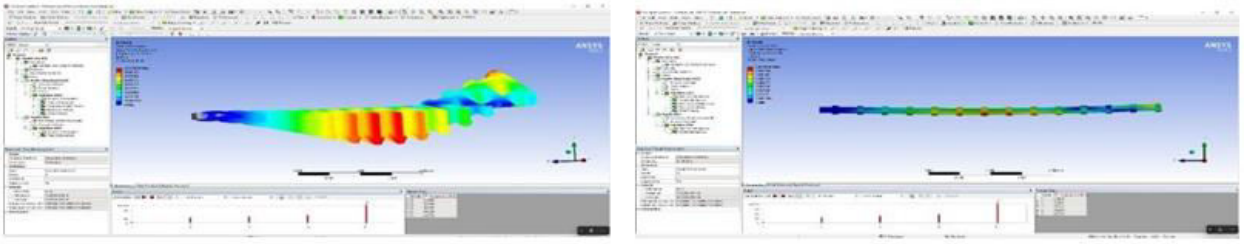

Figure 10 Mode-3 Analysis for Aluminium 7055

Mode	Frequency (Hz)
1	2.5058
2	12.694
3	15.127
4	18.229
5	40.774

2.3 Static Structural Analysis Results for Al 7055 + 3% Si3N4 + 5% Zro2 Composition

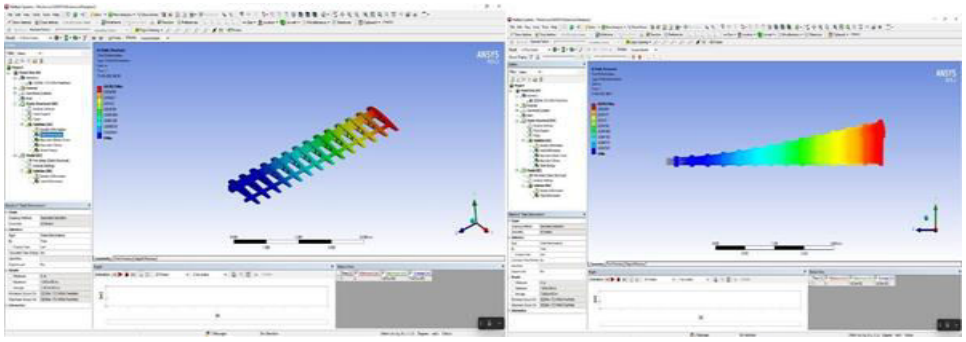

Figure 11Total Deformation for Composition AL7055+3% Si3N4+5% Zro2

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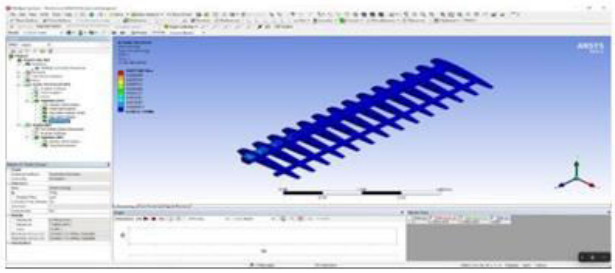

Figure 12 Strain Energy for Composition AL7055+3% Si3N4+5% Zro2 Figure 13 Equivalent Elastic Strain for Composition AL7055+3% Si3N4+5% Zro2

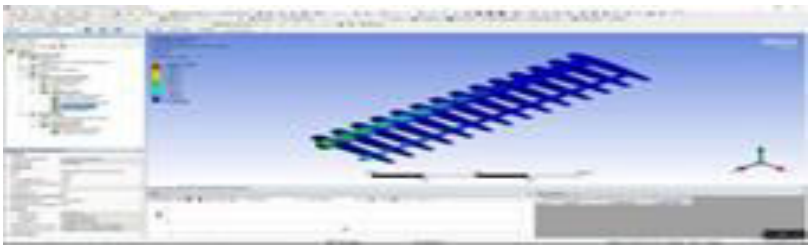

Figure 14 Equivalent Von Mises Stress for Composition AL7055+3% Si3N4+5% Zro2

Table 7 Static Structural Analysis Report for Al 7055 + 3% Si3N4 + 5% Zro2 Composition

Properties	Minimum	Maximum	Average/Total
Equivalent Von Mises Stress	26.391 pa	$3.7622*10^{7}$ pa	$1.4654*10^{6}$ pa
Equivalent Elastic Strain	$9.802*10^{-10}$	$3.0097*10^{-4}$	$1.2245*10^{-5}$
Strain Energy	$3.1661*10^{-14}$ j	$7.2483*10^{-3}$ j	19.965 j
Total deformation	0	$1.833*10^{-2}$ m	$7.3425*10^{-3}$ m

2.4 Modal Analysis Results for Al 7055 + 3% Si3N4 + 5% Zro2 Composition

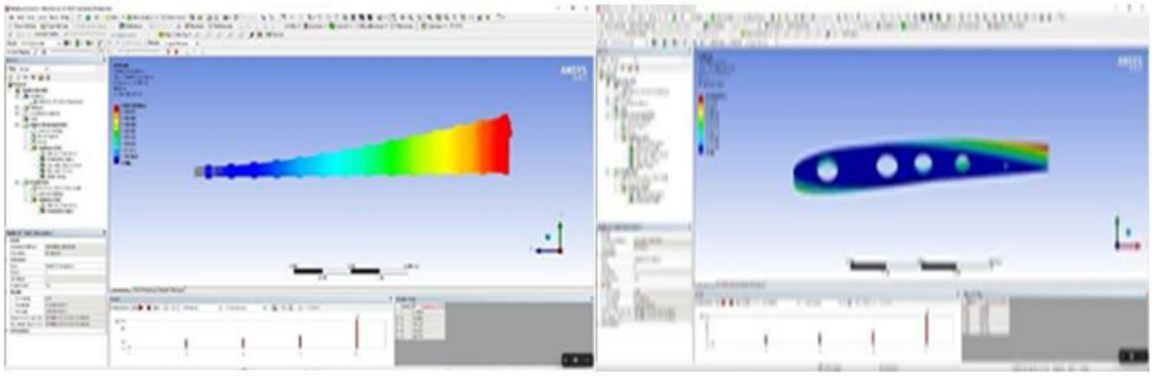

Figure 15 Modal -1 Analysis Results for Al 7055 + 3% Si3N4 + 5% Zro2 Composition

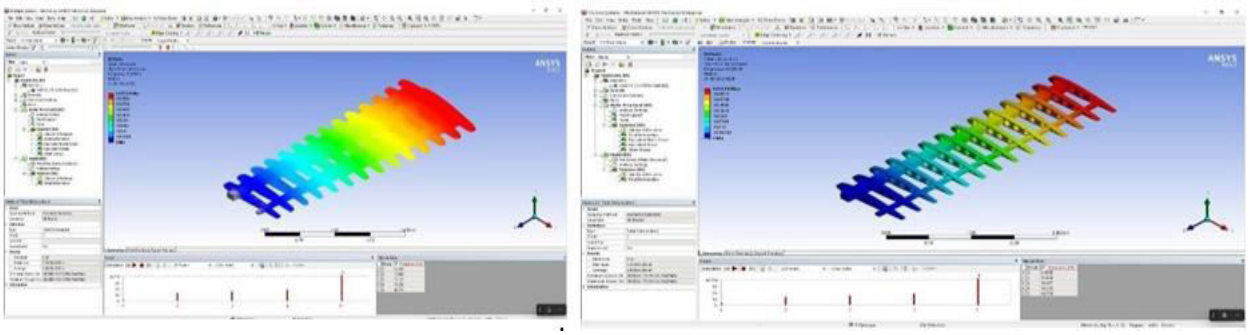

Figure 16 Modal -2 Analysis Results for Al 7055 + 3% Si3N4 + 5% Zro2 Composition

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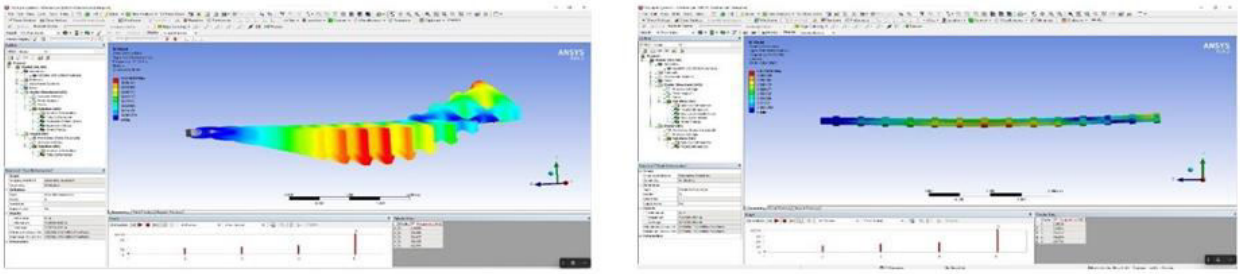

Figure 17 Modal -3 Analysis Results for Al 7055 + 3% Si3N4 + 5% Zro2 Composition

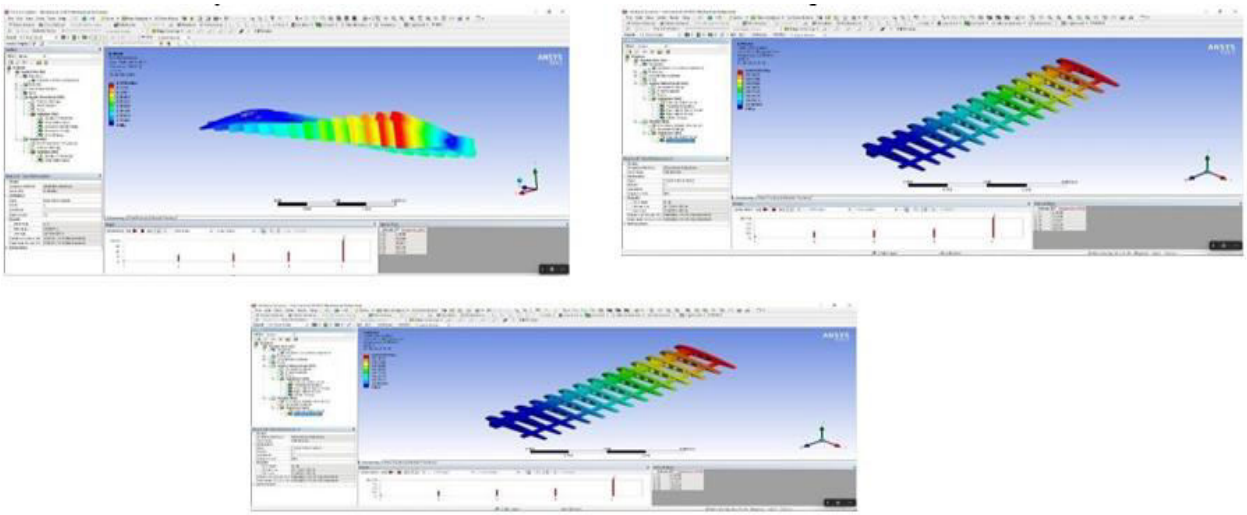

Figure 18 Modal -4 Analysis Results for Al 7055 + 3% Si3N4 + 5% Zro2 Composition

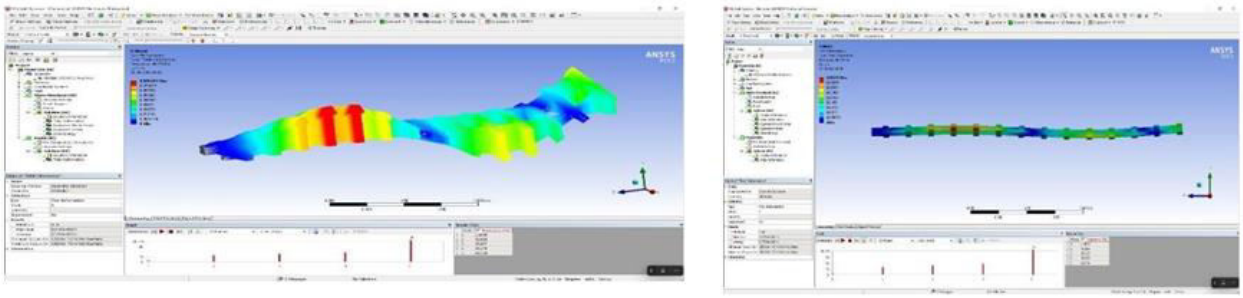

Figure 19 Modal -5 Analysis Results for Al 7055 + 3% Si3N4 + 5% Zro2 Composition Table 8. Modal Analysis Report for Al 7055 + 3% Si3N4 + 5% Zro2 Composition

Mode	Frequency (Hz)
1	3.3817
2	17.071
3	20.305
4	24.072
5	54.697

3. Static structural analysis results

Table 8. Static Structural Analysis Report for Al 7055

Properties	Minimum	Maximum	Average/Total
Equivalent Von Mises Stress	56.71 pa	$3.7136*10^{7}$ pa	$1.4537*10^{6}$ pa
Equivalent Elastic Strain result	$1.881*10^{-9}$	$5.3051*10^{-4}$	$2.1706*10^{-5}$
Strain Energy	$1.2862*10^{-13}$ j	$1.2934*10^{-2}$ j	35.96 j
Total deformation	0	$3.2954*10^{-2}$ m	$1.3228*10^{-2}$ m

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Table 9. Static Structural Analysis Report for Al 7055 + 3% Si3N4 + 5% Zro2 Composition

Properties	Minimum	Maximum	Average/Total
Equivalent Von Mises Stress	26.391 pa	$3.7622*10^{7}$ pa	$1.4654*10^{6}$ pa
Equivalent Elastic Strain	$9.802*10^{-10}$	$3.0097*10^{-4}$	$1.2245*10^{-5}$
Strain Energy	$3.1661*10^{-14}$ j	$7.2483*10^{-3}$ j	19.965 j
Total deformation	0	$1.833*10^{-2}$ m	$7.3425*10^{-3}$ m

