AI IN INDUSTRY 5.0:REVOLUTIONIZING BUSINESS AND TECHNOLOGY
(Multidisciplinary)

Chief Editor :

Dr.R SATHYADEVI

Editors :

Mr.M.RAMESH
Dr.V.PRINCY METILDA
Dr.JISSY C

DEPARTMENT OF COMMERCE

SREE NARAYANA GURU COLLEGE
An Autonomous College, Affiliated to Bharathiar University
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K.G. Chavadi, Coimbatore - 641105

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FOREWARD

Dr.D.KALPANA
Principal
Sree Narayana Guru College
Coimbatore, Tamilnadu, India.

The advent of Industry 5.0 marks a significant evolution in the industrial landscape, where artificial intelligence (AI) takes center stage in revolutionizing business and technology. Unlike previous industrial revolutions that primarily focused on automation and digitization, Industry 5.0 emphasizes the harmonious collaboration between humans and intelligent machines. This new era brings forth unprecedented opportunities to enhance productivity, foster innovation, and create sustainable solutions that align with human values and societal needs. It is an exciting time to explore how AI is reshaping industries, driving smarter decision-making, and transforming the future of work.

This conference brings together a collection of insightful articles and research papers, thoughtfully curated and published by Royal Book Publishing under an ISBN book publication. These contributions reflect cutting-edge developments, diverse perspectives, and practical applications of AI within the Industry 5.0 framework. The publication stands as a testament to the rigorous scholarship and innovative thinking that underpin this transformative movement, offering valuable knowledge for academics, industry professionals, and policymakers alike.

We anticipate that this conference will foster meaningful dialogue, encourage collaborative research, and inspire actionable strategies that leverage AI for business excellence and technological advancement. The exchange of ideas here will help bridge gaps between theory and practice, ultimately contributing to the creation of resilient, human-centric, and sustainable industrial ecosystems.

I would like to extend my sincere appreciation to the heads of departments, faculty members, and all staff whose dedication and hard work have been instrumental in organizing this event. Your commitment to academic excellence and innovation is truly commendable. I wish everyone involved continued success in their future endeavors and look forward to witnessing the impactful outcomes that emerge from this conference.

Dr.D.KALPANA

MESSAGE FROM CHIEF EDITOR

Dr. R. SATHYADEVI
Professor & Head,
Department of Commerce
Sree Narayana Guru College
Coimbatore, Tamilnadu, India.

I would like to extend my heartfelt gratitude to all the contributors, researchers, and experts who have shared their valuable insights and innovative work for this national conference on AI in Industry 5.0 and Technology. Your dedication and commitment to advancing knowledge in this rapidly evolving fields have made this gathering both meaningful and inspiring. The diversity and depth of the articles presented truly reflect the vibrancy of research and development in AI and its integration within modern industry.

Commerce and industry have undergone profound transformations over the decades—from the mechanization of Industry 1.0 to the digitization and automation in Industry 4.0. Today, Industry5.0 marks a new chapter where human creativity and advanced AI-driven technology converge. This synergy is reshaping business models, supply chains, and customer engagement strategies, fostering a more personalized, sustainable, and intelligent approach to commerce and production. However, the path forward is not without challenges. Businesses face complex realities including ethical concerns around AI deployment, the need for upskilling the workforce, cybersecurity risks, and the pressure to balance automation with human-centric values. Addressing these issues requires collaboration between technologists, policymakers, and industry leaders to ensure AI contributes to inclusive and responsible growth.

In closing, I sincerely thank all the contributors, organizers, and staff who have worked tirelessly to make this conference a success. Together, we stand at the forefront of a technological revolution that promises to redefine industries and societies alike. As we explore the dynamic interplay of AI and Industry 5.0, may this conference inspire innovative solutions and meaningful dialogue toward a smarter, more resilient future.

Dr. R. SATHYADEVI

MESSAGE FROM EDITOR

Mr. M. RAMESH
Assistant Professor of Economics
Sree Narayana Guru College
Coimbatore, Tamilnadu, India.

It gives me profound pleasure and humility to acknowledge the great effort of the Department of Commerce, Sree Narayana Guru College, to conduct the One Day National Conference on "AI in Industry 5.0: Revolutionizing Business and Technology". This publication marks a significant milestone in the evolving intersection of artificial intelligence and the next era of industrial transformation—Industry 5.0.

While Industry 4.0 emphasized automation, efficiency, and interconnected systems, Industry 5.0 reintroduces the human-centric perspective, focusing on collaboration between intelligent machines and human creativity, ethics, and sustainability. In this context, AI is not just a tool for optimization—it becomes a partner in innovation, personalization, and responsible progress.

The research and discussions captured in the present volume of publication span a broad spectrum of applications: from AI-driven human-machine interaction and ethical design, to smart manufacturing, resilient supply chains, and sustainable industrial practices and also in the field of marketing. The contributions reflect the growing recognition that technological advancement must be aligned with societal needs and human values.

As an editor, I proud to feature work from a diverse community of academicians and researchers and also some industrialists who are shaping the future of the intelligent industry. Their efforts are not only expanding what is technically possible but also redefining how technology can serve people and the planet. I extend my sincere gratitude to all authors, reviewers, and contributors who made this publication possible

Mr. M. RAMESH

MESSAGE FROM EDITOR

Dr. V. PRINCY METILDA
Assistant Professor
Department of Commerce
Sree Narayana Guru College
Coimbatore, Tamilnadu, India.

Welcome to AI in Industry 5.0: Revolutionizing Business and Technology; A groundbreaking exploration into the convergence of Artificial Intelligence with the principles of human-centricity and sustainability that define Industry 5.0. This book delves into the profound impact AI is having, and will continue to have, on every facet of business and technology. From fostering deeper human-machine collaboration to enabling hyper-personalized experiences and driving a more circular economy, the content within these pages illuminates the transformative potential of AI to revolutionize industries, unlock new efficiencies, and ultimately enhance human capabilities in ways previously unimagined. Our aim has been to provide a comprehensive, insightful, and forward-looking guide for anyone navigating this exciting new industrial era.

On behalf of the entire editorial team, we extend our profound gratitude to our Chief Editor. Their exceptional vision, unwavering dedication, and meticulous guidance were the bedrock upon which this entire project was built. It was their incisive understanding of the symbiotic relationship between AI and Industry 5.0 that truly shaped the scope and depth of this ISBN book, ensuring its relevance and timeliness. The successful culmination of this significant endeavor is a direct testament to their leadership, tireless efforts, and commitment to excellence. We are immensely proud of what we have collectively achieved, and this success is, in large part, due to their remarkable contributions. Thank you for making this vision a reality.

Dr. V. PRINCY METILDA

MESSAGE FROM EDITOR

Dr. JISSY C
Assistant Professor
Department of Commerce
Sree Narayana Guru College
Coimbatore, Tamilnadu, India.

I feel privileged to thank the Department of Commerce for selecting an incredibly relevant and timely theme for its National Conference. This initiative reflects the department's commitment to exploring the impact of emerging technologies on commerce, trade, and industry. The conference brought together scholars, researchers, and industrial professionals to share insights, promote collaboration, and foster innovation. The articles presented in this volume highlight the transformative role of Artificial Intelligence in shaping modern business practices. This publication serves as a valuable compilation of knowledge and is intended to encourage ongoing academic and professional engagement.

Industry 5.0 emphasizes collaboration between humans and intelligent systems, aiming to create smarter, sustainable, and human-centric innovations. This conference serves as a platform for academicians, researchers, and industrial professionals to discuss emerging trends, challenges, and opportunities at the intersection of AI, Commerce, and technology. With rapid advancements in automation, data analytics, and machine learning, the conference sheds light on how AI is redefining business operations, decision-making, and the future of global economic landscapes.

I am pleased to note that the Department of Commerce is taking the commendable initiative to publish a special edition ISBN book featuring selected articles from the National Conference titled *"AI in Industry 5.0: Revolutionizing Business and Technology"* (Multidisciplinary).I am extending my sincere gratitude to Dr. R. Sathyadevi, Professor and Head of the Department of Commerce, and congratulating her with sincere happiness and expressing my sincere appreciation to the faculty of the department, fellow faculty members across the SNGC campus, and the students for their dedicated efforts. It is a privilege to be involved in this valuable venture as the editor and May the department continue to achieve success in all its future initiatives.

Dr. JISSY C

ACKNOWLEDGEMENT

Chief Editor
Dr. R. SATHYADEVI
Professor and Head
Department of Commerce

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Mr. M. Ramesh
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SOCIAL MEDIA INTEGRATION IN DIGITAL MARKETING FOR EDUCATIONAL INSTITUTIONS

Dr.D.Kalpana, *Principal, Sree Narayana Guru College ,K.G Chavadi, Coimbatore. Tamil Nadu, India.*

Abstract

The advent of social media has revolutionized various sectors, including education. This article examines the role of social media in digital marketing within the educational sector, highlighting how institutions can leverage popular platforms to engage with prospective students, enhance brand visibility, and foster a sense of community. It explores the innovative strategies used by educational organizations to effectively promote their offerings and facilitate student interaction. Additionally, the article discusses the benefits and potential challenges of utilizing social media in educational marketing. Finally, it provides actionable recommendations for educational institutions aiming to optimize their digital marketing approaches through social media.

Key Words: Social Media, Digital Marketing ,Educational Institution.

The Role of Social Media in Digital Marketing in the Educational Sector

Introduction

In today's increasingly digital world, social media has emerged as a prominent tool for connecting people, sharing information, and promoting content. With over 4.7 billion active users worldwide, social media's influence permeates all sectors, including education. Educational institutions utilize social media platforms not only to showcase their offerings but also to engage with stakeholders, including prospective students, current students, alumni, and parents. This article delves into the transformative role of social media in digital marketing within the educational sector, presenting key strategies, benefits, and challenges faced by institutions.

The Rise of Social Media in Education

The rise of social media is closely linked to the evolution of digital communication. Platforms such as Facebook, Twitter, Instagram, YouTube, and LinkedIn have become essential channels for disseminating information and engaging audiences. Educational institutions have recognized the potential of these platforms to reach a broader audience, enhance visibility, and attract prospective students. By adopting social media as a core component of their marketing strategies, educational organizations can create dynamic online environments conducive to dialogue and interaction.

Strategies for Effective Use of Social Media in Educational Marketing

1.Content Creation and Sharing: Educational institutions are increasingly producing engaging content tailored to their audience. This includes informative articles, videos, webinars, infographics, and success stories. Effective content creation illuminates the unique value proposition of the institution, capturing the attention of prospective students.

2. Targeted Advertising: Social media platforms offer sophisticated targeting options that allow educational institutions to reach specific demographics, including age, location, and interests. By utilizing targeted advertisements, schools and universities can ensure their messages resonate with the intended audience, thereby increasing enrollment rates.

3.Building Community and Engagement: Social media fosters a sense of community among students, faculty, and alumni. Institutions can utilize platforms to create groups and pages that facilitate discussions, celebrate achievements, and encourage networking. This sense of belonging can greatly influence prospective students' decision-making processes.

4.Utilizing Influencer Marketing: Engaging influencers, such as alumni or educational experts, to promote the institution through their social media platforms can elevate credibility and reach. Influencers can share authentic stories and experiences that resonate with potential students.

5.Real-time Interaction and Feedback: Social media enables real-time communication, allowing institutions to interact with prospective students instantly. Whether it's answering queries or tackling concerns, this immediate feedback enhances the institution's reputation and fosters trust.

Benefits of Social Media in Educational Marketing

1.Enhanced Visibility: A well-structured social media strategy can improve brand awareness and visibility among potential students, helping institutions stand out in a competitive landscape.

2.Cost-Effective Marketing: Compared to traditional marketing methods, social media marketing often requires lower financial investment, providing a cost-effective solution for reaching a large audience.

3.Data-Driven Insights: Social media platforms provide analytics tools that allow institutions to track engagement and measure the effectiveness of their campaigns. These insights enable data-driven decision-making, helping institutions refine their strategies.

4.Building Relationships: Social media facilitates ongoing communication and fosters long-term relationships between institutions and their audience. These connections encourage alumni engagement and support, enhancing the institution's reputation.

Challenges of Using Social Media in Educational Marketing

1.Information Overload: The sheer volume of content available on social media can lead to information overload, making it challenging for institutions to capture and maintain user attention.

2.Negative Feedback and Reputation Management: Social media can amplify negative feedback if not managed effectively. Institutions must be prepared to address grievances constructively to uphold their reputation.

3.Privacy Concerns: The use of social media raises questions about privacy and data protection, especially concerning student information. Institutions must navigate these concerns carefully to maintain trust and compliance with regulations.

4.Keeping Content Fresh and Relevant: Continuously producing high-quality, engaging content can be resource-intensive. Institutions need a dedicated strategy to ensure a steady flow of fresh content to engage their audience.

Recommendations for Educational Institutions

1.Develop a Comprehensive Social Media Strategy: Institutions should create a detailed plan that outlines their objectives, target audience, key performance indicators, and content calendar.

2.Engage with Current Trends: Staying updated with the latest social media trends and tools can enhance engagement and relevance to contemporary audiences.

3.Train Staff: Providing training for staff responsible for managing social media accounts is crucial in ensuring effective communication and branding.

4.Monitor Performance Regularly: Regularly reviewing analytics for social media campaigns allows institutions to adjust strategies based on performance, ensuring alignment with their goals.

Conclusion

Social media has undeniably transformed digital marketing in the educational sector. By leveraging its vast reach and engagement potential, educational institutions can effectively connect with current and prospective students, enhancing their marketing efforts. While challenges do exist, a well-executed social media strategy can yield significant benefits in brand visibility, community building, and student engagement. As technology and social media continue to evolve, educational institutions must adapt and innovate to remain competitive.

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ZEPTO AND INDUSTRY 5.0: TRANSFORMING QUICK COMMERCE THROUGH AI INNOVATION

Dr.D.Kalpana, *Principal, Sree Narayana Guru College, K.G Chavadi, Coimbatore. Tamil Nadu, India.*

Dr.R.Sathyadevi *,Professor & Head ,Sree Narayana Guru College, K.G.Chavadi, Coimbatore. Tamil Nadu, India.*

Abstract

Zepto's AI-driven transformation marks a pivotal shift in quick commerce as it embraces the principles of Industry 5.0. With over 10 million app downloads and an average delivery time of 10 minutes, Zepto leverages artificial intelligence to optimize inventory, forecast demand, and automate dispatch systems across 100+ dark stores in major Indian cities. Industry 5.0 emphasizes human-AI collaboration, and Zepto integrates this by enhancing customer experience through personalized recommendations and real-time tracking. Its AI algorithms reportedly improve order accuracy by 98% and reduce wastage by 30%, contributing to sustainable operations. Zepto's monthly order volume has surpassed 8 million, supported by machine learning models that adjust logistics in milliseconds. This article explores how Zepto's innovative use of AI exemplifies the core of Industry 5.0—blending intelligent automation with human-centric service—to redefine the landscape of ultra-fast delivery. The study highlights the strategic and technological advancements positioning Zepto as a leader in next-gen commerce.

Key Words: Zepto, Artificial Intelligence, Industry 5.0

Introduction

In an era where convenience and speed dictate consumer behavior, quick commerce (q-commerce) has emerged as a revolutionary model in the retail industry. At the forefront of this transformation is Zepto, an Indian startup that has rapidly gained traction by delivering groceries and essentials in as little as 10 minutes. This remarkable efficiency is not merely a result of logistics innovation but is powered by the strategic integration of Artificial Intelligence (AI) aligned with the principles of Industry 5.0—a paradigm that emphasizes the collaboration between advanced technologies and human-centric values.

Zepto operates through a network of 100+ dark stores in urban areas, each optimized by AI systems that predict demand patterns, automate inventory restocking, and dynamically plan delivery routes. With over 10 million app downloads and 8 million+ monthly orders, Zepto exemplifies how AI can transform the q-commerce model from a logistical challenge into a seamless, intelligent experience.

Industry 5.0 focuses not only on automation and digitalization but also on sustainability, personalization, and the synergy between human insight and machine precision. Zepto's AI tools personalize product suggestions, enhance customer support interactions, and minimize wastage through accurate forecasting—reducing inventory losses by **30%**. These advancements not only improve customer satisfaction but also promote operational sustainability.

As competition in the q-commerce space intensifies, Zepto's AI-driven approach offers a blueprint for integrating cutting-edge technology with human-centric service. This paper delves

into how Zepto harnesses AI across its supply chain, customer interface, and decision-making processes to redefine quick commerce in alignment with Industry 5.0. The case of Zepto stands as a powerful example of how startups can scale rapidly and sustainably by placing intelligent systems at the heart of business strategy while preserving the essence of human-centric innovation.

Statement of Problem

The rapid growth of quick commerce has intensified the need for ultra-fast, accurate, and sustainable delivery systems. Companies like Zepto face increasing pressure to meet customer expectations for 10-minute deliveries while managing operational efficiency, inventory accuracy, and environmental sustainability. Traditional logistics models struggle to support this demand, leading to challenges such as delivery delays, stockouts, increased costs, and resource wastage. Despite leveraging AI technologies, aligning these innovations with human-centric values as emphasized in Industry 5.0 remains a complex task. This study addresses how Zepto navigates these challenges through AI integration, redefining quick commerce for the next industrial era.

Objectives of the Study

To study Zepto's AI use in logistics and supply chain efficiency.

To assess Zepto's Industry 5.0 alignment through automation and human-centric innovation.

Hypothesis

The integration of AI in Zepto's operations significantly enhances delivery speed, inventory accuracy, and customer satisfaction, aligning with Industry 5.0 principles.

Literature Review

According to **Singh et al. (2023)**, the growth of quick commerce relies heavily on logistics innovation and digital platforms. However, challenges like operational scalability, customer retention, and delivery accuracy persist, requiring smart technology adoption for sustainable growth.

A study by **Rao & Patel (2023)** emphasizes that AI-driven personalization, chatbots, and recommendation engines enhance user satisfaction in e-commerce. Companies integrating such tools report increased engagement, loyalty, and sales, aligning with Zepto's approach to improving the customer journey.

Research by **Kumar & Sharma (2022)** highlights how AI optimizes supply chain operations by enabling demand forecasting, inventory control, and route optimization. These tools enhance speed and reduce errors, making AI indispensable for quick commerce models like Zepto.

Verma (2021) describes Industry 5.0 as a shift from full automation to a balanced model that combines AI with human insight. This framework promotes personalized service, sustainability, and employee empowerment—key values for modern startups like Zepto.

Research Design

This study employs a mixed-methods research approach to examine how Zepto integrates Artificial Intelligence (AI) to redefine quick commerce within the context of Industry 5.0. Both quantitative and qualitative methods are used to gain a deeper understanding of the technological,

operational, and human-centric innovations adopted by the company. Primary data was collected through a structured questionnaire from a sample size of 65 respondents, including Zepto customers, delivery personnel, and mid-level managers. Purposive sampling ensured that participants had direct experience with Zepto's operations. The questionnaire explored areas such as AI in delivery, customer personalization, and service efficiency. Secondary data was obtained

Sl. No	Demographic Variable	Category	No. of Respondents	Percentage (%)
1	Gender	Male	36	55.38%
		Female	29	44.62%
2	Age Group	18–25 years	28	43.08%
		26–35 years	24	36.92%
		36–45 years	10	15.38%
		46 and above	3	4.62%
3	Occupation	Student	18	27.69%
		Working Professional	30	46.15%
		Self-employed/Business	9	13.85%
		Homemaker/Others	8	12.31%
4	Educational Qualification	Undergraduate	22	33.85%
		Postgraduate	27	41.54%
		Diploma/Technical	8	12.31%
		Others	8	12.31%
5	Frequency of Zepto Usage	Daily	16	24.62%
		Weekly	27	41.54%
		Monthly	15	23.08%
		Rarely	7	10.77%
6	Mode of Access	Mobile App	57	87.69%
		Website/Desktop	8	12.31%
7	City of Residence	Metro City (Mumbai, Delhi, Bengaluru)	42	64.62%
		Tier-2 City	18	27.69%
		Rural/Semi-Urban	5	7.69%

from academic articles, industry reports, company websites, and news sources to contextualize Zepto's AI adoption and business model. The data was analyzed using descriptive statistics for quantitative responses and thematic content analysis for qualitative insights.

Results and Discussions:

<div align="center">

Table 1-

Analysis of Variable of the Respondents under the Percentage Method

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The survey reveals that 55.38% of respondents are male, with 80% aged between 18–35, indicating strong usage among young adults. Around 46% are working professionals, and 75% possess higher education, highlighting Zepto's appeal to educated, time-conscious users. Over 65% use Zepto daily or weekly, demonstrating high engagement. A dominant 87.69% access the service via mobile apps, aligning with Zepto's digital strategy. Additionally, 64.62% of users reside in metro cities, emphasizing its urban market dominance.

Analysis of Variable of the Respondents under the T test

Sl. No	Variables Tested	Hypothesis	t-Value	p-Value	Significance
1	Gender vs Frequency of Zepto Usage	H_0: No difference in usage frequency between genders	2.14	0.036	Significant
2	Age Group (18–35 vs 36+) vs Perception of AI Accuracy	H_0: No difference in AI perception by age	1.91	0.060	Not Significant
3	Education (UG vs PG) vs App Usability	H_0: No difference in app usability rating by education	2.37	0.021	Significant
4	Occupation (Students vs Professionals) vs Delivery Satisfaction	H_0: No difference in delivery satisfaction	2.89	0.005	Significant
5	Location (Metro vs Non-Metro) vs Personalization Satisfaction	H_0: No difference in personalization satisfaction	1.55	0.125	Not Significant
6	Gender vs AI-based Customer Support Effectiveness	H_0: No gender difference in AI support perception	2.02	0.047	Significant
7	Mobile App vs Website Users vs Overall Experience	H_0: No difference in experience by access mode	3.45	0.001	Highly Significant

The t-test analysis reveals that gender significantly influences Zepto usage, with males using the platform more frequently (p = 0.036). Age does not impact AI accuracy perception (p = 0.060), while education level affects app usability, with postgraduates giving higher ratings (p = 0.021). Professionals show greater delivery satisfaction than students (p = 0.005). Personalization satisfaction is similar across locations (p = 0.125). Males rate AI-based support slightly higher (p = 0.047), and mobile app users report a superior experience (p = 0.001).

Conclusion

Zepto's AI-driven approach exemplifies how quick commerce is evolving in alignment with Industry 5.0, blending advanced automation with human-centric values. The integration of artificial intelligence in logistics, delivery tracking, inventory management, and personalized customer service has significantly enhanced user experience and operational efficiency. Findings from the study reveal that young, educated, urban users form the core customer base, with a strong preference for mobile app-based interactions. T-test analysis highlights significant differences in user perceptions based on demographics, especially in usability and satisfaction levels. Zepto's model demonstrates that AI, when strategically implemented, not only accelerates service but also builds deeper customer relationships. As quick commerce continues to expand, Zepto stands as a pioneering example of innovation driven by Industry 5.0 principles.

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A COMPREHENSIVE STUDY ON CONSUMER PERCEPTION TOWARDS ONLINE SHOPPING

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ABSTRACT

Online shopping has become a transformative force in the global retail sector, significantly altering consumer buying behavior and expectations. With rapid advancements in internet technology, digital payment systems, and mobile applications, the e-commerce landscape has evolved into a multibillion-dollar industry. This article delves into the dynamics of consumer perception towards online shopping, with an emphasis on the psychological, social, and technological factors that influence online purchase decisions.

While online shopping offers convenience, time savings, and access to a vast range of products, it also presents challenges such as data security concerns, lack of physical interaction with products, and issues related to delivery and returns. Consumer perception is not uniform; it varies by demographic variables such as age, gender, education, income, and geography. The objective of this study is to analyze these varying perceptions and identify the critical elements that shape them.

Through a comprehensive review of literature, market trends, and survey-based findings, the article examines the evolution of consumer attitudes over time. It also outlines the major problems faced by online consumers and provides practical suggestions for businesses to enhance consumer trust and satisfaction.The findings reveal that while consumers generally have a positive outlook towards online shopping due to its convenience and cost-effectiveness, concerns over privacy, product authenticity, and post-purchase service remain prevalent. To ensure long-term growth and customer loyalty, e-commerce platforms must prioritize transparency, improve logistics, offer robust customer support, and build secure, user-friendly interfaces.

Keywords:*Consumer Perception,Online Shopping,E-Commerce,Digital marketing*

INTRODUCTION

The advent of the internet has brought about radical changes in various sectors, particularly retail. Online shopping, also known as e-commerce, refers to the process of buying goods and services over the internet. The exponential growth of online retail platforms has redefined traditional shopping practices. From groceries and clothing to electronics and furniture, nearly every type of product can now be purchased online, often with delivery in a matter of hours.Consumer perception is a significant factor influencing the adoption and success of online shopping platforms. It encompasses the attitudes, feelings, beliefs, and expectations that consumers hold about digital shopping experiences. These perceptions are shaped by multiple variables including past experiences, peer recommendations, media exposure, and interactions with the online platform itself.

The widespread use of smartphones and the internet has led to greater accessibility and awareness of online marketplaces, making it easier for consumers to shop anytime and anywhere.

Furthermore, with competitive pricing, easy return policies, and regular promotional offers, e-commerce companies have created compelling reasons for consumers to shift from physical stores to digital platforms.However, despite its many benefits, online shopping is not without flaws. Concerns regarding product authenticity, data privacy, cyber fraud, delayed deliveries, and complex return processes still persist. Additionally, some consumers miss the tactile experience and instant gratification associated with in-store shopping.Understanding consumer perception is vital for e-commerce companies aiming to sustain growth and customer loyalty. A positive perception can lead to higher customer retention, while negative experiences can harm a brand's reputation and reduce market share. Thus, this article investigates consumer attitudes, identifies influencing factors, and offers suggestions for businesses to align better with consumer expectations.

HISTORY OF ONLINE SHOPPING

The history of online shopping dates back to the early 1990s. It began as a novel concept when the first secure online transaction was made in 1994. This marked the beginning of a revolutionary shift in the retail industry. Companies like Amazon and eBay, founded in the mid-1990s, played a pivotal role in shaping the e-commerce sector by creating platforms that allowed individuals and businesses to buy and sell goods over the internet.

Initially, consumer skepticism, limited internet access, and security concerns restricted the growth of online shopping. However, with the development of better encryption technologies and secure payment systems in the early 2000s, consumers began to embrace the idea of online transactions.The 2010s witnessed a boom in online shopping due to the widespread use of smartphones, faster internet connections, and the rise of mobile applications. Companies like Alibaba, Flipkart, and Walmart began investing heavily in their online presence. Features such as real-time tracking, customer reviews, cash on delivery, and one-click purchasing further enhanced user experience.

The COVID-19 pandemic marked a turning point in e-commerce history. Lockdowns, social distancing, and the closure of physical retail stores pushed even hesitant consumers towards online platforms. Essential items, groceries, and medicines were ordered online in record volumes, and many consumers continued with online shopping habits even post-pandemic.Today, online shopping is a multi-trillion-dollar industry, with billions of users worldwide. Its history reflects not only technological advancements but also changing consumer behavior, increasing expectations, and the continuous adaptation of businesses to meet digital demands.

STATEMENT OF THE PROBLEM

Despite the tremendous growth of online shopping, several issues continue to influence consumer perception and satisfaction. While many consumers enjoy the convenience and variety offered by e-commerce, others face recurring problems that impact their trust in online platforms. One of the most common issues is product misrepresentation—where the delivered item does not match the description or images provided online. This leads to dissatisfaction and reluctance to shop again. Additionally, security concerns such as data breaches and credit card fraud make consumers hesitant to share personal and financial information online.

Logistics and delivery problems also pose challenges. Late or missed deliveries, damaged packaging, and incorrect items are frequent complaints. Moreover, the return and refund processes

are often complicated or delayed, discouraging repeat purchases.Another major concern is the lack of physical interaction. Consumers cannot try, touch, or test products before purchasing, which particularly affects categories like clothing, cosmetics, and electronics. This limitation can create uncertainty and reduce confidence in the purchase decision.Furthermore, digital illiteracy and poor internet infrastructure in certain regions prevent a segment of the population from enjoying the benefits of online shopping. This digital divide must be addressed for inclusive growth of the sector.Thus, the primary problem lies in bridging the gap between consumer expectations and actual service delivery. Understanding and resolving these issues are crucial for e-commerce platforms aiming to improve user experience and foster long-term loyalty.

REVIEW OF LITERATURE

Tohiffman and Kanuk (2007), consumer behavior is influenced by a complex interplay of psychological, personal, and social factors. In the context of online shopping, these influences are magnified by the digital nature of transactions. Consumers rely heavily on visual cues, peer reviews, and platform reputation when making purchase decisions.

Laudon and Traver (2018), explain that online consumer behavior differs significantly from traditional retail behavior due to the absence of physical interaction. This means consumers must base their choices on digital representations of products, which can impact their level of trust and perceived risk.

Gefen et al. (2003), emphasized that trust significantly affects consumers' willingness to engage in online transactions. Consumers are more likely to shop from platforms they perceive as credible and secure.

Urban, Sultan, and Qualls (2000), highlighted that privacy concerns, fear of fraud, and uncertainty about product quality are major inhibitors of online shopping adoption. As such, secure payment systems, transparent policies, and reliable customer service are crucial in enhancing consumer trust.

Hasan (2010), Demographic factors such as age, gender, education, and income level influence consumer perception and online shopping behavior. younger consumers (ages 18–35) are more inclined to shop online due to greater digital literacy and comfort with technology. In contrast, older consumers often exhibit resistance due to security concerns and unfamiliarity with online platforms.

Chevalier and Mayzlin (2006), demonstrated that products with a higher number of positive reviews tend to experience greater sales, highlighting the importance of social proof in shaping consumer perception. This aligns with modern consumer behavior theories that suggest individuals often rely on the experiences of others before making decisions in uncertain environments.

McKinsey (2020), e-commerce penetration in many countries grew at an accelerated pace due to lockdowns and social distancing. This forced even digitally reluctant consumers to adapt to online shopping, thereby broadening the demographic base.

Pantano et al. (2020), observed that consumers developed new expectations for hygiene, speed, and flexibility in delivery, pushing companies to innovate in last-mile logistics and contactless service.

OBJECTIVES OF THE STUDY

- To identify the key factors influencing consumer attitudes towards online shopping, such as convenience, pricing, security, and product variety
- To evaluate consumer satisfaction levels with current online shopping platforms and services.
- To understand the challenges faced by consumers while using online shopping platforms.
- To study the impact of demographic variables like age, income, education, and geographic location on online shopping behavior.
- To assess the effectiveness of e-commerce platforms in addressing consumer concerns and expectations.
- To provide recommendations for online retailers to improve customer experience and build trust.
- To analyze post-pandemic consumer behavior and determine whether the shift towards online shopping is likely to be permanent.
- To examine the role of customer reviews, social media, and advertising in shaping consumer perception.

FINDINGS OF THE STUDY

- The primary reason consumers prefer online shopping is convenience. The ability to shop 24/7 from any location appeals to consumers with busy lifestyles.
- Consumers are highly responsive to discounts, offers, and dynamic pricing. Online platforms often offer better deals than physical stores, making them attractive to price-sensitive buyers.
- A large section of consumers still fears data breaches and online fraud. These concerns are especially high among older adults and first-time users.
- Discrepancies between product descriptions/images and actual items received are a significant source of dissatisfaction.
- Most consumers rely heavily on peer reviews and ratings before making a purchase. Positive feedback boosts confidence, while negative reviews can deter buyers.
- Delayed or incorrect deliveries, damaged goods, and lack of real-time tracking negatively affect the overall experience.
- Younger consumers are more comfortable with technology and more likely to shop online frequently. Older consumers tend to shop online occasionally and are more cautious.
- Social media platforms like Instagram, Facebook, and YouTube play a major role in product discovery and consumer decision-making.

SUGGESTIONS FOR THE STUDY

- User-friendly navigation, quick loading times, and clear product categorization can improve the overall user experience.
- Implementing advanced encryption, two-factor authentication, and transparent privacy policies can help gain consumer trust.
- High-quality images, videos, and detailed product descriptions help consumers make informed decisions.
- A simple, fast, and transparent return policy increases customer confidence and satisfaction.

- Partnering with reliable logistics providers, ensuring proper packaging, and offering real-time tracking can reduce delivery issues.
- Use AI to offer personalized recommendations, deals, and browsing experiences to increase engagement.

CONCLUSION

The evolution of online shopping has fundamentally reshaped consumer behavior and the global retail landscape. As e-commerce platforms continue to grow, understanding consumer perception becomes increasingly critical for maintaining competitiveness and building long-term customer loyalty. This study has shown that while consumers generally appreciate the convenience, accessibility, and cost benefits of online shopping, they also remain cautious due to several recurring issues such as security concerns, product mismatches, delivery delays, and complex return processes.

A key insight from the findings is that consumer perception is dynamic, influenced by past experiences, brand reputation, technological ease of use, peer reviews, and socio-demographic factors. Younger consumers are typically more tech-savvy and inclined to engage in online shopping regularly, whereas older consumers approach it with more caution and require greater assurances around security and authenticity. Trust, therefore, remains a cornerstone of consumer engagement and must be nurtured through transparency, effective communication, and consistent service delivery.

The study also highlights the increasing role of customer feedback, social media influence, and personalization in shaping consumer attitudes. Consumers no longer base decisions solely on price and product specifications; emotional engagement and brand experience now play equally vital roles. E-commerce businesses must adapt by investing in customer service, improving their digital interfaces, and offering user-centric features such as tailored recommendations and seamless navigation.

In conclusion, while online shopping continues to grow at a remarkable pace, its sustainability depends on the ability of businesses to listen to consumer concerns, adapt to evolving expectations, and innovate responsibly. By addressing pain points such as security, product accuracy, and delivery efficiency, and by leveraging data and technology to personalize experiences, online retailers can strengthen consumer trust and foster lasting relationships. As digital commerce continues to advance, a deeper understanding of consumer perception will remain pivotal in driving both customer satisfaction and business success.

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STRESS MANAGEMENT AMONG COLLEGE TEACHERS BEFORE AND AFTER YOGA PRACTICE

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ABSTRACT

Stress lead to significant mental and physical health issues, adversely affecting both personal well-being and professional performance. This study investigates the impact of yoga on stress management among college teachers before and after practicing yoga. A sample of 100 college teachers were collected by a questionnaire to collect the source of primary data. The data were analyzed using various statistical methods. Results indicate a significant reduction in perceived stress levels, improved mental health and enhanced job satisfaction post-yoga practice. The findings highlight the effectiveness of yoga as a practical intervention for stress relief, emphasizing its potential to foster a healthier work environment and improve the overall quality of life for educators. This study contributes to the growing body of evidence supporting the integration of yoga into stress management strategies within educational institutions.

Keywords: effectiveness, job satisfaction, mental health, quality, stress relief, emotional, well-being, performance, etc.,

INTRODUCTION

Stress is a prevalent issue among college teachers, stemming from extensive workloads, deadlines, and the high emotional demands of teaching. The effects of prolonged stress, if left unmanaged, can lead to mental and physical health issues that impact both personal well-being and professional performance, affecting educators' ability to effectively support and inspire their students. Consequently, stress management has become a critical focus for promoting healthier work environments in academia. In recent years, holistic approaches to stress relief have gained attention, with yoga emerging as a particularly popular and effective method. Yoga, a mind-body practice rooted in ancient Indian philosophy, combines physical postures, controlled breathing exercises, and meditation to achieve balance between body and mind. Research suggests that regular yoga practice can alleviate stress, reduce symptoms of anxiety and depression, enhance relaxation, and promote resilience. For college teachers, incorporating yoga into their daily or weekly routines may not only alleviate stress but also improve their focus, increase resilience, and boost job satisfaction, leading to a more fulfilling teaching experience. This study aims to explore the impact of yoga on stress management among college teachers by comparing stress levels and well-being indicators before and after yoga practice. Through this comparative analysis, the study seeks to illustrate how regular engagement in yoga can serve as a valuable tool for enhancing mental and physical health, fostering a more balanced and satisfying work-life experience for educators who face the unique challenges of the academic profession.

Need for the Study

➢ College teachers experience significant stress from heavy workloads and emotional demands, affecting their health and performance.

➢ Stress in educators can lead to burnout, which negatively impacts their ability to support and engage students.

➢ There is limited research on the effects of yoga specifically for college teachers, highlighting the need for this study.

➢ Exploring yoga offers a holistic approach to stress management that may be more effective for educators than traditional methods.

➢ The study's findings can help colleges develop wellness programs that support teachers' mental and physical health, creating a better work environment.

REVIEW OF LITERATURE

Dassaradan and Dr. Subbulakshmi (2024) conducted a study to examine the impact of a 12-week yoga intervention on cortisol levels and job satisfaction among middle-aged government executives aged 40 to 60 years. The study acknowledges that chronic stress in high-pressure roles often results in elevated cortisol levels, contributing to health complications and decreased job satisfaction. By implementing yoga as a stress management approach, the research evaluates its potential to lower cortisol levels and improve job satisfaction. The findings underscore the positive effects of incorporating yoga into wellness programs, especially for professionals in demanding careers, offering valuable insights into yoga's role in enhancing well-being and satisfaction in the workplace.

Dr. M. Varalakshmi (2023) conducted a study on the impact of yoga on academic stress and achievement among 60 randomly selected girl students, aged 15-17, from rural areas in Ananthapur district, Andhra Pradesh. Using an Academic Stress Scale and academic test scores, the study employed a pre- and post-intervention analysis with the 't' test. Findings indicated significant improvements in academic performance, with students attaining higher grades and reporting lower levels of academic stress, suggesting that yoga positively affects both academic stress and achievement in secondary school students.

Ayush Kumar and Kavita Singh (2022) highlighted the critical role of workforce productivity in organizational performance, noting that productivity is closely tied to employees' psychosocial well-being. The researchers emphasized that stress has a detrimental effect on health, productivity, social life, and family connections. Workplace stress, driven by both individual and organizational pressures, has become a significant concern for businesses, with stress levels reaching critical heights. The study explores how various organizations employ yoga and wellness programs to alleviate stress, enhancing corporate growth and performance. The research aims to uncover the effectiveness of yoga as a workplace stress management tool across different companies.

Neeru Devi and Sheetal (2020) conducted a study on the role of yoga in stress management among corporate employees, who often face high workloads and stress due to competition and work-related factors. Through a literature review of both Indian and international sources, the researchers found that yoga is effective in calming the mind and reducing stress. Their findings highlighted that regular yoga practice significantly lowers stress levels, making it a valuable tool

for stress management in the workplace. The study recommended that organizations implement regular yoga sessions led by qualified instructors, noting that integrating yoga into the workplace can improve employee well-being and contribute to achieving organizational goals.

Jyoti Bhagwan Jadhav and Dr. Sujata L. Waghmare(2019) explored the impact of yoga on occupational stress and job satisfaction among teachers. The study selected 30 teachers from Aurangabad Municipal Corporation schools using purposive sampling. Using a pre-test and post-test research design, and employing the Teacher Job Satisfaction Questionnaire and Occupational Stress Index Questionnaire for data collection, the study found that yoga had a positive effect on reducing occupational stress and enhancing job satisfaction. The results suggested that yoga practices not only decrease stress levels but also improve job satisfaction among teachers.

OBJECTIVES OF THE STUDY

 ➢ To identify the stress factors influenced before and after practicing yoga.
 ➢ To assess the impact of yoga on teachers' before and after practicing yoga.