Table 10. comparing Static Structural Analysis Results for Al 7055 and Al 7055 + 3% Si3N4 + 5% Zro2 Composition

Properties	Average/Total Al 7055	Average/Total Al 7055 + 3% Si3N4 + 5% Zro2
Equivalent Von Mises Stress	$1.4537*10^{6}$ pa	$1.4654*10^{6}$ pa
Equivalent Elastic Strain	$2.1706*10^{-5}$	$1.2245*10^{-5}$
Strain Energy	35.96 j	19.965 j
Total deformation	$1.3228*10^{-2}$ m	$7.3425*10^{-3}$ m

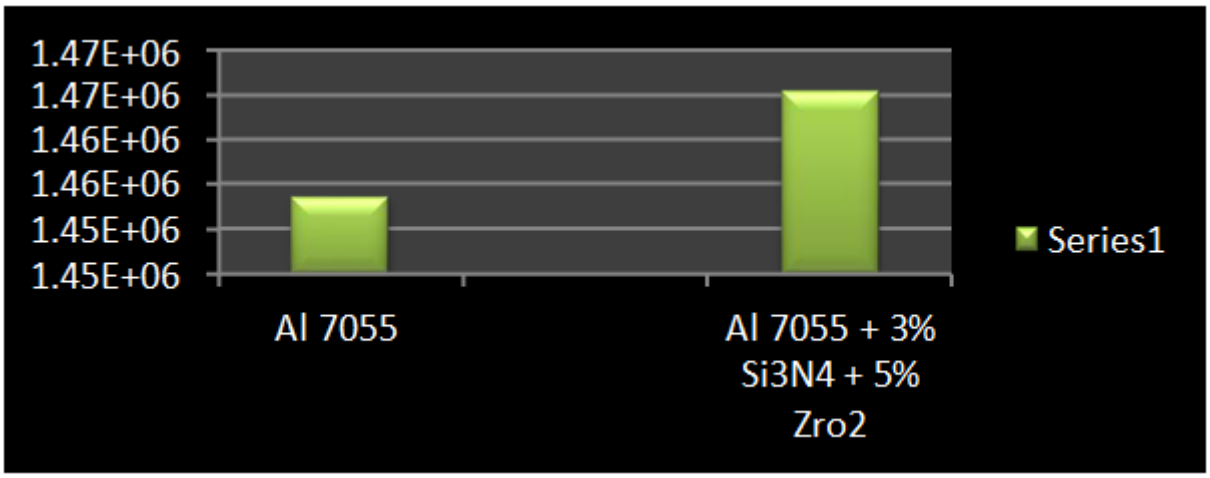

FIG 21 .Vonmisses stress of al7055 and Al 7055 + 3% Si3N4 + 5% Zro2

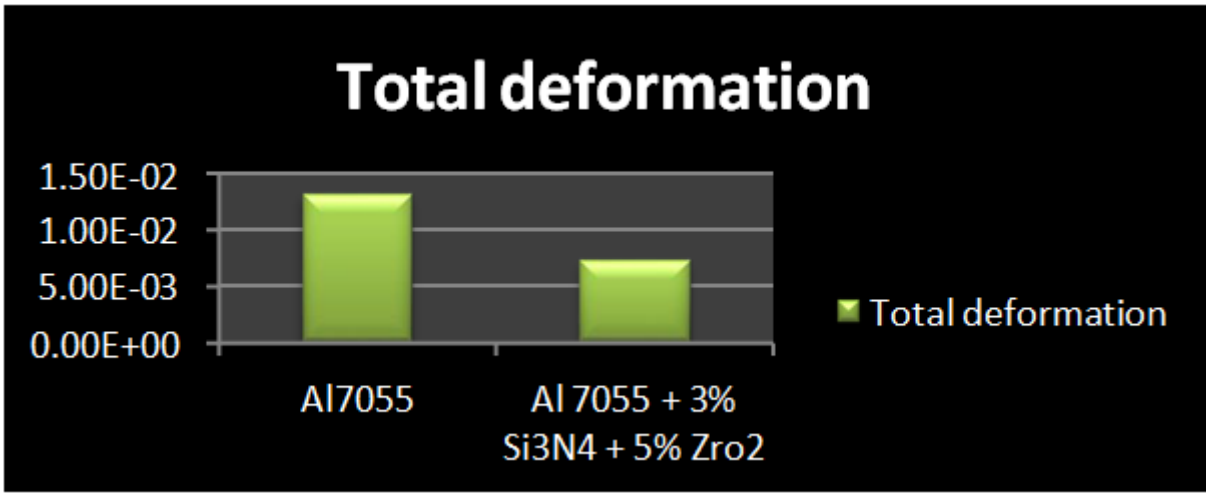

Table 22. Total deformation of al7055 and Al 7055 + 3% Si3N4 + 5% Zro2

4. Modal Analysis Results

The dynamic characteristics of vibrating structures are studied through modal analysis. It is employed to ascertain the continuous structural members' inherent frequency. Because vibration will be reduced compared to higher frequency modes, the lowest frequency mode is preferred. In comparison to other materials, the

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hybrid Al 7055 + 3% Si3N4 + 5% Zro2 exhibits a comparatively higher natural frequency, as indicated by the results of the Modal Analysis. Resonance can be delayed at high natural frequencies.

Table 10. Natural frequency (Hz) for different materials

Mode shape	Al 7055	Al 7055 + 3% Si3N4 + 5% Zro2
1	2.5058	3.3817
2	12.694	17.071
3	15.127	20.305
4	18.229	24.072
5	40.774	54.697

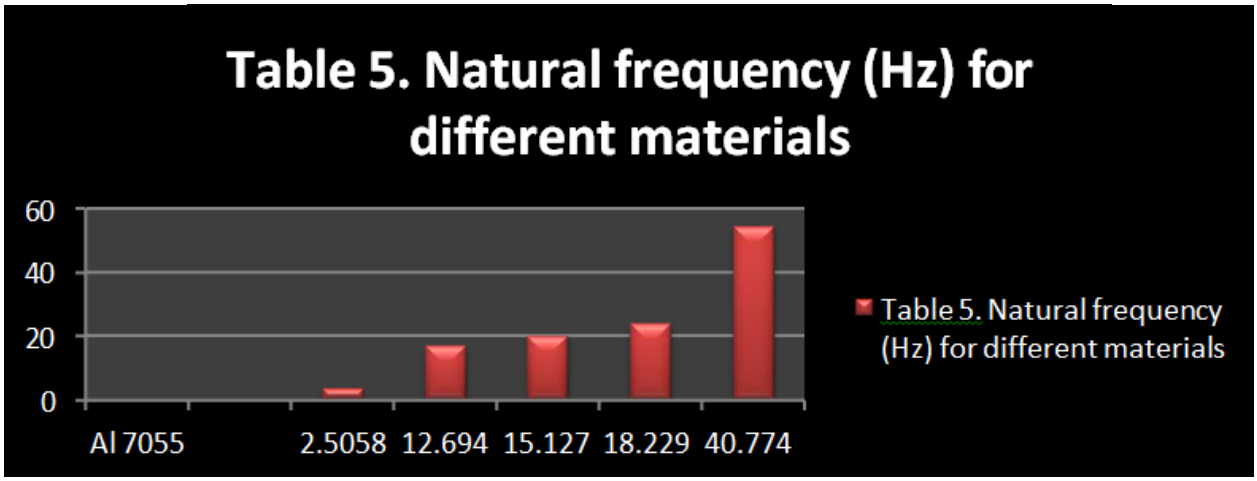

Figure 23. Modal analysis of Al7055

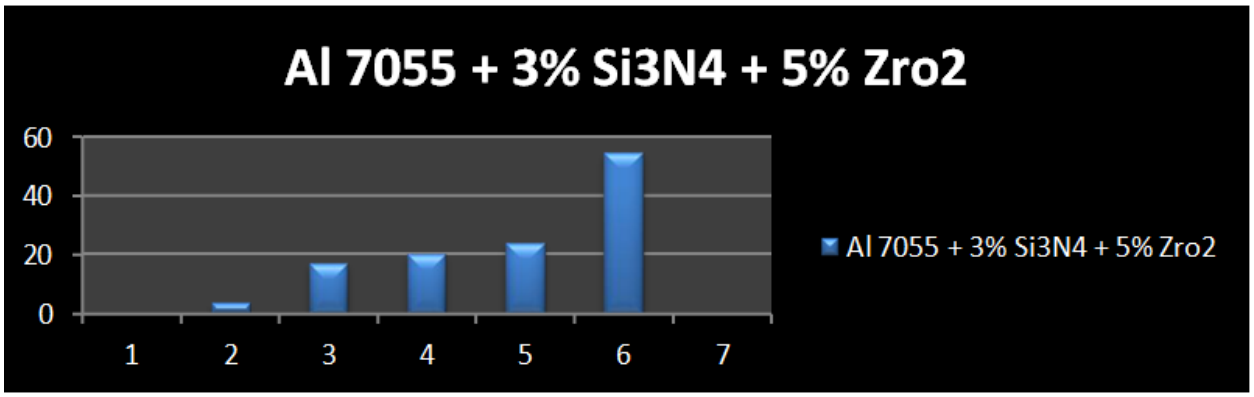

Figure 24. Modal analysis of Al 7055 + 3% Si3N4 + 5% Zro2

5. CONCLUSION

Using solid edge design software, the trainer aircraft's wing with 14 ribs and 2 spars was modelled in accordance with the calculated design requirement. Finite element analysis was then performed to determine the wing's deformation, stress, strain, and frequency. ANSYS Static Structural was utilised to conduct the structural analysis of the wing section for materials like Al 7055 and Al 7055 + 3% Si3N4 + 5% Zro2. To determine the maximum and frequency of wings for the same materials, a modal analysis was performed. . The graph.1 above illustrates how the deformation and stress value increase as the rotating speed increases. Al 7055 + 3% Si3N4 + 5% Zro2 less stress an aircraft wing than aluminium alloy, however, since the deformation curve for aluminium 7055 grows rapidly. In order to determine the maximum vibration amplitude and natural frequency of each material, modal analysis has produced five distinct mode shapes. For any structure (wing), the lowest frequency mode is preferred because it has a smaller vibration amplitude. These findings apply to trainer aircraft wings that are constructed with two spars and fourteen ribs. And with varied aircraft wings and designs, the outcomes could differ correspondingly.

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EXPLORING THE DYNAMICS OF HUMAN-AI INTERACTION: IMPACTS ON SOCIAL RELATIONSHIPS AND COLLABORATION

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ABSTRACT
This research paper delves into the intricate interplay between humans and artificial intelligence (AI), investigating how AI technologies influence human relationships and social interactions. It examines the evolving landscape of human-AI collaboration and communication, shedding light on the social dynamics that shape these interactions. Through a multidisciplinary lens, this paper explores the implications of AI integration into various aspects of daily life and its potential effects on the fabric of social relationships.

Keywords: *Interaction, Algorithm, relationship, communication.*

INTRODUCTION
In recent years, the pervasive integration of Artificial Intelligence (AI) into contemporary society has become increasingly palpable, shaping and redefining the way individuals interact with the world around them. From virtual assistants managing our daily schedules to algorithms curating our online experiences, AI technologies have seamlessly embedded themselves into diverse domains, permeating both professional and personal spheres. As we stand at the intersection of human life and technological advancement, the need to comprehensively understand how AI influences human social dynamics and relationships has never been more pressing.

The exponential growth of AI applications has unfolded across various sectors, including healthcare, finance, education, and entertainment, ushering in an era where AI is not merely a technological novelty but an integral part of the fabric of modern life. Automated decision-making processes, machine learning algorithms, and sophisticated data analytics are now ubiquitous, contributing to the optimization of tasks, the enhancement of productivity, and the personalization of user experiences.

As AI becomes more intertwined with our daily existence, it is imperative to recognize its profound impact on the intricate tapestry of human relationships. Whether in the workplace, where AI technologies influence collaboration and teamwork, or in personal spaces, where virtual assistants and social media algorithms shape our online interactions, the influence of AI is both subtle and profound. Acknowledging and dissecting these influences is essential for fostering a nuanced understanding of the evolving dynamics between humans and intelligent machines.

The purpose of this research is to probe into the multifaceted dimensions of human-AI interaction, with a particular focus on the implications for social dynamics and relationships. By exploring the ways in which AI is integrated into daily life and understanding its effects on communication, collaboration, and emotional connections, this study aims to contribute to the broader discourse on the societal implications of AI integration. Through a comprehensive analysis of literature, case studies, and real-world examples, we seek to unravel the complexities of this relationship and shed light on the challenges and opportunities that arise in the wake of increased reliance on AI technologies.

In a world where AI is not merely a tool but a social actor, the need for a nuanced examination of its impact on human relationships is paramount. By fostering a deeper understanding of the intertwining of AI and social dynamics, we hope to provide insights that can inform future research, policy decisions, and the ethical development of AI technologies. As we embark on this exploration, we invite readers to join us in unravelling the intricate tapestry of human-AI interaction and understanding its profound consequences for the way we live, work, and relate to one another in the 21st century.

LITERATURE REVIEW: UNRAVELLING THE IMPACT OF AI ON SOCIAL RELATIONSHIPS
The exploration of Artificial Intelligence (AI) and its influence on social relationships has become a focal point in interdisciplinary research. This literature review aims to survey existing studies that explore into the multifaceted dimensions of the impact of AI on social dynamics. By synthesizing diverse perspectives and findings, we seek to provide a comprehensive understanding of how AI interfaces with human relationships.

1. Attitudes Toward AI:
- Numerous studies have investigated public attitudes toward AI, revealing a spectrum of sentiments ranging from enthusiasm to apprehension. For instance, research by Wang et al. (2019) found that younger

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demographics tend to be more optimistic about AI's potential benefits, while older individuals express more concerns about job displacement and ethical implications.

2. **Trust in AI Systems:**
- Trust plays a pivotal role in the acceptance and adoption of AI technologies. Studies by Lee and See (2004) and Mayer et al. (1995) suggest that factors such as transparency, reliability, and perceived competence of AI systems significantly influence trust levels. Conversely, trust deficits may arise from instances of algorithmic bias, opacity, or unexplained decision-making processes.

3. **Psychological Aspects of Interacting with AI:**
- The psychological dimensions of human-AI interaction have been explored extensively. Nass and Moon (2000) conducted pioneering research on the 'media equation,' demonstrating that individuals tend to apply social rules to AI interactions, attributing social qualities to machines. More recent studies, such as those by Waytz et al. (2010), delve into the psychological impact of anthropomorphism in human-AI relationships, exploring how individuals form emotional connections with AI entities.

4. **Impact on Social Skills and Communication:**
- The integration of AI into communication platforms and virtual assistants has spurred investigations into its impact on human social skills. Research by Turkle (2011) and Reeves and Nass (1996) discusses the potential consequences of relying on AI for social interaction, examining how it may alter communication patterns and affect individuals' ability to navigate complex social scenarios.

5. **AI in the Workplace:**
- In professional settings, AI's role in collaboration and teamwork has garnered attention. Studies by Davenport and Ronanki (2018) and Woolley et al. (2010) explore how AI tools influence group dynamics, decision-making processes, and the distribution of tasks within teams.

6. **Ethical Considerations and Privacy Concerns:**
- The ethical dimensions of AI in social relationships are a recurring theme. Research by Diakopoulos (2016) discusses the ethical challenges posed by algorithmic bias, while Nissenbaum (2001) addresses the impact of AI on privacy in social contexts, emphasizing the need for ethical AI design and implementation.

The literature review highlights the diversity of research exploring the impact of AI on social relationships. Attitudes, trust, psychological aspects, workplace dynamics, and ethical considerations are integral components of this intricate relationship. As we progress, it becomes apparent that understanding the nuances of human-AI interaction is essential for navigating the evolving landscape of technology and its profound implications for the social fabric.

Human-AI Interaction in Daily Life: Shaping Activities and Information Consumption

In the contemporary digital landscape, the integration of Artificial Intelligence (AI) into daily life has reached unprecedented levels, fundamentally altering the way individuals engage with the world. This section examines the pervasive influence of AI interfaces in everyday activities, focusing on the omnipresence of virtual assistants, social media algorithms, and personalized recommendations. It further delves into the transformative role AI plays in shaping individuals' information consumption and online social interactions.

1. **Virtual Assistants: A Seamless Integration:**
- Virtual assistants, exemplified by technologies like Amazon's Alexa, Apple's Siri, and Google Assistant, have become ubiquitous companions in households. These AI-driven interfaces seamlessly integrate into daily activities, from setting reminders and answering queries to controlling smart home devices. Studies (e.g., Gao et al., 2019) have explored the impact of these virtual assistants on users' daily routines, highlighting the convenience they offer but also raising questions about privacy and data security.

2. **Social Media Algorithms: Curating Online Experiences:**
- Social media platforms leverage AI algorithms to curate content tailored to individual preferences. These algorithms, based on user behavior and preferences, shape the information users encounter. Research by Pariser (2011) on the concept of the "filter bubble" elucidates how these algorithms may inadvertently limit exposure to diverse viewpoints, creating echo chambers and influencing individuals' perspectives.

3. **Personalized Recommendations: Tailoring Content Consumption:**
- E-commerce platforms, streaming services, and content providers employ AI to offer personalized recommendations. Through analyzing user preferences and behavior, AI algorithms suggest products, movies, music, and other content. This personalization enhances user experience but also raises concerns

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about the potential reinforcement of existing preferences and the risk of algorithmic bias (Ekstrand et al., 2018).

4. **Impact on Information Consumption Patterns:**
- The omnipresence of AI interfaces significantly influences individuals' information consumption patterns. Research by Sundar et al. (2017) suggests that the personalized nature of AI-driven content delivery may contribute to information homogenization, limiting exposure to diverse viewpoints. This impact on information consumption has broader implications for societal discourse and the formation of individual opinions.

5. **Shaping Online Social Interactions:**
- AI not only influences information consumption but also plays a pivotal role in shaping online social interactions. Chatbots on social media platforms, for instance, engage users in conversations, offer customer support, and even create a sense of companionship. Studies (e.g., Zhou et al., 2020) explore the psychological aspects of human interaction with AI entities, investigating how users attribute social qualities to these digital counterparts.

6. **Privacy and Ethical Considerations:**
- The seamless integration of AI into daily life raises significant privacy and ethical considerations. The collection and analysis of personal data for AI-driven customization may infringe on privacy rights. Ethical concerns also emerge regarding the transparency of algorithms and the potential for unintentional biases in content recommendations.

Communication Patterns in Human-AI Interaction

Unravelling the Dynamics of Language, Voice, and Conversation

The evolution of Artificial Intelligence (AI) has ushered in a transformative era in human-computer interaction, redefining the way individuals communicate with intelligent machines. This section investigates the intricate communication dynamics between humans and AI, shedding light on the emergence of natural language processing (NLP), voice recognition, and conversational AI. The discussion encompasses the profound impact of these technologies on shaping communication patterns in diverse contexts.

1. **Natural Language Processing (NLP):**
- NLP has emerged as a cornerstone of human-AI communication, allowing machines to interpret, understand, and generate human language. Research by Manning et al. (2014) explores the advancements in NLP algorithms, enabling AI systems to comprehend context, sentiment, and intent within human language. The implications of NLP extend to chatbots, virtual assistants, and other applications that strive to engage in meaningful conversations.

2. **Voice Recognition Technologies:**
- The advent of voice recognition technologies has enabled a more intuitive and hands-free mode of interaction with AI systems. Studies by Sarikaya et al. (2014) delve into the technical aspects of automatic speech recognition, highlighting improvements in accuracy and usability. Voice interfaces, exemplified by virtual assistants like Amazon's Alexa and Apple's Siri, have become integral to daily life, impacting the way users seek information and execute commands.

3. **Conversational AI: From Scripts to Dynamic Interaction:**
- Conversational AI represents a paradigm shift in human-AI interaction, moving beyond scripted responses to dynamic and context-aware conversations. Research by Serban et al. (2017) explores the challenges and opportunities in developing conversational agents capable of understanding and generating human-like dialogue. The evolution of chatbots and virtual assistants reflects a growing emphasis on creating natural and fluid communication experiences.

4. **Impact on User Experience:**
- The integration of NLP, voice recognition, and conversational AI has profound implications for user experience. Research by Clark et al. (2019) discusses how advancements in language models, such as OpenAI's GPT-3, contribute to more coherent and contextually aware conversations. The ability of AI systems to engage in meaningful dialogue enhances user satisfaction and facilitates seamless human-AI collaboration.

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5. **Ethical Considerations in Communication Design:**
- The design of AI communication interfaces raises ethical considerations. Research by Diakopoulos (2017) addresses issues such as transparency, accountability, and the potential for biases in conversational AI. As AI systems become more conversational, ensuring responsible design that respects user privacy and avoids perpetuating stereotypes becomes imperative.

6. **Applications Across Industries:**
- Communication patterns influenced by NLP, voice recognition, and conversational AI extend across various industries. From healthcare chatbots providing medical information to customer service virtual assistants resolving queries, the impact of these technologies is far-reaching. Research by Hovy et al. (2016) explores domain-specific applications and the challenges of tailoring communication for specialized contexts.

Social Implications and Ethical Considerations in the Age of AI: Navigating Societal Impact and Responsible AI Deployment

The widespread integration of Artificial Intelligence (AI) into social interactions brings forth a myriad of societal implications and ethical considerations. This section critically examines the potential impacts of increased reliance on AI in social interactions, shedding light on the ethical dimensions related to privacy, bias, and the delegation of social tasks to AI.

1. **Societal Impacts of Increased AI Reliance:**
- The growing dependence on AI in social interactions has the potential to reshape societal structures. Research by Bryson and Winfield (2017) explores how AI technologies can influence social norms, relationships, and communication patterns. The widespread adoption of AI-powered systems, from virtual assistants to social media algorithms, introduces a new layer of complexity to human interactions and societal dynamics.

2. **Ethical Considerations in Privacy:**
- The collection and analysis of personal data for AI-driven customization raise significant ethical concerns regarding privacy. Research by Barocas and Selbst (2016) highlights the potential for privacy infringements when AI systems process sensitive information. The balance between providing personalized experiences and safeguarding individuals' privacy becomes a crucial ethical consideration in the development and deployment of AI technologies.

3. **Bias in AI Systems:**
- Bias in AI algorithms has profound implications for social interactions. Studies by Buolamwini and Gebru (2018) reveal instances of bias in facial recognition systems, particularly in their accuracy across different demographic groups. Addressing bias in AI algorithms is a critical ethical imperative to ensure fair and equitable treatment, especially in sensitive domains such as hiring, law enforcement, and healthcare.

4. **Implications of Delegating Social Tasks to AI:**
- Delegating social tasks to AI, such as customer service interactions or emotional support chatbots, raises ethical considerations regarding the nature of human relationships. Research by Bostrom and Yudkowsky (2014) explores the ethical implications of creating AI systems that simulate empathy and emotional connection. Balancing the benefits of AI-driven social tasks with the preservation of genuine human connections becomes a central ethical challenge.

5. **Transparency and Accountability:**
- Ensuring transparency in AI systems is paramount for accountability. Research by Diakopoulos (2016) discusses the ethical importance of understanding how AI decisions are made. Transparent AI systems empower users to comprehend and contest decisions, mitigating concerns related to accountability, trust, and the potential consequences of automated actions in social contexts.

6. **Inclusive AI Design:**
- Ethical AI deployment requires a commitment to inclusive design. Research by O'Neil (2016) emphasizes the importance of developing AI systems that consider diverse perspectives and avoid reinforcing existing social inequalities. Inclusive AI design ensures that technologies serve the needs of all individuals, promoting fairness and preventing discrimination.

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Trust and Emotional Connection in Human-AI Relationships: Navigating the Dynamics of Reliance and Connection

The burgeoning field of Human-AI relationships involves not only practical considerations but also intricate emotional dimensions. This section delves into the factors influencing trust in AI systems and explores the complex realm of emotional connections that individuals may form with AI entities, shedding light on the psychological aspects of human-AI relationships.

1. **Factors Influencing Trust in AI Systems:**
- Trust is a cornerstone of successful human-AI interactions. Research by Lee and See (2004) identifies several key factors that influence trust in AI systems. Transparency, reliability, competence, and the ability of AI to perform as expected contribute to the establishment and maintenance of trust. Understanding and addressing these factors are crucial for fostering positive interactions between users and AI.

2. **Transparency and Explain ability:**
- Transparency in the decision-making processes of AI systems is paramount for building trust. Research by Doshi-Velez and Kim (2017) emphasizes the importance of explain ability in AI algorithms. When users can comprehend how AI arrives at decisions, trust is enhanced. Ethical considerations underscore the need for transparent AI systems to avoid unintentional bias and reinforce user confidence.

3. **Reliability and Consistency:**
- Reliability and consistency in AI performance are essential for engendering trust. Users are more likely to trust AI systems that consistently deliver accurate and reliable results. Research by Herlocker et al. (2000) explores the impact of system accuracy on user trust, highlighting the correlation between reliable performance and user confidence in AI technologies.

4. **Emotional Connections with AI Entities:**
- The emergence of advanced AI technologies has paved the way for individuals to form emotional connections with AI entities. Studies by Nass and Moon (2000) delve into the concept of the "media equation," suggesting that humans tend to apply social rules to AI interactions, attributing human-like qualities to machines. Virtual assistants and chatbots, designed with personable interfaces, can evoke emotional responses and connections from users.

5. **Psychological Aspects of Human-AI Relationships:**
- Human-AI relationships involve complex psychological dynamics. Research by Reeves and Nass (1996) explores how users respond socially and emotionally to AI systems. The phenomenon of anthropomorphism, where humans attribute human-like qualities to AI entities, plays a significant role in shaping the psychological aspects of human-AI relationships.

6. **Role of Context and Purpose:**
- The context and purpose of human-AI interactions influence the emotional dimension. For example, AI-driven healthcare assistants may evoke different emotional responses compared to entertainment-oriented chatbots. Research by Sundar (2018) emphasizes the need to consider the context and purpose of AI applications when studying the emotional aspects of human-AI relationships.

7. **Ethical Considerations:**
- Ethical considerations in designing emotionally engaging AI systems are vital. Developers must strike a balance between creating empathetic AI interfaces and ensuring transparency about the AI's non-human nature. Research by Koda et al. (2020) discusses the ethical challenges associated with emotionally intelligent AI, emphasizing the responsibility of designers to avoid manipulating users' emotions.

Challenges and Opportunities in Human-AI Interaction: Navigating the Complex Landscape

The burgeoning field of Human-AI Interaction presents a landscape rich in challenges and opportunities. Understanding and addressing these facets are imperative for harnessing the benefits of AI while mitigating potential risks. This section delineates key challenges in human-AI interaction and identifies opportunities to leverage AI for enhancing social interactions, collaboration, and communication.

Challenges:

1. **Algorithmic Bias:**
   - *Challenge:* Algorithmic bias is a pervasive issue, where AI systems may inadvertently perpetuate or amplify existing societal biases. This bias can manifest in various applications, such as hiring processes or predictive policing.

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- *Mitigation:* Implementing rigorous testing and validation procedures, promoting diverse teams in AI development, and ensuring transparency in algorithmic decision-making are critical steps to address algorithmic bias.

2. **Privacy Concerns:**
- *Challenge:* The integration of AI often involves the collection and processing of vast amounts of personal data, leading to concerns about privacy infringement. Users may be apprehensive about sharing sensitive information with AI systems.
- *Mitigation:* Implementing robust privacy policies, adopting privacy-preserving technologies like federated learning, and providing users with clear and understandable information about data usage practices can help address privacy concerns.