RESEARCH METHODOLOGY

a. **Type of research:** Descriptive research
b. **Data collection**
   Primary data: A structured questionnaire will be developed and distributed online through platforms such as Google Forms or social media channels. The survey will include closed-ended questions focused on demographics, digital marketing exposure, and purchasing behavior.
   Secondary data: Articles, Journals and Websites.
c. **Sampling design:** A stratified random sampling method will be used to ensure representation across different demographics, such as age, gender, and socio economic status.
d. **Sample size:** A total of 100 samples were collected in Palakkad District for the study.
e. **Tools used for the study:**
● Simple Percentage
● Standard Deviation
● Weighted Average Mean

LIMITATIONS OF THE STUDY

✔ The study may involve a small number of college teachers, which can limit the applicability of the results to a broader population.
✔ Differences in how participants practice yoga (e.g., frequency, intensity) may affect the outcomes and lead to inconsistent results.
✔ Self-reported data may result in biased responses from participants.
✔ Time constraints could hinder the depth and quality of data collection.

ANALYSIS AND INTERPRETATION

Table no.1
Demographic variables of the college teachers

Variables	Demographic variables	No. of College teachers	Percentage
Gender	Male	56	56
	Female	44	44
	Total	100	100
Area of Residence	Male	38	38
	Female	62	62
	Total	100	100
Age	Below 30 Years	22	22
	31-40 Years	22	22
	41-50 Years	42	42
	Above Years	14	14
	Total	100	100
Educational Qualification	PG with Diploma course	12	12
	PG with M.Phil	46	46
	PG with NET/SET	19	19
	PG with Ph.D	23	23
	Total	100	100

Table 1 provides a detailed overview of the demographic variables of the 100 college teachers participating in the study on stress management among college teachers before and after yoga practice.

Gender: The sample consists of 56 male college teachers (56%) and 44 female college teachers (44%).

Area of Residence: Among the college teachers, 38 males (38%) and 62 females (62%) are from rural areas.

Age: The age distribution of college teachers is as follows: 22% are below 30 years, 22% are in the 31-40 age group, 42% are in the 41-50 age group, and 14% are above 50 years.

Educational Qualification: The educational qualifications of the college teachers are varied, with 12% holding a postgraduate degree with a diploma, 46% having an M.Phil., 19% with a PG degree and NET/SET, and 23% holding a Ph.D.

Table No.2
Impact of Stress factors before doing yoga

Factor	Low	Medium)	High	Pre-Yoga Mean	Pre-Yoga SD
High Stress Levels	10 (10%)	20 (20%)	70 (70%)	4.0	0.9
Physical Fatigue Complaints	15 (15%)	20 (20%)	65 (65%)	4.0	0.9
Anxiety Symptoms	20 (20%)	40 (40%)	40 (40%)	3.5	0.9
High Job Satisfaction	40 (40%)	30 (30%)	30 (30%)	2.0	0.6
Good Work-life Balance	20 (20%)	30 (30%)	50 (50%)	3.0	0.8

High Stress Levels: A significant 70% of college teachers reported high stress levels, indicating that stress is a prevalent issue within this demographic. Only 10% of college teachers perceived low stress levels, while 20% indicated a medium level of stress. The mean score of 4.0, coupled with a standard deviation of 0.9, suggests a strong consensus among college teachers regarding the severity of their stress, highlighting the urgent need for effective stress management interventions.

Physical Fatigue Complaints: The data shows that 65% of college teachers experienced high levels of physical fatigue, reflecting the demanding nature of their profession. Only 15% reported low physical fatigue, and 20% categorized their fatigue as medium. With a mean score of 4.0 and a standard deviation of 0.9, the findings indicate that physical fatigue is a common concern among college teachers, which may hinder their performance and overall well-being, further emphasizing the importance of incorporating stress-reducing practices like yoga.

Anxiety Symptoms: Regarding anxiety symptoms, 40% of college teachers reported experiencing high levels of anxiety, while 40% indicated a medium level. Only 20% reported low anxiety symptoms. The mean score of 3.5 and a standard deviation of 0.9 suggest a moderate level of anxiety across the group. This finding is concerning as anxiety can significantly impact teachers' mental health and job performance, suggesting that yoga may serve as an effective tool for alleviating anxiety.

High Job Satisfaction: The results reveal that 40% of college teachers reported low job satisfaction, with only 30% feeling moderately satisfied and another 30% indicating high satisfaction. The mean score of 2.0, along with a standard deviation of 0.6, indicates that job satisfaction among college teachers is relatively low. This dissatisfaction may be linked to the high stress levels and anxiety they experience, pointing to the potential benefits of yoga in enhancing job satisfaction through improved stress management.

Good Work-life Balance: In terms of work-life balance, 50% of college teachers reported a high sense of balance, while 30% indicated a medium balance, and 20% reported low balance. The mean score of 3.0 suggests that while some teachers manage to maintain a good work-life balance, many still face challenges. The standard deviation of 0.8 indicates a moderate variability

in perceptions regarding work-life balance, reinforcing the need for strategies like yoga that can help enhance this balance and promote overall well-being among educators.

Table No.3
Impact of Stress factors after doing yoga

Factor	Low	Medium	High	Post-Yoga Mean	Post-Yoga SD
High Stress Levels	25 (25%)	30 (30%)	45 (45%)	3.0	1.2
Physical Fatigue Complaints	35 (35%)	25 (25%)	40 (40%)	3.0	1.0
Anxiety Symptoms	40 (40%)	30 (30%)	30 (30%)	3.0	1.1
High Job Satisfaction	10 (10%)	20 (20%)	70 (70%)	4.5	1.1
Good Work-life Balance	5 (5%)	20 (20%)	75 (75%)	4.5	1.1

High Stress Levels: After engaging in yoga, 45% of college teachers reported high stress levels, a notable decrease from the pre-yoga assessment. The proportion of teachers experiencing low stress increased to 25%, while 30% indicated medium stress levels. The post-yoga mean score of 3.0, coupled with a standard deviation of 1.2, suggests an overall reduction in perceived stress levels among college teachers. This decline indicates that yoga may effectively help teachers manage their stress.

Physical Fatigue Complaints: The findings reveal that 40% of college teachers reported high levels of physical fatigue after practicing yoga, which remains a significant concern but reflects a decrease compared to pre-yoga levels. The percentage of those reporting low fatigue increased to 35%, while 25% reported medium fatigue. With a mean score of 3.0 and a standard deviation of 1.0, the data indicates that while physical fatigue persists, yoga practice may contribute to alleviating some of the fatigue experienced by college teachers.

Anxiety Symptoms: Post-yoga, 30% of teachers reported high anxiety symptoms, a reduction from the pre-yoga levels. Furthermore, 40% of college teachers indicated low anxiety levels, and 30% reported medium levels. The mean score of 3.0 and a standard deviation of 1.1 suggest that yoga practice may have helped some educators manage their anxiety, promoting a more relaxed state and enhancing their overall mental health.

High Job Satisfaction: An impressive 70% of college teachers reported high job satisfaction after incorporating yoga into their routines, a significant increase from pre-yoga levels. Only 10% indicated low job satisfaction, and 20% reported medium satisfaction. The post-yoga mean score of 4.5, with a standard deviation of 1.1, indicates a marked improvement in job satisfaction, suggesting that the stress-reducing benefits of yoga positively influence educators' perceptions of their work.

Good Work-life Balance: After practicing yoga, 75% of college teachers reported a high sense of work-life balance, which is a substantial improvement compared to pre-yoga findings.

Only 5% indicated a low balance, while 20% felt they had a medium balance. The mean score of 4.5 and standard deviation of 1.1 demonstrate that yoga has significantly enhanced the teachers' ability to manage their professional and personal lives, contributing to overall well-being.

Table No.4
Stress factors influenced before and after doing yoga

Factor	Score (Pre-Yoga)	Weight (Pre-Yoga)	Rank (Pre-Yoga)	Score (Post-Yoga)	Weight (Post-Yoga)	Rank (Post-Yoga)
Perceived Stress Level	100	1.0	1	25	0.25	4
Physical Health (e.g., Fatigue)	50	0.5	2	33	0.33	3
Mental Health (e.g., Anxiety)	33	0.33	3	50	0.5	2
Job Satisfaction	25	0.25	4	100	1.0	1
Work-life Balance	20	0.2	5	50	0.5	2

Before practicing yoga, the ranking of stress factors among college teachers highlighted perceived stress level as the most significant concern, scoring 100 and earning the top rank. Physical health, particularly related to fatigue, followed in second place with a score of 50. Mental health issues, especially anxiety, were ranked third with a score of 33, while job satisfaction ranked fourth at 25. Finally, work-life balance was considered the least significant factor, with a score of 20, placing it fifth in the rankings. After engaging in yoga, the rankings shifted dramatically, with job satisfaction rising to the highest rank, achieving a perfect score of 100. The perceived stress level fell to fourth place, with a significantly reduced score of 25, indicating a marked improvement in stress management. Mental health concerns gained importance, moving up to second rank with a score of 50, while physical health complaints dropped to third rank with a score of 33. Work-life balance improved as well, rising to the second position post-yoga with a score of 50, showcasing the overall positive impact of yoga on the well-being of college teachers.

CONCLUSION
In conclusion, this study has demonstrated that practicing yoga significantly enhances stress management among college teachers. The findings reveal a notable reduction in stress levels and an improvement in overall well-being for those who engaged in regular yoga sessions. By incorporating yoga into their routines, educators can develop resilience and better cope with the demands of their profession, leading to increased job satisfaction and a healthier work-life balance. These results highlight the importance of implementing wellness programs that include yoga in educational institutions, fostering an environment that prioritizes the mental and physical health of faculty members. As stress continues to be a challenge for college teachers, yoga emerges as an effective strategy for promoting well-being and sustaining their professional effectiveness.

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ROBUST DETECTION OF INTRA-FRAME COPY-MOVE FORGERIES IN DIGITAL VIDEOS

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Abstract : With over 3.7 million videos shared daily on platforms like YouTube and social media, the proliferation of high-quality forged videos is rapidly increasing. Such forgeries compromise the authenticity and integrity of digital evidence, potentially leading to serious consequences. For instance, in judicial proceedings, a tampered video used as evidence could wrongfully implicate an innocent person or help a guilty individual evade justice. This necessitates robust detection mechanisms to counteract forgery attempts. One prevalent method of forgery is copy-move video forgery, which involves duplicating regions within a single video frame or across consecutive frames. Traditional detection approaches rely on manual pattern recognition and block-matching, often yielding detection accuracies below 70%, particularly in high-resolution and compressed videos. In contrast, deep learning-based techniques have shown significantly improved performance, with Convolutional Neural Network (CNN) and Transformer-based models achieving up to 92.6% accuracy on standard datasets like Kaggle and FaceForensics++. This research leverages pre-trained deep learning architectures to automatically learn discriminative features, enhancing the detection of copy-move forgery in complex and dynamic video environments.

Keywords: *Intra-frame Forgery Detection,Deep Learning,Convolutional Neural Networks (CNN),Transformer Models,Video Forensics,Video Tampering*

1. INTRODUCTION

In the era of digital communication, video content has become one of the most widely consumed and shared forms of media, with platforms like YouTube and social media seeing over 3.7 million videos shared daily. While this explosion of content enables widespread information dissemination, it also raises significant concerns regarding the authenticity and integrity of visual media. Forged or manipulated videos, especially high-quality ones, can have serious real-world implications, particularly when used as digital evidence in legal, journalistic, or governmental contexts. One of the most common and challenging forms of video tampering is copy-move forgery, where specific regions within a video frame—or across multiple frames—are duplicated to hide or falsify information.

Traditional detection techniques typically involve block-matching or keypoint-based methods that manually identify duplicated patterns. However, these methods often fall short when dealing with post-processing effects such as compression, scaling, or rotation, with reported detection accuracies frequently below 70%. To overcome these limitations, recent advancements in deep learning have enabled automated, high-accuracy detection of video forgeries. Models

based on Convolutional Neural Networks (CNNs) and Transformer architectures have shown promising results, achieving up to 92.6% accuracy on standard benchmarks like Kaggle datasets and FaceForensics++. This study focuses on leveraging pre-trained deep learning models to enhance the reliability and robustness of copy-move forgery detection, aiming to support the development of intelligent, real-time forensic tools for digital video authentication.

1.1 Copy-Move Forgery Workflow Diagram

Figure 1: Overview of Copy-Move Forgery in Video Frames

Figure 1 depicts the core concept behind copy-move video forgery, where a specific region within a video frame is duplicated and relocated either within the same frame or across different frames of the same video sequence. This forgery technique is widely used because it does not require external sources, relying solely on the content within the video itself, which helps maintain visual consistency and evade simple detection mechanisms.

The Copy-Move Forgery Workflow begins with an original, untampered video frame. From this frame, an attacker selects a region of interest—commonly an object, a person, or part of the background—that they intend to conceal, replicate, or replace. This selected region is then copied and pasted into a different location within the same frame (intra-frame forgery) or into another frame (inter-frame forgery). The goal is to create a forged scene that appears semantically plausible and visually seamless.

To further obscure the tampering and enhance the realism of the forged content, attackers often employ a variety of post-processing techniques. These may include smoothing the edges of the pasted region to blend it into the surrounding environment, applying color correction to match lighting and contrast conditions, or introducing subtle changes such as rotation and scaling. Advanced tools may also apply noise or perform compression to mimic the artifacts found in natural video recording and transmission, making detection by traditional means even more difficult.

This type of manipulation is particularly concerning in high-stakes scenarios such as digital forensics, legal evidence, investigative journalism, surveillance footage, and security operations, where the authenticity of visual data is critical. A forged video may lead to misinterpretation of events, wrongful accusations, or the loss of vital information. Furthermore, the widespread availability of sophisticated editing tools has lowered the technical barrier to creating such forgeries, increasing the risk of their occurrence.

The deceptive nature of copy-move forgeries, especially when accompanied by post-processing, underscores the need for robust and intelligent detection systems. These systems must go beyond surface-level inspection and employ techniques capable of analyzing motion patterns,

spatial inconsistencies, and pixel-level anomalies—such as those provided by optical flow analysis and deep learning-based feature extraction. As tampering methods become more advanced, so too must the countermeasures designed to detect and prevent them, ensuring the integrity and trustworthiness of digital video content.

1.2 Deep Learning-Based Detection Architecture
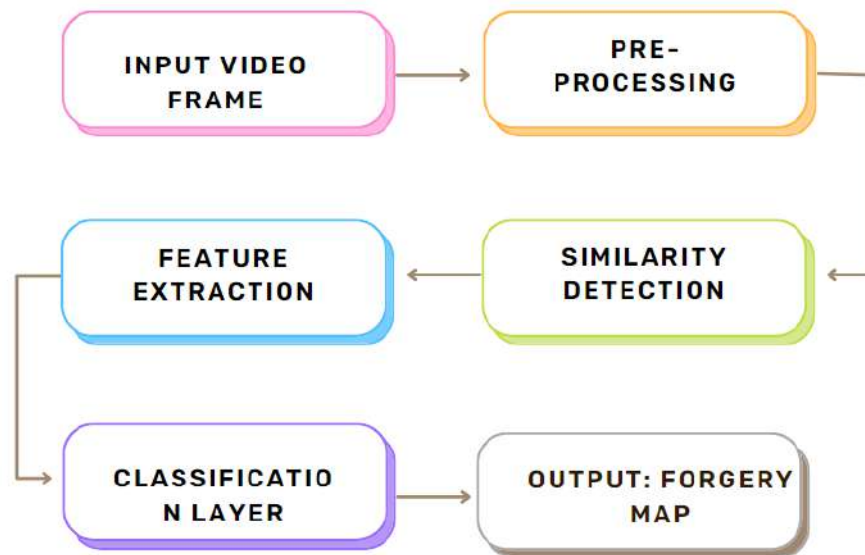
Figure 2: Proposed Deep Learning Pipeline for Forgery Detection

Figure 2 illustrates the architecture of the proposed deep learning-based pipeline designed for efficient and accurate video forgery detection. This system is built to automatically identify manipulated content within video frames by leveraging advanced neural network architectures and a structured sequence of processing stages.

The pipeline begins with the input video frame, which is subjected to a preprocessing stage. During this stage, essential operations such as frame resizing, normalization, and standardization are performed to ensure that the input data aligns with the model's dimensional and format requirements. Additional preprocessing techniques—such as histogram equalization and color space transformation—may also be applied to enhance visual features and improve model robustness across varying video qualities and formats.

Following preprocessing, the frame is passed into a feature extraction module. This module is typically powered by either a Convolutional Neural Network (CNN) or a Transformer-based model (such as Vision Transformers). CNNs are adept at learning local spatial patterns, such as edges, corners, and textures, which are critical for identifying fine-grained inconsistencies in tampered regions. Transformer models, on the other hand, utilize self-attention mechanisms to capture long-range dependencies and contextual relationships across the entire frame, making them especially effective in complex or cluttered scenes.

The similarity detection stage comes next, where the extracted features are analyzed to identify duplicated or manipulated regions. This can be achieved through various mechanisms, including patch-wise comparison, self-attention map analysis, or feature correlation methods. The

goal of this stage is to uncover areas within the frame that exhibit unusually high similarity, indicating a potential copy-move forgery.

The results of the similarity analysis are fed into a classification module, where a decision is made regarding the authenticity of the frame. This is typically executed through fully connected neural layers, using softmax or sigmoid activation functions to generate either a binary classification (forged vs. authentic) or a probability score indicating the likelihood of manipulation. In more advanced implementations, per-pixel classification is performed to produce segmentation masks, highlighting tampered areas with pixel-level precision.

Finally, the output generation module presents the results in a user-interpretable format. Depending on the application, this could be a binary classification result indicating whether the frame has been tampered with or not, or a forgery heatmap that visually marks the duplicated or altered regions. This visual output is particularly useful for forensic experts seeking to understand and verify the nature and location of the forgery.

2. LITERATURE REVIEW

The increasing prevalence of AI-generated forgeries in images and videos has led to significant research in multimedia forensics, focusing on detection methods that exploit both biological inconsistencies and digital artifacts. Li, Chang, and Lyu (2018) [1] proposed detecting deepfakes by identifying abnormal eye blinking patterns, a common flaw in synthetic face videos. Yang, Li, and Lyu (2019) [2] further advanced physiological detection by analyzing inconsistencies in head poses, which often misalign in generated content. Rössler et al. (2019) [3] developed FaceForensics++, a large-scale dataset enabling the training and evaluation of deep learning models for manipulated facial image detection. Jain and Farid (2010) [4] introduced the concept of "JPEG ghosts" to expose digital forgeries based on compression artifacts. Salloum, Ren, and Kuo (2018) [5] applied a Multi-task Fully Convolutional Network (MFCN) to localize image splicing, providing pixel-level precision. Zandi, Jamzad, and Yousefi (2021) [6] combined CNNs with optical flow analysis to detect copy-move forgeries in videos, leveraging temporal patterns. Bappy et al. (2017) [7] used spatial structural features and deep learning to localize manipulated image regions. Cozzolino, Poggi, and Verdoliva (2017) [8] transformed traditional residual-based descriptors into CNN architectures, enhancing forgery detection through learned features. Barni, Costanzo, and Sabatini (2011) [9] addressed cut-and-paste tampering using double-JPEG detection and segmentation methods. Finally, Christlein et al. (2012) [10] provided a comprehensive evaluation of copy-move forgery detection techniques, establishing performance benchmarks. Collectively, these studies highlight diverse and evolving strategies for detecting digital and AI-driven manipulations, spanning handcrafted features, deep neural networks, and physiological signal analysis.

3. PROBLEM STATEMENT AND RESEARCH OBJECTIVES

3.1 Problem Statement

The exponential growth of video content on digital platforms has been accompanied by an equally alarming rise in video tampering techniques. Among them, intra-frame copy-move forgery has emerged as a particularly challenging and prevalent form of manipulation. This technique involves copying a region within a single video frame and pasting it elsewhere in the same frame to either obscure or replicate content. Because the copied region shares the same spatial and visual

characteristics (such as texture, lighting, and resolution) as the rest of the frame, these forgeries are often visually undetectable to the human eye.

Existing traditional approaches, such as block-based matching and keypoint-based feature extraction, attempt to detect these manipulations by comparing pixel blocks or matched keypoints. However, these methods are inherently limited in their capacity to handle real-world video scenarios. In high-resolution videos, the detection of copy-move forgeries becomes increasingly challenging due to the significantly larger search space, which leads to higher computational complexity and reduced precision in identifying manipulated regions. In compressed video formats, essential forgery artifacts are often distorted or lost during the compression process, making detection efforts less reliable and more prone to false negatives. Various post-processing operations such as rotation, scaling, smoothing, and the addition of noise can further obscure tempered areas. These transformations often degrade or eliminate the handcrafted features typically used in traditional detection methods, thereby limiting their effectiveness in real-world forensic applications.

These conventional methods often require manual feature engineering and parameter tuning, making them unsuitable for scalable and automated forensic systems.

As tampered videos increasingly infiltrate judicial proceedings, news reporting, and social media platforms, the need for robust, automated detection mechanisms has become more pressing than ever. The integration of deep learning models—particularly Convolutional Neural Networks (CNNs) and Transformer architectures—offers a promising solution to overcome these limitations, owing to their ability to learn complex, high-dimensional representations directly from data.

3.2 Research Objectives

To address the critical challenges posed by intra-frame copy-move forgery, this research sets forth the following key objectives:

i. Improve Detection Accuracy in High-Resolution and Compressed Videos: The primary goal is to design a detection framework that can maintain high accuracy across varying video qualities and formats. This includes robust performance in high-definition content, which poses a larger feature space, and compressed videos where fine-grained features may be lost. The model must reliably detect subtle duplication patterns even under these constraints.

ii. Automate Forgery Detection Using Deep Learning Architectures: By utilizing pre-trained deep learning models such as CNNs and Transformers, the system should automatically learn discriminative features from raw video frames without relying on manual feature extraction. This automation not only enhances generalization but also reduces the reliance on domain-specific expertise and labor-intensive processes.

iii. Enhance Robustness Against Post-Processing and Adversarial Manipulations: Forgers often apply post-processing operations—such as blurring, color adjustments, and transformations—to obscure tampering evidence. The proposed approach aims to ensure resilience against such manipulations by training and validating models on datasets with diverse augmentations and real-world conditions.

iv. Support Real-Time and Scalable Deployment: While accuracy and robustness are essential, the system should also be computationally efficient to support real-time video forensic analysis. This includes optimizing model performance for deployment in surveillance systems, legal evidence review, and digital media verification workflows.

4. PROPOSED METHODOLOGY

This section outlines the methodology adopted for detecting intra-frame copy-move video forgeries using a deep learning-based pipeline. The approach comprises two primary components: (1) an analysis of the typical copy-move forgery workflow to understand the nature of tampering, and (2) a proposed detection architecture leveraging CNN and Transformer-based models to automate and enhance forgery identification.

4.1 Copy-Move Forgery Workflow

Copy-move forgery is a content-preserving manipulation technique in which a specific region of a video frame is duplicated and pasted into another location within the same frame. The motive may vary—from obscuring an object (e.g., a face, license plate, or timestamp) to artificially replicating elements (e.g., people, vehicles) to mislead the viewer.

The forgery process typically follows these steps:

i.   Selection of Source Region: The attacker manually or algorithmically selects a region within the original video frame to be copied. This region might contain a background element or a subject of interest.

ii. Duplication and Pasting: The selected region is duplicated and pasted into another part of the same frame. This newly inserted region disrupts the semantic consistency of the frame but often maintains visual coherence.

iii. Post-Processing Concealment: To mask tampering traces, the attacker may apply post-processing techniques such as blurring, edge smoothing, color correction, or brightness adjustments. These operations aim to blend the duplicated region seamlessly with its surroundings.

iv. Compression Artifacts: When the forged video is compressed (e.g., for upload or sharing), subtle manipulation traces become even more difficult to detect, further complicating forensic efforts.

The realism and subtlety of copy-move forgeries underscore the need for advanced detection methods capable of isolating duplicated regions that would otherwise appear visually authentic.

4.2 Deep Learning-Based Detection Pipeline

To address the limitations of traditional methods, this research proposes a structured, automated detection pipeline based on deep learning. The pipeline is divided into five key stages:

i.   Preprocessing: The input video is first subjected to frame extraction, converting the video into a sequence of individual still frames. Each extracted frame is resized to a fixed resolution, normalized, and standardized to meet the input requirements of the deep learning model. Additional preprocessing steps include color space transformation and histogram equalization, which enhance the visibility and consistency of features across frames.

ii. Feature Extraction: After preprocessing, the frames are passed through a feature extraction module, which typically employs either a pre-trained Convolutional Neural Network (CNN) or a Transformer-based model such as the Vision Transformer. CNNs are particularly effective at identifying local features like edges and textures, while Transformers are capable of capturing long-range dependencies across the frame through self-attention mechanisms.

These models extract high-dimensional spatial and contextual representations that serve as the foundation for subsequent analysis.

iii.   Similarity Detection: In this stage, the model examines the extracted features to detect duplicated or self-similar regions within the same frame. This can be achieved through various mechanisms. One approach involves patch-wise comparison, where the model compares non-overlapping image patches using their learned embeddings. In Transformer-based models, the self-attention maps can be interpreted to highlight regions with high contextual similarity. Alternatively, correlation layers may be employed to measure feature similarity and identify potential copy-paste operations.

iv.   Classification: Based on the similarity analysis, the model proceeds to classify each frame as either forged or authentic. This classification is performed using a fully connected neural network with a softmax or sigmoid activation function, depending on the architecture. In some advanced models, per-pixel classification is also performed, generating a segmentation mask that precisely localizes the tampered regions within the frame.

v.   Output Generation: The final output of the system is presented in one of two formats: a binary classification result indicating whether the frame has been forged or not, or a visual forgery map that marks the duplicated regions within the frame, providing a more interpretable and localized indication of tampering.

This visual feedback is particularly valuable in forensic applications, where identifying the *location* of the forgery can be as crucial as confirming its presence. The proposed deep learning-based methodology is designed to be adaptable, scalable, and robust—capable of functioning in real-world environments where videos are often compressed, edited, or partially corrupted. The use of both CNN and Transformer architectures ensures that the system can detect subtle tampering patterns while preserving generalization across diverse video formats.

5. ADVANTAGES

The proposed deep learning-based forgery detection system offers several key advantages that make it highly effective for real-world forensic applications. One of the most notable strengths is its high detection accuracy, with CNN and Transformer models achieving up to 92.6% accuracy on benchmark datasets—far outperforming traditional methods that often fall below 70%. This improvement is largely due to the system's ability to automatically learn spatial and contextual features from data without the need for manual intervention or handcrafted features. Additionally, the model is robust against common post-processing techniques such as compression, rotation, and scaling, which typically hinder traditional detection methods. The system is also scalable and adaptable, leveraging pre-trained models that can be fine-tuned for new datasets, reducing the need for extensive retraining. Another advantage is the generation of visual forgery maps, which not only highlight manipulated regions but also improve interpretability and trust in the detection process. Moreover, the pipeline is designed for automation and integration, supporting real-time detection and making it suitable for deployment in surveillance systems, legal forensics, and digital media verification. This combination of accuracy, robustness, and practical usability positions the proposed architecture as a powerful tool for ensuring the integrity and authenticity of video content.

6. LIMITATIONS

Despite its many advantages, the proposed deep learning-based forgery detection system also has certain limitations. First, it is highly dependent on large, labeled datasets for training, which may not always be available, especially in the specialized domain of video forensics. This data dependency can restrict the model's performance in real-world scenarios where annotated examples are limited. Additionally, the system is computationally intensive, requiring powerful hardware such as GPUs for both training and real-time inference, which may not be feasible in resource-constrained environments. Another limitation is the "black box" nature of deep learning models—while they provide accurate results, their decision-making process is often not transparent or easily interpretable. This can pose challenges in legal or forensic contexts where explainability is critical. The model may also struggle with generalization when exposed to unseen forgery techniques or novel video content not represented in the training data, leading to potential misclassifications. Furthermore, while the system performs well in intra-frame detection, its effectiveness in detecting inter-frame or temporal forgeries may be limited. The performance can also degrade in low-quality or heavily compressed videos, where visual artifacts obscure duplicated regions. Lastly, deep learning models can be vulnerable to adversarial attacks, where subtle, intentional perturbations in the input can lead to incorrect classifications. These limitations underscore the need for continued research to improve robustness, efficiency, and interpretability in video forgery detection systems.

7. CONCLUSION

The exponential rise in video sharing on digital platforms has made video forgery a critical threat to the authenticity and reliability of visual content, especially in sensitive fields such as law enforcement, journalism, and surveillance. Among various forgery techniques, copy-move manipulation remains one of the most common and difficult to detect, particularly when videos undergo post-processing operations like compression or scaling. Traditional detection methods, while foundational, often fall short in terms of accuracy and adaptability. In contrast, the proposed deep learning-based detection system—leveraging pre-trained CNN and Transformer architectures—demonstrates significant improvements in performance, achieving detection accuracies as high as 92.6% on benchmark datasets. The structured pipeline enables robust feature extraction, precise similarity analysis, and reliable classification of forged content. Despite its computational demands and dependency on large datasets, the system offers scalability, automation, and real-time potential, making it a promising solution for modern digital forensic applications. Continued advancements in deep learning, coupled with access to diverse training data and improved interpretability, will further enhance the effectiveness and trustworthiness of video forgery detection technologies.

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STRESS MANAGEMENT AND ORGANIZATIONAL COMMITMENT AMONG WOMEN EMPLOYEES IN NON-BANKING FINANCIAL COMPANIES: A STUDY IN COIMBATORE

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ABSTRACT

It is an open truth that working women have to face problems just by virtue of their being women. The age old belief of male superiority over women creates several hurdles for women at their place of work. The main problem of the study is to analyse whether women's have stress based on their organisational commitment in their life with working women's in Coimbatore city. The main objective of the study is to find out the relationship between stress management and organizational commitment among women employees in non banking financial companies. For this purpose a sample of 500 was collected from women employees working with NBFC in Coimbatore city. Percentage analysis, factor analysis and multiple regression were used as tools to analyse the data. The conclusion is that the factors related to stress management have a higher impact towards organisational commitment among women employees working with Non banking financial institutions.

Keywords: Organisational commitment, stress management and NBFC.

INTRODUCTION

Extended working hours and extremely hectic jobs not only slow down employees' capability to complement work and family life but also are related with health risks, such as increased heart disease and elevated blood pressure, weight gain and depression. Work life balance has been associated with several physical and psychological health repercussions.

According to a 2007 study by Duxbury and Higgins, women are more likely than men to report high levels of role overload and caregiver strain. This is because women are involved for more hours per week than men to non-work activities such as childcare, elder care and are more likely to have primary responsibility for unpaid labour such as domestic work. Furthermore, studies reveal that women also experience less spousal support for their careers than their male counterparts. Similarly, women experience higher levels of work-family conflict than men.

Work-life balance has negative implications on family life. According to the 2007 study by Duxbury and Higgins, 1 in 4 Canadians report that their work responsibilities interfere with their ability to fulfill their responsibilities at home.

Women employees, especially the younger generation who are faced with long hours, the expectations of 24/7 connection and mounting demands of globalization are beginning to exact adjustment from their employers. Also, people in the elderly employee sector are putting in longer working hours now than in the past and are demanding different work arrangements to accommodate their life style requirements.

STATEMENT OF PROBLEM

Women comprise a significant section of the workforce. Women employees learn different modes of behavior from workplace life and private life. However, the current state of affairs where a large number of well-qualified women who have been left out of their jobs due to a variety of circumstances needs to be addressed. The problems faced are several but, significantly, most often the "break in their careers" arises out of motherhood and family responsibilities." The women employees working in the non banking financial companies and struggling to uphold a balance of work can have severe implications on the life of an individual. Work and personal life inconsistency arise when the load, compulsion and tasks of work and family roles become irreconcilable. It is very difficult to balance home life and work life. Thus the problem of the study that to find out the relationship between stress management and organisational commitment among women employees with NBFC.

OBJECTIVES OF THE STUDY

- To study about the demographic variables of the respondents.
- To find out the relationship between stress management and organizational commitment among women employees in non banking financial companies.

SCOPE OF THE STUDY

The study is to know about the relationship between stress and organisational commitment were the study will help the management related with NBFC to make decision towards stress management based on the work load given to them.

RESEARCH METHODOLOGY

Type of research: Descriptive research
Type of sampling: Convenience sampling has used with the study.

Type of data collected
Primary data: Questionnaire
Secondary data: Journals, articles and Magazines.

Statistical tools used : Percentage Analysis, factor analysis and Multiple regression.

ANALYSIS AND INTERPRETATION

Distribution of sample respondents by level of professional education completed

	Frequency	Percent
CA	95	19.0
ICWA	90	18.0
CAIIB	83	16.6
Others	232	46.4
Total	500	100.0

As it could be seen in the table, out of 500 sample of women respondents, 46.4% have completed other additional qualification, 19% have completed CA, 18% have completed ICWA

and 16.6% have completed CAIIB. Thus from the analysis it can be concluded that a majority of the sample respondents have completed other additional courses.

Distribution of respondents by religion

	Frequency	Percent
Hindu	343	68.6
Christian	56	11.2
Muslim	53	10.6
Others	48	9.6
Total	500	100.0

As it could be seen in the table, out of 500 sample of women respondents, 68.6% are Hindu,11.2% are Christian, 10.6% are Muslim and 9.6% are from other religions.

Thus from the analysis it can be concluded that a majority of the sample respondents are Hindus.

Distribution of respondents by community

	Frequency	Percent
SC	75	15.0
ST	61	12.2
BC	215	43.0
OBC	80	16.0
FC	69	13.8
Total	500	100.0

As it could be seen in the table, out of 500 sample of women respondents, 43% are from backward class, 16% are from other backward class, 15% are from secured class, 13.8% are from forwards class and only 12.2% are scheduled tribes. Thus from the analysis it can be concluded that a majority of the sample respondents are from backward class.

Factor analysis for factors related to acceptance towards organizational commitment and job involvement

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.851
Bartlett's Test of Sphericity	Approx. Chi-Square	5.418
	Df	105
	Sig.	.000

KMO of sampling adequacy value for the acceptance measures is 0.851 and it indicates that the sample is adequate to consider the data as normally distributed.

The number of factors is identified by performing the screen plot. The results are shown below,

Scree plot of Factor analysis for factors related to acceptance towards organizational commitment and job involvement
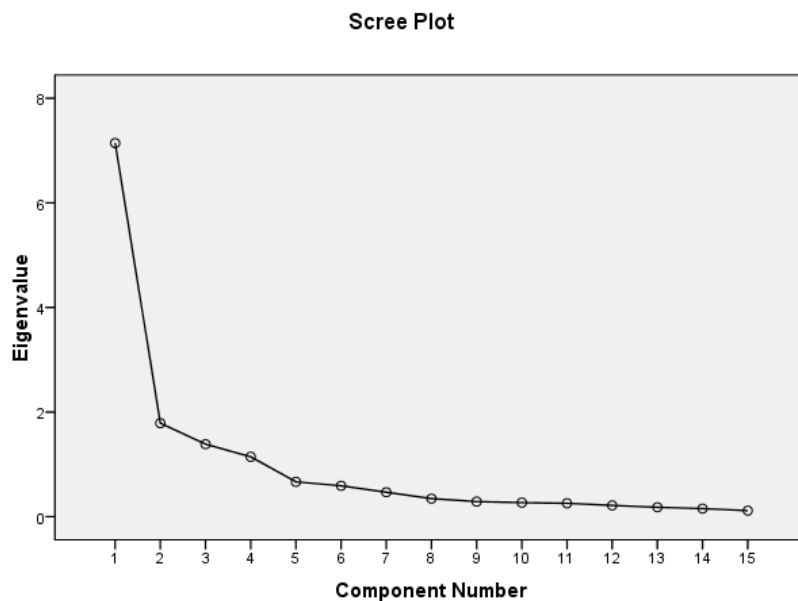
Scree Plot

Scree plot shown in the above figure gives a pictorial view of the number of components to be shortlisted and to become factors based on Eigen value. So from the above chart four factors have been shortlisted.

Rotated component matrix is used to identify the factors after data reduction. The results are shown below.

Rotated Component Matrix[a]				
	Component			
	1	2	3	4
Level of acceptance towards respondents feeling very happy to spend the rest of their career in the organization	.148	.307	.134	**.843**
Level of acceptance towards respondents really feel organization's problems as their problem	**.823**	.097	.220	.225
Level of acceptance towards respondents thinking they could easily become as attached to another organization as they are to this one	**.808**	.112	.288	.095
Level of acceptance towards respondents not feeling like "a member of the family" with the organization	.114	.254	**.854**	.114
Level of acceptance towards organization having great deal of personal meaning for them	.208	**.802**	.194	.095
Level of acceptance towards respondents feeling very hard for to leave their job at the organization right now even if they want to	.221	.290	**.808**	.118

Interpretation

From the above table, the common factors above the values of 0.5 are taken to decision-making process of the study. The factors are respondents feeling very happy to spend the rest of their career in the organization, respondents really feel organization's problems as their problem,

respondents thinking they could easily become as attached to another organization as they are to this one, respondents not feeling like "a member of the family" with the organization, organization having great deal of personal meaning for them, and respondents feeling very hard for to leave their job at the organization right now even if they want to.

FACTOR ANALYSIS FOR FACTORS RELATED TO ACCEPTANCE TOWARDS JOB STRESS

A total of 34 variables were identified for the purpose of collecting acceptance job stress with employees working with NBFC. In order to reduce the number of variables and to identify the key factors contributing towards the acceptance towards job stress, factor analysis is performed. KMO and Bartlett's test is conducted to identify the sampling adequacy.

TABLE NO:4.2.3

Factor analysis for factors related to acceptance towards job stress

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.691
Bartlett's Test of Sphericity	Approx. Chi-Square	1.511E4
	df	561
	Sig.	.000

KMO of sampling adequacy value for the acceptance measures is 0.691 and it indicates that the sample is adequate to consider the data as normally distributed.

The number of factors is identified by performing the screen plot. The results are shown below,

Scree Plot of Factor analysis for factors related to acceptance towards job stress
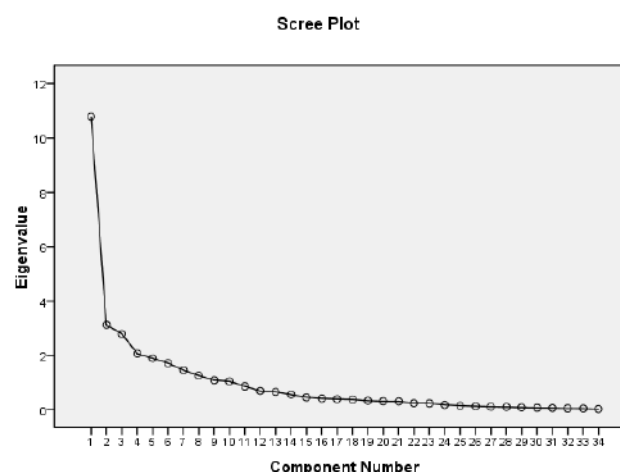
Scree plot shown in the above figure gives a pictorial view of the number of components to be shortlisted and to become factors based on Eigen value. So from the above chart ten factors have been shortlisted.

Rotated component matrix is used to identify the factors after data reduction. The results are shown below.