3. **Job Displacement and Workforce Changes:**
- *Challenge:* The automation enabled by AI has the potential to displace certain jobs, leading to workforce changes and potential unemployment in specific sectors.
- *Mitigation:* Investing in workforce reskilling and upskilling programs, fostering a culture of continuous learning, and strategically deploying AI to augment human capabilities rather than replace them can help manage the challenges associated with job displacement.

4. **Interpretability and Explainability:**
- *Challenge:* Many AI systems operate as "black boxes," making it challenging for users to understand how decisions are made. Lack of interpretability can erode trust in AI systems.
- *Mitigation:* Emphasizing the development of interpretable and explainable AI models, providing users with insights into decision-making processes, and promoting transparency in AI development are crucial steps to address this challenge.

Future Directions in Human-AI Interaction Research: Navigating Evolving Dynamics

1. **Ethical AI Design and Bias Mitigation:**
- *Future Research:* Investigate advanced techniques for mitigating algorithmic bias in AI systems, exploring approaches to ensure fairness, transparency, and ethical considerations in the design and deployment of AI technologies.

2. **Explainable AI and User Trust:**
- *Future Research:* Explore methods to enhance the explain-ability of AI systems, aiming to bridge the gap between complex algorithms and user understanding. Assess the impact of explain-ability on user trust and acceptance in various applications.

3. **Human-Centric AI in Healthcare:**
- *Future Research:* Investigate the integration of AI in healthcare with a focus on human-centric design. Explore how AI can support patient-doctor relationships, address ethical concerns in medical decision-making, and contribute to more personalized and empathetic healthcare interactions.

4. **AI and Human Creativity:**
- *Future Research:* Explore the intersection of AI and human creativity. Investigate how AI can be used as a tool to augment human creative processes in fields such as art, music, and literature while preserving the unique aspects of human expression.

5. **Collaborative AI in Education:**
- *Future Research:* Explore the potential of collaborative AI in educational settings. Investigate how AI can support educators in creating personalized learning experiences, adapting to diverse learning styles, and fostering collaborative learning environments.

6. **AI-Enhanced Workplace Dynamics:**
- *Future Research:* Examine the impact of AI on workplace dynamics, team structures, and job roles. Investigate strategies for creating inclusive work environments where AI technologies augment human capabilities and contribute to enhanced collaboration.

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7. **Human-AI Emotional Dynamics:**
   - *Future Research:* Explore the emotional aspects of human-AI relationships. Investigate the psychological impact of emotional connections with AI entities and how these connections evolve over time, influencing user perceptions and interactions.

Recommendations for Policymakers, Designers, and Practitioners: Navigating Social Implications

1. **Establish Ethical Guidelines:**
   - *Policymakers:* Develop and implement clear ethical guidelines for the responsible development and deployment of AI technologies. Emphasize transparency, accountability, and fairness in algorithmic decision-making processes.
2. **Invest in Education and Training:**
   - *Policymakers and Practitioners:* Invest in education and training programs to equip individuals with the skills needed to navigate the AI-driven future. Promote continuous learning to address workforce changes and ensure a smooth transition to an AI-enhanced society.
3. **User-Centric Design:**
   - *Designers:* Prioritize user-centric design principles in the development of AI interfaces. Focus on creating intuitive and accessible interactions that empower users and enhance their understanding of AI systems.
4. **Transparency and Explain ability:**
   - *Designers and Practitioners:* Prioritize transparency and explain ability in AI systems. Provide users with clear explanations of how AI decisions are made, fostering trust and understanding.
5. **Diversity in AI Development:**
   - *Designers and Policymakers:* Encourage diversity in AI development teams to ensure a range of perspectives and experiences are considered. This can help mitigate biases in AI systems and promote inclusivity.
6. **Privacy Protection Measures:**
   - *Policymakers and Practitioners:* Implement robust privacy protection measures in AI applications. Prioritize user privacy by adopting privacy-preserving technologies and ensuring transparent data usage policies.
7. **Engage in Continuous Dialogue:**
   - *All Stakeholders:* Foster an ongoing dialogue between policymakers, designers, practitioners, and the public. Encourage open discussions about the societal impacts of AI, seeking input from diverse stakeholders to inform ethical and responsible AI development.

By focusing on these future research directions and implementing recommendations, stakeholders can work collaboratively to navigate the evolving dynamics of human-AI interaction, ensuring that AI technologies contribute positively to society while addressing ethical concerns and fostering inclusive and collaborative environments.

The exploration of human-AI interaction reveals a dynamic landscape marked by transformative opportunities and nuanced challenges. As AI technologies continue to evolve, it becomes increasingly crucial to understand, navigate, and shape the complex dynamics that emerge in the interplay between humans and intelligent machines.

Key Findings and Insights:

1. **Transformative Impact on Relationships:**
   - AI technologies have a transformative impact on human relationships, influencing how individuals collaborate, communicate, and interact in various domains. From virtual assistants shaping daily routines to collaborative tools enhancing teamwork, the integration of AI is reshaping the fabric of social and professional connections.
2. **Ethical Considerations and Algorithmic Bias:**
   - Ethical considerations, such as privacy concerns and algorithmic bias, underscore the need for responsible AI development. The inadvertent amplification of biases and potential privacy infringements highlight the importance of transparency, fairness, and user-centric design to build trust and mitigate unintended consequences.

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3. **Trust, Emotional Connection, and Collaboration:**
   - Trust is a foundational element in human-AI interactions. Building and maintaining trust involves factors such as transparency, reliability, and the explainability of AI systems. Furthermore, the emergence of emotional connections between individuals and AI entities adds a new dimension to the dynamics of human-AI relationships.
4. **Opportunities for Innovation:**
   - Despite challenges, AI presents unprecedented opportunities for innovation. Enhanced personalization, improved collaboration in diverse industries, and the potential for AI to assist and augment human capabilities in healthcare, education, and creativity exemplify the positive impacts AI can have on society.
5. **Continuous Learning and Collaboration:**
   - The evolving nature of AI technology necessitates a commitment to continuous learning and collaboration among policymakers, designers, practitioners, and the public. Ongoing dialogue and collaboration are crucial to adapting to the changing landscape, addressing challenges, and maximizing the positive potential of AI.

As AI becomes more ingrained in our daily lives, workplaces, and social interactions, the journey ahead involves ongoing exploration, adaptation, and ethical stewardship. By prioritizing responsible AI development, embracing diverse perspectives, and fostering collaboration, we can navigate the complexities of human-AI interaction to create a future where intelligent technologies enrich human experiences and contribute positively to the advancement of society.

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ENHANCED FRAMEWORK FOR PERSONALISATION IN E-LEARNING FOR ONLINE LEARNERS

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ABSTRACT:
The education industry saw a new paradigm shift in the early 2000s and since then there is a rapid adoption of learning management systems and virtual learning environment for course delivery. The advances in technology have offered a vast scope for adding new teaching material in digital format. Universities have introduced blended learning platforms, virtual classrooms, gamification technologies, simulation tools are slowly moving towards social learning. These technologies have transformed the learner's environment to provide enhanced the learning experience. These developing trends have implications on the quality and relevance of knowledge and delivery of learning content to organization workers and e-learners [15]. With abundance of data on the internet, there has been explosion in the number of people accessing alternative forms of learning. MOOC platforms generally have learners with disparate age groups, different levels of work experience and learners at different career stages who may have varied learning needs. Many universities use proprietary Learning Management Systems (LMS) or open source platform like Moodle for the teaching learning process. An important role of e-content providers is to recognize that their pedagogy and educational material must cater for the individual learner's characteristics and requirements [15]. There is an immediate need to move away from the "one size fits all" paradigm and offer personalized learning experience [1]. This necessitates learner centric content delivery for online learners as every individual's needs, requirements, learning objectives, skill level and learning abilities are different. Personalization is thus an act of customizing learner's environment, content, sequence of delivery of the content and evaluation of the user [2][3]. Through this study, we propose a framework for personalising the e-learning environment of learners, which considers the above parameters thereby enhancing learning experience.

Keywords: *e-Learning, LMS, face-to-face learning, virtual classrooms, personalization, Moodle, Blackboard*

1. INTRODUCTION

Over past many years, there has been massive transformation in technology of online content delivery through various platforms, which is changing the standard learning process. These technologies have influenced the content delivery and dissemination, which adopts a flexible approach in doing formal task, rather than following a linear path The Virtual platform are fundamentally altering the way the content seekers either search varied type of contents for skill development or increase their individual knowledge base. Earlier, the content provided by the instructional designer was fixed and a standard content was provided to all age groups whether for children or adult and even for people possessing different skill set. Today, instruction designer for e-content has to be future focused in order to cater to the various changing needs of an individual [4][5].

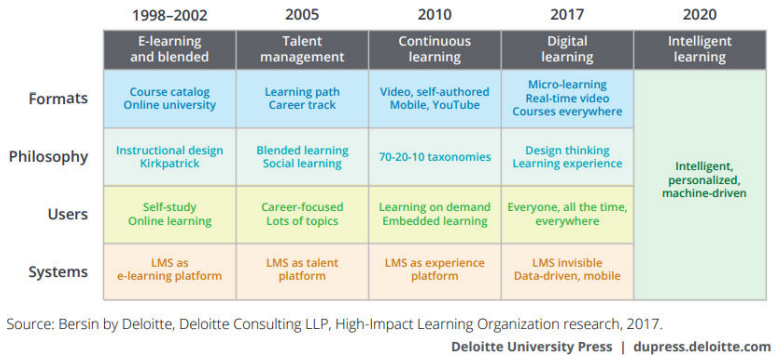

Fig. 1: Learning and development (L&D) opportunities (Source: Bersin by Deloitte)

As intelligent learning is the need of the day, in this study we propose a personalised learning model that integrates the learning styles of the learner with his prolife and dynamic behaviour to recognise his individual learning pattern and further generate association rules for learning objects [6]. This model can work as a middleware agent that can be integrated with any LMS or other intelligent systems.The model uses learning style preference as per the dimensions of Felder Silverman Model extracted using the Index of learning styles test developed by Felder and Soloman for clustering the learning objects [7][8].

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2. RELATED STUDY:

Personalization and adaptive E-learning systems have captured interest of many researchers in the field of computer science as well as education [9][10]. Researchers have proposed recommender and intelligent systems based on their research and but few were implemented in the past few years. Most of these systems focused on addressing the user requests in the manner similar to a standard intelligent system in other application areas [11]. These systems are mostly based on static analysis of learner's profiles and they did not cater to the changing behaviours or actions of the learners. Many educational theories proposed that learning styles could be integrated with the learning activities to improve learning experience of the learner. The integration of learning styles into these recommender or intelligent systems could be a possible solution to the 'cognitive overload' or the so-called problem of 'learning deviation' caused due to the large volume and variety of learning contents placed before the learner.

3. PROPOSED FRAMEWORK:

The benefits of using e-learning are obvious but the process is effective only if the learner is provided with appropriate learning objects, aligned with his learning style, capabilities and requirements. The different learning styles observed are as follows:

Visual/verbal learners:

The online environment is appropriate for them because most of the information for a course are available in writing. This provides passive eLearning interactivity.

Visual/nonverbal Learners:

The interactive activities with sight and sound provide comfort to the student because graphical representations can help them remember concepts and ideas.

Auditory/verbal Learners:

Group participation and collaborative activities are best suited for these types of learners. Online course includes weave streaming audio and synchronous web conferencing.

Tactile/Kinaesthetic Learners:

Online platforms can provide simulations with 3D graphics which can replicate physical demonstration. Online environment is best suited for presentations and discussion of either groups or individual projects. It provides full eLearning interactivity which enhances learning retention and learner's engagement.

Various dimensions of Learning styles are explained with the corresponding teaching requirements by Felder and Silverman [7]:

Dimensions of Learning and Teaching Styles

Preferred Learning Style		*Corresponding Teaching Style*	
sensory / intuitive	perception	concrete / abstract	content
visual / auditory	input	visual / verbal	presentation
inductive / deductive	organization	inductive / deductive	organization
active / reflective	processing	active / passive	student participation
sequential / global	understanding	sequential / global	perspective

Fig. 2. Dimensions of Learning and teaching styles

The authors have also built a web-based application called 'Index of Learning Styles (ILS)' [12]. It is a self-scoring application to assess preferences on the learning styles like Sensory/Intuitive, Visual/Verbal, Inductive/ Deductive, Active/ Reflective, and Sequential/ Global dimensions [13]. This application is freely available for research studies and also licensed to companies and individuals for research or services to their clients. Once the preferred learning style of the learner is analysed the corresponding teaching style can be used by the instructor to enhance the teaching-learning experience of the learner. But the information in the table is useful for the traditional teaching- learning model with is a face to face model where there is a feedback loop and the instructor gets the feedback about the learner's motivation and interest to learn.

An E-Learning environment lacks the feedback loop and the instructor gets the feedback only through the logs maintained on the website. The instructional designers can build contents for the different styles and use association rules to map the appropriate content to the learner's preferred learning style. Prediction method can be used to recommend the correspond content suitable for the learners preferred learning style.