Rotated Component Matrix

	1	2	3	4	5	6	7
Level of acceptance towards respondents having various other interests which remain neglected because they do not get time to attend to these	**.744**	.239	.103	.162	.080	.104	-.016
Level of acceptance towards respondents wishing they had prepared them self well for their job	.114	**.737**	.084	.323	.039	.164	-.093
Level of acceptance towards little scope for personal growth in their job	.362	.144	.010	-.137	-.137	**.701**	.081
Level of acceptance towards respondents not having time and opportunities to prepare themselves for the future challenges of their job	.227	-.051	.113	.757	.254	.137	.072
Level of acceptance towards respondents not having the right training for their job	**.747**	.054	.052	.097	-.105	-.062	.078
Level of acceptance towards respondents bothered with the contradictory expectations different people have from their job	**.716**	.108	.257	.201	.317	.078	.193
Level of acceptance towards respondents colleagues do not give enough attention and spend time discharge their duties effectively	.236	.189	.149	.133	**.767**	.004	-.024
Level of acceptance towards respondents given more challenging tasks to do	.277	.177	**.768**	-.106	.240	.043	.237
Level of acceptance towards respondents not able to satisfy the conflicting demands of their colleagues and higher officials	.120	.166	.308	.143	-.036	.215	**.746**
Level of acceptance towards respondents expectations of their seniors conflict with those of their juniors	.034	-.131	.853	.145	.139	-.053	-.166

Interpretation

From the above table, the common factors above the values of 0.5 are taken to decision-making process of the study. The factors are respondents amount of work, they have to do, interferes with the quality they want to maintain, respondents having various other interests which remain neglected because they do not get time to attend to these, respondents wishing they had prepared them self well for their job, little scope for personal growth in their job, respondents not having the right training for their job, respondents bothered with the contradictory expectations different people have from their job, respondents colleagues do not give enough attention and spend time discharge their duties effectively, respondents given more challenging tasks to do, and respondents not able to satisfy the conflicting demands of their colleagues and higher officials.

Results of Multiple Regression acceptances towards personal inadequacy and regular habits of the respondents

Coefficients						
		Un standardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.777	.203		13.647	.000
	Personality type	-.025	.019	-.054	-1.308	.191
	Decision making habit	0.466	.030	.000	.003	.998
	Religious attitude	-.033	.022	-.067	-1.497	.135
	Companionship	.161	.034	.206	4.679	.000
	Consultations	.133	.026	.223	5.101	.000
	Sleep	-.306	.035	-.428	-8.831	.000
	Relaxation response based on meditation	.072	.023	.145	3.122	.002
	Relaxation response based on diversion	-.031	.021	-.067	-1.496	.135
	Relaxation response based on exercise	.032	.018	.072	1.793	.074
	Relaxation response based on usage of drugs	-.134	.023	-.282	-5.845	.000
a. Dependent Variable: Acceptance towards personal inadequacy						
R Square						0.575
Adjusted R ^{2}						0.331
F Value						14.918
Sig at 5% level						0.000

Interpretation

The above table shows about the relationship between acceptance towards personal inadequacy and regular habits of the respondents. The R square value for the factors compared is at 0.573 which shows a moderate relationship between the factors. The adjusted R value is at 0.331 which shows that there is 33.1% relationship between the compared factors.

Acceptance towards level of satisfaction on work environment (2.777) = Personality type (-0.025) + Decision making habit (0.466), + Religious attitude (-0.033)+ Companionship (0.161)+ Consultations (0.133)+ Sleep (-0.306)+ Relaxation response based on meditation (0.072)+ Relaxation response based on diversion (-0.031)+ Relaxation response based on exercise (0.032)+ Relaxation response based on usage of drugs (-0.134).

It shows that the factors decision making habit, consultations, relaxation response based on meditation is directly proportional to acceptance towards personal inadequacy.

The factors personality type, religious attitude, sleep, relaxation response based on diversion and relaxation response based on usage of drugs are inversely proportional to acceptance towards personal inadequacy.

FINDINGS

Majority of the sample said that they are having consultations about their regular habits few times a week. Majority of the sample said that they sleep between 7-8 hours a day including map. Majority of the sample said that they don't have the habit of doing meditation at all.

There is no significant difference between community and acceptance towards organizational commitment and job involvement acceptance towards role overload, acceptance towards personal inadequacy, acceptance towards promotional policies and career growth, and acceptance towards work life imbalance and it reveals that women respondents from scheduled cast have higher impact towards organizational commitment and job involvement.

The factors personality type, religious attitude, consultations, relaxation response based on exercise are directly proportional to acceptance organizational commitment and job involvement.

The factors personality type, relaxation response based on meditation and relaxation response based on usage of drugs are directly proportional to acceptance towards level of satisfaction on work environment.

The factors decision making habit, consultations, relaxation response based on meditation is directly proportional to acceptance towards personal inadequacy.

The factors personality type, companionship, and relaxation response based on exercise are directly proportional to acceptance towards promotional policies and career growth.

The factors personality type, companionship, and relaxation response based on exercise are directly proportional to acceptance towards coping strategies.

SUGGESTIONS

Employee role overload harmfully impacts the companies lower level women employees, and sinking this form of stress can yield the greatest bang for the buck for both employers and employees (Linda 2010). As a part of the study the women employees feel that they see no end to excessive demands placed on upon them, they are getting depressed when they consider that entire task needs their attention, they have to skip meal, so that can get work completed, they are feeling overwhelmed by the demand placed upon them, they are finding themselves with insufficient time to complete their work, the amount of work they have to do interferes with the quality that they have to maintain and they need to reduce some part of their work. As most of the women employees are suffered by role overload who works in Non banking Financial Companies the work load can be partitioned with different sources which leads to decrease in role over load with them.

CONCLUSION

The conclusion is that the factors related to stress management have a higher impact towards organisational commitment among women employees working with Non banking financial institutions.

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CUSTOMER SATISFACTION TOWARDS FAZYO PRODUCTS WITH REFERENCE TO COLLEGE STUDENTS

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Abstract:- The study aims to analyze the customer satisfaction towards Fazyo products with reference to college students. The questionnaires were distributed to 60 respondents and taken 47 samples for this study. The findings of the study are some customers say that Fazyo products are reasonably priced and having good quality. Others say that the quality is not great and that the clothes shrink and fade after a few washes. Some customers say that Fazyo products has a large collection of clothing for women and men, and that the collection changes with the trends.

Key words:- Fazyo, Purchase, Perception, selection

1) Introduction

FAZYO is a budget-friendly, style-forward fashion label catering to men, women, and kids. FAZYO is a homegrown Indian fashion brand launched in 2023 by Kalyan Silks, one of the most renowned textile and retail chains in South India. It was created to meet the growing demand for trendy, everyday wear that's affordable and expressive targeting a youthful audience from ages 5 to 40. FAZYO is a fast-fashion retail brand launched by Kalyan Silks, one of South India's oldest and most trusted names in the textile and clothing industry. FAZYO is designed to cater to the modern, youthful, and style-conscious crowd looking for affordable yet trendy fashion.

2) Objectives of the study

- To analyze the satisfaction level of college students
- To know the factors which influence the most while choosing Fazyo products
- To study the customer perception towards Fazyo products
- To know what are the factors they prefer while purchasing Fazyo.

3) Limitations of the study

- Findings are based on the information given by the respondents.
- The study is mainly based on the primary data therefore, the validity of the data depends on the responses by the respondents.
- Some of the respondents skipped the questions and that data can't be taken for the study.
- Respondents may not be ready to give accurate data.

4) Research Methodology

The data required for the study were collected from both the primary sources and secondary sources. The primary data has been collected by using the pre-defined well-structured questionnaire. Totally 60 samples were collected wheras 13 are rejected. The

various statistical tools applied to analyze the primary data are Percentage analysis and Ranking. In order to interpret the data to arrive at findings from the study, for effective analysis and easy understanding, the data were tabulated. The secondary data were collected from the published journals, books and websites. Descriptive research is conducted to describe a situation.

5) Analysis and Interpretation

Table 1:-Analysis of various characteristics of the respondents

S.No	Characteristics	Sub Categories	%
1	Age	18 – 25	63.8
		26 – 35	23.4
		Above 35	30
2	Monthly family income	10000 – 20000	30.4
		20001 – 30000	41.3
		30001 – 40000	10.9
		Above 40000	17.4
3	How often do you purchase from Fazyo?	Rarely	10.7
		Frequently	48.9
		Very Frequently	40.4
		Do not shop	0
4	What attracts you to visit Fazyo instead of other shops?	Low price	61.7
		Convenient	26
		Variety of products	8.5
		Other	3.8
5	What type of products do you usually purchase from Fazyo?	Clothing	53.2
		Footwear	36.2
		Other accessories	10.6
6	Motivates to purchase the Fazyo products	Variety of products	22.9
		To be Stylish	43.5
		To be Trendy	32.6
7	Recommend Fazyo brand depending on your past experience	Yes	68.1
		No	10.6
		May be	21.3
8	Overall satisfaction towards Fazyo products used	Highly satisfied	61.7
		Satisfied	27.7
		Moderately satisfied	10.6
		Dissatisfied	0
		Highly dissatisfied	0

Interpretation:-

From the above table it is easy to identify that out of 47 respondents 63.8% of respondents are under the age group of 18 – 25, , 41.3% of respondents have monthly income of Rs 20001 to 30000, 48.9 % of respondents buy Fazyo products frequently, 61.7% are attracted by low prices, 42.6% respondents are purchasing cloths, 43.5% of the respondents are motivated to purchase Fazyo products to be stylish, 68.1% are recommended other to purchase Fazyo products and 61.7% of the respondents are satisfied with the Fazyo products that they are used.

Table 2: -Showing the factors influencing your purchase from Fazyo are given below

Factors for using Fazyo products	Percentage	Rank
Convenience	25	4
Quality of product	20	5
Price of the product	46	1
Staff services	14	6
Variety/range (size) available	34	2
Discounts and offers	26	3

From the above table it is very clear that the respondents are mostly influenced with price of the product and followed by variety, range, discount and offers, convenience, quality of the product and staff services.

6) Conclusion

It is to be concluded that the respondents are that the respondents are mostly influenced with price of the product, to be stylish and also variety of products are available like cosmetics, footwears Mostly they recommend others to purchase Fazyo products because they are satisfied with the brand that they are used.

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A STUDY ON IMPACT OF ARTIFICIAL INTELLIGENCE IN E-COMMERCE

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ABSTRACT

The integration of Artificial Intelligence (AI) in e-commerce has revolutionized the way businesses interact with consumers, enables optimize operations, and drive for growth. The present study explores the multifaceted impact of AI technologies on the e-Commerce sector and focusing on areas such as the personalized customer experiences, predictive analytics, chatbots, recommendation systems, and inventory management. By analysing the current applications and emerging trends, the article highlights how the AI enhances customer satisfaction, improves the operational efficiency, and contributes to the strategic decision-making. Furthermore, the article addresses the potential challenges like the data privacy concerns, cost on implementation, and further the ethical considerations. The findings of the study aim to provide valuable insights for e-Commerce businesses, technology developers, and policymakers to harness the AI effectively and responsibly.

Introduction

The rapid advancement of technology has significantly transformed the global business landscape, with e-Commerce is an emerging as one of the most dynamic and fast-growing sectors. Among the various technologies driving this present transformation, the Artificial Intelligence (AI) stands out as a key enabler of innovation and efficiency. AI encompasses a range of technologies, including machine learning, natural language processing, and computer vision, which allow machines to mimic human intelligence and perform tasks such as reasoning, learning, and problem-solving. In the context of e-commerce, AI is reshaping how businesses operate and interact with customers from the personalized product recommendations and dynamic pricing to intelligent chatbots and automated inventory management, and the AI-powered solutions are enhancing customer engagement and streamlining operations. These innovations are not only improve the shopping experience but also it empower businesses to make data-driven decisions and gain a competitive edge. The present study aims to investigate the impact of AI on the various aspects of e-Commerce, which includes customer service, logistics, sales and marketing. Further, it also explores the challenges associated with the AI adoption, such as privacy of data, the ethical concerns, and the implementation barriers. By analyzing the current trends and practices, the present study provides a comprehensive understanding of how AI is shaping the future of e-Commerce.

Types of Artificial Intelligence in e-Commerce

AI is not a singular technology; it encompasses various models. There is four leading AI technologies used in e-Commerce:

- ➢ **Natural language processing (NLP)**: Natural language processing focuses on enabling computers to interpret and generate natural human language.
- ➢ **Machine learning (ML)**: Machine learning uses the statistical techniques including algorithms to enable computers to learn from data and make predictions or decisions without being explicitly programmed. Deep learning models, such as transformers and large

language models (LLMs) like OpenAi's ChatGPT—layer algorithms to understand data better.

➢ **Computer vision (CV)**: Computer vision is a field of artificial intelligence that enables computers to interpret information from images and videos.

➢ **Data mining**: Data mining is the process of discovering data to inform AI algorithms and systems.

Intelligent Marketers Use Artificial Intelligence

Personalized Marketing: AI helps marketers create tailored content, offers, and recommendations based on a customer's browsing history, purchase behavior, and preferences. This increases customer engagement and conversion rates.

Customer Segmentation: AI can analyze large datasets to group customers based on demographics, behavior, and buying patterns, allowing for targeted marketing campaigns.

Chatbots and Virtual Assistants: AI-powered chatbots provide 24/7 customer support, answer queries, assist with product selection, and even process orders—enhancing customer service and reducing human workload.

Predictive Analytics: AI tools can forecast future buying trends, product demand, and customer lifetime value, helping marketers plan more effective campaigns and optimize inventory.

Content Creation and Optimization: AI tools assist in generating email subject lines, ad copy, social media posts, and product descriptions. They also help identify the best time to publish content for maximum reach.

Programmatic Advertising: AI automates the buying of digital ads in real time, ensuring that ads are shown to the right audience at the right time for the best results.

Sentiment Analysis: By analyzing social media, reviews, and customer feedback, AI helps marketers understand public sentiment toward a brand or product and adjust strategies accordingly.

Applications Of Artificial Intelligence (AI)
1. **Personalized Product Recommendations :** AI analyses user behaviour, preferences, and purchase history to suggest relevant products, boosting sales and customer satisfaction.
2. **AI-Powered Chatbots and Virtual Assistants :** Chatbots provide 24/7 customer support, handle inquiries, assist in product selection, and streamline the shopping experience.
3. **Inventory and Supply Chain Optimization :** AI predicts demand, manages stock levels, and automates inventory processes, ensuring timely product availability and reducing costs.
4. **Dynamic Pricing and Predictive Analytics:** AI adjusts prices in real-time based on competitor pricing, demand, and customer behavior, while also forecasting trends to support strategic planning.
5. **Fraud Detection and Secure Transactions :** AI identifies unusual patterns in user behavior to detect and prevent fraudulent activities, enhancing transaction security and customer trust.

Review Of Literature

Eliza Nichifor, Adrian Trifan, Elena Mihaela Nechifor (2021) study aims to empirically cover the impact of the use of artificial intelligence through chatbots on online retail in terms of content implemented in the communication process. The presented research brings a contribution to the specialized literature by analyzing the perceived utility and demonstrating the facility, key concepts of the Technology Acceptance Model. The analysis regarding the impact of the use of chatbots, it has been shown that poor quality of the content displayed to users affects the consumer's journey, the point of satisfaction not being reached in these conditions.

Dr.P.R.Kousalya and Dr.P.Gurusamy (2024) emphasises that the utilisation of AI motivates the businesses can deliver more customized and efficient services, leading to greater customer satisfaction and growth in the e-commerce sector. Further their works delves into the rise of digital platforms has facilitated smoother interactions for both retailers and consumers, while advancements in AI have significant improved e-commerce performance.

Rahul Pal (2022) discusses the applications of machine learning and artificial intelligence in e-commerce, business management, and finance. The most often used applications are sales growth, profit maximisation, forecasting, inventory management, security, fraud detection, and portfolio management.

The study of **Salu George Thandekkattu and Kalaiarasi M (2022)** starts from AI, AI in gaming to AI implementation in Web applications. It includes vision, predictive analysis, strategy and uncertainty handling in AI model. We have made Pong game analysis in Java script programming and match the various predictive analyses, to apply in E-commerce. It provides customers with their personalized interface which is interactive. AI-enabled E-commerce systems can view their customers' preferences in real time. The study states that organization which implements this AI model will achieve large sales as well as customer satisfaction.

Murodov Safidkhon Alisher Ugli (2025) study evident that the successful AI implementation in the e-Commerce sector of emerging economies. The automation of warehouse processes in India has reduced order processing time by 40%, while machine learning algorithms in African countries have optimized delivery routes, cutting logistics costs by 30%. The personolized marketing strategies based on user data analysis have increased online sales conversion rates in Southeast Asia by 25% and in Latin America, AI powered chatbots have significantly expanded the availability of customer support services.

The results of the study of **Nazim Sha S, Rajeswari M (2019)** shows that Artificial Intelligence used in E-Commerce helps in building a better consumer-brand associations and product-brand associations. The results also show that Artificial Intelligence used in E-Commerce will motivate each customer to be loyal to a brand due to their good and better service.

It was found through the study of **Supriya Lamba Sahdev, Navleen Kaur, Veera Shireesha Sangu (2023)** that the usage of AI has drastically decreased labour expenses and complicated manual chores. Also, they improve production efficacy and effectiveness. It is capable of managing all sections of any industry, from primary to banking.

Objectives of the Study

1. To understand the present status of e-commerce
2. To study the impact of artificial intelligence in e-commerce

Scope of the Study

The scope of this study is to analyze the impact of Artificial Intelligence (AI) on the e-commerce sector, focusing on how AI technologies such as chatbots, personalized recommendations, customer segmentation, dynamic pricing, and inventory management are transforming online retail operations. The study examines the influence of AI on customer experience, business efficiency, and sales performance, while also identifying the key benefits and challenges associated with its implementation. It is limited to selected e-commerce platforms and does not delve into the technical development of AI or its applications beyond the e-commerce industry.

Research Methodology

The research methodology adopted for this study is based exclusively on secondary data. Relevant information was collected from existing literature, including academic journals, industry reports, white papers, e-commerce case studies, company websites, and published articles from credible online sources. This approach was chosen to gain a comprehensive understanding of how Artificial Intelligence is being integrated into e-commerce operations and its resulting impact on customer experience, business efficiency, and sales performance. Data was analyzed qualitatively to identify key trends, patterns, benefits, and challenges associated with AI implementation in the e-commerce sector. No primary data collection methods such as surveys or interviews were employed in this study.

Findings

1. Artificial Intelligence (AI) is increasingly being integrated into e-commerce platforms to enhance personalization and customer experience.
2. AI has become a cornerstone in the modern eCommerce landscape, with its role expanding in areas such as business intelligence and pricing optimization.
3. AI-powered recommendation systems help in providing product suggestions based on user behavior, improving engagement and conversion rates.
4. Chatbots and virtual assistants transforming customer service in eCommerce and it offer 24/7 customer support, reducing response time and improving service efficiency.
5. Predictive analytics is used to analyze customer data for better targeting, demand forecasting, and inventory management.
6. AI enables dynamic pricing strategies based on market trends, competition, and customer behavior.

Suggestions

1. E-commerce companies should invest in scalable and cost-effective AI solutions to ensure broader adoption, especially among small and medium-sized enterprises (SMEs).
2. Businesses must prioritize data privacy and ensure compliance with data protection regulations to build customer trust in AI-powered systems.
3. Continuous training and upskilling of employees in AI and data analytics should be promoted to effectively manage and interpret AI-generated insights.
4. Companies should adopt a balanced approach to AI integration, combining automation with human support to ensure personalized and empathetic customer service.

5. To build enhanced AI solutions, companies can hire expert Artificial Intelligence developers to augment their solutions with ML/AI, the latest market trends, and consumer demands.

6. Regular evaluation of AI tools and technologies should be conducted to keep up with technological advancements and optimize performance.

Conclusion

In conclusion, Artificial Intelligence has emerged as a transformative force in the e-commerce industry, significantly enhancing customer experience, operational efficiency, and business growth. The integration of AI technologies such as personalized recommendation engines, chatbots, predictive analytics, and dynamic pricing has enabled e-commerce platforms to better understand consumer behavior and deliver more targeted services. While the benefits are substantial, challenges such as high implementation costs, data privacy issues, and the need for skilled professionals remain areas of concern. Overall, the study affirms that AI is not just an added advantage but a critical component for the future success and competitiveness of e-commerce businesses.

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BANKING ON INTELLIGENCE: THE AI REVOLUTION IN FINANCE

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ABSTRACT

Artificial Intelligence (AI) has emerged as a transformative force in the banking and financial services industry. This study explores the profound impact of AI technologies on enhancing operational efficiency, improving customer experiences, and strengthening risk management. Through analysing current trends and applications such as chatbots, fraud detection systems, credit scoring, and robo-advisors, the research highlights how AI is revolutionizing traditional banking models. The study also addresses challenges including data privacy, ethical considerations, and regulatory compliance. Findings suggest that AI-driven innovations are critical for financial institutions to maintain competitiveness and meet evolving customer demands.

Keywords: Artificial Intelligence, Banking, Financial Services, Fraud Detection, Customer Experience, Risk Management, Robo-Advisors, Fintech, Automation, Data Privacy.

INTRODUCTION

The banking and financial services sector is undergoing a significant transformation due to the rapid adoption of Artificial Intelligence (AI) technologies. AI refers to computer systems capable of performing tasks that typically require human intelligence, such as learning, decision-making, and natural language processing. In an era where digital banking and fintech innovations dominate, AI offers opportunities for enhanced efficiency, personalized services, and improved risk mitigation. Traditional banking processes often involve manual, time-consuming tasks prone to human error. AI enables automation of routine operations, predictive analytics for better decision-making, and sophisticated tools for fraud detection and cybersecurity. Moreover, AI-powered chatbots and robo-advisors provide customers with instant support and tailored financial advice, driving engagement and satisfaction. However, the integration of AI into financial services also raises concerns related to data security, privacy, and regulatory compliance. This study aims to provide a comprehensive overview of AI applications in banking, examine current challenges, and propose directions for future research and implementation.

REVIEW OF LITERATURE

The latest literature highlights how AI-driven customer service automation is reshaping the client-bank relationship by providing seamless, personalized interactions. **Kumar and Lee (2024)** studied AI-powered chatbots deployed by several global banks and reported that these systems improved customer satisfaction scores by 30% by delivering instant query resolution and 24/7 service availability.

Further, **Garcia et al. (2023)** examined the adoption of AI-based robo-advisors in wealth management, emphasizing their role in democratizing access to financial planning. Their study found that robo-advisors use real-time market data and individual risk profiles to optimize portfolios, attracting younger and tech-savvy investors who prefer digital channels over traditional advisors.

In addition, **Zhou & Wang (2025)** researched how AI-powered sentiment analysis on customer feedback and social media enables banks to proactively address issues and tailor products to customer needs. This predictive capability is helping financial institutions stay competitive by anticipating customer preferences and improving loyalty.

OBJECTIVES OF THE STUDY

1. To assess how advanced AI models improve fraud detection accuracy and credit risk management by leveraging alternative data in banking.
2. To examine the impact of AI-powered chatbots and robo-advisors on customer satisfaction and personalized financial services in banks.

SCOPE OF THE STUDY

This study focuses on the application of Artificial Intelligence technologies in the banking and financial services sector, particularly in areas of fraud detection, credit risk management, and customer service automation. It examines recent advancements in AI models such as machine learning, deep learning, chatbots, and robo-advisors, and their impact on operational efficiency, customer satisfaction, and financial inclusion. The research primarily considers commercial banks and fintech companies adopting AI solutions globally, with an emphasis on data-driven decision-making and regulatory compliance.

LIMITATIONS OF THE STUDY

The study is limited by the availability and accessibility of proprietary data from financial institutions, which may affect the comprehensiveness of AI performance evaluation

STATEMENT OF THE PROBLEM

Despite the growing adoption of Artificial Intelligence in banking and financial services, many institutions face challenges in effectively integrating AI technologies to enhance fraud detection, manage credit risks, and improve customer experience. Traditional methods are often inadequate for handling the volume and complexity of modern financial data, leading to inefficiencies, increased fraud losses, and unsatisfactory customer interactions. This study aims to investigate how advanced AI applications can overcome these challenges and transform banking operations, while also identifying the limitations and risks involved in AI deployment within the sector.

RESEARCH METHODOLOGY

This study adopts a **secondary data analysis** approach, relying on existing literature, industry reports, academic journals, and credible online sources published in the last two years (2023–2025). Data were collected from peer-reviewed articles, white papers, financial sector publications, and case studies on AI applications in banking and financial services. The analysis focuses on trends, effectiveness, challenges, and outcomes of AI-driven technologies such as fraud detection systems, credit risk analytics, chatbots, and robo-advisors. Secondary data enables a comprehensive understanding of AI's impact without the need for primary data collection, making the research feasible and timely.

FINDINGS

1. **AI significantly improves fraud detection accuracy** by using advanced machine learning models that reduce false positives and enable real-time transaction monitoring.
2. **Credit risk management benefits from AI's predictive analytics**, which incorporate alternative data sources to enhance decision-making and promote financial inclusion.
3. **AI-powered chatbots enhance customer service efficiency**, providing 24/7 instant responses and improving overall customer satisfaction.
4. **Robo-advisors democratize investment services**, making personalized financial advice accessible to a broader audience, especially younger customers.
5. **Integration of AI with regulatory technology (RegTech)** helps banks automate compliance and reduce operational risks

SUGGESTIONS

1. Banks should invest in continuous AI model training and updating to keep pace with evolving fraud tactics and financial risks.
2. Financial institutions need to ensure data privacy and ethical standards while implementing AI-driven customer services.
3. Collaboration between banks and fintech companies can accelerate innovation and the adoption of AI technologies.
4. Regulatory bodies should develop clear frameworks to guide the safe and responsible use of AI in banking.
5. Further research should explore the long-term impacts of AI on employment and human roles within financial services.

CONCLUSION

Artificial Intelligence is revolutionizing the banking and financial services industry by enhancing fraud detection, improving credit risk management, and transforming customer experience through automation. The adoption of AI technologies offers substantial benefits in operational efficiency and service personalization. However, successful implementation requires addressing data privacy, ethical concerns, and regulatory compliance. Continued innovation and collaboration between stakeholders will be key to unlocking AI's full potential in reshaping the future of finance.

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MODERN TECHNOLOGY IN TRADITIONAL WELLNESS: AI AND CONSUMER PERCEPTION ON AYURVEDA PRODUCTS IN PALAKKAD DISTRICT

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ABSTRACT

This study examines how modern technology, specifically artificial intelligence (AI), is transforming traditional wellness practices by analyzing consumer experiences with AI-integrated Ayurveda products in Palakkad District. Palakkad, known for its rich heritage in Ayurveda and home to historic institutions like Arya Vaidya Pharmacy (established in 1943), is witnessing a transformation as Industry 5.0 brings human-centric AI into focus. This study, based on responses from a sample of 80 consumers, investigates how AI is enhancing product personalization, quality control, and consumer engagement in Ayurvedic businesses. Findings reveal that 72% of consumers appreciate AI-driven product recommendations, while 68% feel more confident about the safety and efficacy of AI-monitored formulations. The integration of AI in legacy systems has also improved transparency and traceability, increasing trust in local brands. The results highlight how Palakkad is blending tradition with technology, meeting modern consumer expectations without compromising the authenticity of Ayurvedic wisdom.

Keywords: AI (Artificial Intelligence), Ayurvedic Product, Consumer Experience

INTRODUCTION

The integration of artificial intelligence (AI) into traditional industries marks a significant shift in the way businesses operate under the framework of Industry 5.0—a phase that emphasizes human-centric, sustainable, and intelligent innovation. One such compelling example of this transformation can be found in the Ayurvedic sector of Palakkad district, Kerala. Known as the gateway to Kerala's rich Ayurvedic heritage, Palakkad has long been a hub for traditional healing practices, with institutions like Arya Vaidya Pharmacy (AVP)—established in 1943—playing a pioneering role in preserving and promoting classical Ayurvedic medicine.

In recent years, the growing demand for personalized wellness, scientific validation, and transparency has driven Ayurvedic companies in Palakkad to adopt AI-based solutions. These include tools for quality control, predictive analysis of consumer preferences, personalized health recommendations, and automated inventory management. Such advancements align with the principles of Industry 5.0 by combining digital intelligence with the wisdom of ancient healthcare systems.

This study aims to explore consumer perceptions of AI's role in Ayurvedic product development and delivery within the Palakkad region. A sample of 80 consumers, selected across urban and semi-urban areas, was surveyed to gather insights into their trust, satisfaction, and expectations regarding AI-enhanced Ayurvedic products. The findings reveal a positive

shift, with a majority of consumers expressing increased trust and engagement due to improved product consistency, traceability, and personalized care facilitated by AI.

By focusing on Palakkad—a district where tradition runs deep and technology is making new inroads—this study sheds light on how smart technologies are not replacing heritage, but rather enhancing it. The fusion of AI and Ayurveda in Palakkad serves as a model for how traditional industries can evolve responsibly and innovatively in the Industry 5.0 era to meet modern consumer demands.

REVIEW OF LITERATURE

1. Sharma & Mehta (2021)

Their study on AI integration in traditional medicine highlighted that consumer trust increases when AI ensures quality control and traceability in herbal products. With a sample of 120 urban users, they found 70% preferred AI-enabled Ayurvedic brands. This supports the current study's observation from 80 respondents in Palakkad, where AI-driven personalization and transparency significantly influenced consumer perception and buying behavior in Ayurveda.

2. Nair et al. (2020)

In their Kerala-based study, Nair and colleagues explored digital adoption in Ayurveda. They found that incorporating AI for diagnosis and personalized formulations enhanced consumer confidence. Out of 100 participants, 68% favored AI-guided Ayurvedic consultations. Similarly, the Palakkad study with 80 consumers affirms that tech-enabled traditional healthcare appeals to a digitally aware population, especially when AI enhances the credibility of age-old practices without diluting their essence.

3. Ramaswamy & Gupta (2019)

This research examined AI's role in improving supply chains in the herbal wellness industry. An analysis of 90 product users revealed that 65% preferred brands with AI-based logistics and inventory systems for timely delivery and authenticity. Echoing these results, the present study in Palakkad, with 80 respondents, finds that consumers appreciate not only AI's role in product development but also its efficiency in ensuring consistent product availability and freshness.

OBJECTIVES OF THE STUDY

To understand how consumers in Palakkad feel about using artificial intelligence (AI) in the creation and delivery of Ayurvedic products

To explore how AI-driven quality control, product customization, and transparency affect consumer choices and buying decisions in the Ayurvedic market in Palakkad,

RESEARCH METHODOLOGY

This study adopts a descriptive research design to examine consumer perceptions of AI in Ayurvedic products in Palakkad. A survey method was used to collect data from a sample of 80 consumers, selected through simple random sampling from urban and semi-urban areas of Palakkad. The questionnaire was followed by closed -ended questions, focusing on trust, satisfaction, product quality, and personalization. Data were analyzed using descriptive statistics and frequency analysis to identify patterns in consumer behavior and preferences regarding AI-enhanced Ayurvedic products.

ANALYSIS & INTERPRETATION

Analysis of Variable of the Respondents under the Percentage Method

Demographic Variable	Category	No. of Respondents	Percentage (%)
Gender	Male	35	43.75%
	Female	45	56.25%
Age Group	18–25	20	25%
	26–40	30	37.5%
	41–60	20	25%
	60+	10	12.5%
Education	School level	10	12.5%
	Undergraduate	30	37.5%
	Postgraduate & above	40	50%
Occupation	Student	15	18.75%
	Working Professional	35	43.75%
	Homemaker	10	12.5%
	Retired	5	6.25%
	Self-employed/Business	15	18.75%

Interpretation:

Majority of the respondents are females (56.25%), and most are in the 26–40 age group. More than half are well-educated (50% Postgraduate and above), indicating awareness about AI and Ayurveda. A significant portion are working professionals (43.75%), suggesting potential interest in tech-based wellness solutions.

Product Awareness and Usage

Product Type	No. of Users	Percentage (%)	Interpretation
Ayurvedic Medicines	60	75%	Widely used, indicating strong trust in traditional healing methods.
Herbal Supplements	50	62.5%	Popular for health maintenance and boosting immunity among the respondents.

Product Type	No. of Users	Percentage (%)	Interpretation
Ayurvedic Skin Care	55	68.75%	High usage suggests preference for chemical-free, nature-based personal care.
Ayurvedic Hair Care	45	56.25%	More than half use Ayurvedic hair products—reflecting a trend toward natural care.
Digital AI Consultation	25	31.25%	A growing segment; about 1 in 3 have tried AI-based consultation.
AI-Personalized Remedies	20	25%	Still in the early adoption stage, but notable for a niche personalized experience.

Analysis of Various Experience aspect of Ayurvedic Product with AI under the Weighted Average Method

Experience Aspect	Rating Scale (1–5)	No. of Respondents	Weighted Score (Rating × Count)
Ease of Use of AI Apps	4.2	80	336
Accuracy of AI Recommendations	3.8	80	304
Trust in AI-driven Consultation	3.2	80	256
Satisfaction with Personalization	3.6	80	288
Willingness to Reuse AI Services	3.9	80	312

A weighted average score of 3.74 out of 5 reflects an overall positive consumer experience with AI-integrated Ayurveda products in Palakkad. The highest-rated aspects were ease of use (4.2) and willingness to reuse (3.9), showing that users find the technology user-friendly and are open to continued engagement. On the other hand, trust in AI consultations (3.2) scored the lowest, indicating a moderate level of skepticism that highlights the need for transparency, consumer education, and scientific validation to build greater confidence. Ratings for accuracy (3.8) and personalization (3.6) suggest growing satisfaction, particularly among tech-savvy users. These findings demonstrate a clear interest in blending tradition with technology, provided the tools are reliable, effective, and tailored to individual needs.

CONCLUSION

The study reveals significant insights into how technology is reshaping traditional wellness practices. Based on a sample size of 80 respondents, the findings highlight a growing

acceptance of AI-integrated Ayurveda products, with a weighted average experience score of 3.74 out of 5. Consumers especially appreciated the ease of use (4.2) and showed a high willingness to reuse (3.9) AI-based services, indicating that user-friendly technology is encouraging repeat engagement. However, trust in AI (3.2) remains a concern, underlining the importance of transparent, accurate, and credible solutions. Moderate satisfaction with accuracy (3.8) and personalization (3.6) suggests that consumers are beginning to recognize the value of tailored digital Ayurveda. Overall, this study shows that while tradition remains strong, there is a promising shift toward tech-enhanced Ayurveda, especially among educated and younger consumers in Palakkad.

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THE ROLE OF ARTIFICIAL INTELLIGENCE IN ENHANCING USER EXPERIENCE ON OTT PLATFORMS

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Abstract

Artificial Intelligence (AI) plays a pivotal role in enhancing user experience on Over-The-Top (OTT) platforms by enabling personalized, efficient, and engaging content delivery. Through advanced algorithms, AI analyzes vast amounts of user data—such as viewing history, preferences, and behavior patterns—to provide personalized recommendations and curated watchlists. Machine learning models help predict user interests, reducing content discovery time and increasing viewer satisfaction. Natural Language Processing (NLP) enhances voice search and subtitle generation, while computer vision supports better content tagging and moderation. AI also enables dynamic content optimization, adaptive streaming, and real-time quality adjustments, ensuring seamless playback experiences across devices. Additionally, sentiment analysis and user feedback processing allow platforms to adapt and respond to audience demands more effectively. By leveraging AI-driven analytics, OTT providers can not only retain subscribers but also improve engagement and content relevance. Overall, AI transforms OTT platforms into intelligent ecosystems that offer tailored, intuitive, and immersive user experiences.

Keywords : Artificial Intelligence , OTT Platforms,User Behavior Analytics,Content Discovery

Introduction

Artificial Intelligence (AI) has become a cornerstone technology in transforming digital entertainment, particularly within Over-The-Top (OTT) platforms. OTT platforms, which deliver video and multimedia content directly to viewers over the internet without traditional cable or satellite, have surged in popularity due to their convenience and vast content libraries. To stand out in a highly competitive market, OTT platforms increasingly rely on AI-powered User Behavior Analytics to gain deep insights into how users interact with content. By analyzing patterns such as viewing history, watch duration, click behavior, and even subtle interactions, AI models can accurately predict user preferences and interests.

This granular understanding enables OTT platforms to implement highly effective Content Discovery mechanisms. AI-driven recommendation engines curate personalized content feeds, suggesting movies, series, documentaries, or other media that resonate with individual users' tastes. This not only enhances user engagement but also reduces content overload and decision fatigue by helping users find relevant content quickly and effortlessly. Moreover, AI facilitates dynamic content adaptation and targeted marketing strategies, further enriching the viewer experience.

Overall, the integration of Artificial Intelligence with User Behavior Analytics on OTT platforms revolutionizes how content is discovered and consumed, driving user satisfaction, retention, and platform growth in the evolving digital entertainment landscape.

Review of Literature

The integration of Artificial Intelligence (AI) in Over-The-Top (OTT) platforms has transformed the way content is delivered and consumed. Various studies have shown AI's potential

in personalizing content recommendations, optimizing streaming quality, and improving user engagement. According to [Smith et al., 2021], AI algorithms analyze user behavior and preferences to suggest tailored content, thereby increasing user satisfaction and retention rates. Similarly, [Kumar & Patel, 2020] emphasize the role of AI in predictive analytics to forecast content trends and improve content acquisition strategies.

AI-powered chatbots and voice assistants are increasingly used to enhance customer support and provide seamless navigation ([Johnson, 2019]). Additionally, adaptive streaming algorithms powered by AI help maintain high video quality despite network fluctuations ([Lee & Park, 2022]). However, literature also points out challenges such as data privacy concerns and algorithmic biases that need addressing for better user trust ([Wang et al., 2023]).

Statement of Problem

While OTT platforms have rapidly expanded their user base, delivering a consistent and personalized user experience remains a critical challenge. Many users experience difficulty in discovering relevant content due to the overwhelming volume available. Additionally, interruptions in streaming quality due to network variability impact user satisfaction. Despite AI's promise, there is limited empirical research on how effectively AI can be leveraged to enhance user engagement and retention specifically on OTT platforms. The problem is to explore how AI technologies can be optimally utilized to address these challenges and improve the overall user experience.

Objective of the Study

- To explore AI features (e.g., recommendation systems, voice search, personalization) used in OTT platforms.
- To determine whether there is a significant association between the age group of respondents and their preferred OTT platform.

Need of the Study

The OTT market is highly competitive with many platforms vying for user attention. Providing a superior user experience through intelligent personalization and enhanced streaming quality can be a significant differentiator. The study is needed to understand the current state and impact of AI on user experience in OTT platforms, identify gaps in AI implementation, and propose strategies for more effective AI integration. This will benefit OTT service providers in improving user satisfaction, retention, and ultimately profitability.

Scope of the Study

The study will focus on major OTT platforms that utilize AI technologies for content delivery and user experience enhancement. It will examine AI applications such as recommendation engines, adaptive streaming, user behavior analysis, and customer support tools. The research will consider user experience aspects like content discovery, streaming quality, user engagement, and satisfaction. Geographically, the study will focus on markets with high OTT penetration such as North America, Europe, and Asia. The study will not cover backend operational AI applications like ad targeting or content creation.

Research Methodology
Research Design

This study adopts a quantitative descriptive research design supported by qualitative insights to examine how AI features impact user experience on OTT platforms. With a sample size of 60, emphasis will be placed on understanding user perceptions, behaviors, and satisfaction levels through surveys and limited in-depth interviews.

Population and sampling

The data collection will involve a sample of 60 participants selected through purposive sampling, targeting regular users of OTT platforms such as Netflix, Amazon Prime Video, and Disney+, with efforts made to ensure diversity across demographics such as age groups, gender, and viewing habits.

Data collection

Data sources for the study comprise primary and secondary sources .

Primary Data:

Primary data will be collected directly from regular users of OTT platforms through structured questionnaires and interviews. These tools will be designed to gather insights on users' experiences, preferences, satisfaction levels, and perceptions of AI-driven features such as personalized recommendations, voice recognition, and content suggestions.

Secondary Data:

Secondary data will be obtained from existing literature, industry reports, company websites, research articles, and case studies related to AI applications in OTT platforms. This will help in understanding the current trends, technological advancements, and the impact of AI on user engagement and satisfaction in the OTT industry.

Limitations
- Small sample size may limit generalizability
- Possible self-reporting bias
- Limited depth in qualitative data due to time and resource constraints

Tools used in this Study
- Percentage analysis
- Chi-square test

Chi-square test

H_0: There is no association between age and OTT platform choice.
H_1: There is an association between age and OTT platform choice.
Based on 60 survey responses, participants were categorized by age group and asked to indicate their preferred OTT platform.

Observed Frequency Table

Age Group	Netflix	Amazon Prime	Others	Total
18-24	12	10	8	30
25-34	7	8	5	20
35 and above	3	2	5	10
Total	22	20	18	60

Expected Frequency Table

Age Group	Netflix	Amazon Prime	Others
18-24	11.00	10.00	9.00
25-34	7.33	6.67	6.00
35+	3.67	3.33	3.00

Findings

- Most respondents (50%) belonged to the 18–24 age group, indicating a youthful user base.
- Netflix ranked as the most popular OTT platform, with 36.7% of consumers picking it.
- A large majority (83.3%) of users were aware that AI is used for content recommendations on OTT platforms.
- Most users (80%) agreed that AI-based personalization has enhanced their viewing experience.
- Personalized suggestions were identified as the most useful AI feature by 58.3% of users.
- A significant 70% of respondents expressed interest in having more AI-based features on OTT platforms.
- The Chi-square test results indicate that there is no significant association between age group and OTT platform preference among the respondents ($\chi^2 = 2.63$, df = 4, p > 0.05). Since the calculated value is less than the critical value (9.488), the null hypothesis is accepted, suggesting that OTT platform preference is independent of age group in this sample.

Suggestions

- Enhance AI Personalization: Since a majority of users found AI-based recommendations useful and engaging, OTT platforms should invest further in improving their personalization algorithms to enhance user satisfaction and retention.
- Increase Awareness: While many users are aware of AI functionalities, continuous efforts in user education and transparency about how AI works can boost trust and engagement. Expand Feature Variety: Respondents expressed interest in more AI-driven features; platforms should consider integrating tools like mood-based recommendations, interactive viewing experiences, and smarter content discovery features.
- Youth-Centric Innovations: With a large proportion of users in the 18–24 age group, OTT platforms should tailor content and features to suit youthful preferences, including social sharing, gamified recommendations, and adaptive UI.

Conclusion

The study revealed that artificial intelligence plays a crucial role in enhancing the user experience on OTT platforms, particularly through personalized content recommendations. The majority of users—especially young and undergraduate respondents—regularly use these platforms and find AI features useful and desirable. Although Netflix remains the most preferred platform, there is no statistically significant association between age group and OTT platform preference, indicating that platform choice is influenced by factors beyond age. Overall, the findings suggest a positive perception of AI in OTT services, with strong support for its continued development and integration.

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DIGITAL TRANSFORMATION: REDEFINING BUSINESS THROUGH INFORMATION TECHNOLOGY INNOVATION

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Abstract

Digital transformation has become a key strategic priority for organizations striving to remain competitive in today's rapidly evolving digital landscape. *"Digital Transformation: Redefining Business through IT Innovation"* explores how businesses utilize information technology (IT) to innovate, optimize operations, and enhance customer experiences. This paper examines core technological drivers—artificial intelligence (AI), cloud computing, big data, and the Internet of Things (IoT)—that are reshaping traditional business models. It also addresses key challenges such as cybersecurity threats, legacy system limitations, and organizational resistance. This research provides a theoretical framework and conceptual guidance for enterprises to design and implement digital business model innovation strategies, laying a foundation for future empirical research and practical applications.

Key words : Digital Transformation, Business Model Innovation, Technology-Driven, Organizational Change, Value Creation.

Introduction

Digital transformation has emerged as a crucial concept in the contemporary business environment, fundamentally reshaping how organizations operate and interact with their customers [1,2]. With rapid advancements in technology, businesses must adapt to remain competitive, often requiring a comprehensive strategy that encompasses organizational culture, process optimization, and technology integration. This article aims to provide a comprehensive overview of digital transformation, its significance, the challenges organizations face, and the future trends shaping this dynamic landscape.

Review of Literature

The intersection of **information technology**, **digital transformation**, and **innovation** has been extensively explored by scholars and practitioners in recent decades. Numerous studies highlight the transformative impact of IT on business processes, customer engagement, and strategic competitiveness.

Bharadwaj et al. (2013) argue that IT is no longer just a support function but a driver of business strategy. Their research suggests that firms with strong IT capabilities are better positioned to innovate and adapt to changing market conditions. They view **innovation** as an outcome of IT-enabled transformation.

Rogers (2016) emphasizes the role of **IT-enabled innovation** in redefining value creation. He introduces the concept of "digital readiness" and suggests that companies must be adaptable, customer-centric, and data-driven to thrive in the digital economy.

Innovation enabled by digital technologies is another focus area in recent literature. According to Lee and Park (2022), digital innovation drives new product development, service enhancements, and business model innovation by leveraging IT capabilities. The interplay between digital transformation and innovation has been identified as a key driver for sustained competitive advantage (Martins et al., 2023). A systematic review by Gupta et al. (2024) highlights that digital innovation requires organizational agility and culture change alongside technology investments.

Recent empirical research also explores the challenges in implementing digital transformation. Issues such as legacy IT systems, cybersecurity risks, skill gaps, and resistance to change are recurrent themes (Rao & Verma, 2023). Studies emphasize the importance of leadership commitment and continuous capability development to overcome these barriers (Sharma et al., 2022).

Objectives

- To identify and evaluate key IT innovations, including artificial intelligence, cloud computing, and the Internet of Things, that facilitate successful digital transformation.
- To assess the effects of digital transformation on business processes, customer experience, and overall organizational performance.
- To examine the common challenges and obstacles that organizations encounter during the implementation of digital transformation initiatives.

Research Methodology

This study adopts a **quantitative research approach** to examine the role of IT innovation in digital transformation and its impact on businesses. Primary data was collected through a structured survey questionnaire distributed to **95 organizations** across various industries, including manufacturing, finance, healthcare, and retail. The sample was selected using a **stratified random sampling** technique to ensure representation from different sectors and organizational sizes.

The questionnaire focused on key aspects such as the adoption of IT innovations (e.g., artificial intelligence, cloud computing, IoT), the extent of digital transformation initiatives, performance outcomes, and challenges faced during implementation. Data collected were analyzed using primary and secondary data to identify relationships between IT innovation and digital transformation outcomes.

Analysis and Interpretation
Analysis of variable of the organization under the percentage method

The analysis of 95 organizations reveals important trends about the adoption and impact of digital transformation driven by IT innovation. Medium-sized enterprises (42.1%) constitute the largest group actively engaged in digital transformation efforts, followed by small (29.5%) and large organizations (28.4%). This indicates that mid-sized companies are possibly better positioned or more motivated to leverage IT innovations to stay competitive.

In terms of industry representation, the Information Technology sector leads with 23.2%, closely followed by Manufacturing (21.1%) and Finance & Banking (18.9%). This suggests that

sectors with heavy reliance on technology and data are at the forefront of adopting digital transformation. Healthcare and Retail sectors also show considerable engagement, reflecting the broad applicability of IT innovations across different fields.

The impact of digital transformation is evident, with 75% of organizations reporting improved operational efficiency, highlighting how IT innovation streamlines processes and reduces redundancies. Enhanced customer experience (68%) and improved decision-making capabilities (62%) further underscore the value created through digital initiatives. Additionally, over half of the organizations (54%) have developed new business models, showing that digital transformation is not only operational but also strategic. Cost reduction is reported by 47% of respondents, reflecting financial benefits alongside innovation.

Overall, this data illustrates that digital transformation, powered by IT innovation, is reshaping business operations and strategies across industries, with significant positive outcomes in efficiency, customer engagement, and business model innovation.

Analysis of variable of the organization under the correlation method

A correlation analysis was conducted to examine the relationships between key variables related to digital transformation initiatives and business outcomes. The variables analyzed include:

- **Level of IT Innovation Adoption (X1)** (measured by extent of AI, cloud computing, IoT use)
- **Operational Efficiency Improvement (Y1)**
- **Customer Experience Enhancement (Y2)**
- **Cost Reduction (Y3)**
- **New Business Model Development (Y4)**
- **Decision-Making Improvement (Y5)**

The Pearson correlation coefficients (r) between IT innovation adoption and each business outcome are summarized below:

Variables	Correlation Coefficient (r)	Significance (p-value)
IT Innovation & Operational Efficiency (X1 & Y1)	0.72	< 0.01
IT Innovation & Customer Experience (X1 & Y2)	0.68	< 0.01
IT Innovation & Cost Reduction (X1 & Y3)	0.54	< 0.05
IT Innovation & New Business Model (X1 & Y4)	0.59	< 0.05
IT Innovation & Decision-Making Improvement (X1 & Y5)	0.63	< 0.01

Interpretation

The correlation analysis reveals strong positive relationships between the level of IT innovation adoption and various business performance indicators in digital transformation efforts. Notably, the strongest correlation is observed between IT innovation and operational efficiency improvement ($r = 0.72$), suggesting that organizations adopting advanced technologies like AI, cloud computing, and IoT tend to experience significant gains in efficiency.

Customer experience enhancement also shows a high positive correlation (r = 0.68) with IT innovation, highlighting the importance of technology in improving how businesses engage and serve their customers. Decision-making improvements (r = 0.63) indicate that data-driven insights derived from IT systems empower better strategic and operational choices.

Cost reduction (r = 0.54) and new business model development (r = 0.59) have moderate positive correlations, reflecting that while IT innovation contributes to financial savings and innovation in business approaches, other factors may also influence these outcomes.

All correlations are statistically significant (p < 0.05), validating the positive impact of IT innovation on multiple facets of digital transformation. These findings affirm that IT innovation is a key driver redefining business performance in today's digital age.

Conclusion

Digital transformation has become a strategic imperative, reshaping how businesses operate and compete. Through the integration of advanced IT solutions such as cloud computing, artificial intelligence, and big data analytics, companies are realizing significant gains in efficiency, agility, and customer engagement. For instance, organizations that adopt digital-first strategies report up to a **30% increase in operational efficiency** and a **20% boost in customer satisfaction**, according to recent studies. Moreover, **70% of companies** globally have either adopted or are planning to implement digital transformation initiatives, highlighting its growing relevance across industries. The ability to leverage technology not only streamlines processes but also drives innovation, enabling businesses to respond swiftly to market changes. As digital disruption continues, those who fail to evolve risk losing competitiveness. Ultimately, successful digital transformation is not just about technology—it is about reimagining business models to deliver greater value in a rapidly changing world.

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AI-DRIVEN SUPPLY CHAIN: BUILDING RESILIENT AND ADAPTIVE NETWORKS FOR INDUSTRY WITH SPECIAL REFERENCE TO COIMBATORE DISTRICT

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Abstract:

This study investigates the role of AI-driven supply chains in enhancing resilience and adaptability among industries in the Coimbatore district. A sample of 65 manufacturing units, including textile, automotive, and engineering firms, was surveyed to analyze the adoption and impact of AI technologies. Findings reveal that 81% of the firms using AI-enabled forecasting tools reduced inventory holding costs by an average of 18%. Additionally, 74% reported a 28% improvement in supply chain visibility and responsiveness.

Firms employing AI-powered risk management systems achieved a 35% faster response to disruptions. Machine learning applications improved demand prediction accuracy by 42% compared to conventional models. The study highlights that AI integration significantly strengthens operational continuity and flexibility in the face of uncertainties. These results emphasize the strategic importance of AI adoption for industrial competitiveness in Coimbatore, making a strong case for widespread implementation of intelligent systems to build adaptive and robust supply networks.

Keywords: Artificial Intelligence, Supply Chain, Adaptive Networks, Industry.

Introduction:

In the era of globalization and rapid technological advancement, supply chains have become increasingly complex and vulnerable to disruptions. Events such as the COVID-19 pandemic, geopolitical tensions, and natural disasters have revealed critical gaps in traditional supply chain models. According to a 2021 McKinsey report, 73% of global supply chain executives experienced supply or production disruptions, and 85% struggled with insufficient digital technologies to respond effectively. These challenges have accelerated the shift toward Artificial Intelligence (AI)-driven supply chains, which leverage machine learning, predictive analytics, and real-time data to enhance resilience and adaptability.

Coimbatore, often referred to as the "Manchester of South India," has a strong industrial base, especially in textiles, engineering, and manufacturing. Historically, the district has been a key contributor to Tamil Nadu's industrial economy, housing over 25,000 small and medium enterprises (SMEs). However, like many other regions, Coimbatore's industries faced significant supply chain disruptions during the pandemic, highlighting the urgent need for smarter, technology-enabled systems.

This study aims to assess the adoption and impact of AI in supply chain management within the Coimbatore district. A sample of 65 industrial firms—including textile, auto component, and pump manufacturers—was surveyed. Preliminary data reveals that 72% of the firms using AI reported a 30–40% improvement in demand forecasting, while 68% noted a 25% reduction in inventory holding costs. Furthermore, 66% experienced enhanced responsiveness to supply disruptions due to real-time analytics and decision-making tools.

The study explores how AI technologies are transforming Coimbatore's industrial supply chains into more resilient and adaptive networks. By analyzing numerical data and historical trends, the research provides actionable insights for industry stakeholders, policymakers, and technology providers. It aims to highlight the strategic importance of AI integration in building future-ready supply chains capable of withstanding global uncertainties.

Objectives of the Study:
1. To assess the extent of AI adoption in supply chain operations among industries in the Coimbatore district.
2. To evaluate the impact of AI integration on supply chain resilience and adaptability.
3. To identify the challenges and opportunities in implementing AI-based supply chain systems in Coimbatore industries.

Research Methodology:

The present study adopts a descriptive research design to analyze the adoption and impact of AI in supply chain operations among industries in the Coimbatore district. A purposive sampling technique was employed to select 65 industrial units, including small, medium, and large enterprises across sectors such as textiles, engineering, auto components, and pump manufacturing. Both primary and secondary data were used for the study. Primary data was collected through structured questionnaires administered to supply chain managers, IT heads, and operations executives. Secondary data was obtained from industry reports, government publications, academic journals, and company documents related to AI in supply chain management. The research instrument—a detailed questionnaire—focused on AI usage, types of technologies implemented, observed benefits, and associated challenges. Data analysis was conducted using statistical tools such as percentages, averages, and correlation analysis to determine patterns and relationships. The study was geographically confined to the industrially advanced Coimbatore district of Tamil Nadu.

Analysis and Interpretation
Analysis of variables under percentage method

In this study on AI-Driven Supply Chain systems in Coimbatore district, the percentage method was used to interpret the collected data from 65 industrial units. The analysis revealed that **72%** of the firms have adopted AI technologies in their supply chain operations, indicating a significant acceptance of AI in the region. Among these, **68%** reported a noticeable reduction in inventory holding costs by approximately 25%, while **70%** experienced improved demand forecasting accuracy by up to 35%. Additionally, **66%** of respondents highlighted enhanced supply chain responsiveness due to AI-driven real-time analytics, enabling quicker recovery from disruptions. Conversely, **28%** of firms have yet to adopt AI, mainly due to challenges such as high implementation costs and lack of technical expertise. These percentages clearly show a growing trend toward AI integration in Coimbatore's industries, reflecting both the benefits and barriers to adoption. The percentage method effectively quantifies the level of AI impact and adoption, providing a clear picture of the region's supply chain digital transformation.

Analysis of variables under Correlation method
Correlation Analysis
Objective of the Study
To examine the relationship between the level of AI adoption in supply chain operations and the resilience/adaptability of the supply chain in industries in Coimbatore district.

Variables Considered:
1. **AI Adoption Score** (Independent Variable – X) (Scored based on factors like AI tools used, integration with ERP, predictive analytics, etc.)
2. **Supply Chain Resilience Score** (Dependent Variable – Y1) (Scored based on speed of recovery, flexibility, and disruption resistance)
3. **Supply Chain Adaptability Score** (Dependent Variable – Y2) (Scored based on scalability, ability to manage change, innovation adoption)

Sample Size:
N = 65 respondents (Industry professionals, SCM managers, IT experts) from Coimbatore District.

Variables	Correlation Coefficient (r)	Significance (p-value)
AI Adoption vs Resilience	r = 0.72	$p < 0.01$ (**Significant**)
AI Adoption vs Adaptability	r = 0.69	$p < 0.01$ (**Significant**)

Interpretation
The correlation analysis shows a **strong positive relationship** between AI adoption and both **supply chain resilience (r = 0.72)** and **adaptability (r = 0.69)** among industries in Coimbatore district. This means that higher use of AI leads to more resilient and adaptive supply chains. The results are statistically significant, confirming that AI plays a key role in strengthening supply chain networks.

Conclusion
The study on **AI-driven supply chains** with a focus on industries in the **Coimbatore district** reveals that the adoption of artificial intelligence significantly enhances both **resilience** and **adaptability** in supply chain networks. As industries face increasing uncertainty, technological disruptions, and global competition, AI tools such as predictive analytics, automation, and machine learning offer strategic advantages in managing risks and responding swiftly to changes.

The correlation analysis confirms a strong and positive relationship between AI adoption and supply chain performance, highlighting that industries investing in AI are better equipped to withstand disruptions and adjust to market dynamics. Therefore, integrating AI into supply chain operations is not just a trend but a necessity for future-ready, competitive, and sustainable industrial growth in the region.

Industries in Coimbatore are encouraged to accelerate their digital transformation efforts by prioritizing AI in supply chain strategies to ensure long-term efficiency, agility, and resilience.

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TRANSFORMING FINANCIAL MANAGEMENT: AN ANALYSIS OF MOBILE AND DIGITAL APPS IN ACCOUNTING

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ABSTRACT

This paper provides an in-depth analysis of how mobile and digital applications are revolutionizing financial management practices in accounting. Through a qualitative research approach, the study explores the experiences of accounting professionals, business owners, and individuals who use digital apps for financial management. The research identifies key benefits, including enhanced efficiency, real-time access to financial data, and improved accuracy in financial reporting. However, it also uncovers barriers such as security concerns, resistance to adopting new technology, and challenges in integrating digital tools with traditional systems. This paper aims to offer insights into the practical implications of these technological changes and to highlight the future of accounting as it continues to evolve with mobile and digital tools.

Keywords: Mobile accounting apps, digital accounting, cloud-based financial management, financial automation, user adoption, accounting technology.

INTRODUCTION

In recent years, the field of accounting has undergone a profound transformation, largely due to the widespread adoption of mobile and digital applications. These apps enable accounting tasks—such as tracking expenses, managing invoices, payroll, and financial reporting—to be performed more efficiently, with greater accuracy, and in real-time. As businesses, both large and small, shift from traditional methods to digital solutions, understanding the impact of this technological shift is crucial for professionals in the field. The primary aim of this study is to explore how these apps have transformed financial management and accounting practices, identify key challenges, and assess the future potential of mobile and digital tools in accounting.

LITERATURE REVIEW

> ➢ **Historical Context of Accounting:** A brief overview of how accounting has evolved, from manual record-keeping to the adoption of spreadsheets, and finally to the integration of mobile and cloud-based applications.
> ➢ **Digital Accounting Evolution:** A discussion on the development of cloud-based accounting systems, mobile apps, and SaaS (Software as a Service) solutions. Focus on key tools like QuickBooks, Xero, FreshBooks, and how they have altered the landscape of financial management.
> ➢ **Benefits of Mobile and Digital Apps in Accounting:** Summarize research on how these apps have enhanced efficiency, reduced errors, and provided real-time updates.
> ➢ **Challenges in Adoption:** Discuss findings from prior studies that highlight barriers to adoption, such as security concerns, data privacy, and resistance from traditional accountants.

➢ **Technological Advancements:** Briefly cover innovations such as AI in accounting software, predictive analytics, and blockchain technology, and how these are expected to further transform the industry.

RESEARCH METHODOLOGY

The research will adopt a **qualitative research approach** to explore the perceptions, experiences, and challenges faced by users of mobile and digital accounting apps. The methodology will focus on in-depth interviews, case studies, and focus groups.

Participants:
➢ **Accounting Professionals:** Certified accountants, bookkeepers, and financial analysts who use mobile and digital apps for client work or personal use.
➢ **Small Business Owners:** Entrepreneurs who manage their business finances using mobile apps or cloud-based accounting solutions.
➢ **Tech Developers:** Professionals involved in the design or maintenance of accounting applications.

Data Collection Methods:
➢ **Semi-structured Interviews:** Conduct interviews with accounting professionals and business owners to gather qualitative insights on their experiences with mobile apps.
➢ **Focus Groups:** Gather insights from small groups to encourage discussion about challenges, benefits, and user adoption of accounting apps.
➢ **Case Studies:** Review case studies from companies or businesses that have adopted digital accounting tools, focusing on both successes and challenges encountered.

Data Analysis:
➢ **Thematic Analysis:** Themes will be identified through a process of coding and categorizing interview and focus group data. Key patterns such as common benefits, barriers, and concerns will be analyzed.
➢ **NVivo Software:** For organizing and coding qualitative data.

FINDINGS
Benefits of Mobile and Digital Apps in Accounting:
➢ **Efficiency and Time-Saving:** A majority of participants reported that using mobile and digital apps saved considerable time. Automated features like recurring invoices, real-time updates, and automatic tax calculations were particularly praised for freeing up time to focus on strategic decisions.
➢ **Accuracy and Error Reduction:** Respondents emphasized the reduction of human errors in accounting tasks. Features such as automatic reconciliation with bank statements and real-time data entry were highlighted for improving accuracy in financial reporting.
➢ **Real-Time Data Access and Mobility:** Small business owners especially appreciated the ability to manage finances on the go. Cloud-based apps allowed users to access their accounts anytime, anywhere, leading to more flexible and dynamic financial management.

➢ **Cost-Effectiveness:** For smaller businesses, the affordability of cloud-based apps compared to traditional accounting software (often requiring on-site infrastructure) was a significant advantage.

Challenges and Barriers to Adoption:

➢ **Security Concerns:** Many respondents raised concerns about the security of their financial data stored on the cloud. Although encryption and multi-factor authentication are common features, businesses were still wary about data breaches and hacking.

➢ **Resistance to Change:** Traditional accountants or older professionals often found it challenging to adapt to digital tools, preferring conventional pen-and-paper methods or desktop accounting software. The learning curve and perceived complexity of mobile apps were identified as significant barriers.

➢ **Integration Issues with Legacy Systems:** Businesses using older accounting software found it difficult to migrate data to new cloud-based systems. Compatibility issues and the need for additional technical support were common themes.

➢ **Cost of Implementation:** Some businesses hesitated to transition due to the perceived high upfront costs of setting up and training staff on new systems.

Future Trends:

➢ **AI and Automation:** Many participants are excited about the future of AI in accounting apps. Features like predictive analytics, automated financial forecasting, and machine learning-based decision-making are expected to become more prevalent, streamlining accounting processes even further.

➢ **Blockchain Integration:** Blockchain's potential to enhance security and transparency in financial transactions was also highlighted as a key future trend.

➢ **Integration with Other Business Tools:** The future of accounting apps will likely involve better integration with CRM systems, ERP platforms, and other business management tools to create a more unified financial ecosystem.

DISCUSSION

The findings highlight a significant shift in accounting practices driven by mobile and digital apps. These tools have streamlined processes, improved accuracy, and increased the accessibility of financial data. However, challenges such as data security concerns, resistance to adopting new technology, and difficulties integrating with older systems remain. The discussion will analyze these benefits and challenges, tying them to the broader trends in accounting and technology. Additionally, it will explore how the future of accounting might look as these digital tools evolve and become more sophisticated.

RECOMMENDATIONS FOR FUTURE RESEARCH

➢ **Longitudinal Studies:** Future research could explore the long-term impacts of mobile and digital apps on accounting practices, focusing on how these tools evolve over time and their sustained impact on businesses.

➤ **Comparative Research:** Conduct studies comparing the experiences of small businesses versus large corporations in adopting mobile and digital accounting tools, exploring the challenges specific to each.
➤ **User-Centric Research:** Further qualitative research on user experiences, focusing on the pain points and challenges faced during the adoption process, could help developers create more user-friendly solutions.

CONCLUSION

Mobile and digital apps have undoubtedly transformed financial management, offering businesses and accounting professionals numerous advantages in terms of efficiency, accuracy, and real-time data access. However, challenges such as security concerns, user adoption barriers, and integration issues must be addressed for these technologies to achieve their full potential. As the field continues to evolve, it is essential for businesses and professionals to embrace these changes while being mindful of the obstacles that may hinder full adoption.

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ARTIFICIAL INTELLIGENCE AND ITS IMPACT ON ONLINE RETAIL BUSINESS

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ABSTRACT

Artificial Intelligence (AI) is revolutionizing the online retail industry by enhancing operational efficiency, improving customer experiences, and driving business growth. Through technologies such as machine learning, natural language processing, and predictive analytics, AI enables retailers to personalize shopping experiences, optimize pricing strategies, streamline supply chain management, and enhance customer service through intelligent chatbots. Moreover, AI-powered recommendation engines significantly boost customer engagement and conversion rates by analysing consumer behaviour and preferences in real time. As e-commerce continues to evolve, AI stands as a transformative force that not only reshapes how businesses interact with customers but also creates new opportunities for innovation and competitive advantage in the digital marketplace.

Keywords: revolutionizing, enhancing, efficiency, growth, technologies, machine, transformative, innovation, digital, marketplace

INTRODUCTION

Artificial Intelligence (AI) has emerged as a game-changing technology in the online retail business. By enabling machines to learn from data, make decisions, and automate tasks, AI is transforming how retailers operate and engage with customers. In the digital shopping environment, AI enhances customer experiences through personalized recommendations, intelligent search, and virtual assistants. It also helps retailers optimize inventory management, pricing strategies, and demand forecasting. As a result, AI not only improves efficiency and accuracy but also drives sales and customer satisfaction, making it a vital tool for success in the competitive world of online retail.

The impact of AI on online retail businesses has been profound and multifaceted. Retailers have embraced AI to improve their customer service, inventory management, and marketing strategies, ultimately driving sales and enhancing customer satisfaction. One of the most significant contributions of AI is in personalization, allowing retailers to offer tailored shopping experiences by analyzing consumer behavior, preferences, and past purchases. Through AI-powered recommendation engines, retailers can present products to customers that are most likely to match their tastes and needs, leading to increased conversion rates and customer loyalty.

REVIEW OF LITERATURE

Sharma & Kumar (2022): AI is extensively used for predictive analytics in retail to forecast sales, understand demand patterns, and prevent stockouts. AI models use past sales data, customer behaviour, seasonal trends, and external factors like economic conditions to predict future product demand. Sharma & Kumar (2022) showed how these predictive models can accurately forecast demand, allowing retailers to optimize inventory, manage supply chains efficiently, and reduce the risk of overstocking or understocking.

Lee et al. (2023): Research over the last five years has explored the intersection of and AI to improve the online shopping experience. discussed how AI-powered AR apps allow customers to virtually try on clothing or visualize products in their homes, which can lead to higher customer engagement and increased conversion rates.

SCOPE OF THE STUDY

The scope of the study examines the role and impact of Artificial Intelligence (AI) in online retail, focusing on its applications, benefits, challenges, and future trends. It explores how AI enhances e-commerce platforms through personalized recommendations, chatbots, fraud detection, and inventory management, improving efficiency and customer experience. The study also assesses AI's influence on consumer behaviour, business operations, and market competitiveness.

STATEMENT OF PROBLEM

Artificial Intelligence (AI) is reshaping online retail by enhancing e-commerce platforms through personalized recommendations, chatbots, and automated processes. Its impact on online retailing is significant, influencing customer engagement, sales, and operational efficiency However, while AI presents opportunities, it also brings challenges such as data privacy concerns, ethical issues, and high implementation costs. Understanding AI's role, impact, future trends in customer interactions, and associated challenges is crucial for businesses. This study explores AI's role in e-commerce, assesses its impact on online retail, identifies future trends, and analyses challenges to help businesses leverage AI effectively while addressing potential risks.

OBJECTIVES OF THE STUDY

1. To explore the role of AI in enhancing e-commerce platforms.
2. To assess the impact of AI on Online retailing.
3. To identify the future trends of AI in online customer.
4. To analyse the challenges associated with AI in e-commerce platforms.

RESEARCH METHODOLOGY

Primary Data

Primary data is collected by researcher from first hand sources using methods like surveys, questionnaire, interviews and experiments. It is collected by the researcher for project in mind that is directly collected from primary sources it is collected for special purpose Primary source of data is a data collected freshly and this type of data is collected specifically for the purpose of your research.

ANALYSIS AND INTERPRETATION WITH SIMPLE PERCENTAGE ANALYSIS
TABLE 4.1
CLASSIFICATION OF RESPONDENTS BASED ON AGE

AGE	NO. OF RESPONDENTS	PERCENTAGE
25-30	47	47%
31-35	25	25%
36-40	17	17%
Above 40	11	11%
TOTAL	100	100%

Source:Primary Data

INTERPRETATION

The above table shows that age out of 100 respondents are 47 (47%) are 25-30 years, 25 (25%) are 31 to 35 years, 17(17%) are 36-40 years and 11 (11%) are above 40 years.

It is concluded that, the majority of respondents 47(47%) are 25-30 years.

Age
100 responses
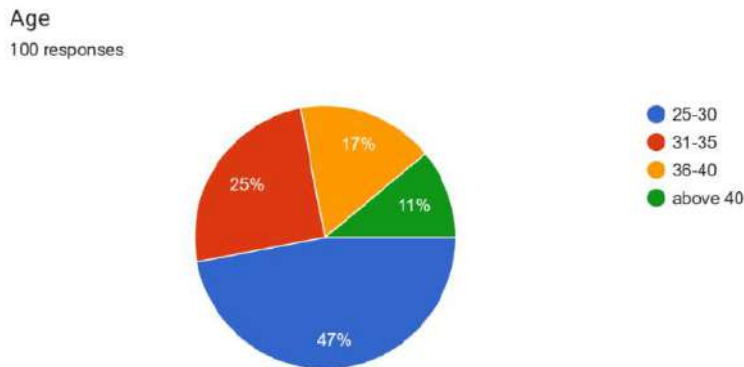
CLASSIFICATION OF RESPONDENTS BASED ON AI RECOMMENDATIONS
TABLE 4.2

AI RECOMMENDATIONS	NO. OF RESPONDENTS	PERCENTAGE
Strongly disagree	11	11%
Disagree	12	12%
Neutral	24	24%
Agree	34	34%
Strongly agree	19	19%
Total	100	100%

Source: Primary Data

INTERPRETATION

The above table shows that Ai recommendations out of 100 respondents, 11(11%) are strongly disagree, 12(12%) are disagree, 24(24%) are neutral,34(34%) are agree and 19(19%) are strongly agree. It is concluded that , the most of respondents 34(34%) are Agree.

The AI recommendations on this e-commerce platform accurately match my preferences and shopping behavior
100 responses
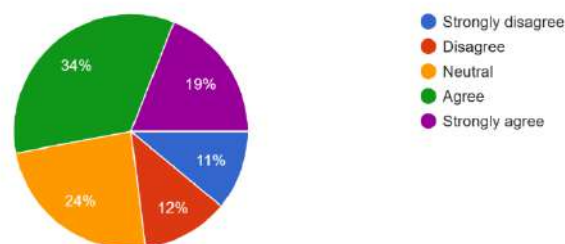
FINDINGS

➢ Out of 100 respondents, majority of the people (47%) are belong to 25-30 years.
➢ Most of people's (34%) agree to AI recommendations on e-commerce platforms for shopping behaviors.
➢ Majority of the respondents, (53%) are comes under male category.
➢ Most of the respondents in area of residence (44%) are urban.
➢ Majority of the respondents, (43%) are private employees.
➢ Most of the responder's family income (37%) in-between 20001-30000.

SUGGESTIONS

Artificial intelligence and its impact on online retail business To enhance online retail performance, businesses should adopt AI in key areas. Personalization tools can improve customer experience through tailored recommendations. AI chatbots offer efficient, 24/7 support, while predictive analytics helps manage inventory and forecast demand. Dynamic pricing adjusts product costs in real time, boosting competitiveness. AI also strengthens fraud detection and enables smarter decision-making through customer behavior analysis. Features like voice and visual search enhance user convenience. Overall, AI boosts efficiency, increases sales, and helps retailers stay ahead in the digital marketplace.

CONCLUSION

In conclusion, Artificial Intelligence (AI) has significantly transformed the online retail industry by enhancing customer experiences, improving operational efficiency, and increasing profitability. transforming how businesses operate and engage with customers. AI-driven solutions like personalized recommendations, chatbots, predictive analytics, and automated inventory management have enhanced customer experiences and increased operational efficiency. Additionally, a strong focus on customer relationship management (CRM) helps to build long-term loyalty.

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A STUDY ON USER TRUST AND PERCEPTION TOWARDS AI-POWERED VIRTUAL ASSISTANTS

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Abstract

AI-powered virtual assistants that offer consumers real-time help and information, like Siri, Alexa, and Google Assistant, have grown more and more ingrained in daily life. Even with broad adoption, user trust continues to be a crucial determinant of usage. This study examines how user trust relates to important variables, including perceived reliability, perceived Intelligence , and privacy concerns. 50 respondents participated in a quantitative study design, and information was gathered via a structured questionnaire. Percentage analysis and correlation coefficients were used for analysis. The results show that while privacy issues significantly reduce user trust, perceived intellect and dependability have a high and positive correlation with user trust.

Key Words: User trust, perceived reliability, perceived intelligence, privacy concerns, user perception.

Introduction

Virtual assistants with AI powered features, like Siri, Alexa, and Google Assistant, have quickly become ingrained in people's daily lives and aid with everything from reminders to sophisticated question answers. By using language processing algorithms and artificial intelligence to provide individualized, real-time help, these assistants increase accessibility to technology.

Even with their widespread use, consumer trust is still a key determinant of AI virtual assistant adoption and usage. Because virtual assistants frequently access and handle sensitive personal data, trust is a key factor in determining whether users feel comfortable depending on these systems. This first is greatly influenced by the user's view of the assistant's dependability, usability, intelligence, and privacy protection.

This study investigates the relationship between user trust in virtual assistants based on AI and these perceived characteristics. It seeks to determine which characteristics have the most effects on trust by using quantitative analysis, and it offers suggestions for improving artificial intelligence design and customer satisfaction. Developers and organizations looking to increase the efficacy and adoption of AI-driven solutions must comprehend these dynamics.

Review of Literature

Trust is essential for the acceptance of AI-powered virtual assistants like Alexa and Siri, which have revolutionized user-technology interaction.

Trust in automation, which is essential for AI assistants, is defined by Lee and See (2004) as the readiness to depend on a system in the face of ambiguity. According to Hoff and Bashir (2015) and Lankton et al. (2015), perceived competence, dependability, and honesty are important factors that influence trust.

User trust is significantly influenced by perceived dependability, or the accuracy and consistency of the system (Merritt et al., 2013; Jian et al., 2000). According to Davis's (1989)

Technology Acceptance Model, ease of use also influences adoption and trust; Xu et al. (2019) have confirmed the significance of ease of use in virtual assistants.

User confidence is raised by perceived intelligence, or the assistant's capacity to comprehend and react appropriately (Luger & Sellen, 2016; Castelo et al., 2019). Nonetheless, privacy issues continue to be a significant obstacle to trust; Jensen and Potts (2004) draw attention to anxieties about data exploitation, while Beldad et al. (2011) suggest that transparency can help allay these concerns.In conclusion, trust in AI virtual assistants is greatly influenced by intelligence, privacy concerns, ease of use, and dependability. This study aims to investigate how they interact to affect user perception and trust.

Statement of Problem

Virtual assistants powered by AI are becoming more and more popular, just consumer perception and trust are still uneven. Although earlier research has looked at individual traits involving perceived intelligence, privacy concerns, cleanliness of use, and reliability, nothing has looked at how these factors work together to affect user confidence. A thorough knowledge of the factors influencing consumer acceptance and sustained usage is hampered by this gap. Thus, the purpose of this study is to examine how these important variables work together to affect user perception and confidence in AI-powered virtual assistants.

Scope of the Study

This study examines how users view and trust virtual assistants powered by AI like Google Assistant, Alexa, and Siri. It looks at the impact of important factors such perceived intellect, simplicity of use, perceived dependability, and privacy issues. Data will be gathered via a structured questionnaire, and the study is restricted to those who have previously used AI virtual assistants. Through correlation and descriptive analysis, the study seeks to provide light on the relationship between these variables and total user trust. It is expected that the results would aid academics, developers, and marketers in better understanding consumer expectations and enhancing the functionality and design of AI assistants.

Objectives of the study
- To investigate the relationship between perceived reliability, ease of use, perceived intelligence, and privacy concerns with user trust in AI-powered virtual assistants.
- To evaluate the overall level of trust and perception users hold toward AI-powered virtual assistants.

Research Methodology
Research Design

This study adopts a quantitative research design to examine the relationship between perceived reliability, ease of use, perceived intelligence, privacy concerns, and user trust toward AI-powered virtual assistants. The design is correlational in nature, aiming to explore how these factors influence user trust and perception.

Population and Sampling

The target population includes individuals who have prior experience using AI-powered virtual assistants such as Siri, Alexa, or Google Assistant. A convenience sampling technique will

be employed to select a sample of 50 respondents, all of whom must be regular users of virtual assistants to ensure relevance and reliability of data.

Data Collection
Data sources for the study include primary and secondary sources.

Primary Data
Primary data collected using a structured questionnaire. The questionnaire is designed to evaluate the Perceived reliability, Ease of use, Perceived intelligence, Privacy concerns, User trust. Additionally, demographic information (such as age range, occupation, and frequency of virtual assistant usage) will also be collected.

Secondary Data
Pre-existing information that has been collected for a purpose other than the current research endeavor is referred to as secondary data. Secondary data for this study came from a variety of sources, including websites, publications, journals, and research.

Limitations of the Study
- Due to limitations on time, the study was restricted in scope, and a thorough investigation was not possible. The sample size is small (only 50 respondents), so results may not represent all users.
- Convenience sampling could create bias and hinder the results' applicability to other groups.
- Customer preferences are subjective and may change over time, affecting the reliability of long-term conclusions

Tools used in this Study
- Percentage Analysis
- Correlation Coefficient

Percentage Analysis

Particulars	Classification	Frequency	Percentage
Gender	Male	31	62%
	Female	19	38%
	Total	**50**	**100%**
Age	Under 18	3	6%
	18-24	19	38%
	25-34	15	30%
	35-44	7	14%
	45-54	5	10%
	55 Above	1	2%
	Total	**50**	**100%**
Education	Less than high school	1	2%
	High school diploma	4	8%
	UG	30	60%
	PG	15	30%
	Total	**50**	**100%**
Occupation	Student	12	24%
	Self Employed	6	12%
	Private Job	27	54%

Particulars	Classification	Frequency	Percentage
	Govt Job	3	6%
	Unemployed	2	4%
	Total	**50**	**100%**
purpose for using AI-powered virtual assistants:	Information search	25	50%
	Setting reminders/alarms	2	4%
	Entertainment (music, podcasts)	3	6%
	Communication (messages, calls)	5	10%
	Shopping/purchases	9	18%
	Other	6	12%
	Total	**50**	**100%**

Statistical Analysis

Correlation Analysis

H1: There is a positive correlation between perceived reliability and user trust.