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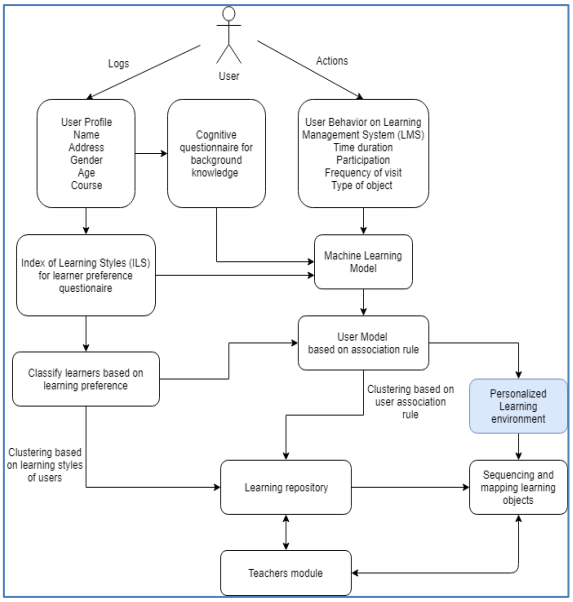

Fig. 3. Proposed framework for personalization in e-learning

The proposed method shown in Fig. 3, deals with capturing the basic learning style of the learner and then providing appropriate contents to the learners after analysing the learner's preferred learning style. Static Personalization deals with collecting the necessary data from the user and then analysing the data using techniques of Data Mining to find individual needs and providing learning contents useful to them. For static Personalization active databases can be used because Databases are essential to efficiently analyse the data [14].

Static personalization has its limitations to deal with the changing needs and behaviour of the learners so dynamic personalization can be used as it involves studying and analysing the behaviour and capabilities of the users and then dynamically mapping the contents to the user. It can be done using machine learning. The term Machine Learning and artificial intelligence are used interchangeably, but they are two different but related technologies. Machine learning is subset of artificial intelligence. Machine learning algorithms can extract information automatically and predict patterns of future data. Thus, it boosts personalization to a greater extent, where every piece of information makes the program more intuitive. They help in extracting data sets from Learning Management Systems and predict the learners need based on their activity logs.

4. DISCUSSION:

Many organizations use Learning Management Systems for dissemination of learning materials to the users. These environments allow the instructor to create various types of learning contents like audio, video and also allow the user to users to navigate through external sites. In the proposed model, the Index of Learning Styles is integrated with Learning Management Systems for analysing the learners learning style so that appropriate contents can be developed by the course designers. Every time the learners log in to the LMS they access different types of contents available for them. Logs are maintained by all the LMS for the activities of individual learners. The variables of interest would be the type of content accessed by the learner, the frequency of access of contents of different type and duration of access of this content. Based on the above logs the learners the appropriate learning contents can be mapped considering his specific learning style. The learner's profile can be updated based on the learner's activities and the subsequent logs could be recorded.

There are numerous algorithms used in machine learning, but the algorithms that can be used for dynamic personalisation are as follows:

1. Supervised: The system evaluates past examples along with new data to predict the results. The developer needs to provide the inputs and outputs in the system for training. After specific training period system can automatically generate outputs or target.
2. Unsupervised: The system uses data to identify patterns and make predictions. It is used to observe trends in the data set containing unlabelled data. It provides greater accuracy and it uses online resources to map inputs and outputs.
3. Reinforcement: The system includes specific goals that must be accomplished. It constantly evaluates feedback to learn user behaviour.

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The changing behaviour and activities of the learners in the e-learning environment can be captured for updating the model so as to dynamically map the contents based on the changing needs of the learner. Machine learning techniques can then be used so that the system can change as per the changing requirements of the learners which are highly influenced by the technological advancements.

4. CONCLUSION AND FUTURE WORK:

This paper proposes a personalised e-learning system framework based on Felder-Silverman Learning style dimensions observing learner's behaviour using data mining and machine learning techniques. It combines the static data obtained through the logs of any Learning Management System for extracting the base knowledge level of the learner. It classifies the learners as per their learning styles and background knowledge. The behaviour aspects of the learners are also considered for generating association rules of the learner with the learning objects. The learner profile is updated as he progresses through the course. The association rules are modified with changing behaviour of the learner. Appropriate learning contents are mapped to the learner as per the individual needs in order to enhance learning experience of the learners. Future work involves implementation and testing of the proposed framework using data collected from Learning Management System.

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VENTURI FEEDER TYPES AND ITS IMPACT ON DIFFERENT APPLICATIONS IN POWDER CONVEYING SYSTEMS, A CASE STUDY.

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ABSTRACT
A general physics-based venturi works by converting the medium's pressure energy into its velocity energy, which can then be used to convey solid. The main factors determining the parameters of a venturi-based pneumatic conveying system usually based on questions What is the product to be conveyed? What product volume and weight needs conveying over time? What distance does the product need to be conveyed? Venturi eductors are best for conveying products that are abrasive, fine, fragile or irregularly shaped. However, they can be used to transport most types of bulk powder, pellets and granular products.

Venturi as a feeding device is a static device without any moving parts, which injects solids into high pressure gas/air for onward pneumatic conveying. Venturi based pneumatic conveying system is widely used for conveying various types of bulk solids. Minimum throat angle and smooth construction help powder particles to move through it.

The current paper shares various case studies from different applications using the pneumatic conveying system transport. These details helpful for the designers, system engineers in evaluation the feed characteristics and its importance while designing the system and at same, gives awareness to the system operators the essential parameters to agree which are needed for desired output.

Keywords: *Pneumatic conveying system, Eductor, Venturi, Free Flow.*

PREFACE AND DETAILS
While the positive pressure based conveying systems, the air leakage arising from the adverse pressure gradient can interfere with the flow of the material into the pipeline, this basic problem with feeding positive pressure systems, can be improved, to a certain extent, by using venturi feeders. These work on the principle of reducing the pipeline cross-sectional area in the region where the material is fed from the supply hopper, as shown schematically. It will be seen that there are no moving parts with this type of feeding device, which has certain advantages regarding wear problems and frequent adjustments or rotary parts. There are, however, no inherent means of flow control either, and so this has to be provided additionally while considering in total system engineering.

A consequence of the reduction in flow area, is an increase in the entraining air velocity and a corresponding decrease in pressure in this region. With a correctly designed venturi the static pressure at the throat should be just a fraction below that in the supply hopper. This then aids the material to flow more readily under gravity into the pipeline, because under these conditions there is no leakage of air in opposition to the material feed.

To keep the throat at atmospheric pressure, and also of a practical size that will allow the passage of material, and for it to be readily conveyed, a relatively low limit must be imposed on the air supply pressure. These feeders, therefore, are usually incorporated into systems that are required to convey free-flowing materials at low flow rates over short distances. Because only low pressures can be used with the basic type of venturi feeder shown.

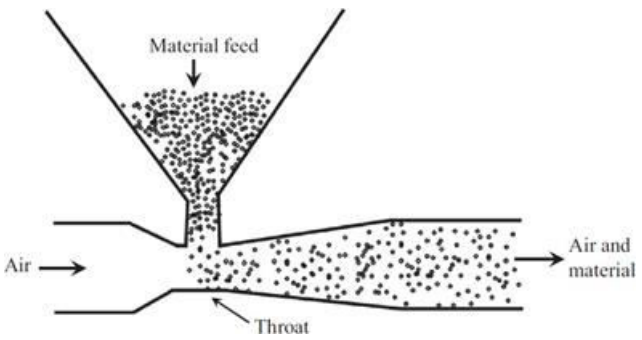

Fig: Setup of Venturi feeder system

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Particular advantages of using venturi feeders for positive pressure conveying lines are that minimum. headroom is required, there are no moving parts and, if the device is correctly designed, there need be no air leakage from the feeder, as there is with many other types of devices used for feeding positive pressure conveying systems. A venturi basically consists of a controlled reduction in pipeline cross section in the region where the material is fed from the supply hopper.

The prominence of continuity equation in venturi characteristics is quite high. If steady flow exists in a channel and the principle of conservation of mass is applied to the system, there exists a continuity of flow, defined as: "The mean velocities at all cross sections having equal areas are then equal, and if the areas are not equal, the velocities are inversely proportional to the areas of the respective cross sections." Thus, if the flow is constant in a reach of channel the product of the area and velocity will be the same for any two cross sections within that reach. This is expressed in the Continuity Equation

$Q = A1 \times V1 = A2 \times V2$

Q = the volumetric flow rate

A = the cross-sectional area of flow V = the mean velocity

A consequence of this reduction in flow area is an increase in the entraining air velocity and a corresponding decrease in pressure in this region. With a correctly designed venturi, the pressure at the throat should be just a little lower, or about the same, as that in the supply hopper which, for the majority of applications, is atmospheric pressure. This then encourages the material to flow readily under gravity into the pipeline, and under these conditions, there will be no leakage of air from the feeder in opposition to the material feed.

For low-pressure applications, to keep the throat at atmospheric pressure, and of a practical size such that it will allow the passage of material to be conveyed, a relatively low limit has to be imposed on the air supply pressure. These feeders, therefore, are usually incorporated into systems that are required to convey free-flowing materials at low flow rates over relatively short distances. Because only low pressures can be used with the basic type of venturi operating at atmospheric pressure, a positive- displacement blower or a standard industrial fan is all that is needed to provide the air. To fully understand the limitations of this type of feeder, the thermodynamic relationships are presented in the following equations. The two parameters of interest in venturi feeders are the velocity at the throat and the area, or diameter, of the throat.

There two different type of venturi designs been examined here, in Image 1, the circular nozzle is used for arriving different velocities and pressures adjustment, in other design, Image 2, there is a adjustable plate on air side, to arrive different throat area and hence velocity & pressures. These two are proven and given desired results for the intended applications.

The material been fed into the system via closed clearance Rotary Air Locks. The free flowing material been gravity discharged into the venturi throat area at a constant speed. The motive air volume been delivered under constant speed motor for conveying the air & material mixture to the next process. The parameters were recorded and are detailed below.

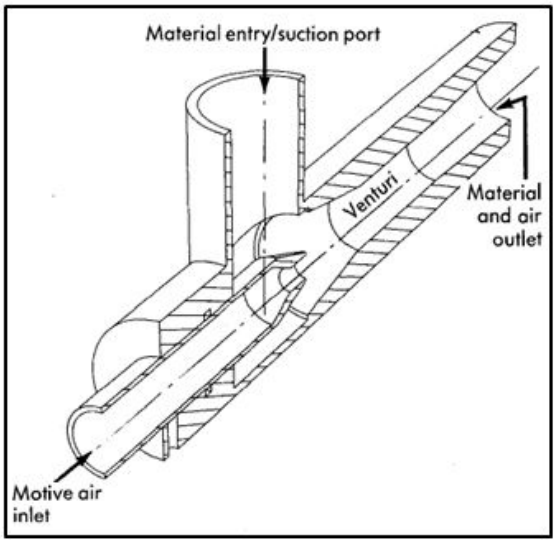

Image 1: Nozzle adjustable type Venturi

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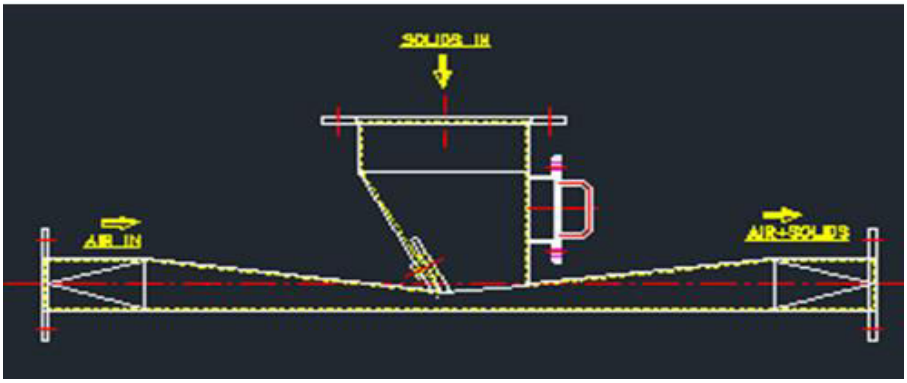

Image 2: Throat adjustable Venturi

Pic1: Actual installed nozzle type Venturi.

Pic2: Actual installed adjustable blade type venturi

Site collected data:

Parameters	**Site 1**	**Site 2**
Application	Sander Dust	Hydrated Lime
Type of Venturi Eductor	Nozzle type Design	Adjustable Blade type Venturi
Motive Air Pressure	7000 mmwc (g)	5000 mmwc (g)
Motive Air Volume	945 m3/s	500 m3/s
Conveying Capacity	1700 kg/h	800 kg/h
dP	9740 mmwc	2800 mmwc
Throat Dia	40/35/30 mm	25/20/15 mm

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The selection of venturi is sensitive considering the material characteristics. Also, the nozzle type venturi adjustment is a relatively complex activity in order to attain the desired velocity where the pressure is less or at same as the upstream of RAL. On the other side, the adjustable plate type venturi is operable relatively easier to obtain the velocity. The distinguished comparison is in the air & material mixture at throat and moving forward toward diverging outlet. In nozzle type venturi, the material mixture happens surrounded the nozzle holder and get mixed with air emanated at low pressure, in adjustable blade type venturi, this mixture happens at the bottom plate and air flow cut into the material drop and pass toward divergent as a mixture.

From the data referred and experienced from the installations, these two types of venturis are performing as per required however, the costs involved in developing and installing, along with the operable flexibility of the adjustments if any required due to variable materials feeding into system to take into considerations. The selection of type of venturi is equally sensitive though the free flowing material characteristics are not same for all materials.