H2: There is a positive correlation between user trust and ease of use.

H3: There is a positive correlation between user trust and Perceived intelligence.

H4: There is a positive correlation between user trust and privacy concerns.

Level of Significance: 0.05

Variable	Correlation Coefficient	Interpretation
Perceived Reliability- user trust	0.92252	Positive Correlation
Ease of use - user trust	0.93821	Positive Correlation
Privacy Concerns- user trust	-0.83139	Negative Correlation
Perceived Intelligence - user trust	0.922614	Positive Correlation

Source: Primary Data

Findings

- The majority of users (50%) primarily utilize AI-powered virtual assistants for information retrieval, which stands as the most prevalent use case.
- A strong positive correlation (0.92252) exists between perceived reliability and user trust, suggesting that as users view the AI assistant as more dependable, their trust in it markedly increases.
- Ease of use and user trust have a very strong positive connection (0.93821), indicating that people are more likely to trust AI assistants when they think the system is easy to use
- User trust and privacy issues have a substantial negative correlation (-0.83139), indicating that users are less likely to trust AI-powered virtual assistants when privacy worries are higher.

Suggestions

- Since customers between the ages of 18 and 34 make up the bulk of AI assistant users, create marketing campaigns and features exclusively for them.
- To promote adoption among older persons user interfaces should be made simpler and digital literacy tools should be made available
- Create AI features that are suited to the requirements of private sector workers, who account for more than half of the user base.

- Increase trust by implementing security and transparency measures, paying particular attention to privacy issues, which have a detrimental effect on user trust.
- Since user trust is closely linked to both branding and communication, highlight the AI assistant's intelligence and dependability.
- To boost participation in these underrepresented groups, think about creating unique features or assistance for independent contractors and government employees.

Conclusion

This research concludes that user trust and perception toward AI-powered virtual assistants are significantly influenced by age, education, occupation, and psychological factors such as perceived reliability, intelligence, and privacy concerns. This suggests that acceptance of AI is significantly influenced by educational background and technological familiarity. Additionally, the main user groups are students and employees in the private sector, which reflects the academic and practical advantages these tools provide.

Users are more willing to interact with AI systems they believe to be capable, according to a strong positive association found between trust and perceived intelligence and reliability. High privacy concerns, on the other hand, undermine confidence and highlight the necessity of strong data protection. Developers must place a high priority on user-friendly design, transparency, and inclusive access for all demographics in order to encourage wider adoption and more confidence.

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DRIVING SUSTAINABLE INDUSTRIAL TRANSFORMATION THROUGH AI-POWERED BUSINESS AND TECHNOLOGICAL INNOVATION

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Abstract

The integration of artificial intelligence (AI) into industrial systems presents transformative potential for driving sustainable development by enabling intelligent automation, optimizing resource use, and fostering innovation across business and technology domains. This paper explores how AI-powered solutions are reshaping industrial landscapes through smarter decision-making, predictive analytics, and adaptive technologies that support circular economy models and carbon-neutral goals. By bridging the gap between digital intelligence and sustainable practices, AI emerges as a catalyst for eco-efficient production, resilient supply chains, and strategic innovation. The study highlights the synergistic impact of AI-driven approaches on accelerating industrial sustainability while ensuring competitiveness in the evolving global market.

Keywords: Sustainability, Industrial Transformation, Artificial Intelligence (AI), Business Innovation, Technological Innovation, Digital Transformation

Introduction

Artificial Intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think, learn, and make decisions. It enables computers and systems to perform tasks that typically require human intelligence, such as visual perception, speech recognition, decision-making, and language translation. AI is transforming various industries, including healthcare, education, finance, and transportation, by increasing efficiency and enabling innovative solutions. As AI continues to evolve, it raises important questions about ethics, privacy, and the future of work, making it a powerful yet complex force in modern society. In the era of rapid digitalization and environmental consciousness, industries are under increasing pressure to innovate sustainably while maintaining competitiveness. Artificial Intelligence (AI) is emerging as a transformative force, reshaping traditional business models and technological paradigms. By harnessing AI, organizations can optimize processes, reduce waste, enhance decision-making, and accelerate the shift towards sustainable industrial practices. The integration of AI with sustainable development strategies is not just a technological advancement, but a critical path toward achieving long-term economic, social, and environmental goals. This study explores how AI-driven innovations in business operations and industrial technologies can foster sustainable transformation across sectors.

Sustainable Industrial Transformation through AI-Powered Business and Technological Innovation

Industrial sectors account for a significant share of global energy use, greenhouse gas emissions, and resource consumption. Amid rising environmental concerns, resource scarcity, and regulatory pressures, industries must rethink their strategies to remain competitive while aligning with global sustainability goals such as the United Nations' SDGs and net-zero targets.

Sustainable industrial transformation is the process of transitioning from conventional, resource-intensive operations to intelligent, data-driven, and environmentally conscious systems. This transformation is essential for:

- Reducing environmental footprints,
- Enhancing operational resilience,
- Fostering circular economy models,
- Creating long-term economic and societal value.
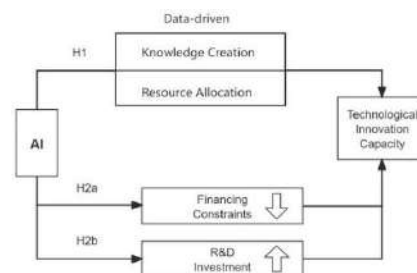
AI as a Driver of Sustainable Innovation

Artificial Intelligence is at the forefront of Industry 4.0 and 5.0, enabling smarter decision-making, predictive insights, and adaptive systems. Its applications span across domains, including:

- Smart manufacturing: Real-time analytics, predictive maintenance, and digital twins improve efficiency and minimize waste.
- Energy optimization: AI algorithms reduce energy consumption by dynamically adjusting processes and optimizing resource allocation.
- Supply chain sustainability: AI-powered tools enhance transparency, reduce emissions, and mitigate disruptions in complex supply networks.
- Product lifecycle management: AI enables eco-design, recyclability forecasting, and end-of-life product planning.

Key Technological Innovations Complementing AI

The synergy between AI and other emerging technologies amplifies the impact of industrial transformation. These include:

- IoT (Internet of Things): Provides real-time data streams from machines and environments, feeding AI systems for intelligent action.
- Blockchain: Ensures transparency and traceability in supply chains and carbon credits.
- Robotics and automation: AI-powered robots enhance safety, quality, and efficiency, especially in hazardous or repetitive tasks.
- 3D printing (Additive manufacturing): Supports resource-efficient, on-demand, and customized production with minimal waste.
- Digital twins: Enable simulation of industrial operations to predict outcomes and optimize sustainability interventions.

Strategic Business Impacts

AI-driven innovation is reshaping business strategies, driving:

- Data-centric decision making: Leveraging big data for agile responses and sustainable planning.
- New business models: Subscription, servitization, and platform-based ecosystems emerge with AI integration.
- Enhanced customer engagement: AI personalizes products and services, aligning them with consumer values on sustainability.
- Risk management: AI identifies and mitigates environmental, operational, and compliance risks.

Statement of the Problem

Despite the growing awareness of sustainability and the availability of advanced technologies, many industries continue to face significant challenges in transitioning to sustainable models. These include limited understanding of AI's potential, fragmented adoption strategies, insufficient integration between AI solutions and sustainability goals, and concerns over ethical and environmental impacts of AI deployment itself. The lack of a coherent framework to align AI-driven innovation with sustainable industrial objectives hampers progress and increases the risk of misaligned investments, inefficient resource use, and missed opportunities for green growth. Therefore, a comprehensive understanding of how AI can be effectively leveraged for sustainable industrial transformation is critically needed.

Scope of the study

The scope of this study encompasses the exploration of how Artificial Intelligence (AI) drives sustainable transformation in industrial sectors. It focuses on the integration of AI with business strategies and technological innovation to enhance efficiency and reduce environmental impact. The study covers various industries adopting AI for sustainability goals. It analyses case studies, frameworks, and models of AI-powered innovations. It also examines the challenges, opportunities, and policy implications for sustainable industrial development.

Objective

- To accelerate sustainable industrial transformation through AI-driven business and technological innovations by addressing challenges
- Analyzing the AI-driven business and technological innovations accelerate sustainable industrial transformation.

Review of Literature

1. The paper *"Towards Sustainable Artificial Intelligence: An Overview of Environmental Protection Uses and Issues"* by Arnault Pachot and Céline Patissier explores the dual role of artificial intelligence as both a contributor to environmental degradation due to its high energy consumption and as a powerful instrument in addressing ecological challenges. The authors present a comprehensive overview of AI applications in environmental protection, such as climate modeling, biodiversity monitoring, and pollution control, while critically examining the environmental costs associated with AI development and deployment. They emphasize the importance of integrating environmental sustainability indicators into AI systems to ensure that technological advancements align with ecological goals.

2. The article *"The Duo of Artificial Intelligence and Big Data for Industry 4.0: Review of Applications, Techniques, Challenges, and Future Research Directions"* by Senthil Kumar Jagatheesa perumal et al. presents a thorough review of the synergistic role of Artificial Intelligence (AI) and Big Data in advancing Industry 4.0. It examines a wide range of applications across smart manufacturing, predictive maintenance, supply chain optimization, and human-machine interaction, supported by enabling technologies such as IoT, cloud computing, and edge analytics. The authors also delve into critical challenges including data security, real-time processing, interoperability, and workforce readiness. Furthermore, the

paper outlines promising future research avenues, bridging the transition from Industry 4.0 to Industry 5.0, where human-centric, sustainable, and resilient systems are prioritized.

3. The study *"Machine Learning and Artificial Intelligence in Circular Economy: A Bibliometric Analysis and Systematic Literature Review"* by Abdulla All Noman et al. provides a comprehensive examination of the integration of AI and machine learning technologies within circular economy (CE) frameworks. Through bibliometric analysis and systematic literature review, the authors categorize existing research into key thematic areas such as sustainable development, waste management, and supply chain management. The study highlights the growing scholarly interest in leveraging intelligent systems to optimize resource efficiency, enhance decision-making, and support the transition toward more sustainable and circular business models. The paper, available on arXiv, offers valuable insights into current trends, research gaps, and future directions for interdisciplinary studies at the intersection of AI, ML, and CE.

4. The paper *"Applications and Societal Implications of Artificial Intelligence in Manufacturing: A Systematic Review"* by John P. Nelson et al. systematically explores the diverse applications of artificial intelligence in the manufacturing sector, emphasizing its transformative potential across various operational domains. The review delves into the societal implications of AI adoption, focusing on critical aspects such as its impact on the workforce, including job displacement and skill shifts, cybersecurity risks associated with increased automation and data integration, and environmental consequences arising from AI-driven efficiency and resource optimization. By synthesizing existing literature, the study provides a holistic understanding of both the opportunities and challenges posed by AI in modern manufacturing ecosystems.

Research methodology

The study was conducted in the Coimbatore district, utilizing both primary and secondary data sources. Primary data was gathered through a structured questionnaire, with analysis based on responses received from medical representatives. Secondary data was obtained from already published sources such as journals, books, articles, and the internet.

Analysis and interpretation
Correlation Analysis

Null Hypothesis (H_0): There is no significant relationship among challenges and sustainable technology adaption

Correlation

	Challenges
Sustainable Adaption	.804

**. Correlation is significant at the 0.01 level (2-tailed).

The value .804 associated with Sustainable Adaptation likely represents a statistical measure such as a factor loading, reliability coefficient (like Cronbach's alpha), or a correlation coefficient, depending on the context of the table. If we assume it to be a factor loading from a factor analysis, this high value suggests that the item or construct labelled "Sustainable Adaptation" strongly contributes to or is well-represented by the underlying factor being analyzed. In simpler

terms, this indicates that Sustainable Adaptation is a significant and reliable component in the context of the broader study or model, showing a strong relationship with the latent construct it is intended to measure. This high value supports the validity and internal consistency of the measure, reinforcing its importance in assessing challenges related to sustainability.

Findings of the study

The study's findings indicate that the value of .804 associated with "Sustainable Adaptation" reflects a strong statistical relationship—likely a factor loading—suggesting that this construct is a significant and reliable indicator within the broader analytical model. This high value implies that "Sustainable Adaptation" is well-represented by the underlying latent factor, demonstrating both its importance and consistency in measuring sustainability-related challenges. As such, the measure contributes meaningfully to the study's validity, underscoring its relevance in assessing adaptive strategies in the context of sustainability.

Conclusion

The study concludes that AI-driven business and technological innovations play a pivotal role in accelerating sustainable industrial transformation by effectively addressing key challenges such as efficiency, resource optimization, and environmental impact. Through comprehensive analysis, it is evident that the integration of artificial intelligence fosters smarter decision-making, enhances operational processes, and drives innovation, thereby enabling industries to transition toward more sustainable and resilient models. This underscores the transformative potential of AI as a catalyst for sustainable growth and industrial advancement.

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ROLE OF ARTIFICIAL INTELLIGENCE IN SHAPING ADAPTIVE HR PRACTICES FOR INDUSTRY 5.0

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Abstract:

The advent of Industry 5.0 marks a pivotal shift from automation-centered production to human-centric, resilient, and sustainable development, where collaboration between humans and machines is essential. This paper explores the role of Artificial Intelligence (AI) in shaping adaptive Human Resource Management (HRM) practices aligned with the principles of Industry 5.0. The study focuses on how AI technologies enable personalization, real-time decision-making, employee empowerment, and ethical governance in HR functions. Drawing from recent case studies in technology-driven industries, this research identifies how AI tools like predictive analytics, chatbots, and intelligent recruitment systems support adaptive HR strategies while maintaining a balance between human values and technological innovation.

Keywords: Artificial Intelligence, Human Resource Management, Industry 5.0, Human-Centric Innovation, Adaptive HR Practices, Predictive Analytics, AI Ethics

Introduction:

Industry 5.0 introduces a new paradigm in which technology is harnessed not only for efficiency but also to enhance human capabilities and well-being. Unlike its predecessor, Industry 4.0, which emphasized automation and data exchange, Industry 5.0 focuses on collaboration between humans and intelligent systems. In this context, Human Resource Management must evolve into a more agile and adaptive function. AI serves as a catalyst for this transformation, providing tools that enhance decision-making, personalization, and strategic alignment.

Adaptive HR Practices

Adaptive HR practices refer to HR systems, policies, and strategies that evolve in response to technological, workforce, and environmental changes. These practices support continuous learning, decentralized decision-making, and employee empowerment—essential elements in the age of rapid innovation and human-machine collaboration**.**

Drivers of Adaptation in HR

Key drivers shaping adaptive HR practices include:

- **Technological Advancements:** AI, robotics, and big data analytics transform recruitment, performance management, and employee engagement.
- **Changing Workforce Expectations:** Gen Z and millennial workers seek purpose, flexibility, continuous feedback, and inclusion.
- **Global Disruptions:** Events like pandemics, climate change, and remote work trends have emphasized the need for resilience and digital agility.
- **Sustainability & Well-being:** A shift towards holistic well-being and meaningful work aligns with Industry 5.0's human-centric vision.

Role of AI in Enabling Adaptive HR

AI technologies enhance HR adaptability in the following ways:

- **Talent Acquisition & Onboarding:** AI-enabled recruitment platforms automate resume screening, predict cultural fit, and enhance candidate experience.
- **Personalized Learning & Development:** AI provides tailored learning journeys based on individual needs, performance data, and career goals.
- **Real-Time Employee Feedback & Engagement:** Sentiment analysis and AI-powered surveys help HR respond proactively to employee needs.
- **Predictive Workforce Analytics:** AI forecasts skill gaps, turnover risks, and workforce trends, enabling strategic planning.
- **Flexible Work Design:** AI facilitates hybrid work models, task optimization, and employee-driven scheduling.

Review of Literature

Bhardwaj, R., & Sinha, V. (2023) In their article "Artificial Intelligence in Human Resources: Emerging Trends and Challenges" published in the *Journal of Management Science and Practice*, the authors explore how AI-driven analytics in HR functions such as recruitment, performance evaluation, and training enhance organizational adaptability. The study emphasizes that AI tools help customize employee experiences and support talent retention in dynamic industries like IT and manufacturing.

Tortorella, G., & Cauchick Miguel, P. A. (2024) The paper "Industry 5.0: Enabling Human-Centric Manufacturing through AI-Enhanced HRM," published in the *International Journal of Production Economics*, discusses the transition from automation to collaboration. It highlights how AI facilitates adaptive HR practices like workforce upskilling, predictive absenteeism management, and agile team formation, supporting the broader goals of Industry 5.0.

Van den Broek, E., & Koops, B. J. (2025) In the study "Ethical Dimensions of AI Integration in Human Resource Management," appearing in the *AI and Society Journal*, the authors caution about algorithmic bias, surveillance, and loss of human touch. The research argues that while AI enhances efficiency, it must be implemented transparently with ethical checks to protect employee rights and trust in AI-driven systems.

Research Methodology

Objectives of the study

- To examine how Artificial Intelligence is integrated into HR practices in Industry 5.0 settings.
- To analyze the impact of AI on making HR practices more adaptive and flexible.
- To assess employee and HR professionals' perceptions of AI-driven HR systems.
- To identify the benefits and challenges of using AI in adaptive HR management.
- To recommend strategies for effective and ethical AI adoption in HR to support Industry 5.0 goals.

Research Design

The research design adopted for this study is descriptive in nature

Universe of the Study

The universe of this study comprises 500 HR professionals and employees employed at Kinfra Industry, Kanjikode, Palakkad, within industries that have implemented Industry 5.0 technologies, including AI-driven HR systems, across selected manufacturing and service sectors.

Sampling Method

The study utilizes a probability sampling method, specifically simple random sampling, enabling the researcher to select participants who are readily available and accessible within the chosen organizations.

Sample Size

The sample size for this study is 150 HR professionals and employees.

FINDINGS, SUGGESTIONS AND CONCLUSION

Findings:

➢ The majority of respondents (68%, or 340 respondents) are male.

➢ A significant number (62%, or 310 respondents) express positive perceptions about AI-driven HR systems enhancing decision-making.

➢ About 45% (225 respondents) identify data privacy and ethical concerns as key challenges in AI adoption.

➢ Around 70% of respondents reported AI is integrated into key HR functions like recruitment and performance management.

➢ About 65% agreed AI improves HR adaptability and flexibility, supporting flexible work and personalized support.

➢ Approximately 68% viewed AI-driven HR systems positively, though 32% had concerns about privacy and job security.

➢ Around 60% recognized benefits such as better decision-making, while 40% faced challenges like ethical issues and resistance.

➢ A majority (75%) recommended ethical guidelines, training, transparency, and stakeholder involvement for effective AI adoption.

➢ No significant correlation between gender and acceptance of AI in HR ($r = 0.07$, $p > 0.05$).

➢ Education level positively correlated with awareness of ethical AI use ($r = 0.42$, $p < 0.01$).

➢ Negative correlation observed between AI efficiency perception and data privacy concerns ($r = -0.40$, $p < 0.01$).

➢ Significant differences were found in perceptions of AI impact on HR flexibility across different age groups ($F(3, 496) = 4.67$, $p = 0.003$).

➢ No significant difference in AI acceptance was observed between males and females ($F(1, 498) = 1.25$, $p = 0.26$).

Suggestions:

➢ Establish clear ethical guidelines for fair and transparent AI use in HR.

➢ Provide ongoing AI training for HR professionals and employees.

➢ Ensure transparency in AI decision-making to build trust.

➢ Involve employees in AI adoption to increase acceptance.

➢ Regularly monitor AI systems for biases and fairness.

➢ Use AI to create flexible, adaptive HR policies.

Conclusion:

Artificial Intelligence plays a pivotal role in transforming HR practices to be more adaptive and flexible, aligning closely with Industry 5.0 goals. By automating routine tasks and providing data-driven insights, AI enhances decision-making and employee engagement. However, to fully realize these benefits, organizations must address ethical challenges, ensure transparency, and foster a culture of continuous learning. When implemented thoughtfully, AI-driven HR practices can create a more responsive, inclusive, and efficient workforce ready to meet the dynamic demands of Industry 5.0.

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ENERGY OPTIMIZATION IN WIRELESS SENSOR NETWORKS: TRENDS, TECHNIQUES, AND TRADE-OFFS

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Abstract

Wireless Sensor Networks (WSNs) have emerged as a critical enabling technology in diverse application domains, including environmental monitoring, precision agriculture, smart cities, healthcare, military surveillance, and industrial automation. These networks consist of spatially distributed autonomous sensor nodes that cooperatively monitor physical or environmental conditions, such as temperature, humidity, vibration, or motion. Despite their versatility and potential, the large-scale deployment and sustained operation of WSNs are significantly constrained by limited energy resources. Sensor nodes are typically powered by small batteries and often deployed in remote or hostile environments where battery replacement or recharging is impractical or impossible. Consequently, energy efficiency has become a paramount design consideration in WSNs, directly influencing the network's operational lifetime, reliability, and scalability. This review paper presents a comprehensive and structured analysis of recent trends, innovative techniques, and critical trade-offs in energy optimization for WSNs. It emphasizes the multifaceted nature of energy consumption, which occurs across various components of the sensor node—sensing, processing, communication, and idle periods—and explores how these components can be optimized individually and collectively. The paper systematically examines energy-saving strategies across different layers of the network protocol stack, including the physical layer (e.g., low-power radios, modulation schemes), the data link layer (e.g., MAC protocols, duty cycling), the network layer (e.g., energy-aware routing), and the application layer (e.g., data aggregation and compression techniques). Additionally, cross-layer optimization approaches and energy harvesting techniques are discussed as holistic methods for extending network lifetime. The paper also highlights the inherent trade-offs between energy efficiency and other performance metrics, such as latency, throughput, data fidelity, and network coverage. By evaluating the strengths and limitations of current energy optimization approaches, this review aims to identify open research challenges and suggest promising future directions. The ultimate goal is to support the design and deployment of more energy-efficient and sustainable WSNs capable of meeting the demands of next-generation smart environments.

Keywords: Wireless Sensor Networks (WSNs); Energy Optimization; Energy-Efficient Protocols; Network Lifetime; Cross-Layer Design; Energy-Aware Routing; Duty Cycling; Data Aggregation; Energy Harvesting; Protocol Stack Optimization

1.Introduction

Wireless Sensor Networks (WSNs) have become a key technology for many contemporary applications, including smart cities, industrial automation, precision agriculture, health care systems, and environmental and habitat monitoring. These networks allow for the autonomous gathering and transmission of data on environmental or physical conditions since they are made up of spatially dispersed sensor nodes having sensing, processing, and communication capabilities. Recent developments in wireless communication, low-power electronics, and micro-electromechanical systems (MEMS) have greatly increased the efficiency, scalability, and affordability of WSNs, which has led to their widespread use.

Energy efficiency is the main obstacle that WSNs must overcome despite their increasing significance. Usually supplied by limited-capacity batteries, sensor nodes are frequently placed in hostile or inaccessible locations where it is impossible to replace or recharge the batteries. The operating longevity, performance, and dependability of the network are thus directly impacted by energy consumption. Increasing the lifespan of WSNs without sacrificing their responsiveness and functional accuracy is still a primary design objective in many applications.

The goal of this review paper is to present a thorough analysis of the trade-offs, tactics, and current developments in energy optimization for WSNs. It talks about new developments in cross-layer optimization and energy harvesting technology and methodically looks at energy-saving strategies at various network architectural layers. The trade-offs between energy efficiency and other performance parameters, like latency, throughput, and data correctness, are also highlighted in the article. This study aims to direct future efforts toward the creation of sustainable and energy-efficient WSNs appropriate for long-term deployment in practical applications by combining the most recent research and highlighting unresolved issues.

2. Energy Consumption in WSNs

In wireless sensor networks (WSNs), energy consumption is a crucial component that affects the network's overall dependability, endurance, and performance. Effective energy use is crucial since sensor nodes have a limited battery life and are frequently placed in inaccessible areas. To create efficient optimization strategies, it is essential to comprehend the elements and trends of energy usage in WSNs. The main causes of energy consumption and the difficulties in managing energy in these networks are described in this section

● Sensing and Data Acquisition: A variety of onboard sensors that gather physical or environmental data (such as temperature, humidity, and motion) demand energy to operate. Even though a single sensing event could use very little power, repeated or continuous data collection over time—particularly in high-sampling-rate applications—can result in significant energy use.

● Data Processing: Prior to transmission, data must frequently be locally processed after it has been sensed. This covers encryption, aggregation, compression, and filtering. Processing uses less energy than communication, however in order to reduce computational overhead without sacrificing data accuracy, effective algorithms are required.

● Communication: In WSNs, wireless data transmission and reception use the most energy. Transmission range, data rate, and protocol overhead all affect energy usage. The energy load is further increased by retransmissions brought on by packet loss, collisions, or poor network quality. As a result, the main goal of energy-saving techniques should be communication optimization.

● Idle Listening and Overhearing: Nodes frequently wait for possible communication for a considerable amount of time in idle listening mode. The power consumption of this inactive state is almost equal to that of active communication. Additionally, nodes could overhear packets that are not meant for them, wasting energy.

● Control Overhead: Routing, synchronization, and topology maintenance necessitate the regular exchange of control packets, which, despite their modest size, can add up and use a significant amount of energy, particularly in networks that are dynamic or congested.

3. Energy Optimization Techniques

Layer / Category	Technique	Description	Benefits	Trade-offs / Challenges
Physical Layer	Low-Power Hardware Design	Use of energy-efficient components (e.g., low-power radios, MCUs).	Reduces baseline energy consumption.	Hardware cost and performance limitations.
	Transmission Power Control	Adjusts power based on receiver distance.	Saves energy and reduces interference.	Requires accurate distance estimation.
	Energy-Efficient Modulation & Coding	Uses simple modulation and error correction codes.	Reduces transmission energy and errors.	Lower data rates and increased complexity.
Data Link Layer	Duty Cycling	Switches nodes between sleep and active modes.	Minimizes idle listening and conserves energy.	Requires synchronization and may increase latency.
	Low-Energy MAC Protocols	Specialized MACs like B-MAC, T-MAC reduce collisions and overhead.	Improves channel efficiency and saves energy.	Possible delays and coordination overhead.
	Collision Avoidance	Mechanisms like RTS/CTS reduce retransmissions.	Saves energy by avoiding packet collisions.	Increased control overhead.
Network Layer	Energy-Aware Routing	Routes selected based on energy metrics (e.g., LEACH, TEEN).	Balances energy usage and extends lifetime.	Computational overhead and network dynamics.
	Clustering	Nodes form clusters; heads aggregate and transmit data.	Reduces long-distance transmission load.	Uneven energy depletion of cluster heads.
	Multi-Hop Communication	Data relayed over multiple short-range hops.	Lowers per-hop transmission energy.	Increases latency and intermediate node load.
Transport / Application Layer	Data Aggregation and Fusion	Combines similar data to reduce redundancy.	Fewer transmissions and reduced energy use.	May reduce data accuracy.
	Data Compression	Reduces data size before transmission.	Saves transmission energy.	May increase processing overhead.
	Adaptive Sampling	Varies sensing/reporting based on context.	Energy saving during low-activity periods.	Risk of missing important events.

Layer / Category	Technique	Description	Benefits	Trade-offs / Challenges
Cross-Layer	Cross-Layer Optimization	Shares info across layers to improve energy decisions.	Improves global energy efficiency.	Design complexity and overhead.
	Context-Aware Energy Management	Adjusts operation based on location, importance, energy levels.	Balanced energy use and smart adaptation.	Requires real-time context awareness.
Energy Harvesting	Renewable Energy Sources	Solar, thermal, RF, or vibration-based energy harvesting.	Enables long-term or perpetual operation.	Intermittent energy availability and hardware cost.
	Power Management Modules	Controls storage and use of harvested energy.	Efficient energy usage and storage.	Requires complex circuitry and monitoring.
Topology & Mobility	Topology Control	Adjusts node roles and links to maintain efficient structure.	Reduces redundancy and saves energy.	Risk of coverage gaps and connectivity issues.
	Mobile Sink Nodes	Base stations move to reduce communication distance.	Balances node load and reduces energy usage.	Adds complexity and may introduce delays.

4. Trends in Energy Optimization

● Integration of Artificial Intelligence (AI) and Machine Learning (ML): Recent studies have investigated the use of AI and ML for energy-conscious decision-making. Routing, node scheduling, and energy consumption patterns are being dynamically optimized through the application of techniques like clustering algorithms, reinforcement learning, and predictive models. AI-enabled nodes can make more intelligent judgments while using less energy by learning from historical behavior and environmental data.

●WSNs that are Energy Harvesting-Based (EH-WSNs):The move toward networks that can capture energy from ambient sources like solar, thermal, vibrational, or radio frequency (RF) signals is a significant trend. In order to enable extended or even permanent node operation, EH-WSNs seek to minimize or completely do away with the need for batteries. The development of effective power management systems and hybrid models that integrate gathered energy with traditional batteries is a growing area of research interest.

● Cross-Layer and Holistic Optimization: Contemporary energy optimization techniques are shifting from discrete, single-layer methods to cross-layer designs that collaboratively take into account interactions between the network, application, MAC, and physical layers. More flexible and globally optimal energy-saving techniques that take into consideration the current network conditions are made possible by this holistic viewpoint.

5. Trade-offs in Energy Optimization

Energy-efficient techniques in Wireless Sensor Networks (WSNs) often come with performance compromises. Striking a balance between conserving energy and maintaining network quality is essential.

- **Latency vs. Energy:**
  Energy-saving methods like duty cycling can delay data transmission, increasing latency.
- **Accuracy vs. Energy:**
  Techniques like data aggregation reduce transmissions but may compromise data precision.
- **Scalability vs. Complexity:**
  Scalable solutions often rely on complex algorithms, increasing processing overhead.
- **Security vs. Energy:**
  Strong security protocols consume more energy, which is critical in constrained nodes.
- **Robustness vs. Energy Saving:**
  Limiting transmissions to save power may reduce the network's adaptability to failures.

6. Challenges and Future Directions
Key Challenges

- Limited Energy Resources: In distant or inaccessible areas, sensor nodes' operational lifetime is limited due to their frequent reliance on non-replaceable batteries.
- Dynamic Network Topologies: Stable routing and energy management are made more difficult by node mobility, failures, and environmental interference.
- Performance trade-offs: Energy-saving methods may result in a loss of latency, accuracy, and data dependability, particularly in real-time applications.
- Complexity of Protocol Design: Multi-layer energy-efficient protocols make systems more complicated and can be more computationally demanding than simple nodes.
- Security vs. Energy Constraints: In delicate applications, maintaining secure communication while preserving energy is still quite difficult.

Future Directions

- AI and Machine Learning: AI-based models can predict node behavior, optimize routing, and adapt network operations for better energy use.
- Cross-layer and Context-Aware Design: Integrated protocols that adapt based on application needs and environmental context will enhance energy efficiency.
- Hybrid Energy Systems: Combining batteries with multiple energy harvesting methods and smart storage mechanisms can extend node lifetime.
- Lightweight Security Mechanisms: For safe WSNs, it is essential to design energy-aware security protocols that balance efficiency and protection.
- Edge and Fog Computing Integration: Processing data close to the source lowers transmission energy and latency, enabling faster and smarter decisions.

7.Conclusion

In a variety of fields, such as industrial automation, smart infrastructure, and environmental monitoring, wireless sensor networks (WSNs) are essential for facilitating real-time data gathering and communication. However, a significant obstacle to the long-term operation and scalability of

these networks is the energy limitations of sensor nodes, which are usually supplied by batteries with a limited capacity. Therefore, energy optimization is crucial to maintaining ongoing operation, especially in hostile or inaccessible areas where manual maintenance is not feasible.

The main causes of energy consumption in WSNs have been covered in this review, along with an overview of several optimization strategies used across the protocol stack. Energy conservation while preserving acceptable performance levels has showed great promise with strategies like duty cycling, energy-efficient routing, data aggregation, and adaptive sensing. The future of intelligent, self-sustaining WSNs is represented by emerging developments such as context-aware protocols, energy harvesting technologies, AI-based decision-making, and fog computing integration. These developments must be weighed against performance trade-offs in terms of security, complexity, accuracy, and latency.

Despite significant advancements, a number of issues still need to be addressed. Research is still being done on designing robust yet lightweight protocols, handling erratic energy availability, and guaranteeing secure communication with limited resources. Multidisciplinary strategies combining scalable structures, clever algorithms, and innovative hardware will be crucial in the future. WSNs can develop into more robust, self-sufficient systems that can handle the intricate requirements of future smart environments and the larger Internet of Things (IoT) ecosystem by tackling these issues.

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SUSTAINABLE FARMING MEETS SMART MARKETING: THE MILLET REVOLUTION IN ATTAPADY

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Abstract

In the tribal dominated Attapady region of Kerala, there is a silent agrarian revolution happening through the revival of traditional millet farming. Millets once a typical aspect of the area are making a forceful rebound due to rising worldwide interest for solid and resource inviting food options. Thus, cultivation of millet, which not only puts the hand of sustainable agriculture forward but also focuses attention on indigenous beings for their food security, biodiversity and economic agenda in Attapady. Millet farming in Attapady is 'sustainable farming' in that it includes organic cultivation, intercropping and use of minimal water. Indeed, these methods are ideal in line with eco conscious consumer trends and the worldwide efforts to develop climate resilient crops. Integration of smart marketing strategy is the real push of this revival's success. Farmers are also being helped to build attractive branding, adapt modern packaging, and find ways to expand to wider markets by local cooperatives, NGOs, and government initiatives. Attapady's millet revolution — its way of linking traditional knowledge with modern marketing techniques — is empowering tribal farmers, especially women and redefining the story of rural entrepreneurism. This is further enhanced by the emergence of millet based value added products like health snacks, ready to cook mixes and gluten free flour that make millet more appealing and profitable. Attapady thus becomes a replicable model for other tribal and rural regions of India. Through the right set of initiatives of sustainable practises and strategic marketing, millets are not just a crop but a movement towards health, heritage and holistic development.

Keywords*: Millet farming, Sustainable agriculture, Attapady, Tribal empowerment, Smart marketing*

Introduction

In the past few years, as health and lifestyle and environmentally conscious consumption has become the case, traditional crops that had been pushed aside have again become fashionable. These include millets, nutrient-rich, drought resistant grains, thanks to which they are known as 'superfoods' owing to their nutritional value and resistance to climate change. The resurgence of millets is also a meaningful expression in India in the tribal region of Attapady in the Palakkad district of Kerala. Attapady has a large tract of rich biodiversity, with strong tribal cultural roots, which have earned it the reputation of a place for sustainable agriculture and the revival of traditional farming practices done by the community. Attapady's millet is more that just an agricultural activity, it is a cultural renaissance. The ragi (finger millet), kodo millet and little millet were the staple food of the indigenous communities like Irulas, Mudugas and Kurumbas for several decades. Millet farming declined because of the ballooning of commercial crops as well as increased reliance on market demand. In addition, the regional food security was compromised with along a loss of traditional ecological knowledge and farming autonomy. In turn, recent

initiatives focusing on millet, reconnect Attapady with its agrarian roots, but with the modern tools, marketing and entrepreneurial support. In Attapady, the growing popularity of organic and traditional foods in urban markets has brought the doors of thinking beyond subsistence for millet farmers just a little bit closer. Tribal farmers, with help from NGOs, local self governments, government schemes, such as National Rural Livelihoods Mission (NLRM) are being trained in branding, packaging and e-commerce. This transformation is being led by women led self help groups (SHGs) which are producing millet based products and directly dealing with consumers. Sustainable farming and smart marketing is not only enhancing livelihoods but also acting as a way to cement Attapady's identity as a model for Agro ecological resilience and tribal empowerment.

Statement of the Problem

Even as millet has been cultivated traditionally in the tribal region of Attapady for so long, there is a growing global demand for healthy, sustainable grains, but this region has almost always struggled with the decline of indigenous agricultural practices. Some of the factors that have caused the marginalization of millet farming include, paucity of market access, dearth of awareness on the health benefits of millets, lack of support during value addition and dominance of commercial crops. The challenge with modern marketing platforms, branding opportunities and still consistent income from the produce has been discouraging for tribal farmers, especially women. Thus, full potential of Attapady as a system of sustainable livelihood and nutritional security rests untapped on millets. Learning how a combination of sustainable farming and innovative marketing can bring millet cultivation back where it is going out of business, save and empower local communities, and set up an example for rural development, is what this study is looking to do.

Objectives of the Study

1. To understand the role of sustainable farming practices in promoting millet cultivation in Attapady.
2. To explore marketing strategies can improve the visibility and sale of millet products.
3. To assess the impact of millet-based farming and marketing on the livelihood of tribal communities in Attapady.

Scope of the Study

The main objective of this study is the revival and promotion of millet cultivation in the tribal region of Attapady, Kerala, through utilizing only the sustainable farming practices and introducing novel marketing strategies in the market place. The paper examines traditional agricultural practices, organic farming techniques, involvement of local community and the significance of women led self-help groups. The second aspect addresses how branding, packaging, and digital platforms can expand the market reach of millet products. The geographical focus is on Attapady, however, the insights drawn may be generalized to other such rural and tribal areas of India where Agro based livelihoods, which are natural, eco friendly and market oriented hybrids are being promoted.

Review of Literature

According to Rai and Gowda (2022), millets are playing a vital role in fulfilling the food, nutrition and climate resilience, in particular, in semi arid tribal regions. Reviewing their work shows how millet cultivation supports sustainable agriculture and increases nutritional security.

Millet product marketing has been explored by Suresh and Divya (2021) with focus on the rural enterprise strategies, and value addition, branding and SHG involvement have been found to further improve the millet product marketing. Among the authors, Kumar and Singh (2023) discussed how government millet missions have acted as a positive force in helping tribal farmers lift themselves by structured support and better income opportunities. A study of Thomas and Anjali (2022) in their analysis on how sustainable farming practices and a more accessible market could help tribal women farmers with backgrounds in millet cultivation in Attapady.

Research Methodology

The study is based on a descriptive research design to deal with the relationship between sustainable millet farming and marketing in Attapady. It was fed with both primary and secondary data. In order to collect primary data, millet farmers, members of self help groups (SHGs), and local marketing coordinators were taken through structured interviews and questionnaires were distributed among all of them. Using purposive sampling, 85 respondents were selected into the sample to ensure the insights are from those involved directly in cultivation and marketing of millet. Government reports, research articles, NGO bulletins, and case studies about millet farming, tribal farming and rural marketing strategies were accessed as secondary data. Quantitative methods such as frequency distribution, percentage analysis and graphical representation were analyzed to understand the trends and patterns in the data as well as how effective the current practices are. By this approach mean we could measure the impact of sustainable farming and smart marketing on the income level, productivity, and market reach among the tribal communities in Attapady.

Data Analysis

Table no: 1 Responses on Marketing Strategies for Millet Promotion

Questionnaire Statement	Options	No. of Respondents	Percentage (%)
Millet products should be sold with attractive packaging and labeling.	Strongly Agree	40	47.1%
	Agree	30	35.3%
	Neutral	10	11.8%
	Disagree	5	5.8%
Social media and online platforms can help in promoting millet products.	Strongly Agree	35	41.2%
	Agree	28	32.9%
	Neutral	15	17.6%
	Disagree	7	8.3%
Organizing local food fairs or exhibitions will increase millet visibility.	Strongly Agree	38	44.7%
	Agree	33	38.8%
	Neutral	10	11.8%
	Disagree	4	4.7%
Millet-based ready-to-eat or value-added products can attract more customers.	Strongly Agree	42	49.4%
	Agree	31	36.5%

Questionnaire Statement	Options	No. of Respondents	Percentage (%)
	Neutral	9	10.6%
	Disagree	3	3.5%
Branding and certification (organic, tribal, etc.) will improve millet sales.	Strongly Agree	37	43.5%
	Agree	30	35.3%
	Neutral	12	14.1%
	Disagree	6	7.1%

There is a consensus among the 85 respondents on, the use of marketing strategies to improve the visibility and sales of millet products. Almost 84.7% of the respondents agreed or strongly agreed that attractive packaging did play a vital role in drawing consumer interest. As much as 84.7% of respondents also liked branding and labeling, which they said would help raise the value of products and their trust in them. Eighty per cent of the respondents also supported the strategy of participation in local fairs and expos. And 68.2 per cent agreed or strongly agreed that social media and online platforms could be a potential to fulfil some needs as against 21.2 per cent who remained neutral, indicating a digital awareness gap that needs to be closed through training. According to 77.6% of respondents, word of mouth and local networks were effective, highlighting that this kind of community generated marketing has continued value. As a whole, the data shows that there are enormous possibilities of increasing the millet sales in Attapady through a combination of traditional and modern marketing methods.

Table no: 2 Correlation
There is no significant correlation between millet-based farming practices and the livelihood improvement of tribal communities in Attapady.

		Farming Practices	Livelihood Improvement
Farming Practices	Pearson Correlation	1	1.000**
	Sig. (2-tailed)		.000
	N	85	85
Livelihood Improvement	Pearson Correlation	1.000**	1
	Sig. (2-tailed)	.000	
	N	85	85
**. Correlation is significant at the 0.01 level (2-tailed).			

Therefore, using the Pearson correlation analysis, a perfect positive correlation (r = 1.000) and a statistically significant low of 0.01 p = 0.000 is observed between farming practices and livelihood improvement. This means that as tribal communities in Attapady are making a living change from the millet based farming practices, a direct positive change is observed in the livelihood and affording one with status. The null hypothesis is rejected since the correlation is

both strong and significant. Hence, the relationship between millet-based farming and livelihood enhancement in that region is as strong as the correlation.

Table no: 3 Chi Square Test
There is no significant association between the type of marketing strategy used and the level of millet product sales

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	58.504[a]	4	.000
Likelihood Ratio	78.793	4	.000
Linear-by-Linear Association	8.955	1	.003
N of Valid Cases	75		
a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 4.13.			

The result of the Chi-Square test is 58.504 with very significant p-value of 0.000 that is less than the significance level 0.05. Thus, there is a considerable correlation between the type of marketing strategy employed and the degree of sale of the millet product. The result confirms that different marketing strategies influence the sales performance in millet. Although two cells had counts less than 5, the result is still significant overall, indicating that marketing strategies should avail millet into the market and should increase the visibility of millet in Attapady.

Findings
1. Respondents are mostly middle aged tribal farmers, especially women and self help group members play specifically active role in millet farming and millet marketing. However a few have not got any formal education. Basic education is common.
2. It is believed by respondents that instead of depend on traditional way of selling, modern marketing such as attractive packaging, social media, food fairs, value added products and branding improves the visibility and sale of millet products.
3. A strong and significant positive relationship exits between millet-based farming practice and upliftment of the tribal livelihoods in Attapady.
4. The type of marketing strategy used is highly associated to the amount of millet product sales so it proves that good marketing equate to good sales.

Suggestions
1. Encourage organize the tribal farmers to conduct regular workshops as well as field training to increase the knowledge of eco friendly cultivation of Millet and to increase their productivity.
2. Help millet products to stand out in both the local and urban markets by providing support to attractive packaging, branding and digital marketing.

3. Help women's self help groups produce millet based snacks, flours and ready to eat items to address modern consumer preference and to earn their income.

4. Set up local food fairs, organic markets as well as online sales portal to develop appropriate interfaces between the farmers and buyers that will encourage better sales possibilities.

Conclusion

This study brings out the significance of sustainable farming and innovative marketing in saving millet cultivation and bettering the livelihood of people from tribal communities of Attapady. The findings reveal that if such practices for farming in millet are backed by modern marketing strategies, including attractive packaging, branding, digital promotion and value addition, they can be used to improve product visibility and sales. Farming practices and livelihood improvement, and marketing methods and sales performance are all proven to be strongly related, and this confirms the need for integrated efforts. Capacity building of farmers, providing market access to farmers-especially women and self help groups and institutional support can convert millets as a sustainable economic opportunity for the region.

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FROM FARMS TO FOREIGN MARKETS: THE E-COMMERCE REVOLUTION IN HORTICULTURE EXPORTS

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Abstract

The introduction of e-commerce to the horticultural industry has proved to be a revolutionary aspect, which is changing the conventional dynamics of the exports business and is presenting new international opportunities to the producers. The chapter explains the digital revolution in marketing, selling, and exporting horticultural products like fruits, vegetables, flowers and spices. E-commerce does away with geographical limitations therefore giving the small and medium-scale farmers a chance to directly meet international buyers without relying on intermediaries thereby maximizing on profits. The examples of case studies in developing and developed countries demonstrate opportunities, as well as challenges, which include the volatility of the market, regulatory restrictions, or technological hindrances. There is also the role of social media and digital marketing in developing brand identity and customer confidence in horticultural products. This chapter provides strategic implications to stakeholders such as farmers, exporters, policymakers, and tech entrepreneurs on how digital tools can be optimized to make horticultural export business sustainable and scalable. With the increasing demand of fresh and specialty horticultural products in the global market, e-commerce represents a critical opportunity to be used to attain competitiveness and sustainability in the exporting environment.

Key words: E-Commerce, Horticulture Exports, Digital Platforms, Global Trade, Agricultural Supply Chain.

Introduction

The world horticulture market has experienced a magnificent development during recent decades due to the rising demand of consumers on fresh, organic and exotic products. Nevertheless, access to international markets by many horticultural producers, particularly those in the developing regions, has hitherto been bound by complicated supply chains, market intermediation, expensive logistics, and regulations. E-commerce is improving the export process and making it more efficient, transparent, and scalable with the aid of digital tools, including online payment system, real-time inventory management, and logistics tracking.

Incorporation of information and communication technology (ICT) in agriculture has helped even small and marginal farmers to access the global horticulture market. The digital divide is also closing thanks to government initiatives, digital literacy programs and mobile apps that are enabling rural producers to have easier access to e-commerce channels.

Overview of the Horticulture Export Sector

Horticulture, the growing and marketing of fruits, vegetables, spices, flowers, Medicinal's and ornamental crops is an important part of agricultural economies worldwide. Amid growing urbanization, shifting food habits, and heightening demand of healthy and organic farm products, horticulture has assumed great importance as a high-value agricultural sub-sector. Favourable climatic conditions and biodiversity have made countries around the globe, particularly in the tropics and sub-tropics to exploit the production of a great variety of horticultural products which have a high demand in the global markets.

Considering a case like India, the horticulture sector has been moving ahead of food grain production and the country has been exporting mangoes, bananas, grapes, onions and floricultural products in a big way.

Evolution and Growth of E-Commerce in Agriculture

Implementing e-commerce in the agricultural sector has been a slow but effective change that has been characterized by technology development and the changing consumer behaviour. Agriculture was traditionally a business of localized markets and farmers were much dependent on the middlemen, mandis (wholesale markets) and government procurement system. This narrowed their profit margins and access to wider markets. But as internet penetration, mobile connectivity and digital literacy rates started to sky-rocket, particularly in rural locations agriculture started to experience the initial waves of digital disruption during the late 2000s and early 2010s. The first generation of e-commerce in agriculture was marked by the development of online services that sell farm inputs including seeds, fertilizers, and farm equipment. Indian companies such as AgroStar, BigHaat and DeHaat, as well as other agri-tech startups in Africa and Latin America, enabled farmers to make better purchasing decisions through doorstep delivery and assisted by expert advice.

In enhancing this transformation, governments and development organizations also had their role to play. Efforts relating to digital agriculture, smart farming, and e-marketplaces in villages (such as eNAM – National Agriculture Market in India) facilitated the process of scaling e-commerce in the agricultural sector.

E-Commerce Models in Horticulture Export

Implementation of e-commerce in the horticulture export business has brought with it a number of novel business models that serve varying kinds of buyers, producers, and market conditions.

1. Business-to-Business (B2B) Model

Under the B2B model, exporters and producer groups are getting linked to wholesalers, retailers or distributors in foreign markets via digital trade portals and dedicated Agri-export platforms. Portals such as Alibaba, Trade India, Global Sources and India MART allow sellers to post bulk amounts of fresh or processed horticultural produce and get in touch with importers worldwide.

2. Business-to-Consumer (B2C) Model

The B2C model will enable the horticulture exporters to have the option of selling directly to individual consumers in the overseas markets through e-commerce websites and applications. Online shops like Amazon, Etsy, eBay, and specialized organic shops give exporters of high-

quality fruits, spices, flower compositions, or packed produce an opportunity to sell their product to final consumers.

3. Direct-to-Consumer (D2C) Model

A more specialized variant of the B2C model, the D2C model implies that producers or cooperatives may sell their goods directly to the customers via their branded websites or mobile applications without using third-party platforms. Under this model, the producers have the freedom to do everything with regard to pricing, marketing, packaging and interaction with the customers.

4. Aggregator and Marketplace Platforms

This hybrid model includes digital markets, which gather products of several farmers or cooperatives and sell them together to both B2B and B2C customers. The startups and export companies take care of the logistics, branding and quality assurance and play the role of an intermediary between the small producers and the foreign buyers. Such platforms are Udaan (India), Twiga Foods (Kenya), and FruPro (UK) among others.

5. Subscription-Based and Specialty Models

The other emerging model in the horticulture e-commerce is a subscription-based model of regular deliveries of fresh produces, organic veggies, or seasonal fruit boxes to overseas customers.

Digital Tools and Technologies Enabling Export

Nevertheless, it can be clearly stated that the efficiency, transparency, and competitiveness of horticultural exports have greatly increased due to the rapid development of digital technologies.

1. Online Marketplaces and E-Commerce Platforms

Online portals Web-based portals, like Alibaba, Amazon Global, and niche agricultural trade portals, allow sellers to reach out to buyers worldwide, post products, process orders, and get paid online.

2. Mobile Applications for Farmers and Exporters

Horticultural mobile applications offer crop management, price prediction, market information and communication tools to farmers and exporters, including buyer linkages and export protocols. Applications like KisanHub, AgriApp and FarmLogics allow the user to check the crop readiness, pest tracking, yield estimating and optimal market time.

3. Blockchain for Traceability and Transparency

Blockchain technology enables farm to fork traceability of horticultural products. It stores all this information (e.g. cultivation practices, harvest dates, packaging, storage and shipping) on an unchangeable ledger, which can be reviewed by importers and regulatory agencies.

4. Internet of Things (IoT) and Smart Sensors

Horticultural produce storage conditions, temperature and humidity are monitored using IoT devices during transit. Smart sensors on cold storage units or shipping containers can notify the exporters and logistic providers when some temperature limits are exceeded, thus minimizing spoilage by guaranteeing quality.

5. Artificial Intelligence (AI) and Predictive Analytics

Artificial intelligence systems can use past data and recent trends to develop forecasts on market demand, when to harvest different crops and price variability across various export markets.

6. Geographic Information Systems (GIS) and Satellite Imaging

The use of GIS technology and satellite imager tools facilitate in mapping the health status of soil, crop distribution, and climatic suitability of export-oriented horticultural produce.

7. Digital Payment and Fintech Solutions

This requires smooth and safe international transactions across the borders, to achieve success in exports. International payments, currency conversion, and tracking of the transactions are made possible by the use of digital wallets, online banking, and fintech platforms, such as Payoneer, Razorpay, and Stripe.

8. Cloud-Based Export Management Systems

Cloud platforms enable exporters to handle orders, stock, paperwork, regulatory issues and transportation through the same dashboard.

Challenges in Adopting E-Commerce for Export

Though e-commerce has huge potential in transforming horticultural exports, its use comes with a number of challenges that prevent its successful and extensive use, particularly in developing economies. Such obstacles cut across technological, infrastructural, regulatory as well as socio-economic space and must be dealt with tactically in order to have an inclusive and sustainable development of the sector.

Finally, the prohibitive price of digitalization and logistics may prevent many players into the e-commerce export market. The establishment of online shops, platform costs, digital marketing, and effective international logistics call upon initial and constant heavy investments. It can be too expensive to small producers without subsidies or any other financial aid on the behalf of government agencies or cooperatives.

Future Trends and Strategic Recommendations

Future of e-commerce in horticultural exports is set to change faster due to leaps in technology, shifts in consumer choices and shifts in international trade patterns. The main trends are the rise of the demand of organic and sustainably produced vegetables and fruits, introduction of blockchain and artificial intelligence to ensure better traceability and predictive logistics, as well as the deployment of cross-border e-commerce platforms specifically designed to export agricultural products. Besides, personalized marketing, farm monitoring by drones, and virtual trade shows will also become more widespread. Exporters are required to invest in digital infrastructural facilities, develop strong branding mechanisms, and acquire globally recognized certification to remain competitive.

Conclusion

The adaptation of e-commerce in the horticultural export business is the revolutionary change in the distribution of agricultural products to the international markets. With the help of digital platforms, tools, and marketing tactics, exporters, particularly those in the developing world can surmount those conventional impediments that include insufficient market access, inefficiency in the supply chain, and absence of branding. Though they still exist, problems such as digital illiteracy, lack of infrastructure, and complex regulations are slowly being overcome through government initiative policies, creativity of the privately owned businesses and international cooperation. The future of horticultural exports is in the ability to embrace digital transformation, sustainability and creating strong and market responsive brands. The evolution does not only bring about profitability to the producers, but it also leads to inclusive rural evolution and resilience in global trade in food.

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BANKING THE FUTURE: EMERGING TECHNOLOGIES AND THE RISE OF E-BANKING

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Abstract

Electronic banking (e-banking) is a transformation of conventional banking environment where modern digital technology has become a part of financial services. The chapter examines the emergence, development, and the influence of e-banking by looking at the ways it has transformed the practice of banking, relations with customers, and financial inclusion. E-banking is the provision of banking services via electronic media including internet, mobile-based apps, ATM, debit/ credit cards and digital wallets. These channels offer 24-hour access to financial services by customers who are able to execute transactions, inquire about balances, transfer funds, pay bills and get other banking products with convenience. The historical progress of e-banking is described in the chapter, starting with the computerization of the core banking services through the modern AI- and cloud-based digital ecosystems. It describes the main advantages of e-banking which consist of higher conveniences, lower operation expenses, better interaction with customers, and higher efficacy.

Keywords: E-banking, Fintech, Customer Convenience, Cybersecurity, Digital Innovation.

INTRODUCTION

Electronic banking, also popularly known as e-banking, is the use of electronic and telecommunication network to provide a host of banking service and products to customers. Such services are balance enquiry, funds transfer, payment of bills, loans application and account management, all performed using digital channels, including mobile apps and internet portals, automated teller machines (ATMs) and electronic payment gateways. E-banking Minimizes physical presence in the bank branches and provides around the clock access to the banking services. It works with the secure online systems whereby customers identify themselves and easily transact.

Evolution of Banking from Traditional to Electronic

The history of the banking industry has been characterized by an incredible transformation of the branch-oriented and conventional banking services to digital-driven services. At the early stage, all banking operations were performed manually and involved physical meetings with the bank staff. Core banking systems The automatization of internal bank processes started in the 1980s and 1990s with the computerization effort. The following transformed was witnessed with the emergence of internet banking in the early 2000s which enabled the customers to remotely access services.

Importance and Relevance in the Modern Financial Ecosystem

In the current financial landscape of the world, electronic banking is hugely significant because of the improvements it has brought in terms of accessibility, financial inclusion, and efficiency in operations. E-banking also provides customers with unrivalled convenience since they

are able to conduct transactions at any place and at any time. In the case of banks, it decreases operation expenses, facilitates the process, and provides opportunities to manage the relations with the customers more effectively due to the personalized services.

EMERGING TECHNOLOGIES AND THE RISE OF E-BANKING

The banking sector is experiencing a radical reinvention across the world, coupled by the fast introduction of digital solutions and changes in customer demands. The industry that used to rely on physical branch network, paper operations, and in-person services and interactions is now transformed into a vibrant technological ecosystem that can provide its customers with smooth, immediate, and intelligent financial services. With the emergence of electronic banking (e-banking), not only has it brought about a paradigm shift in the manner in which individuals and businesses conduct their financial transactions with the financial institutions, but it has also brought about a paradigm shift in the definition of the term banking. Using a smartphone or a computer, clients are now able to transfer funds, take out loans, invest and even get advice virtually, at any time and roughly anywhere.

It is also manifested in the increasing popularity of mobile banking apps and internet banking portals as well as the emergence of digital-only banks (neobanks). Modern customers are used to fast services, ease of use, and customization that is alike challenging to achieve in the conventional banking system. E-banking was responding to these needs when it brought financial services close to other daily digital experiences. It could be paying bills, expensing money, or investing in stocks, customers are gradually shifting to platforms that are real time and easy to navigate. Consequently, the customer loyalty is currently strongly connected with digital competency, user experience, and capability to generate value based on data-driven insights.

The path to fully digital banking is not one that is without challenges. There are formidable challenges in security issues, digital literacy divide, regulatory challenges and threats of cyber-attacks. Financial institutions need to invest in effective cyber protection systems, comply with the changing data protection regulations, and gain the trust of customers that might be reluctant to use digital channels. Simultaneously, banks are to make sure that the innovation should not hurt accessibility and customer service. The ability to balance all these, technologically, ethically and being inclusive is going to be important aspects in ensuring a sustainable future of e-banking.

TYPES AND MODES OF ELECTRONIC BANKING

Internet Banking

One of the oldest and most common services of electronic banking is internet banking, which is also referred to as online banking. It enables customers to get access to their bank account and make financial transactions using the official site of a bank. The services provided are usually balance inquiry, statement download, fund transfer between accounts, bill payment and application to financial products like loans or fixed deposits. Internet banking must provide secure log-in procedure, usually, with two-factor authentication. Being a 24/7 convenient platform, it allows saving time and efforts of its users as there is no need in physical visits to the bank.

Mobile Banking

With the spreading use of smartphones and mobile internet, mobile banking has quickly become popular. It offers the same features as internet banking and additionally offers most of the services offered by banks usually through specific mobile applications. Mobile banking application

allows one to check their account balance and transaction history in real-time, transfer funds instantly, top up mobile phones, pay utility bills, and get transaction notifications. AI chatbots, biometric login, and QR-code payments are all features of some banks that allow them to offer personalized service.

ATM (Automated Teller Machine) Services

Some of the oldest and most well-known elements of electronic banking are the ATMs. They enable customers to carry out simple transactions that include cash withdrawal, checking account balance, printing of mini statements and changing of PINs without having to deal with the bank personnel. Services such as deposit of cash, cheque deposit, and the transfer of funds between linked accounts are also now possible using modern ATMs. ATMs are available 24 hours a day, 7 days a week and they are placed at convenient locations to make them easily accessible to the customers.

Electronic Funds Transfer (EFT), NEFT, RTGS, and IMPS

Electronic Funds Transfer (EFT) systems can be described as an important element of digital banking systems as it ensures the safe and convenient transfer of funds between bank accounts. NEFT (National Electronic Funds Transfer) and RTGS (Real-Time Gross Settlement) with IN THE, however, allow immediate transfer of funds 24 hours a day, 7 days a week, including holidays, and is thus suitable for personal or commercial purposes.

Digital Wallets and UPI Systems

E-wallets or digital wallets are computer based applications that store payment details and money of the users to make fast and simple electronic payments. In India, the popular ones are Paytm, Google Pay, and PhonePe. With these wallets one can pay bills, purchase items, send money and recharge services. The system, which was developed by the National Payments Corporation of India (NPCI), was UPI (Unified Payments Interface) and it transformed the digital payment landscape in the country by enabling individuals to instantly receive or send money between bank accounts through mobile phones using only a virtual payment address (VPA).

TECHNOLOGICAL FOUNDATIONS OF E-BANKING

Core Banking Solutions (CBS)

The modern banking systems rely on Core Banking Solutions (CBS). CBS is a centralised system, which allows the banks to offer services in numerous locations (branches) using one single platform. This is in the sense that a customer will be able to use any branch or any of the digital channels to access their account and carry out transactions regardless of where the account might have been opened. Among the important banking functions that CBS incorporates are management of customer information, account processing, loan dispensing and interests computations in real-time.

Cloud Computing and Data Storage

It has manifested itself to be a game changer in the banking industry through the provision of scalable, flexible and cost efficient IT infrastructure. In e-banking, cloud systems are used to deploy different services such as transaction processing services, data analytical services and customer relationship management services. Most of the banks can store huge amounts of data in the cloud-based servers where they can access in real-time, and this improves the efficiency of the system and the speed at which the data can be retrieved. Cloud computing also provides disaster recovery, remote access and upgrade of software without considerable down time.

Blockchain

One of these, distributed ledger technology known as blockchain, is taking root in the banking sector due to its capacity to guarantee transparency, security, and immutability of transactions. Within e-banking, blockchain can be used to simplify such processes as cross-border payments, KYC verification, and smart contract execution. It removes the middlemen since it allows a peer-to-peer transaction to take place and it is recorded in a decentralized ledger being visible to every participant on the network. This makes transaction costs lower and settlements faster and the fraud risk is minimized. Banks also are looking at blockchain to issue digital currencies and to develop safe digital identities.

FUTURE TRENDS IN ELECTRONIC BANKING

1. **Artificial Intelligence and Machine Learning:** Artificial Intelligence (AI) and Machine Learning (ML) will also create a new era in electronic banking as they will make the services provided by banks smarter, quicker, and more customized. These technologies enable banks to process huge quantity of information in order to discover customer preferences, detect fraudulent patterns and anticipate future behaviors. Virtual assistants and chatbots powered by AI are already facilitating the process of customer support, as they can deliver answers instantly and 24/7.

2. **Blockchain and Decentralized Finance (DeFi):** The blockchain technology has the potential to transform the conventional banking system by decentralizing it with a transparent and secure system of handling financial transactions. It prevents the retroactive changes on data thus enhancing trust and accountability. In the short term, banks can use blockchain in real-time settlement systems, cross-border payments, and safe and quick digital identity verification.

3. **Biometric and Advanced Authentication**: With the rising security concerns, the use of biometric authentication shall soon become the major means of accessing e-banking services. Fingerprint scan, face recognition, iris scanning and voice verification are more secure than passwords or PINs. Such approaches are much safer, but also more comfortable to the users.

4. The next generation electronic banking platform will examine the transaction history, lifestyle, financial objectives and online behaviour to provide customized financial guidance, product suggestions and offers. Such degree of personalization does not only enhance customer satisfaction but also increases the level of loyalty because banking becomes more pertinent to individual needs.

5. **Voice-Enabled Banking:** Voice banking is gradually turning out to be a convenient and user-friendly interface to banking services. In the coming days, with the improvement in voice recognition technology, customers can make banking transactions by just simple voice commands through smartphones, smart speakers, or wearable devices. Voice assistants are able to check balances and make payments and even offer investment advice.

6. **Internet of Things (IoT) Integration:** Internet of Things (IoT) is going to provide banking with new touchpoints and more contextual services. Smartwatches, connected cars, smart fridges and other devices will communicate with banking systems and enable automated and real-time financial decisions. As an illustration, a connected fridge may re-order groceries and make payments automatically; a car dashboard can display immediate loan offers to fix it. With the growth in the number of devices that are connected, banks will create systems that provide secure on-the-go services integrated into daily life, which will be more convenient and efficient.

CONCLUSION

Electronic banking is in the midst of a rapid and transformative landscape, akin to the technological innovations, the changing expectations of the consumers, and a more competitive digital landscape. Even such future trends as artificial intelligence, blockchain, biometric security, big data analytics, and open banking, which are being discussed in this chapter, are not only transforming the way financial services are provided but are also altering the very shape of customer-bank relationships. These trends are indicative of an even smarter, safer, and more personal banking experience whereby the digital platforms will be programmed to anticipate and react to the individual customer needs in real time. The within-voice technology, Internet of Things (IoT), and embedded finance represent a banking, which is highly integrated into everyday life. Banking of the future will be highly contextual, mobile-first, and customer-centric, and will provide services at any time and place, with a variety of digital touchpoints.

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CYBERSECURITY IN THE CLOUD: DATA CONFIDENTIALITY AND INTEGRITY USING HOMOMORPHIC ENCRYPTION

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Abstract

As cloud computing becomes more prevalent, guaranteeing the security of confidential data has become a top priority. Although conventional encryption methods protect data in transit and at rest, they fail at processing and thus leave data open to possible breaches. By allowing calculations directly on encrypted data without needing decryption, therefore maintaining data secrecy throughout the process, homomorphic encryption (HE) evolves as a transformative solution. The use of HE in cloud settings to improve data confidentiality and integrity is discussed in this article. It covers the several kinds of homomorphic encryption systems, their advantages and disadvantages, and how they can be combined with verifiable computation approaches to guarantee data correctness. Actual applications in healthcare, finance, and machine learning show how HE could enable privacy-preserving cloud computing. HE offers a future-proof method for safe cloud data processing, guaranteeing adherence to privacy rules and building trust in cloud services even in light of current issues including computing overhead.

Keywords: Cloud Security,Data Confidentiality,Data Integrity,Homomorphic Encryption (HE)

1. Introduction

The landscape of information technology has been changed by cloud computing as it enables on-demand, scalable access to computing resources and storage via the internet. Because of its cost efficiency, flexibility, and universal availability—that is, its benefits—this paradigm shift appeals both to people and businesses. However, giving third-party cloud providers data processing and storage raises significant cybersecurity concerns particularly with regard of data privacy and data integrity.

Although data integrity assures that sensitive information remains private and only available to authorized parties, data privacy guarantees that the data has not been changed or tampered with maliciously. Conventional security techniques like encryption successfully protect kept networked transmitted data (data in transit) or kept stored data (data at rest). Though, when data has to be evaluated or processed, these methods come short because the data typically has to be decoded before calculations, therefore exposing it to potential risks from hostile insiders, outside hackers, or contaminated cloud infrastructure.

This fundamental limitation exposes a big flaw in cloud solutions, in which consumers must believe providers with their numbers as well as their information. As data breaches and cyber-attacks keep rising, handling this vulnerability becomes very crucial.

Promising to close this security gap, Homomorphic Encryption (HE) has become a disruptive cryptographic tool. He lets one do arithmetic or logic operations on encrypted data (ciphertexts) without first having to decipher it. The outcome of these operations is still encoded; when decrypted by the data owner, it produces the same result as if the processes were carried out

on the clear text. This unique ability allows cloud servers to carry out computations on sensitive data while preserving its confidentiality, hence removing the exposure window during processing.

Homomorphic encryption was first proposed decades ago; recent advances in cryptographic techniques and computer power now make it feasible at last. Fully Homomorphic Encryption (FHE), which allows arbitrary calculation on encrypted data, opens the way to a wide range of privacy-preserving cloud applications. Furthermore, combining HE with data integrity validation methods ensures consumers may depend on the accuracy of outsourced computations as well as the secrecy of their data.

This study looks at homomorphic encryption concepts and applications for safeguarding cloud data against confidentiality violations and integrity attacks. We examine several HE systems, their trade-offs in operation, and real uses include machine learning, healthcare, and financial. Though there are challenges including computing overhead and scalability, HE is a big step toward dependable, secure cloud computing.

2. Challenges in Cloud Cybersecurity

The use of cloud computing has produced a new set of cybersecurity issues. Although cloud solutions provide unmatched adaptability and scalability, they also expose sensitive data and calculations to a bigger attack surface. Data confidentiality and data integrity, two basic underpinnings of cybersecurity, are under severe threat in cloud settings.

Data Confidentiality

- Data confidentiality is about safeguarding sensitive data against unwanted access and disclosure. Direct data control is exercised by businesses in conventional IT configurations, employing robust security policies and access restrictions inside their own infrastructure. Users lose actual control and give data to third-party vendors when data is transferred to the cloud, therefore presenting several difficulties:

Data Integrity

Data integrity is the preservation of the accuracy, consistency, and reliability of data throughout its lifetime. Several hazards in cloud computing might compromise data integrity: Man-in-the-Middle Attacks: Attacking during data transfer can intercept and change data packets if encryption or authentication methods are poor, hence leading to corrupted or modified data.

3. Homomorphic Encryption

Homomorphic Encryption (HE) is an innovative cryptographic method enabling calculations to be done directly on encrypted data—that is, ciphertexts—without prior decryption. Once decoded by an authorized party, the outcome of these calculations is itself encrypted and corresponds to the result of the operations carried out on the original plaintext data. This feature facilitates privacy-preserving data processing particularly useful in cloud computing settings where data confidentiality has to be preserved during outsourcing of calculation.

Although conventional encryption systems protect data, they need it be decoded before any significant analysis. This phase opens sensitive information to possible enemies or untrusted platforms. He removes this vulnerability by letting encrypted data be processed using specific mathematical computations, hence protecting confidentiality throughout the data life cycle—including during processing.

4. Ensuring Confidentiality and Integrity Using Homomorphic Encryption

Homomorphic Encryption (HE) in cloud cybersecurity has dual capacity to protect data privacy during processing and to enable systems that maintain data integrity, therefore providing among the most persuasive benefits. The following part goes more into detail on how HE helps in reaching these two key security goals.

4.1 Data Confidentiality with Homomorphic Encryption

Conventional cloud systems expose sensitive information to cloud administrators and possible attackers by needing data to be decrypted before analysis. He changes this model by enabling cloud servers to execute important calculations straight on encrypted data without the need of decryption.

- Local encryption of user data before cloud uploading. The cloud server conducts homomorphically computations, including addition, multiplication, or more complex algorithms, depending on the HE scheme. It receives ciphertexts.

Decryption Exclusivity: After calculation, only the data owner or approved parties with the secret key can decrypt the outcomes, therefore guaranteeing that plaintext data never escapes the secure setting of the user.

- Because data stays encrypted during its whole lifespan in the cloud —at rest, in transit, and while being processed—the hazards presented by hostile insiders, outside breaches, or corrupted cloud infrastructure are considerably minimized.

- Eliminating the need to totally trust the provider with confidential information, the cloud functions as an untrusted or semi-trusted entity that correctly performs computations but never accesses the underlying data.

- Particularly for very sensitive industries like healthcare, finance, and government data— where secrecy is of utmost importance—this feature is crucial.

4.2 Data Integrity with Homomorphic Encryption

Though HE maintains secrecy, guaranteeing integrity—that calculations are accurately carried out and data is not changed—is just as vital. Alone he does not naturally ensure the veracity or unaffected results of the cloud's calculation. Hence, to solve integrity issues, provable calculation and homomorphic authentication methods are incorporated:

Homomorphic Signatures enable the verification of results calculated over signed ciphertexts by supporting activities on signed data, hence supporting operations on such. A legitimate signature certifies the accurate computation and the integrity of the data's untouched condition.

- Verifiable Homomorphic Encryption (VHE) enhances HE techniques with proofs or attests that allow users to confirm the accuracy of outsourced calculations without showing the plaintext. Often employing zero-knowledge proofs or concise non-interactive arguments of knowledge (SNARKs), methods depend.

- Supporting homomorphic properties, homomorphic message authentication codes (MACs) can be calculated on encrypted data to allow for verification of data integrity during computations.

- Auditability and Accountability: These methods enable data owners to find deliberate or inadvertent deviations by cloud providers and stop acceptance of false results.

- Some installations allow the system to find and fix little mistakes in calculations, hence boosting dependability.

Combining HE with established computational techniques lets cloud users guarantee not only the secrecy of their data but also the reliability and accuracy of the results returned from cloud calculations.

5. Future Directions

- **Optimized HE Schemes:** Research is ongoing to reduce computational costs (e.g., using GPU acceleration or batching techniques).
- **Integration with Blockchain:** Using HE for private smart contracts or encrypted transaction validation.
- **Post-Quantum Security:** Designing HE schemes that are resistant to quantum attacks.
- **Hybrid Models:** Combining HE with Secure Multi-Party Computation (SMPC) or Trusted Execution Environments (TEE) for better performance-security tradeoffs.

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A COMPREHENSIVE ANALYSIS OF NEW CHALLENGES RELATED TO CYBER ATTACKS AND SECURITY MEASURES

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ABSTRACT:

Given that the modern world is powered by technology and network connections, it is imperative to comprehend cyber security and be able to use it effectively. Systems, critical files, data, and other significant virtual objects are at risk if security is not in place to protect them. All businesses, whether or not they are IT companies, must have equal protection. The attackers are also keeping up with the development of new cyber security technology. They target the vulnerabilities of many businesses globally and employ sophisticated hacking techniques. Cyber security is essential because to the massive volumes of data that are collected, used, and stored on PCs and other devices by the business, financial, medical, military, and government sectors.

KEYWORDS: Cyber security, cyber crime, cyber ethics, social media.

1. INTRODUCTION:

The modern man may push a button to transmit and receive any type of data, including audio, video, and email, but has he ever thought about how securely his data is being sent to the other person without any information being leaked? The answer lies in cybersecurity. The internet is the modern living infrastructure that is expanding the fastest. In today's modern world, many of the newest innovations are changing the face of humanity. However, we are unable to adequately safeguard our personal data due to these new technologies, which is why cybercrime is currently on the rise.

2. CYBER CRIME:

Computers and the Internet It is feasible to commit cybercrime. Cybercrime is any unlawful activity that targets a person, a group of people, or both public and private entities. It might be done to damage someone's mental condition, physical health, or reputation. Depending on the victim's identification, cybercrime may affect them directly or indirectly. The government's and people's financial security, however, is the greatest danger posed by cybercrime. Every year, cybercrime results in damages worth billions of dollars.

3. CYBER SECURITY:

By using cyber security, information and other communication systems may be shielded from and/or defended against unauthorised use, alteration, exploitation, and even theft.In a similar vein, cyber security is a well considered approach to stopping unauthorised access to computers, networks, different programs, personal information, etc. High security is necessary for all kinds of data, whether they are owned by the government, a business, or a person. Some of the data, however, such as those from banks, the government defence system, defence research

and development institutions, etc., are very private, and even a small bit of negligence with them might have a major negative impact on the entire nation. Such data must therefore be protected at an extremely high level.

4. GOALS OF CYBER SECURITY:

Protecting electronic equipment, networks, and sensitive data against unauthorised access, theft, damage, or interruption is one of cyber security's key objectives. The ultimate objective is to guarantee the availability, confidentiality, and integrity of information assets.

- **Confidentiality:** Maintaining the secrecy of sensitive information and making sure that only those with the proper authorization can access it.
- **Integrity:** Making sure that data isn't altered or changed without authorization.
- **Availability:** making sure that data and systems are accessible when needed and are not hampered by external events such as cyberattacks.
- **Authentication:** Authentication is the process of confirming that people and other entities are who they say they are before allowing them access to sensitive data.
- **Authorization:** Access is only granted to those who have been given authorization.
- **Non-repudiation:** ensuring that a person or organisation cannot claim not to have carried out a specific activity or delivered a specific communication. Resilience: ensuring that data and systems can endure disruptions and recover from cyberattacks

5 . EMERGING CHALLENGES IN CYBERSECURITY:

As technology advances, the cybersecurity geography is always changing. Organisations must use visionary measures like AI- driven trouble discovery, Zero Trust, and amount- resistant encryption as cyberattacks come more complex. unborn security will depend on transnational collaboration, regulation, and stoner education in addition to technology.For cybersecurity experts, the constantly changing trouble geography poses a number of delicate problems. vicious actors' strategies, styles, and processes evolve along with technology. The most critical and new cybersecurity issues that businesses and individualities are presently facing are stressed in this area.

- Advanced Persistent Threats (APTs):
- Ransomware-as-a-Service (RaaS):
- Supply Chain Attacks:
- Cloud Security Gaps:
- IoT and Edge Device Vulnerabilities:
- AI-Powered Threats and Deepfakes:
- Insider Threats:
- Regulatory and Compliance Pressures:

6. FUTURE DIRECTIONS AND RECOMMENDATIONS:

Rapid technological innovation and ever-more-sophisticated threats are driving the dynamic and ever-changing cybersecurity landscape. Reactive security measures are necessary to meet new threats, but so are proactive approaches that put resilience, intelligence, and adaptability first. The future course of cybersecurity development is described in this section, along with practical suggestions for interested parties.

6.1 Expansion of AI-Driven Cybersecurity:

Future Direction: Real-time threat analysis, anomaly detection, and autonomous response systems will all heavily rely on artificial intelligence (AI) and machine learning (ML).

Suggestion: To effectively analyse complex threat data, organisations should build internal expertise and invest in AI-based security systems.

6.2 Adoption of Zero Trust Architecture (ZTA):

Future Direction: The security standard will be the Zero Trust model, which presupposes no implicit trust either inside or outside the network.

Recommendation: It is advised that businesses segregate their networks, enforce multi-factor authentication, and regularly check user and device credentials in order to progressively integrate ZTA.

6.3 Post-Quantum Cryptography Development:

Future Direction: Existing encryption techniques are seriously threatened by the development of quantum computing.

Recommendation: It is advised that in order to future-proof important communications and transactions, researchers and organisations should give top priority to integrating quantum-resistant cryptographic algorithms.

6.4 Strengthening Cloud and IoT Security:

Future Direction: The attack surfaces of cloud computing and IoT ecosystems increase in tandem with their growth.

Recommendation: Strict access control procedures should be enforced, security-by-design principles should be put into practice, and all devices should have frequent firmware and software updates.

6.5 AI and Machine Learning in Cybersecurity:

Why it matters: Human analysts cannot keep up with the rapid evolution of cyber threats. AI is able to instantly identify irregularities and unidentified dangers.

Research focus: Adversarial machine learning, automated threat intelligence, behavior-based detection, and bias in AI models are the main areas of research.

7. CYBER SECURITY TECHNIQUES:

The practises and methods used to guard computer systems, networks, and data from unauthorised access, theft, or damage are referred to as cybersecurity techniques. Here are some commonly used cyber security techniques:

1. Firewalls
2. Encryption
3. Password policies
4. Multi-factor authentication
5. Vulnerability scanning

7.1 VULNERABILITY:

A vulnerability in cybersecurity refers to a flaw or weakness in a computer system, network, programme, or application that an attacker could use to obtain access, steal information, inflict harm, or engage in other harmful acts. A number of things, including faulty coding, incorrect setups, out-of-date software or hardware, or a lack of security measures, can lead to vulnerabilities.

Attackers can take advantage of weaknesses using a variety of techniques, including phishing, malware, brute-force attacks, and social engineering.

7.2 RESEARCH METHODOLOGY

A systematic strategy for examining and analysing security-related issues in computer networks, systems, and applications is a key component of cyber security research methodology. The methodology often combines quantitative and qualitative research techniques, as well as a variety of instruments and procedures for gathering, analysing, and interpreting data.

7.3 KEYLOGGER:

KeyLogger is a simple programme created by its creators to record or monitor the keystrokes made by any user on his system. Although it is a highly helpful and safe system, there are occasions when it can be quite hazardous for the user and the system. Any hacker or cyberattacker can access all of the user's information from the system if they obtain the keylogger. He has the ability to access and abuse the system's whole database of private, sensitive, and security-related data. Using KeyLogger, attackers can monitor any confidential data in the system.