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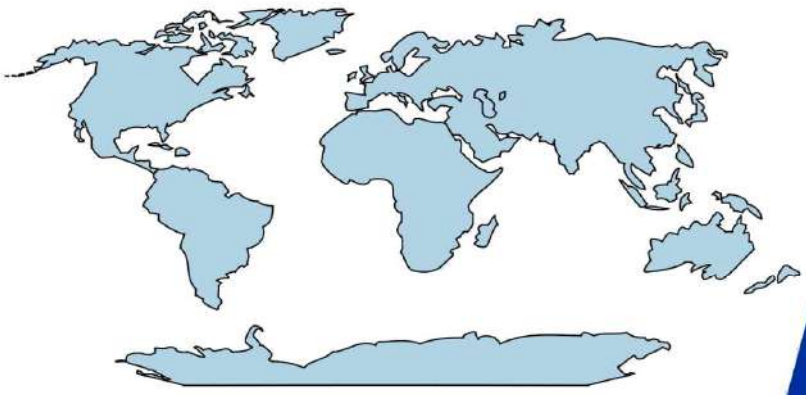

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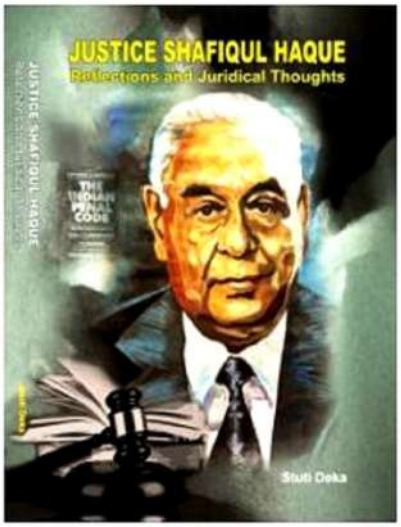

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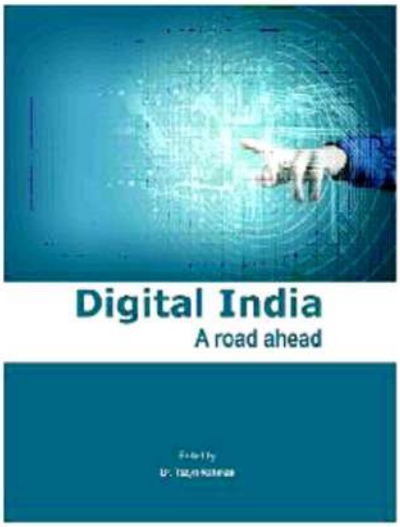

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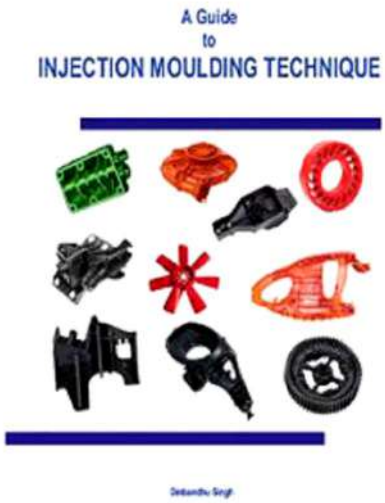

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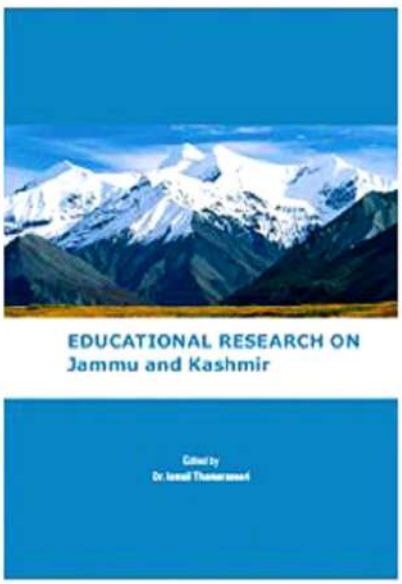

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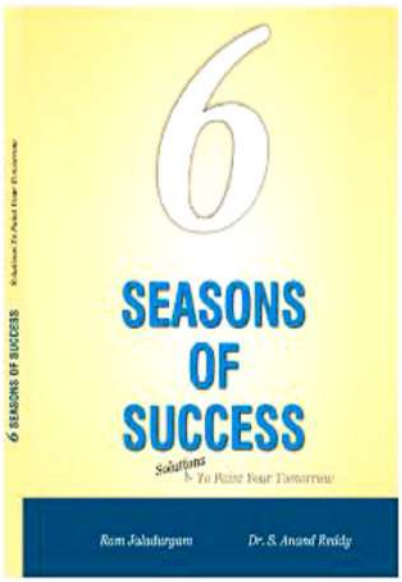

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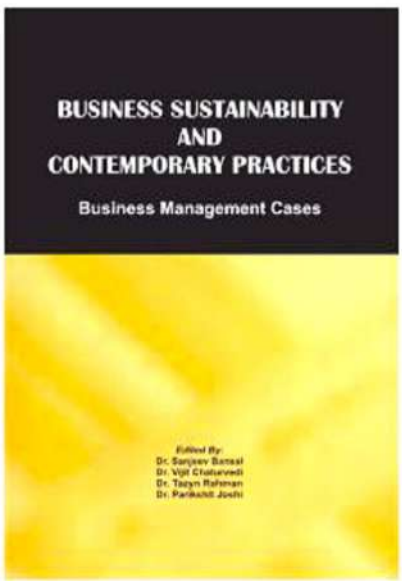

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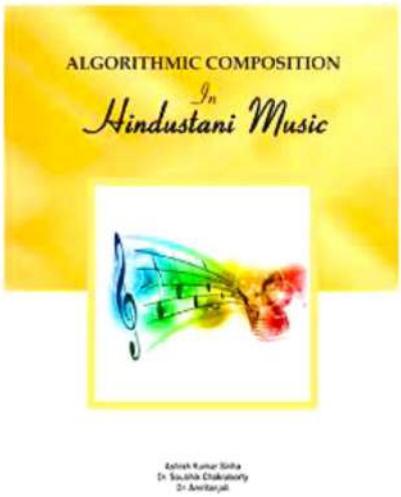

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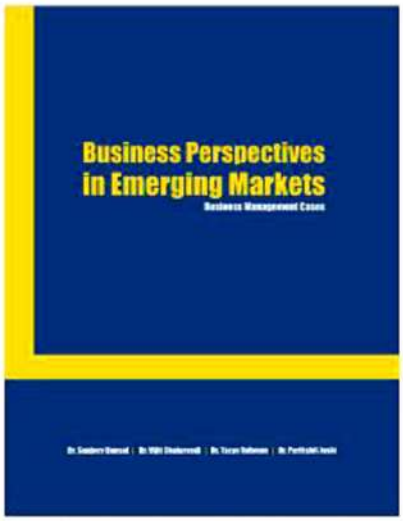

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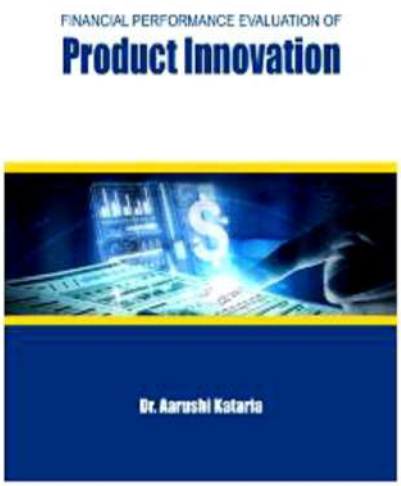

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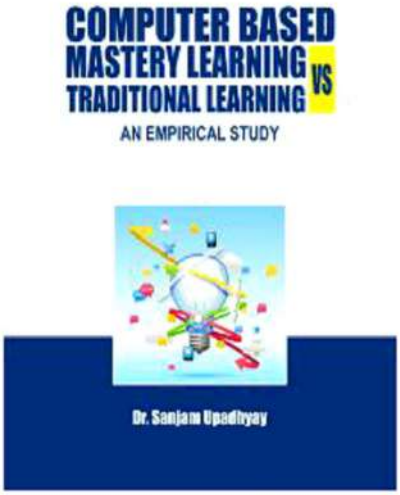

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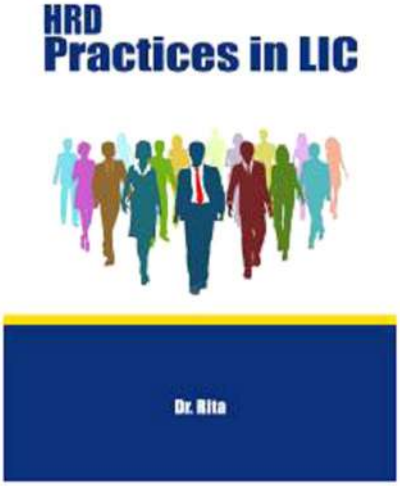

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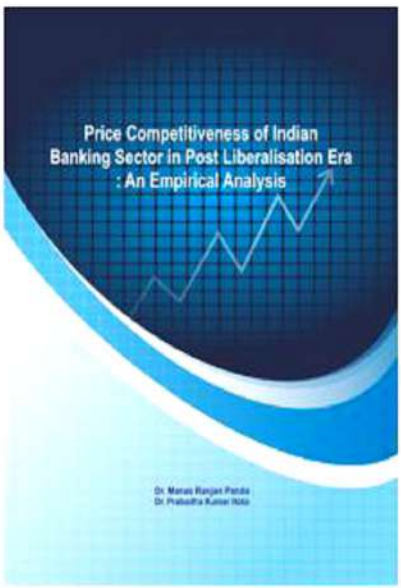

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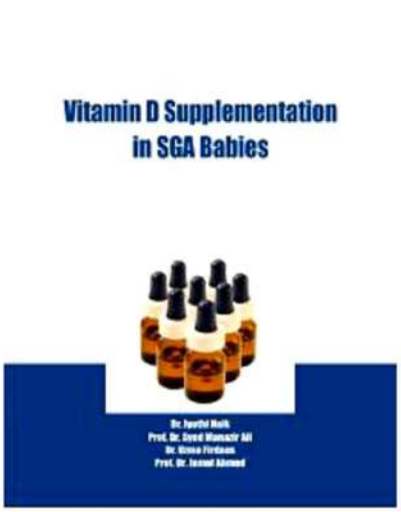

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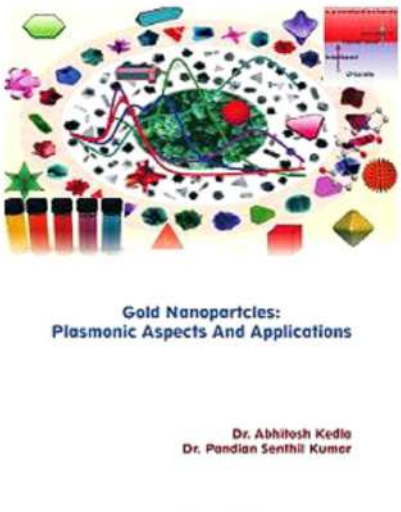

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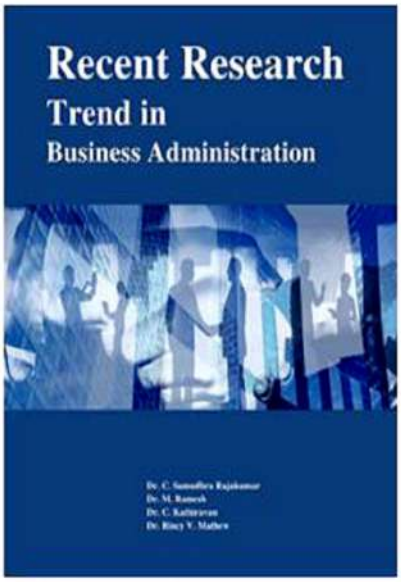

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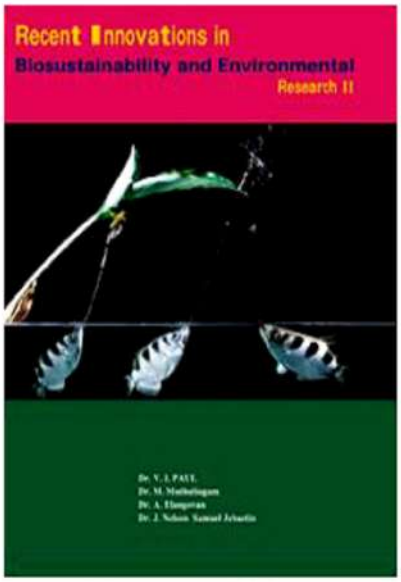

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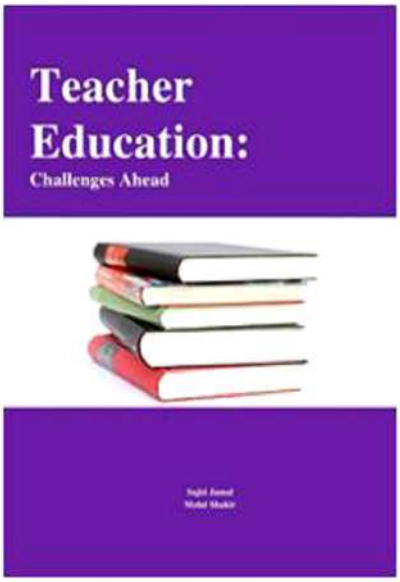

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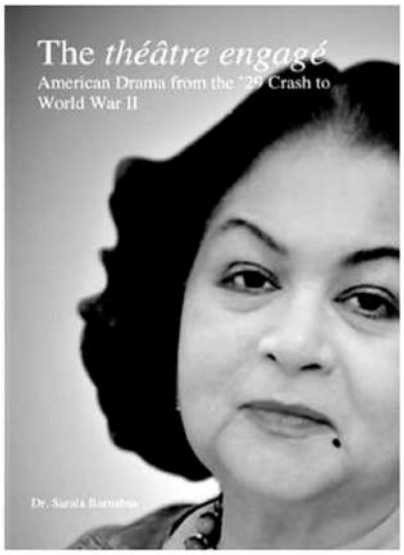

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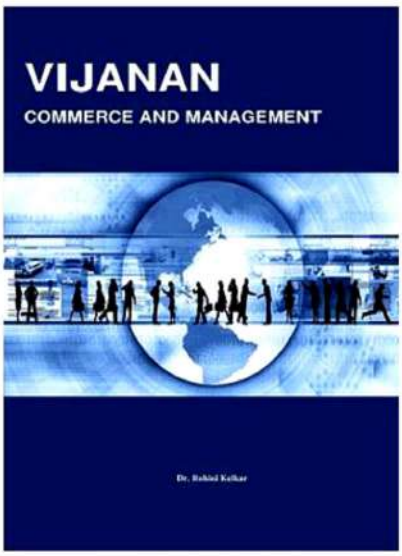