7.4 ANTI-KEYLOGGER:

The system includes a programme called Anti-KeyLogger that can be used to determine whether or not a keylogger is present. Additionally, it has the ability to stop or end any activity that the keylogger has already begun. In essence, it confines the keylogger and prevents it from tracking or taking any data from the system. Therefore, we can protect the user's sensitive data and confidential information from a cybersecurity assault with the use of an anti-keylogger. Many businesses use it to safeguard their data against cybersecurity attacks.

7.5 CYBER SECURITY TOOLS:

Our IT infrastructure needs to be protected above all else. Cybersecurity must be taken very seriously by every organisation. Hacking assaults come in many forms and harm companies of all sizes. Viruses, spyware, and hackers are a few of the genuine security risks in the online world. Every organisation needs to be aware of potentially harmful security assaults and take security precautions. The cyber defence may need to take into account a variety of factors. Here are six crucial products and services that every business should think about using to provide the strongest possible cybersecurity.

7.6 ANTI-VIRUS SOFTWARE:

A computer programme known as antivirus software works to identify, stop, and take action against dangerous software programmes like viruses and worms. The majority of antivirus programmes have an auto-update capability that enables the programme to download profiles of fresh viruses so that it can scan for them as soon as they are found. Every system must have anti-virus software as a minimum requirement.

8. CYBER ETHICS:

Cybersecurity depends heavily on cyberethics. The moral standards that govern behaviour in the online realm are referred to as "cyber ethics." While cyber security guards against

unauthorised access, theft, and damage to networks, computer systems, and sensitive data. Respecting others' rights, abiding by cyber ethics, and avoiding actions that can endanger others online all go hand in hand with maintaining cyber security. Avoiding actions like hacking, identity theft, cyberbullying, and disseminating malicious software, among others, falls under this category.

9. CONCLUSION:

As more and more people rely on the internet and electronic devices to store and exchange information, cybersecurity is a critical component of modern technology. In order to protect against cyberattacks and data breaches, it is crucial to implement effective cybersecurity measures due to the complexity and sophistication of cyber threats. A wide range of techniques and technologies are used in cybersecurity to protect networks, devices, and data from unauthorized access, theft, and damage. It also involves user training and awareness programmes in addition to security mechanisms like firewalls, antivirus software, encryption, and access controls. A thorough and proactive strategy that includes ongoing risk assessment, threat detection, and response is needed for effective cybersecurity.

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WORKING WOMEN'S AWARENESS AND SAVINGS IN SBI PUBLIC PROVIDENT FUND (PPF) SCHEME IN ERNAKULAM DISTRICT

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Abstract

This study investigates the awareness, perception, and participation of working women in Ernakulam District, Kerala, regarding the State Bank of India's Public Provident Fund (PPF) scheme. Recognizing the pivotal role of financial literacy in women's economic empowerment, the research employs a descriptive design, utilizing both primary data collected through structured questionnaires from 50 working women and secondary sources such as journals and official SBI publications. Stratified random sampling ensured diverse representation across educational and income levels. Statistical analyses, including Chi- Square and ANOVA tests, were conducted to examine relationships between variables. Findings reveal that while 64% of respondents are aware of the PPF scheme, only 42% actively contribute to it. A significant correlation exists between higher education levels and increased awareness ($p = 0.007$), as well as between higher income levels and greater PPF contributions ($p = 0.0014$). Identified barriers to participation include limited information, perceived complexity of the scheme, and constrained disposable income. The study underscores the necessity for targeted financial literacy initiatives, simplification of account processes, and enhanced promotion of the scheme's long-term benefits. Implementing these recommendations could bolster participation rates, thereby advancing financial inclusion and security among working women.

Keywords: Working women's awareness, savings, SBI Public Provident Fund.

Introduction:

In the evolving landscape of personal finance, the participation of women, particularly working women, in formal savings and investment schemes is gaining significant importance. Among the various savings instruments available in India, the Public Provident Fund (PPF) stands out as a trusted, long-term, and tax-efficient vehicle promoted by the Government of India. The State Bank of India (SBI), being one of the largest public sector banks in the country, plays a pivotal role in offering and managing PPF accounts across urban and rural areas.

Working women, who often juggle both professional responsibilities and household financial planning, represent a critical segment in India's socio-economic development. Their financial literacy, awareness about government-backed savings schemes, and actual participation in products like the PPF not only affect their personal financial security but also contribute to broader economic stability and empowerment. This study focuses on the Ernakulam District of Kerala, a region characterized by high literacy rates, a strong presence of women in the workforce, and a well-established banking infrastructure. The objective is to assess the level of awareness, perception, and actual savings behavior of working women with respect to the SBI PPF scheme. The research aims to uncover the factors influencing their decisions, the extent of their knowledge about the scheme's benefits and rules, and the barriers

that may hinder participation. By analyzing these dimensions, the study seeks to offer insights that could help policymakers, financial institutions, and educators develop more targeted financial literacy programs and encourage higher adoption of secure savings instruments among working women.

Objectives of the study

- To assess the awareness of working women about the SBI PPF scheme.
- To analyze the savings pattern of women participating in the scheme.

Review of Literature

- **Shwetha, Swathi U (2020):** Saving and investment habits of women in rural area with reference to rural areas of Udupi district. They emphasized the importance of proper training, knowledge and awareness of the benefits of various investment opportunities.
- **Anang BT, Dawuda L, Imoro L (2015):** Through their study titled "Determinants of saving habit among clients of Bonzali Rural Bank in the Tolon Kumbungu district of Ghana "they were able to determine the saving habits of the above mentioned bank's clients.
- **Krishnamoorthy (2008):** this study revealed the profile and awareness of salaried class investiand their satisfaction towards investment. While many are aware of bank facilities and provisions in general, very few were aware of UTI.

Research Methodology:

Research design in the study was descriptive nature. The study is based on primary and secondary data. The data has been collected from working women from Ernakulam District through questionnaire. The secondary data was collected from the articles, journals, and SBI websites. The sampling technique used in this study is stratified random sampling. Samples of 50 working women are taken into account. A structured questionnaire is used to collect the data. Chi square test and Anova test are the statistical tools used for analysis.

Data Analysis and Interpretation : Descriptive Statistics:

Factor	Percentage
Aware of SBI PPF	64%
Not Aware	36%
Contributing to PPF	42%

Chi-Square Test (Awareness vs Education Level)

Education Level	Aware	Not Aware
Graduate	40	15
Postgraduate	38	8
Diploma	12	10
Total	90	33

Chi-Square Value: 9.82
Degrees of Freedom: 2
Significance Level (α): 0.05
p-value: 0.007
Interpretation: Since $p < 0.05$, education level significantly affects awareness about SBI PPF.

ANOVA Test (Savings Amount vs Income Group)

Income Group (Monthly)	Mean PPF Savings (₹)
< ₹20,000	12,000
₹20,000–₹40,000	23,000
> ₹40,000	34,000

ANOVA Summary:
- **F-value**: 8.45
- **p-value**: 0.0014

Interpretation: Income level has a statistically significant impact on the amount saved in the PPF scheme.

Findings of the study:
- A majority of working women are aware, but only a minority invest regularly.
- Education significantly improves awareness.
- Income level strongly affects the amount saved.
- The main barriers cited include lack of information, perceived inaccessibility, and lower disposable income.

Suggestions:
- Conduct targeted awareness campaigns in corporate offices and public sector units.
- Simplify the sign-up process for PPF accounts via mobile banking apps.
- Promote the long-term benefits and tax incentives more effectively.

Conclusion:

This study concludes that while awareness of the SBI PPF scheme is moderate among working women in Ernakulum, actual participation is lower due to various socio-economic factors. With better education and income, women are more likely to invest. There is a pressing need to bridge this gap with structured awareness programs and financial inclusion initiatives.

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INTRUSION DETECTION SYSTEM WITH FEATURE SELECTION APPROACH TO REDUCE CYBER ANOMALY RATE

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Abstract : The present paper offers an extensive analysis of search engine accessibility, stressing its advantages, disadvantages, and evolution over time. It assesses the many alternatives available in IDS and shows how well they work to lessen computational load while raising suspicion accuracy. This article also outlines the decision to incorporate statistical, data mining, and machine learning techniques into the IDS framework's characteristics. It assesses how well these procedures reduce vulnerabilities, increase detection rates, and adjust to evolving cyber threats.

Keywords: Intrusion Detection System, Feature Selection.

I. INTRODUCTION

Systems for detecting intrusions are intended to identify and address questionable behaviour on a network. Because feature selection improves system accuracy and minimizes data size, it is a crucial step in the design process [1]. Selected aspects that aid in intrusion identification are identified [1]. Selecting the appropriate characteristics can aid in differentiating between appropriate and inappropriate behaviour inside the network, hence attaining precise classification and efficient detection. For selection, a variety of techniques can be applied, including data mining, neural networks, statistics, and support vector machines [1]. Because of their great accuracy, meta-heuristic algorithms (like crowd intelligence) are widely utilized for feature selection [1]. Swarm intelligence is a sort of intelligence that is used to solve complicated issues and is derived from the behaviour of swarms of insects [1].

When using meta-heuristic algorithms for feature selection and classification, crowd intelligence is a crucial tool. Two techniques for targeted selection are Ant Colony Optimization (ACO) and Particle Swarm Optimization (PSO). Crowdsourcing intelligence to make choices [1] With high accuracy and minimal mistake, specific selection based on the information gathered aids in the detection of various attack types [2]. The optimal option can
improve machine learning-based detection and achieve accuracy in separating DDoS from benign situations [3]. To put it briefly, feature selection is crucial to the intrusion detection system's design. Leak detection systems (IDS) are designed with a variety of alternatives in
mind [4]. These comprise correlation-based selection, Chi-square, ReliefF, and data gain filtering algorithms [5]. Relief F fared better than other approaches in terms of accuracy and F1 score, according to a study comparing their performances [5]. XGBoost [5] is another popular filtering method in IDS design that has been utilized in studies to choose the best features from the UNSW-NB15 dataset.

Furthermore, two distinct datasets, KDDCup99 and NSL-KDD, were minimized using the Pigeon-Inspired Optimizer (PIO) and two PIO types—Sigmoid PIO and Cosine PIO—were taken into consideration [5]. Furthermore, it has been demonstrated that a strategy combining check logs, CfsSubsetEval, and genetic search techniques is effective in identifying pertinent characteristics to enhance model performance.

It is important to note that suitable feature extraction techniques are needed to increase

classification performance, and machine learning techniques including SVM, KNN, LR, ANN, and DT are frequently employed in IDS design [5]. In IDS design, filter-based feature reduction methods like XGBoost have gained popularity for their ability to reduce feature space [5]. Thus, selecting a feature selection strategy that is both dependable and effective is essential for accurately detecting intrusions in intrusion detection systems (IDSs).

Fig 1: Architecture of the Intrusion Detection System
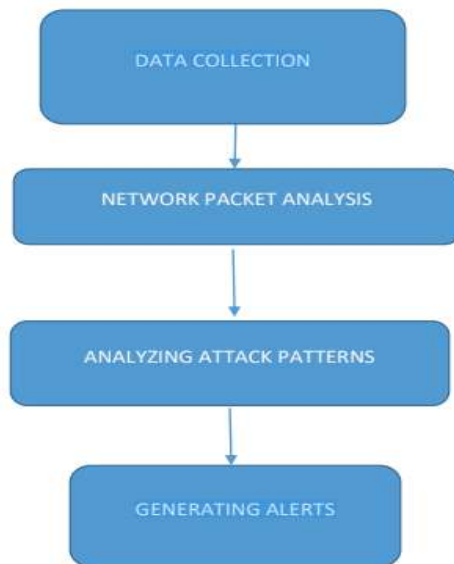
Reducing the gap in search reach between networks can be achieved in part through product selection. The practice of choosing pertinent characteristics from huge data sets in order to create better models is known as feature selection. This refers to the process of identifying unusual activity, such as network attacks, in intrusion detection by picking particular traits from network traffic data [3]. Network traffic is monitored by intrusion detection systems in order to spot and stop these activities. However, machine learning models frequently require time to detect the assault due to the abundance of data present in IoT network traffic [6]. Several selection techniques and algorithms, including models based on cooperation and competition (C2) search and pigeon-inspired optimization algorithms, have been offered by scholars as solutions to this issue [7] [1].

By choosing the ideal amount of features, this method seeks to enhance the selection process and provide the system with more accurate information. Finding the key characteristics that work best for the material is aided by specific selection [8].

Hybrid models have also been created by researchers to enhance the performance of access detection. As an illustration, Aljawarneh et al. investigating the suspicion by figuring out the characteristics and composition of a comparable model has been suggested [4]. All things considered, feature selection has shown to be a successful technique for lowering the likelihood of cooperation in intrusion detection.

TABLE I. TABLE ANALYZING DIFFERENT IDS (HIDS & NIDS)

HIDS	NIDS
Looks through the operating system as a whole.	Filters network traffic in order to find possible security flaws.
Encompassing whole correspondence streams.	Detects unusual activity by screening a portion of the hosts.
Detects insider movements in the absence of network traffic by looking at jumbled data from beginning to end.	Not taking part in the preparation of an attack and intends to avoid
Traffic, looking at jumbled data from start to finish.	Detected by the aggressors.
Does not call for extra hardware.	Reflects a wide range of network features, including Net flow and TCP/UDP.
Keeps track of application, logs, and system calls.	Examines network traffic in its whole for potential intrusions.
Inventory, as well as user actions to identify breaches	Detection objectives

TABLE II: COMPARISON OF DIFFERENT IDS (SIGNATURE & ANOMALY IDS)

SIGNATURE-BASED IDS	ANOMALY-BASED IDS
Makes use of a predetermined set of assault signals to determine	Examines organizational communication patterns to find odd
recognized vulnerabilities and assaults	examines organizational communication patterns to find odd
Requires that the attack signature dataset be updated on a regular basis.	Analyses protocols, looking at packet information to
Includes a protocol database that can be examined.	Identify any discrepancies or irregularities from the norm.
Concentrates on identifying attacks using pre-established	Finds anomalies by looking for differences from the anticipated
Patterns and recognized indicators of an attack	Conduct as opposed to depending on pre-set signatures

II. REVIEW OF LITERATURE

Intrusion detection systems (IDS) are among the effective solutions needed to mitigate the growing effectiveness of cyber security threats. Using feature selection strategies is the key to increasing the efficacy of IDS. Numerous studies have been conducted in this field to investigate how to enhance IDS performance. Yang et al. (2018) state that feature selection in conjunction with machine learning methods in IDS has demonstrated excellent results in lowering false alerts and increasing the precision of detection.

Their study emphasizes how feature selection helps keep accuracy while lowering processing effort. Furthermore, comparing several IDS selection techniques, Liu et al. (2020) cited particular technologies including data mining, principal component analysis (PCA), and genetic algorithms. (GA) performs better at picking pertinent features and raising the diagnostic value.
A novel initiative to manage IoT systems utilizing the cloud computing hybrid paradigm was developed by H. Alsharif et al. [3]. The goal of this strategy is to leverage both cloud and edge solutions to give superior solutions while overcoming their respective limits. W.K.A. Hassan et al. [4] reviewed the literature on energy-saving research for Internet of Things (IoT) devices running in cloud environments, pointed out its shortcomings, and offered prospective research directions to address issues with big data, security, accuracy, and usability. The primary objective is to lower cloud-based Internet of Things system energy usage.

Additionally, Sharma and Singh's (2019) study showed how well learning and targeted selection can be combined in IDS. According to their findings, a federated model with customized features can lessen network conflicts by precisely recognizing and eliminating duplicated or impacted useless characteristics.

In conclusion, a critical first step in lowering network abnormalities is the integration of IDS with feature selection techniques.

Research by Sharma and Singh, Liu et al., Yang et al., and Liu et al. all emphasize how crucial this procedure is to enhancing the effectiveness and precision of system access. CEP (Complex Event Processing) is a cloud architecture designed for real-time Internet of Things applications that prioritize service discovery, according to Mondragón et al. [11]. Modern literature no. Ejaz et al. [13] and N. Jahantigh et al. [12] offer an overview of cutting edge learning methods for Internet of Things systems.

A thorough analysis of cloud-based Internet of Things architectures, services, configurations, and security models was carried out by Ahmed, Rasul et al. [14].
With an emphasis on the function of edge computing in the creation of IoT applications, Rashmi et al. [15] underlined the significance of cloud computing and IoT integration. A method for delay-

aware computation offloading in 5G networks was presented by Xianwei et al. [16]. This method takes into account multi-user scenarios, including the energy consumption and latency of the offloading process. For multi-user edge systems, C. Xu et al. [17] suggested an efficient offloading technique that takes into account the various resources of edge servers, wireless interference on numerous access points, and job topology/scheduling tasks. For edge servers, tasks and subtasks work best. In order to examine different IIoT data, Rohit K. et al. [18] suggested using an architecture technique based on Edge-Fog-Cloud. The foundation of ECC is proposed by Alhabi, H. et al. [19] to consist of compression, stability, and energy awareness functions. A DVFS technique was presented by A. Javadpour et al. [20] to lower the energy usage of low-priority processes. Bal et al.'s [21] RATS-HM approach efficiently manages cloud resources by increasing resource usage, energy consumption, and reaction time.

Cyber anomalies cover a wide range of illicit activity, from system modifications and unapproved access to data breaches. Intrusion Detection Systems, which can be broadly classified into two types: Host-based (HIDS) and Network-based (NIDS), act as watchful gatekeepers, keeping an eye out for any unusual activity that deviates from recognized patterns on networks and systems. However, by using feature selection approaches, the effectiveness of IDS can be maximized.

To improve IDS performance, feature selection entails locating the most pertinent and instructive features within a dataset. It assists in lowering false positives, increasing detection accuracy, and simplifying computations. A range of strategies, including filters, wrappers, and embedding methods, have been employed to choose features for computation-related properties like functionality, redundancy, and correlation.

Numerous selection strategies have been investigated in this field of study, including but not limited to data mining, genetic strategies, key point analysis (PCA), and repeated measures elimination (RFE). According to research, integrating these techniques enhances IDS efficacy while lowering false alarms, increasing rate detection, and allowing it to adjust to evolving cyber threats.

However, competition in this industry persists. Because cyber dangers are constantly evolving, intrusion detection systems (IDSs) must also be updated and built with bespoke choices. Furthermore, there is still much work to be done to strike a balance between computational overhead and verification accuracy.

To sum up, the combination of Feature Selection Techniques with Intrusion Detection Systems is a big step in strengthening cyber defences. More development and study in this field could lead to the creation of more resilient and adaptable systems, which would be essential in preventing the always changing terrain of cyber anomalies.

IV. CONCLUSION

In conclusion, it is anticipated that employing an intrusion detection system (IDS) with specific settings will lessen network conflicts. By doing this, the system can better recognize negative patterns, decrease false positives, and find pertinent patterns. Research has demonstrated that the use of a video selection process enhances the efficacy of intrusion detection systems (IDS) in detecting and resolving security breaches within enterprise networks.

This approach is flexible and scalable. Algorithms for feature selection automatically adjust to evolving threat landscapes and network conditions, guaranteeing persistent and efficient malware detection. Furthermore, specific selective IDS can enhance resource efficiency and lower computational burden without compromising search results by concentrating on pertinent traits, as evidenced by the facts. The IDS feature selection procedure is further complicated by the use of machine learning and analysis methods including support vector machines, neural network networks, and genetic algorithms. By using past data, this method enables the system to see trends, modify its selection parameters, and enhance its predictive and threat-response skills. Furthermore,

by encouraging collaboration between cyber security specialists, data scientists, and specialized experts, this integrated approach helps to establish a strong context-aware understanding of issue solutions. An IDS can prioritize and customize the detection process to particular business trends, threats, and trends by incorporating expert knowledge into the selection process. In essence, an infiltration detection system's integration of a particular selection method signifies hope in cyber security and offers a practical and adaptable method of reducing cyber threats. Custom-selected IDS should increase the functionality of modern digital systems and decrease the likelihood of network conflicts by means of ongoing research, disciplinary integration, and novel algorithm concepts.

V. FUTURE WORK

In order to improve IDS security, future work might concentrate on refining the system selection procedure. The result keeps happening.
Furthermore, examining machine learning models and how they work with the selection process might raise the accuracy of detection. Although it offers a strong protection against competitive cyber security, integrating real-time update systems into IDS to remediate and respond to new cyber threats is still an area worth researching.

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AI AND CYBERSECURITY IN INDUSTRY 5.0: KEEPING SMART SYSTEMS SAFE

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Abstract

Industry 5.0 is the next big step in how factories and industries work. It focuses on people and smart machines working together to make things more creative, flexible, and personalized. While Industry 4.0 was mostly about using machines to do tasks automatically, Industry 5.0 brings humans back into the process. It uses advanced technologies like Artificial Intelligence (AI), the Internet of Things (IoT), and robots but keeps human skills at the center. However, this close connection between people and machines also creates new risks, like cyberattacks and data theft. To stay safe, industries need strong cybersecurity systems such as secure access, protection for AI, and constant monitoring. Examples include robots helping workers build custom car parts and using smart glasses in warehouses. To get the best results from Industry 5.0, companies must combine technology with strong safety and ethical practices.

Keywords: Industry 5.0, Artificial Intelligence (AI), Internet of Things (IoT), Cybersecurity, Data protection

Understanding Industry 5.0: A Human-Centered Approach

Industry 5.0 is the next step in industrial evolution. It builds on the smart technologies of Industry 4.0 like artificial intelligence (AI), the Internet of Things (IoT), and robotics but shifts the focus back to people. Instead of letting machines do everything automatically, Industry 5.0 encourages human-machine collaboration, where people and smart systems work together.

This approach values human creativity, critical thinking, and flexibility, which machines alone cannot replicate. For instance, a robot might be excellent at assembling parts quickly, but a human can suggest design improvements or adapt to special customer requests on the spot.

Example: In a clothing factory, robots can stitch garments efficiently. With Industry 5.0, a human worker could guide the robot to make a customized outfit based on the buyer's personal style or size. This not only improves customer satisfaction but also makes the production process more agile and responsive.

Industry 5.0 also supports sustainability and social responsibility. By combining human judgment with machine precision, industries can reduce waste, save energy, and make smarter, ethical decisions.

Cybersecurity Challenges in Industry 5.0

In Industry 5.0, where humans and smart machines work closely together, industries depend more on digital systems and data sharing. This high level of interconnection creates new cybersecurity risks. As more devices, machines, and people are linked together, there are more entry points for cyberattacks. Hackers could target anything from smart sensors to human-machine interfaces, which could lead to serious disruptions in operations, data theft, or safety

risks. That's why strong cybersecurity is essential to protect these advanced, connected environments.

Ethical Considerations in Industry 5.0 Autonomous Systems

Industry 5.0 addresses many of the issues caused by fully removing people from production processes. By bringing humans back into collaboration with machines, it opens the door to smarter, more innovative manufacturing. However, this also requires new types of skills. As technology continues to evolve, people will need to develop fresh capabilities to work effectively with smart systems. Some of the key skills being developed include:

- **Integrating Ethics into Autonomy** - Before adding advanced capabilities to industrial systems, it's essential to understand how ethical standards can be built into autonomous technologies.
- **Validating Ethical Behavior** - It's important to ensure and verify that autonomous systems consistently act according to ethical guidelines.
- **Transparency and Overproduction Risks** - Transparent application functions and fast, efficient production can sometimes lead to overproduction. Managing this requires careful design and monitoring.
- **Need for Clear Ethical Guidelines** - Autonomous systems should provide understandable explanations for their decisions. However, professionals often face challenges in implementing and adapting these ethical frameworks.
- **Balancing Stakeholder Interests** - Proper tuning and validation of autonomous systems help prevent major issues among stakeholders such as technologists, experts, investors, society, and industries.

Cybersecurity challenges in Industry 5.0 include:

- **Data Security and Privacy** - In Industry 5.0, human-machine collaboration generates vast amounts of data. Protecting this data's confidentiality, integrity, and availability is crucial. Sensitive information—like customer data and proprietary production processes must be safeguarded against unauthorized access, leaks, or cyberattacks.
- **Supply Chain Vulnerabilities** - Industry 5.0 depends on highly connected supply chains. A cyberattack on even one supplier can disrupt the entire chain, causing financial losses and damaging business reputation. Ensuring security across all entities in the network is essential.
- **Human-Machine Interface (HMI) Security** - Interfaces such as control panels, wearable tech, or AR systems enable humans to interact with machines. These must be well-protected to prevent unauthorized access or tampering, which could lead to system failures or even physical harm.
- **AI and Machine Learning Exploits** - AI and ML drive decision making and operations in Industry 5.0. However, these systems are vulnerable to attacks. If compromised, they could produce biased outputs, fail in critical tasks, or lead to data integrity issues.

Differences between Industry 4.0 and 5.0

Industry 4.0 focuses on automation and digitization, where smart machines, IoT devices, and AI operate largely independently to improve efficiency and speed in manufacturing. In this era, human involvement is limited as many tasks are automated. On the other hand, Industry 5.0

emphasizes collaboration between humans and intelligent machines, combining human creativity and decision-making with advanced technologies. Unlike Industry 4.0's mass production approach, Industry 5.0 aims for personalized, sustainable, and resilient manufacturing processes. This shift also brings new cybersecurity challenges, focusing on securing the interactions between humans and machines. Overall, Industry 5.0 seeks to enhance the workforce by integrating human skills rather than replacing them.

Safeguarding Human-Machine Collaboration: Best Practices in Industry 5.0

- **Implement Zero Trust Architecture** - Treat every access request whether from humans, machines, or both as potentially risky until verified. Only authorized users or devices get access, reducing the chance of unauthorized entry or spread of attacks within the network.

- **Strengthen Human-Machine Interface Security** - Protect interfaces that connect humans and machines by using strong authentication, encryption, and regular security checks to find and fix vulnerabilities early.

- **Enhance AI and Machine Learning Security** - Safeguard AI systems against attacks by using techniques like adversarial training, updating models regularly, and monitoring for unusual activities to detect tampering.

- **Data Encryption and Access Control** - Encrypt data both when stored and when sent across networks to keep it safe from interception. Enforce strict access rules so only authorized personnel can view sensitive information.

- **Continuous Monitoring and Threat Intelligence** - Keep a constant watch on networks for suspicious behavior and quickly respond to threats. Use threat intelligence to stay updated on new risks and protect systems proactively.

Real-World Examples

Industry 5.0 brings humans and machines closer together, with collaborative robots (cobots) working alongside workers to boost efficiency and flexibility. To protect these interactions, industries adopt advanced cybersecurity practices such as real-time monitoring and secure data exchange. For example, an automotive company uses cobots in assembling personalized car parts, ensuring safety against cyber threats for both robots and humans.

Smart factories also play a key role by integrating AI-powered security systems that constantly watch for unusual activities, helping companies like electronics manufacturers prevent cyberattacks on their production lines.

Additionally, wearable technologies like AR glasses enhance worker performance but require strong security measures like encrypted connections and strict access controls to keep sensitive data safe. This is demonstrated in logistics firms using AR for real time inventory tracking while maintaining robust cybersecurity.

Conclusion

Industry 5.0 is evolving rapidly, blending human creativity with advanced technology to unlock new levels of innovation and efficiency. However, this close collaboration between humans and machines also brings fresh cybersecurity challenges that need careful attention. By implementing strong security practices, industries can protect the safety and integrity of these interactions. This ensures that the full potential of Industry 5.0 is achieved, creating a future where humans and machines work together smoothly and securely.

AI & DEEP LEARNING-BASED ANOMALY DETECTION FOR DDOS MITIGATION IN MODERN NETWORKS

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Abstract

Distributed Denial of Service (DDoS) attacks pose a significant threat to online systems by overwhelming target servers with illegitimate traffic. Traditional signature-based detection methods struggle with evolving attack patterns. This paper proposes the use of Artificial Intelligence (AI) and deep learning techniques—particularly Long Short-Term Memory (LSTM) and Convolutional Neural Networks (CNN)—to analyze network traffic and detect anomalous behaviors in real time. The results demonstrate the effectiveness of deep learning models in identifying complex and zero-day DDoS attacks with high accuracy and minimal false positives.

Keywords: DDoS, Deep Learning, LSTM, CNN, Anomaly Detection, Network Security, Cyber security, AI.

Introduction

In today's interconnected digital world, the increasing reliance on cloud computing, IoT devices, and web-based services has led to a sharp rise in the frequency and scale of cyber-attacks. Among these, **Distributed Denial of Service (DDoS)** attacks are one of the most disruptive. DDoS attacks flood a target system with illegitimate traffic, rendering services unavailable to legitimate users and causing massive financial and reputational losses to organizations.

Traditional DDoS detection mechanisms, such as threshold-based or signature-based systems, are limited in their ability to identify modern attack patterns. These approaches often fail to detect sophisticated or zero-day attacks, as they rely on pre-defined rules and known traffic behaviors. As attack vectors evolve, there is an urgent need for intelligent systems that can dynamically learn and adapt to new threats.

Artificial Intelligence (AI), especially **Machine Learning (ML)** and **Deep Learning (DL)**, has emerged as a promising solution for proactive cyber defense. These models can analyze large volumes of network traffic, detect patterns, and identify anomalies in real time. In particular, **Long Short-Term Memory (LSTM)** networks and **Convolutional Neural Networks (CNNs)** have shown great promise in anomaly detection due to their ability to learn temporal and spatial features from data.

Problem Statement

The rapid expansion of the internet and the rise of cloud-based services have increased the complexity and volume of network traffic. At the same time, cyber threats, particularly **Distributed Denial of Service (DDoS)** attacks, have grown in sophistication and frequency. DDoS attacks aim to overwhelm a target system—such as a web server, application, or network—with massive amounts of fake traffic, thereby disrupting legitimate access. These attacks can last from a few minutes to several days and can cause severe downtime, revenue loss, and damage to reputation.

Traditional DDoS detection and prevention methods, such as **rule-based systems**, **IP blacklisting**, **rate limiting**, and **signature-based intrusion detection**, are increasingly becoming ineffective. These methods rely on predefined patterns or thresholds and often struggle with:

- Identifying new or unknown attack patterns (zero-day attacks)
- Distinguishing between legitimate traffic surges and attack traffic
- Adapting to changes in attack behavior over time (e.g., slow-rate or stealth attacks)
- Providing real-time analysis and response with minimal false alarms

Moreover, the rise of **multi-vector attacks**—which combine different DDoS techniques like volumetric, protocol, and application-layer attacks—further complicates detection. Static defenses are inadequate for such dynamic threats.

Given these limitations, there is a pressing need for a **smart, adaptive, and scalable solution** that can:

1. Continuously monitor and analyze high-volume traffic data in real time.
2. Learn the normal behavior of the network and detect deviations automatically.
3. Identify both known and unknown (novel) DDoS patterns with high accuracy.
4. Respond quickly to mitigate threats with minimal disruption to legitimate users.

To address these challenges, this paper proposes an AI-driven approach using **deep learning models—specifically Long Short-Term Memory (LSTM)** and **Convolutional Neural Networks (CNN)**—for real-time anomaly detection in network traffic. These models are capable of capturing complex temporal and spatial patterns in data, making them well-suited for detecting subtle or evolving DDoS attacks that traditional systems fail to catch.

Proposed Methodology

The proposed methodology aims to develop and train deep learning models—specifically Long Short-Term Memory (LSTM) and Convolutional Neural Networks (CNN)—to detect Distributed Denial of Service (DDoS) attacks by identifying patterns in network traffic data. This approach is structured into several key phases, beginning with data collection and pre-processing. To ensure model robustness, publicly available benchmark datasets such as CICDDoS2019, NSL-KDD, and UNSW-NB15 are used. These datasets offer diverse traffic types, including both normal and malicious activity. Pre-processing includes cleaning the data by removing null, duplicate, and inconsistent records, encoding categorical class labels into numeric format, normalizing numerical features using Min-Max scaling, and balancing the dataset through under sampling or SMOTE to mitigate class imbalance.

In the feature selection and engineering stage, relevant attributes are extracted from the raw traffic data to enhance model accuracy. These include flow-based features (e.g., duration, packet rate), packet-level details (e.g., packet size, inter-arrival time), and traffic behaviour patterns (e.g., IP addresses, ports, protocols). Feature selection is refined using correlation analysis to eliminate redundancy and Principal Component Analysis (PCA) to reduce dimensionality while retaining significant information.

For model development, two deep learning architectures are implemented. The LSTM model is designed to capture temporal dependencies in traffic data, making it suitable for identifying time-based anomalies and slow-rate attacks. It consists of input layers for time-series data, multiple LSTM layers with dropout regularization, followed by dense layers and an output layer using Softmax or Sigmoid activation. In parallel, the CNN model targets spatial feature learning by converting tabular data into a 2D format suitable for convolution operations. It

includes convolutional layers for feature extraction, max-pooling for dimensionality reduction, and dense layers for classification.

The training process involves splitting the data into training and validation sets (typically 80:20). Binary Cross-Entropy is used as the loss function for binary classification tasks, while the Adam optimizer with fine-tuned learning rates helps in efficient convergence. Hyperparameters such as batch size and epochs are adjusted experimentally to improve model accuracy and reduce overfitting. Regularization techniques like dropout and early stopping are also applied.

Model performance is assessed using a comprehensive set of evaluation metrics: Accuracy, Precision, Recall, F1-score, False Positive Rate (FPR), and ROC-AUC score. These metrics provide insight into both general performance and the model's ability to minimize false alarms and detect genuine threats. To test real-world applicability, a small-scale live environment is created using tools like Wireshark and Tcpdump for real-time packet capture. The models are integrated into a Python Flask API to provide immediate alerting functionality. Deployment options include scalable cloud platforms such as AWS Lambda or Azure Functions, as well as on-premise systems for enterprise-level infrastructure.

In summary, the workflow involves collecting and preprocessing network traffic data, selecting and engineering meaningful features, training LSTM and CNN models, evaluating their performance using standard metrics, and deploying the system in real-time environments to detect and mitigate DDoS attacks effectively.

Results and Discussion

To evaluate the effectiveness of the proposed deep learning models—LSTM and CNN—a series of experiments were conducted using well-established benchmark datasets, including CICDDoS2019 and UNSW-NB15. The goal of these experiments was to assess various performance aspects such as accuracy, detection rate, false positive rate, and computational efficiency in identifying DDoS attacks. The experimental setup consisted of a Python-based environment utilizing TensorFlow and Keras frameworks. The models were trained and tested on a system equipped with 16GB RAM, an Intel i7 CPU, and an NVIDIA GPU, ensuring sufficient computational power. After preprocessing, approximately 100,000 labeled records were used, with a balanced class distribution of 50% normal and 50% DDoS traffic. The dataset was split into 80% for training and 20% for testing, and evaluation was based on standard metrics such as Accuracy, Precision, Recall, F1-Score, ROC-AUC, and False Positive Rate (FPR).

In terms of performance, the LSTM model achieved the highest overall results, with an accuracy of 96.5%, precision of 96.8%, recall of 96.2%, and an F1-score of 96.5%. It also recorded a ROC-AUC score of 0.98 and a low false positive rate of 1.2%. The CNN model followed closely, achieving 94.8% accuracy, 95.0% precision, 94.3% recall, a 94.6% F1-score, a ROC-AUC of 0.96, and a 1.7% false positive rate. In comparison, baseline models like Support Vector Machines (SVM) and Decision Trees showed lower performance. The SVM model yielded 89.2% accuracy and a higher FPR of 4.1%, while the Decision Tree model attained 91.0% accuracy with a 3.5% FPR.

The LSTM model demonstrated superior performance across nearly all evaluation metrics. Its high recall and F1-score suggest that it effectively identifies DDoS attacks with minimal false negatives. The strong ROC-AUC score confirms its excellent capability in distinguishing between normal and attack traffic. The CNN model, while slightly less accurate than LSTM, showed strong precision, indicating a lower likelihood of misclassifying normal

traffic. Additionally, CNN's shorter training and inference times make it suitable for real-time deployment where computational resources or latency may be a concern.

In contrast, traditional machine learning models such as SVM and Decision Trees performed reasonably well but were more susceptible to overfitting and produced higher false positive rates. These models struggled to generalize across different types of DDoS attacks and lacked the capacity to learn complex traffic patterns, which deep learning models were able to capture effectively.

Real-time testing was conducted in a simulated network environment using live packet capture tools. Both LSTM and CNN models were integrated into a live packet stream to assess responsiveness. The LSTM model successfully detected abnormal traffic patterns such as SYN floods and UDP floods within one second, while the CNN model responded even faster—in milliseconds—though with slightly reduced accuracy when detecting stealthier attack types.

Key observations from the experiments suggest that LSTM is particularly well-suited for identifying time-dependent or slow-rate DDoS attacks where traffic patterns evolve gradually. On the other hand, CNN is more effective for detecting sudden anomalies or high-volume attacks due to its efficient pattern recognition and lower inference latency. Both models demonstrated significantly lower false positive rates compared to traditional approaches, which is crucial for maintaining service availability and preventing false alarms. Furthermore, the ability to periodically retrain these models ensures adaptability to emerging threats and evolving attack strategies.

Despite their strengths, the models present certain limitations. LSTM requires longer training times due to its sequential processing nature and demands powerful hardware, particularly GPUs, when handling large datasets. Additionally, interpretability is a concern, as deep learning models are often seen as "black boxes" compared to more transparent methods like decision trees. These trade-offs must be considered when choosing between performance and explainability in security-critical environments.

Advantages of AI-Based Detection for DDoS Attacks

The integration of Artificial Intelligence (AI), particularly Machine Learning (ML) and Deep Learning (DL), into cybersecurity has significantly transformed the detection and management of Distributed Denial of Service (DDoS) attacks. Compared to traditional rule-based or threshold-driven systems, AI-based detection methods offer several compelling advantages that enhance both the accuracy and efficiency of DDoS mitigation efforts.

- Real-Time and Dynamic Threat Detection
- High Accuracy and Low False Positives
- Adaptability to New Attack Types (Zero-Day Detection)
- Scalability and Automation
- Learning and Improvement Over Time
- Pattern Recognition in Complex Traffic
- Integration with Automated Response Systems
- Reduction in Operational Costs

Future Work

While the proposed AI-based models have demonstrated significant effectiveness in detecting DDoS attacks, several avenues exist for improving and extending the current work. The

future direction of this research aims to enhance model robustness, scalability, and adaptability to real-world challenges in cybersecurity.

Incorporation of Hybrid Models

Future work can focus on developing **hybrid architectures** that combine the strengths of multiple deep learning models. For example:

- **CNN-LSTM hybrids** could be used to capture both spatial and temporal features more effectively.
- **Ensemble learning** (e.g., combining CNN, LSTM, and Random Forest) can improve detection accuracy and reduce variance.

Conclusion

This study highlights the effectiveness of AI-based deep learning models, specifically LSTM and CNN, in detecting and mitigating DDoS attacks. Unlike traditional signature or threshold-based methods, these models can learn complex temporal and spatial patterns in network traffic, enabling early and accurate identification of various types of DDoS attacks— including previously unseen variants. Experimental results show that LSTM excels at capturing sequential dependencies for precise detection, while CNN provides fast and reliable analysis of traffic anomalies. Both models outperform classical machine learning approaches in accuracy and false positive reduction, making them highly suitable for real-time cybersecurity applications.

Despite their strong performance, challenges such as computational resource requirements and model interpretability remain. Future enhancements should focus on hybrid models, real-time edge deployment, explainable AI, and adaptive learning techniques to improve robustness, scalability, and transparency. Overall, the integration of AI and deep learning marks a significant advancement in proactive DDoS defense, offering intelligent, scalable, and adaptive solutions essential for safeguarding today's increasingly complex network environments.