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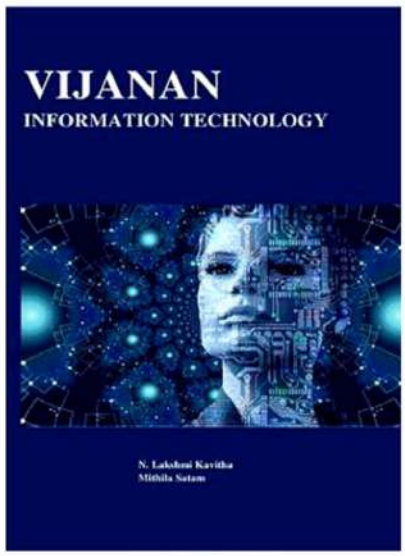

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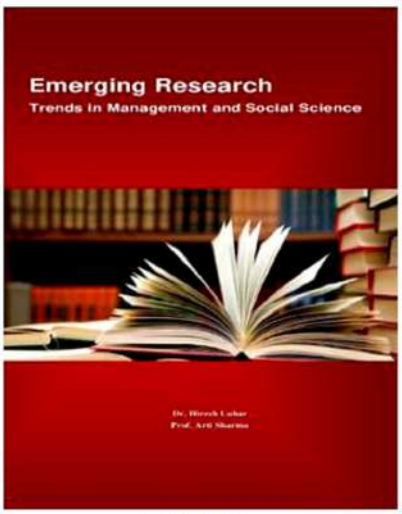

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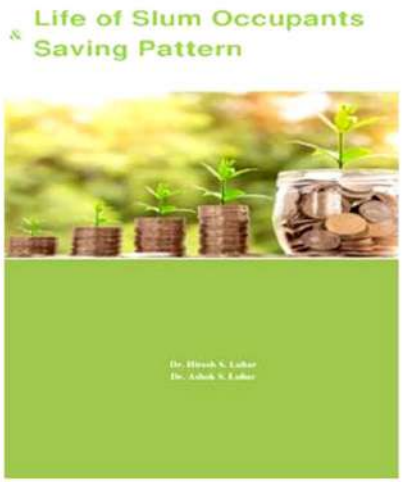

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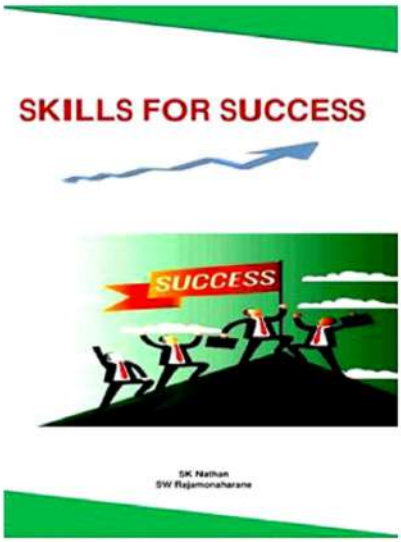

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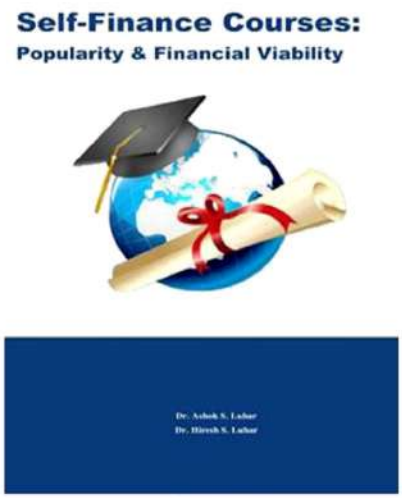

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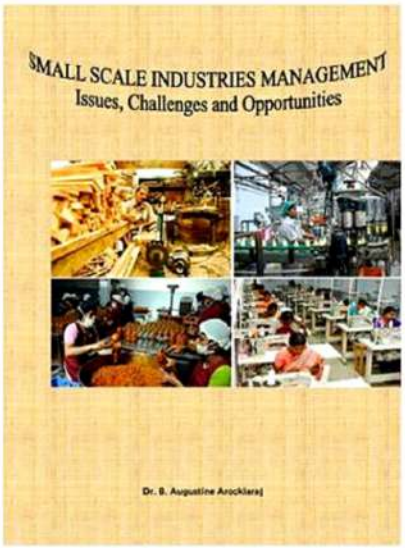

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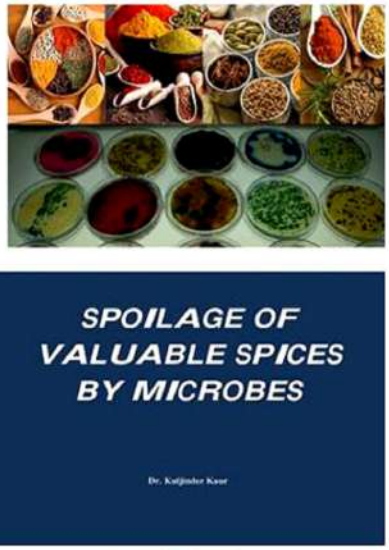

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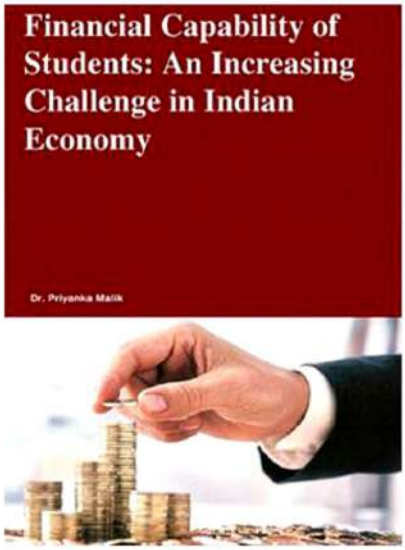

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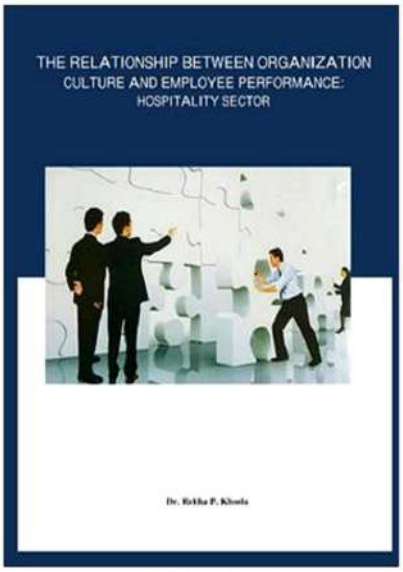

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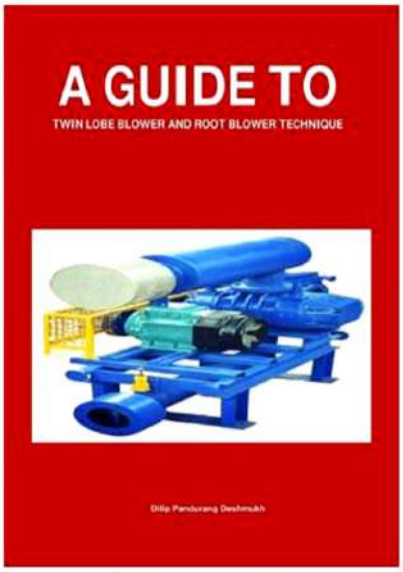

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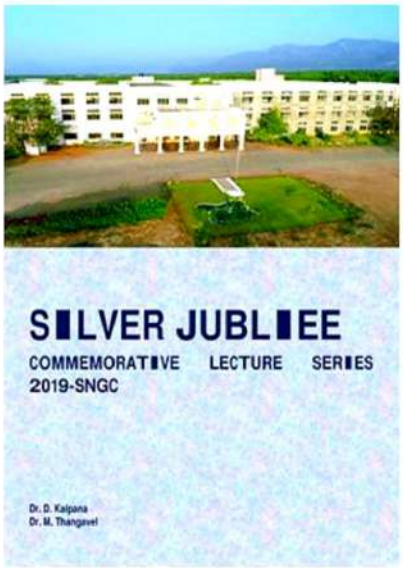

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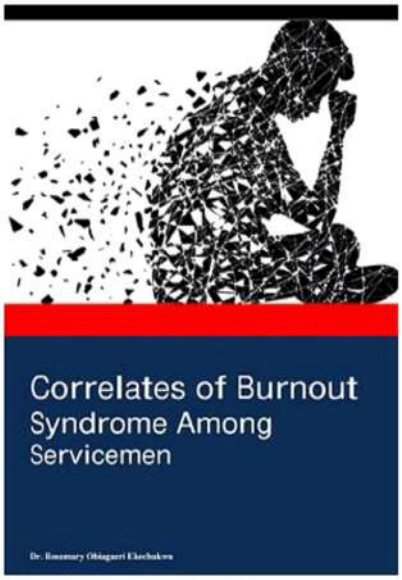

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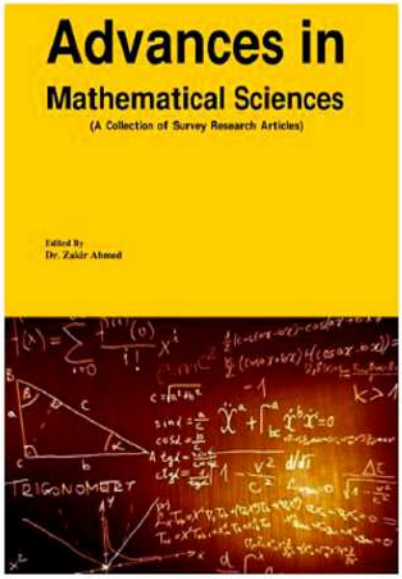

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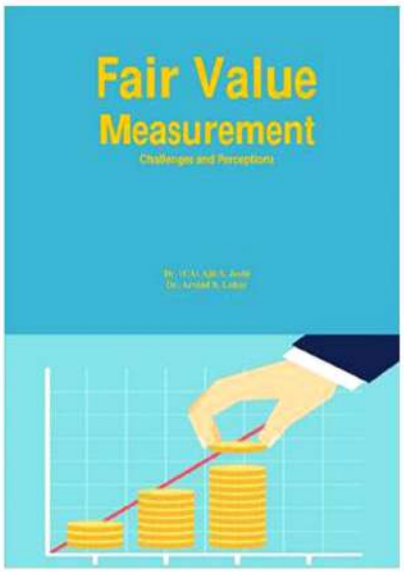

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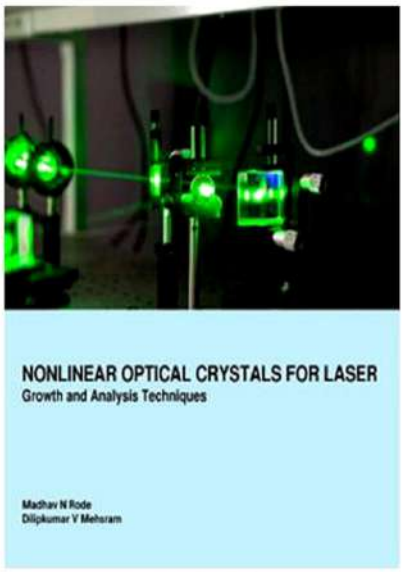

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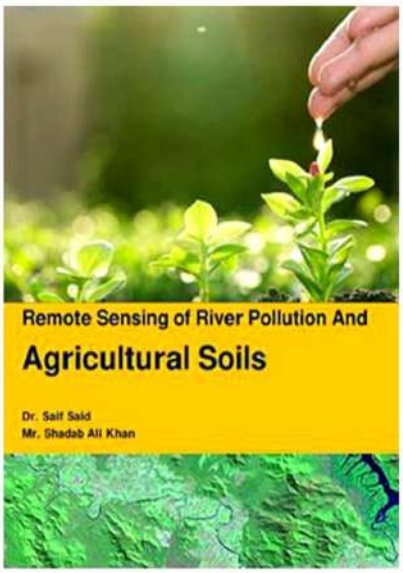

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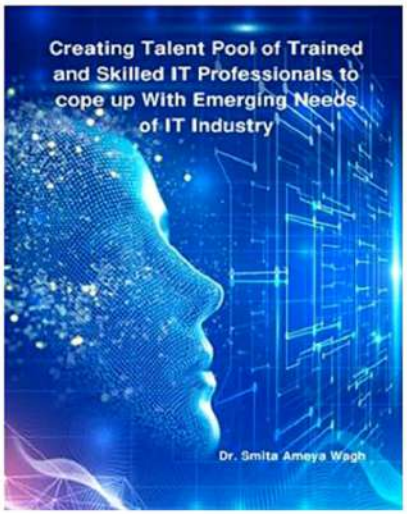

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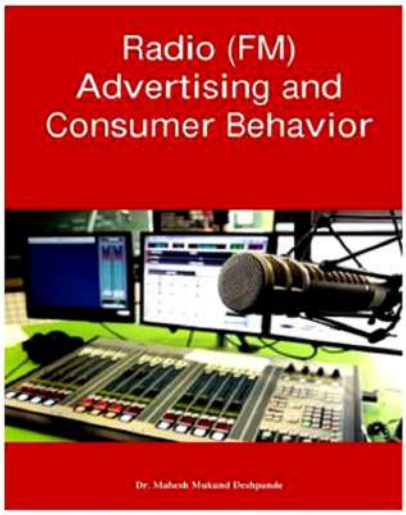

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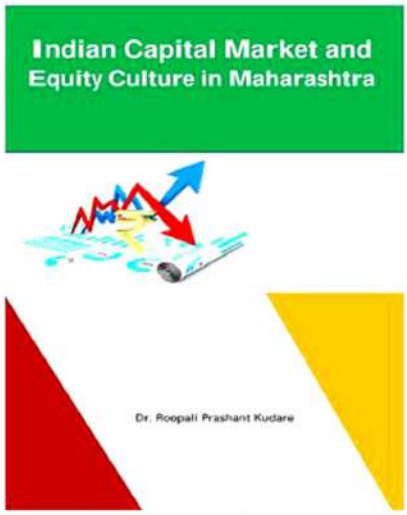

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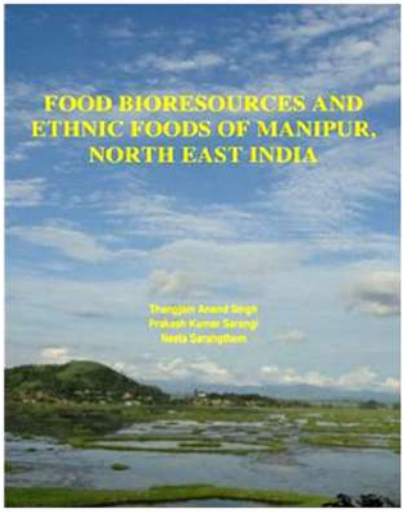

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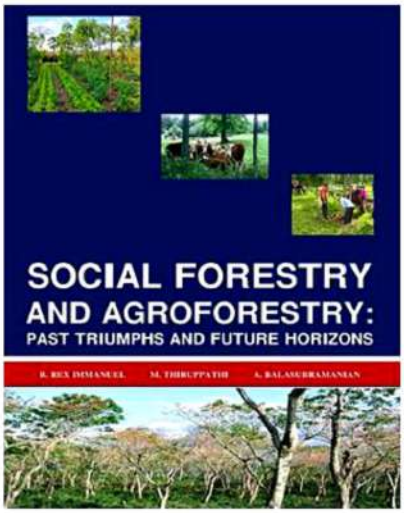

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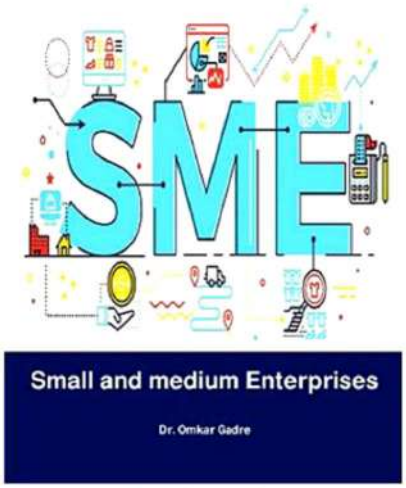

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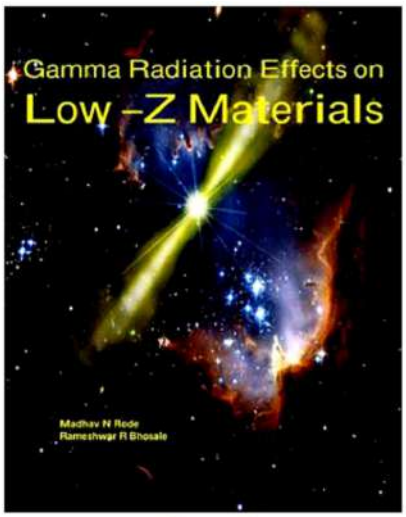

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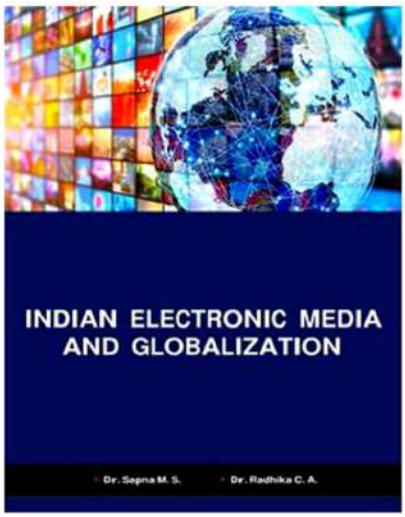

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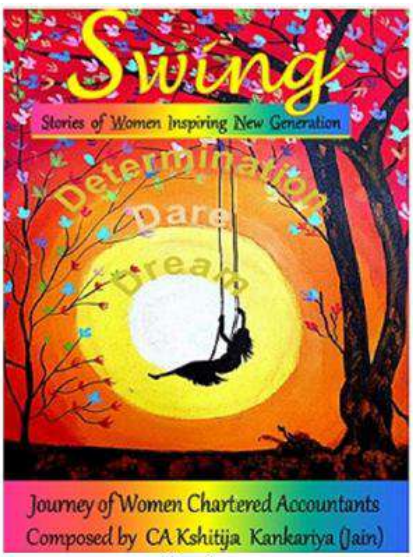

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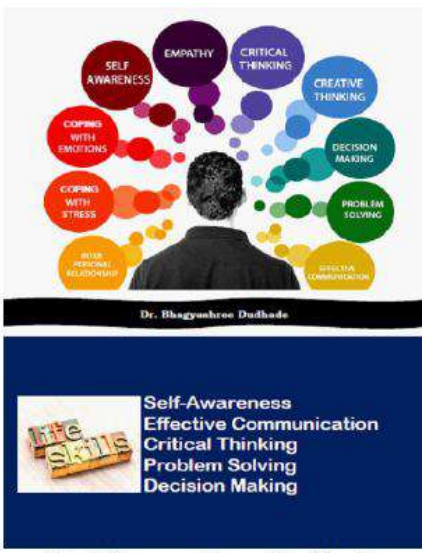

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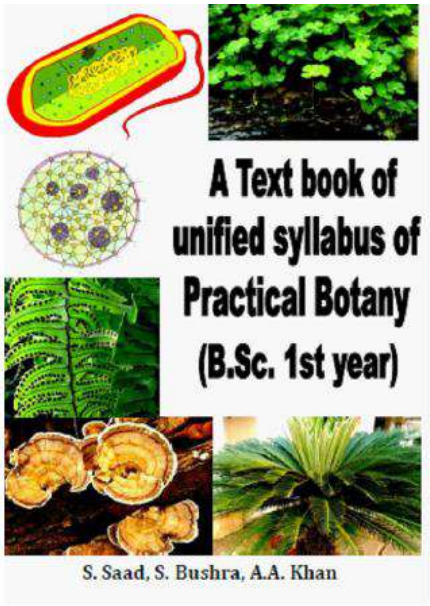

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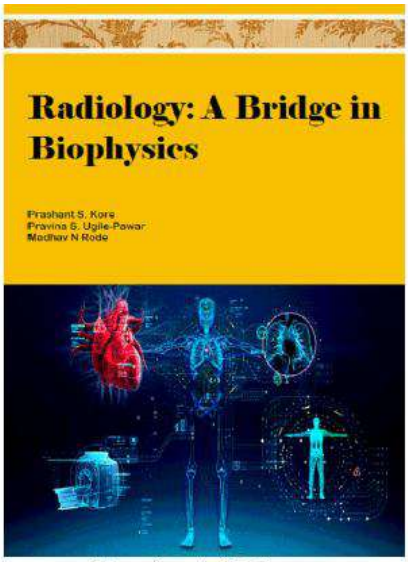

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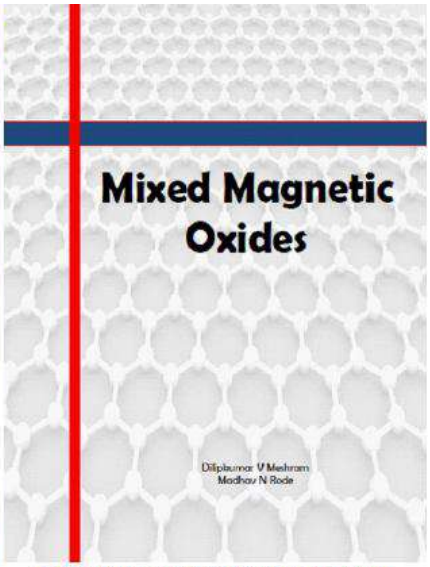

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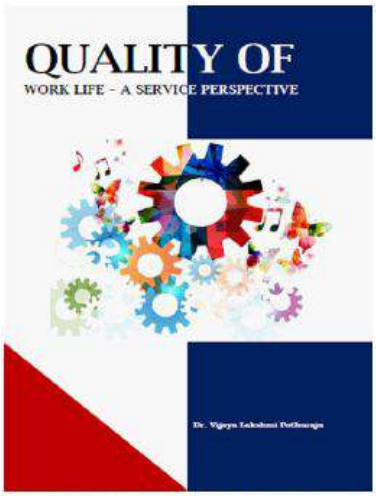

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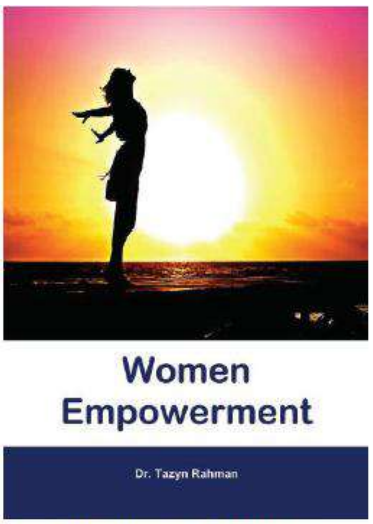

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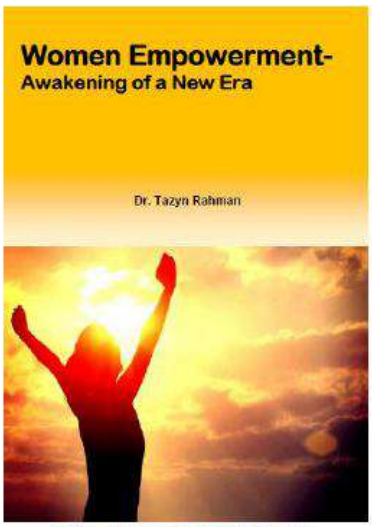

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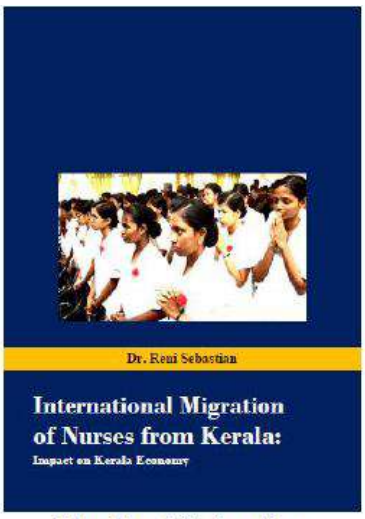

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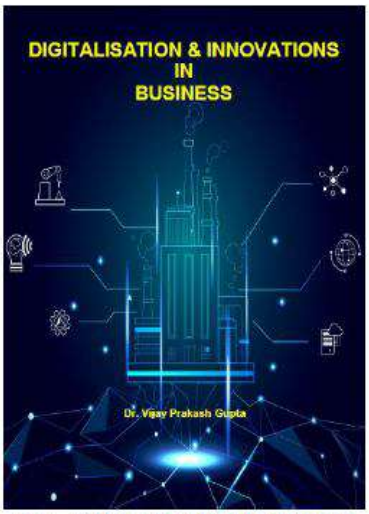

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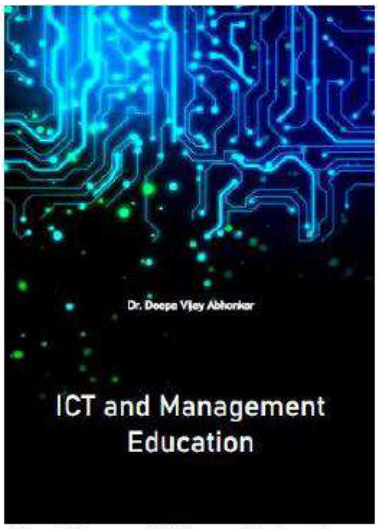

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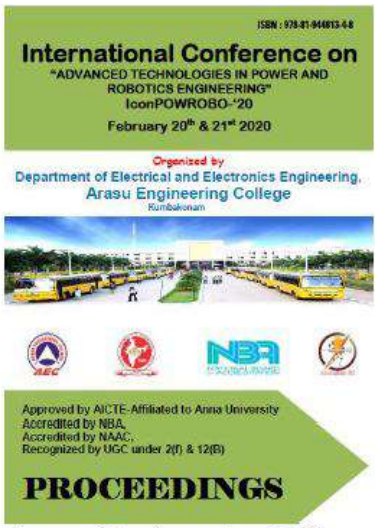

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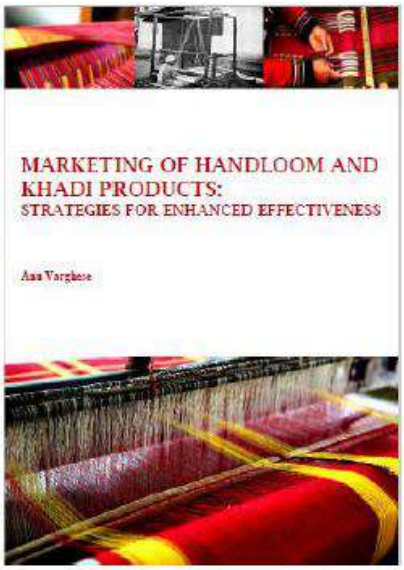

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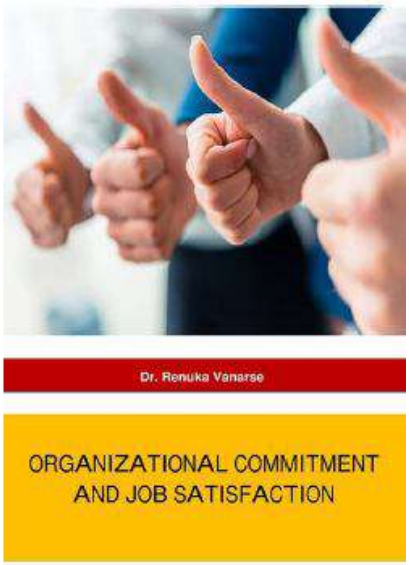

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