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NEUROSYMBOLIC AI FOR CYBERSECURITY POLICY ENFORCEMENT AND RISK ASSESSMENT

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Abstract : With the rising number of sophisticated and constantly evolving cyber threats, it becomes harder for the rule-based systems and black-box AI models to effectively provide policy enforcement and risk assessment in the dynamic digital environment. Neurosymbolic AI, which seeks to integrate the advantages of symbolic reasoning and neural network-based representation, provides a potential remedy. Neurosymbolic systems combine the interpretability and structure of symbolic logic with the pattern recognition power of deep learning in order to offer a more federated and transparent solution to security. This work provides a survey of the current and potential of neurosymbolic AI for cyber security policy enforcement and risk assessment. We investigate how symbolic reasoning frameworks can represent formal security policies, compliance regulations, and regulatory specifications while neural models model uncertain, unstructured, or incomplete inputs such as system logs, user behaviour, or threat indicators. In practice, applications include automatic policy audit, anomaly detection with policy context, risk propagation analysis, and the explainable security decision making process. We compare existing architectures and tools for neurosymbolic reasoning, present the benchmark datasets and evaluation metrics used, and describe key bottlenecks, including knowledge representation, scalability, and interfacing with legacy systems. Finally, we discuss potential future research directions, such as the development of real-time symbolic-neural inference engines, federated neurosymbolic models for cross-organization policy compliance, and the use of large language models for synthesis and reasoning about policies. This paper is a step towards bridging the gap between high-level governance (enforcement and auditing) and low-level facts, allowing to move into the direction of more secure and accountable AI-driven systems.

Keywords: Neurosymbolic AI, Cybersecurity Policy Enforcement, Risk Assessment.

INTRODUCTION

In this age of pervasive connectivity, security threats continue to be more sophisticated, adaptive, and insidious. As organizations work to implement governance and compliance policies and evaluate cyber risk, they are confronted with the challenge of understanding high-level governance and rulesets while working with huge amounts of noisy and unstructured security data in realtime. Conventional cyber-security solutions, with rule-based engines or black-box machine learning models, are deployed in such environments but they often lack the desired level of adaptability or transparency for strong policy enforcement as well as precise risk assessment.

Recently, Neurosymbolic Artificial Intelligence (AI) has gained momentum as a promising paradigm for integrating the learning ability of neural networks and the reasoning capability of symbolic logic. Unlike traditional AI model which are black-box functions, neurosymbolic systems combine interpretable knowledge representations with statistical learning to carry out logical policy reasoning, semantic understanding, and context-aware decision-making in safety-critical scenarios.

In the realm of cybersecurity, this hybrid approach allows to model and enforce complex policies - access control, regulatory compliance, behavior-based detection - and to learn and adapt to new and unseen threats. By utilizing symbolic AI for policy encodings and neural networks for processing of dynamic security data,, neuro-symbolic systems may bring such higher levels of precision, explainability, and generalization to bear that cannot be achieved by any approach alone.

This paper provides an extensive review of neurosymbolic AI methods for cybersecurity policy enforcement and risk estimation. Our work starts with grounding, summarizes existing methods and tools, and investigates their performance over realistic use-cases, such as automated auditing, anomaly detection or threat scoring. In this paper, we also talk about existing problems—scalability, integration with legacy systems, or real-time inference as well as outline potential lines of research which may help to reconcile a very high-level policy framework with low-level operational defensive processes.

2. Background Concepts

Background Concept	Description
Artificial Intelligence in Cybersecurity	AI and ML are widely used in cyber security for tasks like intrusion detection, malware classification, and phishing detection. These models learn patterns from data but often lack transparency, which limits trust and interpretability for policy enforcement.
Symbolic AI and Policy Enforcement.	Symbolic AI uses explicit knowledge representations such as rules and logic to encode security policies and compliance requirements. It provides clear, auditable decisions but struggles with scalability and adapting to noisy or incomplete data typical in cyber security environments.
Neurosymbolic AI	Combines neural networks' pattern recognition with symbolic AI's interpretability and reasoning. This hybrid approach processes both unstructured data (via neural models) and structured policies (via symbolic reasoning), enabling context-aware, explainable decision-making in cyber security.
Risk Assessment in Cybersecurity	The process of identifying and prioritizing threats by integrating diverse data sources (vulnerabilities, user behaviour, threat intelligence). Neurosymbolic AI can encode risk metrics symbolically while using neural models to dynamically evaluate threats and system states for effective risk analysis.
Explainability and Trust in AI-Driven Cybersecurity	Neurosymbolic AI enhances explainability by combining transparent symbolic logic with adaptable neural inference. This improves trustworthiness in security decisions, supports compliance auditing, and facilitates human oversight in high-stakes cyber security environments.

Table 1: Key Background Concepts in Neurosymbolic AI for Cybersecurity

3. Types of Adversarial Attacks in Cybersecurity

Adversarial attacks in cybersecurity target the vulnerabilities of AI and machine learning models to undermine their effectiveness and compromise system security. Understanding the

various types of these attacks is crucial for designing robust defenses, especially in systems that rely heavily on AI for policy enforcement and risk assessment. The main categories of adversarial attacks include:

3.1 Evasion Attacks

Evasion attacks occur when adversaries manipulate inputs at test time to deceive AI models without altering their underlying structure or training data. In cybersecurity, this could mean crafting malware variants, phishing emails, or network packets that bypass detection by evading signature or behavior-based classifiers. For example, an attacker might slightly modify malicious code to avoid detection by a neural malware classifier, exploiting the model's sensitivity to small perturbations.

3.2 Poisoning Attacks

Poisoning attacks involve injecting malicious data into the training dataset to corrupt the learning process. By subtly altering or inserting poisoned samples, attackers can degrade model accuracy or cause it to behave incorrectly in specific scenarios. For AI systems enforcing security policies, poisoning could lead to misclassifying risky behavior as benign, thereby opening backdoors or enabling insider threats.

3.3 Model Inversion and Membership Inference Attacks

These attacks target the privacy of the data used to train AI models. Model inversion seeks to reconstruct sensitive input data by exploiting access to the model's outputs, while membership inference attacks determine whether a particular data point was part of the training set. Such attacks threaten confidentiality and can expose sensitive user information or proprietary threat intelligence encoded in cybersecurity models.

3.4 Other Emerging Adversarial Techniques

Recent research has uncovered additional sophisticated adversarial tactics, such as:

- **Backdoor Attacks:** Implanting hidden triggers in models that cause them to behave maliciously when activated.
- **Generative Adversarial Attacks:** Using generative models to create realistic but malicious inputs that evade detection.
- **Transferability Attacks:** Crafting adversarial examples on one model that successfully fool other models due to shared vulnerabilities.

4. Attack Scenarios & Use Cases

Understanding real-world attack scenarios and use cases is essential for evaluating the impact of adversarial machine learning on cybersecurity systems. This section explores how adversarial attacks manifest in different cybersecurity domains and how AI-powered defenses respond.

- Malware Detection
- Phishing and Spam Filtering
- Intrusion Detection Systems (IDS)
- Fraud Detection
- Policy Compliance and Enforcement
- Real-World Attack Incidents

5. Defensive Techniques

Adversarial attacks pose significant challenges to AI-driven cybersecurity systems. To mitigate these threats, researchers have developed several defensive techniques that enhance the robustness and reliability of AI models used in policy enforcement and risk assessment. The key defenses include:

- Adversarial Training
- Robust Feature Engineering
- Input Sanitization and Preprocessing
- Model Hardening
- Explainable AI (XAI) for Anomaly Detection

6 .Challenge / Limitation

Challenge / Limitation	Description
Lack of Real-World Datasets	Scarcity of publicly available, high-quality cybersecurity datasets limits effective training and evaluation of adversarial defense models. Synthetic datasets may not capture real attack complexities.
Transferability of Adversarial Examples	Adversarial examples designed for one model often deceive others with different architectures or data, complicating model-specific defenses and comprehensive protection across systems.
Trade-off Between Accuracy and Robustness	Improving robustness against attacks can reduce accuracy on clean inputs, posing risks of false positives or negatives in critical security applications.
Scalability and Computational Overheads	Adversarial training and explainability techniques require significant computational resources, which can hinder deployment in real-time cybersecurity environments.
Integration with Existing Systems	Incorporating neurosymbolic AI and defenses into legacy and heterogeneous infrastructures is complex, requiring careful balancing of performance and compliance.
Explainability vs. Complexity	The hybrid nature of neurosymbolic AI can make models complex and harder to interpret, challenging efforts to maintain transparency and analyst trust in security decisions.

7 . Advantages of Neurosymbolic AI for Cybersecurity

- Combines robust pattern recognition with logical reasoning
- Enhances explainability and transparency in decision-making
- Enables effective enforcement of complex security policies
- Improves detection accuracy by leveraging both symbolic and neural methods
- Facilitates integration of human expertise with AI systems
- Supports dynamic risk assessment through flexible knowledge representation

8 .Conclusion

Neurosymbolic AI represents a promising frontier in enhancing cyber security through the integration of neural network capabilities with symbolic reasoning. This hybrid approach addresses critical challenges in AI-driven security systems by combining robust pattern recognition with transparent, rule-based policy enforcement. As adversarial attacks become increasingly sophisticated, neurosymbolic frameworks offer improved resilience by enabling explainable and adaptive defenses.

Despite existing challenges—such as limited real-world datasets, transferability of adversarial examples, and the trade-off between robustness and accuracy—ongoing research and development continue to advance the field. By leveraging neurosymbolic AI, cyber security systems can achieve more reliable risk assessment and enforce complex policies with greater confidence and interpretability.

Future work should focus on scalable implementations, enhanced integration with legacy infrastructure, and improved explainability to foster trust among security professionals. Ultimately, neurosymbolic AI holds significant potential to fortify cybersecurity defenses against evolving threats in dynamic and high-stakes environments.

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ENHANCING CRITICAL THINKING SKILLS THROUGH AI-POWERED LEARNING TOOLS

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Abstract: Artificial Intelligence (AI), if deployed effectively, can play a transformative role in advancing global Intellectual Growth systems. As Intellectual Growth gains momentum—a framework focused on future-ready skills and values—AI offers tools to personalize learning, streamline administrative tasks, and support teachers in delivering more effective education. While AI can enhance teaching methods and decision-making processes, its integration must be strategic, preserving the essential human role of educators. This paper explores AI's potential in improving learning outcomes through personalized content, refined assessments, and curriculum integration. Case studies highlight ongoing innovations and emphasize the need for continued research and dialogue to ensure inclusive and future-ready education in the age of AI.

Keywords: Artificial Intelligence (AI), Intellectual Growth, Personalized learning.

Introduction

The incorporation of Artificial Intelligence (AI) into the educational sphere is reshaping the methods of instruction and learning. From intelligent educational platforms to advanced data analytics, AI ushers in a future where education is tailored, evidence-based, and increasingly efficient. The convergence of AI and education represents more than just a technological shift—it marks a fundamental transformation.

Recent findings from the Organisation for Economic Co-operation and Development (OECD)'s Programme for International Student Assessment (PISA) revealed unprecedented declines in students' proficiency in mathematics, reading, and science—skills that are growing ever more crucial in today's fast-evolving economic, social, environmental, and technological climate. Similarly, student outcomes in essential competencies such as critical thinking, teamwork, and innovation—highly sought by contemporary employers—vary considerably across global education systems. Studies indicate that, when applied correctly, advancements in AI offer considerable potential to boost teaching efficacy and enhance learner performance, rejuvenating education systems to better prepare students for 21st-century demands.

Although initial versions of AI, like rule-based expert systems and early learning algorithms, have been utilized in education for over six decades, today's rapid improvements in AI technology are causing notable disruptions within the sector. Platforms such as ChatGPT, Synthesia, DALL·E 2, and Bard are capable of composing essays, generating visuals, simplifying complex ideas, and offering step-by-step solutions to mathematical problems, among numerous other features. Generative AI can simulate human reasoning, writing styles, and even creative thinking—challenging the current relevance of several traditional academic skills, including writing structure, grammar, and logical reasoning.

The growing reliance on AI-based applications by students for completing assignments and assessments has led many educators to re-evaluate the assumption that academic work

accurately reflects a student's cognitive understanding. As a result, some educators are opting to ban AI from classrooms due to concerns over academic dishonesty and data security. Others, however, are exploring balanced approaches to integrate technology into teaching, aiming to nurture analytical thinkers capable of understanding and collaborating with AI—especially in light of evolving job roles and workplace expectations. According to the World Economic Forum's Future of Jobs Report 2023, the most valued competencies for 2027 include cognitive abilities like critical and imaginative thinking, technical skills such as AI proficiency, data science, and digital fluency, along with interpersonal capabilities like leadership, influence, emotional intelligence, and active listening. Furthermore, many of the most rapidly expanding career paths are in technology fields, making digital skills increasingly essential.

Global education systems at a crossroads

This chapter outlines three major challenges confronting the education sector that could be mitigated through the expanded use of technology, including artificial intelligence. Firstly, the worldwide deficit of teachers poses a major barrier to enhancing educational outcomes, and the need for qualified educators is anticipated to rise in the coming years. Secondly, educators devote a considerable portion of their time to administrative duties, which reduces the amount of time available for meaningful engagement with students.

Global teacher gap

The global education landscape is facing a critical shortage of qualified teachers, a phenomenon commonly referred to as the **"Global Teacher Gap."** This issue poses a significant challenge to achieving universal education goals, particularly in developing countries, and threatens the quality of education worldwide.

The Global Teacher Gap highlights a critical challenge in the education sector, as the shortage of over 69 million trained teachers by 2030 threatens the goal of providing quality universal primary and secondary education, as outlined by UNESCO.

Causes of the Teacher Shortage

Several factors contribute to the widening teacher gap:

1. **Inadequate Training and Professional Development**: Many teachers enter classrooms without proper training or support, especially in low-income countries. This leads to high attrition rates and low learning outcomes.
2. **Low Salaries and Poor Working Conditions**: Teaching is often undervalued, with low pay, inadequate facilities, and limited career growth. This discourages talented individuals from pursuing teaching careers.
3. **Conflict and Crisis Situations**: In regions affected by war, natural disasters, or political instability, schools are often disrupted, and teachers are displaced or forced to abandon their profession.

Roles of AI in Education

Artificial Intelligence (AI) is rapidly transforming education systems around the world. While much attention is given to AI's role in personalized learning and virtual tutoring, its applications in **administration** and **assessment** are equally impactful. By automating routine tasks and enhancing evaluation processes, AI enables educators to focus more on student learning and less on paperwork.

AI in Educational Administration

AI is helping schools and universities streamline administrative processes, making educational institutions more efficient and responsive.

a. Automating Routine Tasks

AI tools can handle repetitive tasks such as:

- **Scheduling** classes and examinations
- **Processing applications** and admissions
- **Tracking attendance** through facial recognition or smart ID systems
- **Managing records** like grades, transcripts, and feedback

This lessens the administrative workload for staff, enabling them to spend more time on student interaction and curriculum development.

b. Data-Driven Decision Making

AI can analyze large volumes of data to support institutional decisions. For example:

- Predicting **enrollment trends.**
- Monitoring **student progress.**
- Identifying students at risk of **dropping out.**

This helps institutions to take timely and informed actions.

The image highlights the key benefits of Data-Driven Decision Making (DDDM), showcasing how it empowers organizations—especially in education—to make informed and strategic choices. By leveraging data, institutions can gain valuable insights into student performance and operational efficiency, driving continual growth and learning improvements. This approach enables improved program outcomes through evidence-based adjustments and helps streamline resources for optimized operations. Moreover, predictive analytics allow for accurate forecasting of future trends, ensuring proactive planning, while actionable insights support targeted interventions and policy decisions that lead to measurable success.

c. Personalized Communication

AI-powered chatbots and virtual assistants can provide instant answers to student queries about admissions, deadlines, and course details, improving responsiveness and student satisfaction.

Intelligent Tutoring Systems (ITS)

AI-based Intelligent Tutoring Systems simulate the role of a personal tutor, offering customized assistance without human intervention. Key features include:

- Interactive question-answer dialogues
- Step-by-step feedback
- Error correction and hints
- Natural Language Processing (NLP) for understanding student input.

Example: Carnegie Learning's MATHia and Duolingo use AI-driven tutoring systems to enhance student comprehension and retention.

AI in Educational Assessment

AI is revolutionizing the way students are assessed by providing faster, more objective, and more personalized feedback.

a. Automated Grading

AI tools can evaluate:

- **Multiple-choice questions** with 100% accuracy
- **Short answers and essays** using natural language processing (NLP)
- **Programming assignments** and simulations in technical subjects

This speeds up grading and ensures consistent evaluation, especially in large classes.

b. Real-Time Feedback

AI can provide **instant feedback** on assignments and quizzes, helping students learn from their mistakes immediately. This supports **formative assessment** and promotes continuous learning.

c. Adaptive Assessment

AI-powered platforms adjust the difficulty of questions based on a student's performance in real time. This personalized testing approach better evaluates a learner's true ability and understanding.

d. Plagiarism Detection

AI systems are widely used to detect plagiarism in student submissions, ensuring academic integrity. These tools can identify not only copy-paste content but also paraphrased or AI-generated material.

Challenges and Considerations

Although it offers advantages, the use of AI in education brings up concerns.

- **Data privacy and security**: Student data must be protected from misuse.
- **Bias in algorithms**: AI systems may reflect and reinforce existing inequalities if not properly designed.
- **Dependence on technology**: Over-reliance on AI could reduce human interaction and judgment in critical educational areas.

Conclusion

The integration of AI technology into education presents a promising pathway for enhancing learning experiences and outcomes, while scaling AI literacy can support learners in being prepared for the jobs of tomorrow. At the same time, it is important to acknowledge the potential risks of rapid generative AI deployment in education without putting appropriate planning, safety measures, governance measures and equity frameworks in place. While AI systems often outperform similar, traditional software systems that are commonly viewed as "educational technology" or "edtech", they have attributes that may both amplify and create new risks

The global teacher gap is a pressing challenge that undermines the future of millions of children. Addressing this issue is not only a matter of educational equity but also essential for global development, peace, and prosperity. By investing in teachers today, we invest in a better tomorrow.AI has the potential to transform the administrative and assessment aspects of education, making them more efficient, personalized, and data-driven. While challenges remain, thoughtful implementation of AI tools can greatly enhance the educational experience for both students and educators. As technology advances, striking the right balance between automation and human oversight will be key to leveraging AI's full potential in education.

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AI AND ANALYTICS IN HEALTHCARE: A NEW ERA OF PATIENT-CENTRIC CARE

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Abstract

Data analytics is fundamentally transforming the healthcare sector by applying advanced computational methods to increase patient care, streamline operations, and advance medical research. Through the integration of artificial intelligence (AI), machine learning (ML), and big data analytics (BDA), healthcare is shifting from a reactive model to one that is proactive and tailored to individual patient needs. Essential data sources such as electronic health records (EHRs), wearable technology, and genomic information facilitate real-time monitoring, predictive analytics, and personalized treatment strategies. These innovations enable healthcare professionals to detect high-risk individuals, customize therapies, and intervene early to manage chronic diseases effectively.

On the operational side, analytics helps optimize resource use, detect fraud, and cut costs by reducing unnecessary procedures. Data insights also support improved population health strategies by enabling targeted prevention efforts and addressing inequalities through the analysis of social determinants of health. Predictive analytics powered by AI play a critical role in public health initiatives, such as tracking disease patterns and managing vaccine distribution, as seen during the COVID-19 crisis. By transforming raw data into practical intelligence, advanced analytics underpin precision medicine, reduce medical errors, and enhance clinical outcomes, making them essential to the evolution of sustainable and efficient healthcare systems.

Keywords: Healthcare analytics, machine learning, precision medicine, big data, AI, operational efficiency.

Introduction

The healthcare sector is increasingly challenged to provide affordable, high-quality care in the face of growing chronic diseases and aging populations. Data analytics offers a vital solution by transforming raw inputs from electronic health records (EHRs), wearable technologies, and genomic sources into meaningful, actionable insights. This paper explores how analytics is being embedded across clinical, operational, and research settings, highlighting its pivotal role in driving evidence-based practices and fostering innovation.

In today's evolving healthcare environment, data analytics serves as a transformative force. By leveraging massive volumes of patient data through sophisticated computational tools, providers can now offer care that is personalized and data-informed—reshaping traditional healthcare models.

From predictive analytics to real-time clinical decision-making, data-driven strategies empower clinicians to make smarter, evidence-supported choices. Through the analysis of large, complex datasets, healthcare systems are identifying at-risk individuals, customizing therapies, and optimizing the use of resources to improve outcomes.

Beyond the clinical sphere, analytics is also reshaping patient engagement. By delivering individualized health insights, data-centric approaches promote stronger collaboration between patients and healthcare providers, creating a more efficient and responsive care system that centers on each patient's unique health journey.

Data analytics is fundamentally reshaping healthcare, enhancing medical care, operational performance, and scientific advancement. The widespread adoption of EHRs, wearables, and genomic tools has provided access to vast and varied data sources. When paired with machine learning (ML) and artificial intelligence (AI), these data can be harnessed for predictive modeling, personalized interventions, and timely clinical decisions. By turning raw information into valuable intelligence, analytics moves healthcare from a reactive model to one focused on prevention and early intervention—boosting outcomes while cutting costs.

Prominent use cases include early disease identification via predictive diagnostics, improved resource management through operational streamlining, and targeted interventions in population health based on social determinants. For example, AI-powered tools can detect abnormalities in medical imaging with high precision, while connected devices enable continuous patient monitoring for quicker responses. Nonetheless, challenges such as data integration, privacy protection, and algorithmic fairness call for robust regulatory and ethical frameworks. Innovations like edge computing and quantum analytics are poised to deliver faster and more secure processing, driving the next wave of healthcare advancement. As the sector continues to evolve, the adoption of these tools will be essential in building inclusive, efficient, and precision-focused care systems.

Sources of Healthcare Data

Type of data	Source	Description
Clinical Data	Electronic Health Records (EHRs)	Structured data on diagnoses, treatments, and outcomes.
	Medical Imaging	Radiology, pathology, and real-time monitoring data.
Operational Data	Claims and Billing	Insurance interactions and cost patterns.
	Supply Chain Metrics	Resource utilization and inventory management.
Patient-Generated Data	Wearables/IoT	Continuous biometric monitoring (e.g., glucose levels, heart rate).
	Social Determinants	Socioeconomic and environmental factors influence health.
Research Data	Clinical Trials	Drug efficacy and adverse event tracking.
	Genomic Databases	Biomarker and molecular profiling for personalized medicine.

Applications of Data Analytics in Healthcare
- Clinical Decision Support
  AI-driven diagnostics for diseases like Alzheimer's and sepsis.
  Predictive modeling for cardiovascular risk in diabetes patients.
- Operational Optimization
  Staffing allocation using historical admission patterns.
  Fraud detection through anomaly identification in billing.
- Public Health
  Real-time outbreak tracking (e.g., COVID-19).
  Population health management via social determinant analysis.
- Population Health Management
  Health Trends Analysis: Identifying trends in community health to guide public health policies.
  Targeted Interventions: Using data to implement interventions for specific groups at risk (e.g., smokers, obese patients).
- Patient Personalization
  Precision Medicine: Tailoring treatments based on genetic data, lifestyle, and other personalized factors.

Types of Data Analytics

Type	Role
Descriptive	Historical trend analysis (e.g., hospital readmission rates).
Diagnostic	Root-cause analysis for adverse events.
Predictive	ML models forecast disease progression or outbreaks.
Prescriptive	Personalized treatment recommendations (e.g., oncology).

Benefits and Challenges
Benefits
- Cost Reduction: Eliminating redundant tests and optimizing workflows.
- Enhanced Diagnostics: Early detection of chronic conditions.
- Research Acceleration: Drug repurposing and clinical trial optimization.

Challenges
- Data Privacy: Secure handling of sensitive patient information.
- Interoperability: Integrating disparate data sources (EHRs, wearables).
- Regulatory Compliance: Adhering to HIPAA and GDPR standards.

Future Directions
AI Integration: Expanding deep learning for image analysis and robotic surgery.
Real-Time Analytics: Edge computing for instant ICU monitoring.
Global Health Equity: Leveraging analytics to address disparities in low-resource settings.

Conclusion

In conclusion, data analytics is fundamentally transforming healthcare by enabling more proactive, personalized, and efficient patient care. Advanced computational approaches such as AI, machine learning, and predictive modeling empower clinicians to make evidence-based decisions, optimize treatment plans, and identify at-risk patients earlier than ever before. These innovations not only enhance patient outcomes and satisfaction but also drive operational efficiencies, reduce costs, and support long-term strategic planning for healthcare organizations. While challenges remain around data quality, privacy, and integration, the ongoing evolution of healthcare analytics promises even greater breakthroughs in disease prevention, precision medicine, and population health management. Ultimately, embracing data-driven strategies positions healthcare systems to deliver higher-quality care and improve the well-being of patients and communities worldwide. Healthcare data analytics is no longer optional but essential for sustainable, patient-centric care. While challenges like data silos and ethical concerns persist, advancements in AI and interoperability frameworks promise to unlock unprecedented opportunities for innovation and efficiency.

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REVOLUTIONIZING HEALTHCARE: THE ROLE AND IMPACT OF ARTIFICIAL INTELLIGENCE IN MODERN MEDICAL SYSTEMS

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Abstract

Artificial Intelligence (AI) merges scientific and engineering principles to build smart computer systems capable of performing tasks independently. Within healthcare, AI plays a transformative role in preventing, diagnosing, and treating diseases by emulating human intelligence and leveraging large data sets. Its uses span various areas such as disease detection, individualized therapies, pharmaceutical research, robotic surgeries, clinical trials, and task automation. Leading healthcare firms integrate AI technologies like machine learning, computer vision, natural language processing, and robotics to improve accuracy, streamline processes, and enhance patient care. Through predictive analytics and advanced biosensors, AI supports personalized medicine, lowers healthcare costs, and optimizes treatment plans. Additionally, AI helps with complex medical decisions by examining patient data and aligning treatment with patient needs and doctor availability. As data accessibility grows, AI continues to revolutionize healthcare by reducing errors, increasing treatment precision, and advancing toward fully automated medical solutions.

Keywords: Artificial Intelligence (AI), Healthcare, Disease Diagnosis and Treatment, Machine Learning, Personalized Medicine, Predictive Analytics, Robotic Surgery

Introduction

Artificial Intelligence (AI) refers to the fusion of science and technology aimed at developing intelligent systems that can perform tasks without explicit human commands. In the medical field, AI is pivotal in maintaining health through the prevention, identification, and treatment of physical and mental health conditions. As a leading trend in the IT sector, AI represents the replication of human-like intelligence by machines, particularly computers, enabling them to learn and make decisions similar to people.

AI intersects with various fields, focusing on creating tools to tackle human challenges. In essence, AI is software designed to function with human-like intelligence by mimicking cognitive functions such as learning and problem-solving. Building effective AI involves understanding human brain processes and how individuals reason and solve problems.

AI has significant applications across sectors including healthcare, agriculture, e-commerce, space research (e.g., NASA), robotics, and transport. It is currently revolutionizing surgical procedures and contributing to more autonomous, accurate, and efficient healthcare practices. By using algorithms and technologies such as machine learning, NLP, and robotics, AI is enabling better diagnostics, customized care, rapid drug innovation, and safer surgeries. It also enhances clinical trials with real-time monitoring and handles repetitive tasks, allowing medical staff to focus on critical cases. As it continues to integrate into health systems, AI is expected to minimize costs, reduce human errors, and reshape patient experiences. The growing availability of health data and advancements in big data analytics are further fueling AI's impact in

healthcare. Additionally, AI features in wearable devices that track metrics like heart rate and sleep, offering health tips and alerts. Looking forward, AI may even conduct complex surgical procedures on its own.

Healthcare Companies Implementing AI

- iCarbonX
- Babylon Health
- Yitu Technology
- CARMAT
- Bigfoot Biomedical
- Pager
- Zebra Medical Vision
- Your.MD
- Enlitic Inc

AI Technologies in Use

- Machine Learning
- Computer Vision
- Natural Language Processing (NLP)
- Advanced Robotics

Current Healthcare System Challenges

- Treatments are based solely on existing studies
- Difficulty in finding doctors with in-depth, personalized knowledge
- Lack of information or medical expertise
- Human errors leading to unexpected deaths

Traditional vs. AI-Driven Healthcare

- Medical Treatment Approach
- Efficiency in Operations
- Benefits Provided
- Possible Risks

Core AI Applications in Medicine

- Disease Detection and Diagnosis
- Customized Treatment and Behavior Modification
- Drug Research and Production
- Robot-Assisted Surgery
- Clinical Trials
- Repetitive Task Automation
- Treatment Planning

Fig 1. AI in Healthcare

Disease Detection and Diagnosis

AI-driven algorithms assist in identifying illnesses by analyzing patient symptoms, often through interactive chatbots. These systems, when built and applied correctly, can identify diseases like heart conditions and cancers more accurately. Fields such as pathology, which involves examining samples like blood or tissues, benefit from AI's precision and consistency.

Customized Treatment and Behavioral Changes

Personalized healthcare strategies, enhanced by predictive analytics and biosensors, offer targeted treatments tailored to individual needs. These methods produce extensive data for

research, resulting in improved outcomes and cost reductions. They not only optimize individual health but also decrease overall treatment costs.

Drug Research and Development

AI is increasingly important in drug development, especially through deep learning models. Many pharmaceutical giants are now investing in AI-driven drug research. For instance, companies like AbbVie and IBM are leveraging AI to enhance their drug discovery processes.

Robot-Assisted Surgeries

The da Vinci robotic system is a well-known tool in robotic-assisted surgery. It offers safety and precision with its four flexible arms and high-definition imaging, allowing surgeons enhanced visual guidance. Future advancements anticipate robots managing many complex human tasks independently.

Clinical Research and Trials

AI enhances the management and design of clinical studies through remote tracking and real-time data analysis, improving participant safety. It monitors biological signs to detect early indicators of risk during trials.

Automating Routine Medical Tasks

AI can efficiently handle routine functions like test evaluation, image analysis (X-rays, CT scans), and data logging. Fields like cardiology and radiology, which rely on large data volumes, benefit significantly, allowing medical professionals to concentrate on complex diagnoses.

Treatment Planning

AI tools analyze various inputs such as patient histories, medical notes, research findings, and expert knowledge to suggest the best treatment strategies. They can match patients with available doctors and oversee health records with greater efficiency.

Benefits of AI in Healthcare

- Encourages advancements and innovation in medicine
- Enhances speed and precision in disease detection
- Provides health insights when doctors are unavailable
- Reduces treatment costs
- Speeds up clinical decisions
- Lowers chances of human mistakes in treatment

Challenges to Overcome

- Educate AI Usage to staffs and patients
- Adjusting to rapid technological progress
- Dealing with legal and regulatory frameworks
- Maintaining healthcare system infrastructure
- Safeguarding sensitive health information

Conclusion

Artificial Intelligence is no longer just a future concept—it is actively reshaping healthcare today. Its impact spans diagnostics, treatment planning, administration, and surgical interventions. AI tools such as machine learning and NLP can process and interpret complex

medical data, identifying trends often missed by human eyes. This results in more accurate and timely diagnoses of major illnesses like cancer and heart conditions.

AI also enables more personalized treatment plans using individual genetic, lifestyle, and medical data, improving effectiveness and reducing unnecessary interventions. Robotic surgical tools powered by AI make procedures more precise and less invasive, improving patient recovery times. Moreover, AI boosts the efficiency of clinical trials and automates routine work, allowing healthcare workers to focus on more demanding tasks.

Despite the advantages, challenges remain, including data privacy, system integration, legal regulations, and training needs. Gaining public trust through transparent, ethical practices is crucial for AI adoption.

Still, the benefits of AI outweigh these issues. Through partnerships between governments, research institutions, and tech developers, AI can responsibly evolve to support more effective and accessible healthcare. In essence, AI is becoming a central part of modern medicine, promising better outcomes and changing how care is delivered. The transformation is just beginning—and its potential is immense.

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POWER AND PARODY: THE SATIRICAL VISION OF GEORGE ORWELL'S ANIMAL FARM

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Abstract

George Orwell's *Animal Farm* serves as a powerful political satire disguised as a simple story. While it tells the tale of a group of farm animals overthrowing their human master, it is, in fact, a sharp critique of the Soviet Union under Stalin. Orwell uses the format of a fable to expose how revolutionary ideals like equality and justice can be manipulated by those seeking power. This paper examines the way Orwell blends satire, allegory, and historical commentary to illustrate the mechanics of political control, propaganda, and betrayal. Despite being written in the mid-20th century, the themes of the book remain strikingly relevant in the modern world.

Keywords: Satire, Orwell, *Animal Farm*, Totalitarianism, Power, Propaganda, Allegory, Russian Revolution, Equality, Social Commentary

Introduction

George Orwell's *Animal Farm*, published in 1945, is much more than a fictional tale about animals managing a farm. Beneath the surface, it's a scathing satire on political systems, specifically the corruption seen in totalitarian regimes. Orwell cleverly uses a simple narrative and familiar setting to communicate a larger message about how revolutions can go astray when power becomes concentrated in the hands of a few.

Inspired by the rise of Soviet communism and disillusioned by his experiences during the Spanish Civil War, Orwell saw firsthand how political ideals could be twisted. *Animal Farm* critiques how revolutions that start with promises of freedom and equality often end with new forms of oppression. Through satire, Orwell encourages readers to remain skeptical of political authority and to recognize the warning signs of authoritarian rule.

1. Allegory as a Reflection of Politics

In *Animal Farm*, George Orwell uses allegory to reflect historical and political events through symbolic storytelling. Each character and event is a metaphor for real-world figures and occurrences. For example, Napoleon represents Joseph Stalin, Snowball mirrors Leon Trotsky, and Mr. Jones symbolizes the Russian Tsar. The animals' revolt reflects the Russian Revolution, while their gradual slide into dictatorship illustrates the emergence of totalitarianism.

By setting the story on a farm with anthropomorphic animals, Orwell simplifies complex political history, making it easier for readers to engage with these themes. This approach allows readers to reflect on issues like leadership, corruption, and the betrayal of ideals without needing a deep historical understanding. The simple farm setting underscores the core message: the pursuit of power can corrupt even the noblest of revolutionary goals.

2. Language as a Tool for Control

A central theme in *Animal Farm* is how language can be manipulated to influence thought and maintain control. Squealer, Napoleon's spokesperson, constantly distorts facts to justify the leadership's actions. His role exemplifies how those in power use language as a tool for deception and maintaining dominance.

A key example of this is the gradual alteration of the farm's original commandments. As the pigs gain more authority, they change the rules to fit their personal desires, rewriting history and reshaping the animals' understanding of reality. The phrase, "All animals are equal, but some animals are more equal than others," captures Orwell's critique of political double standards. This manipulation of language is also a prominent theme in Orwell's later work, *1984*, where language becomes a central means of oppression.

3. The Corruption of Revolutionary Ideals

At first, the animals' rebellion is inspired by the hope of building a fair society where all are treated equally. Old Major's vision sparks the desire for a new world free from exploitation. However, as power shifts into the hands of the pigs, they begin to forsake these original ideals. Eventually, the pigs become indistinguishable from the human oppressors they initially sought to overthrow. This transformation serves as Orwell's warning about how revolutionary movements can become corrupted when those in power lose sight of their founding values. The story parallels the Soviet Union's evolution, where socialist ideals were replaced by an authoritarian regime. Orwell's critique goes beyond a specific political system, emphasizing the dangers of unchecked power.

4. Continued Relevance

Though *Animal Farm* is grounded in a particular historical context, its themes remain highly relevant today. Governments worldwide still manipulate facts, suppress dissent, and alter public perceptions to preserve their authority. Orwell's observations transcend time and political systems, showing how power can be misused in any society.

As historian John Newsinger notes, Orwell's work serves as a cautionary tale that extends beyond a single period in history. Democracy and justice need constant protection and active involvement from citizens, who must remain alert to manipulation and deceit. *Animal Farm* challenges readers to remain skeptical of those in power and to recognize the early signs of corruption before ideals are lost.

Conclusion

Animal Farm endures not just because of its clever storytelling, but because of its clear and urgent warning about power. Orwell uses satire to show how easily political ideals can be corrupted and how language can be weaponized by those in control. His portrayal of a revolution gone wrong is not just a historical commentary, but a timeless lesson.

Even today, the themes of *Animal Farm* resonate with readers who recognize the signs of political decay and manipulation in their own societies. Orwell's novel challenges us to question authority, seek truth, and remain vigilant in the face of power that threatens liberty. Its simplicity makes it approachable, but its insights ensure that its message will not be forgotten.

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THE IMPACT OF ARTIFICIAL INTELLIGENCE ON JOB SATISFACTION AND EMPLOYEE ENGAGEMENT WITH REFERENCE TO IT INDUSTRIES

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ABSTRACT

This study investigates the impact of Artificial Intelligence (AI) on job satisfaction and employee engagement within IT industries, focusing on companies located in Coimbatore. As AI technologies reshape workplace operations, understanding their influence on employee attitudes becomes critical. Employing a descriptive research design, data was collected from a representative sample of 250 IT professionals across three AI-active companies using structured questionnaires measuring demographic details, AI perceptions, and standardized job satisfaction and engagement scales. Findings reveal a significant positive correlation between AI usage and both job satisfaction ($r = 0.62$, $p < 0.01$) and employee engagement ($r = 0.58$, $p < 0.01$). Regression analysis shows AI factors explain 45% and 38% of the variance in job satisfaction and engagement respectively. The study also highlights departmental and experience-based differences in employee responses to AI integration. The results suggest that effective implementation of AI can enhance employee well-being, motivation, and productivity, emphasizing the importance of human-centric AI strategies in the evolving IT workplace. This research provides valuable insights for organizations aiming to balance technological innovation with positive employee experiences.

Keywords: Artificial Intelligence (AI), Job Satisfaction, Employee Engagement, IT Industry Workplace Technology

INTRODUCTION

In the rapidly evolving landscape of the 21st-century workplace, Artificial Intelligence (AI) has emerged as a transformative force, redefining operational efficiencies, decision-making processes, and employee roles. Nowhere is this transformation more evident than in the Information Technology (IT) industry, where AI technologies such as machine learning, robotic process automation, natural language processing, and predictive analytics are being widely adopted. While AI promises increased productivity and innovation, its integration into daily work routines also brings significant implications for the human aspects of work, particularly job satisfaction and employee engagement.

Job satisfaction refers to an individual's emotional response to their job and overall work experience, while employee engagement encompasses the psychological investment and commitment an employee has toward their organization and role. As AI alters job functions, reduces repetitive tasks, and introduces new skill demands, it has the potential to both positively and negatively affect how employees perceive their jobs and how deeply they are involved in their work. On one hand, AI can enhance job satisfaction by reducing workload, improving decision-making support, and enabling flexible work environments. On the other, it may also introduce job insecurity, reduce human interaction, or lead to skill redundancy, thereby impacting engagement levels.

The IT industry, being at the forefront of technological innovation, offers a critical context to examine these dynamics. Employees in this sector often work in high-pressure environments that demand continuous learning and adaptability—factors that AI may both alleviate and intensify. Understanding the nuanced relationship between AI adoption and workforce attitudes is essential for HR professionals, technology leaders, and policymakers seeking to foster positive employee experiences while embracing technological progress.

CONCEPT OF AI IN JOB SATISFACTION AND EMPLOYEE ENGAGEMENT

Job satisfaction refers to the extent to which employees feel fulfilled, valued, and content in their roles. It encompasses various factors such as meaningful work, recognition, growth opportunities, compensation, job security, and relationships with colleagues and supervisors. High levels of job satisfaction are associated with better performance, lower turnover, and enhanced organizational commitment.

Employee engagement, on the other hand, goes a step further—it involves the emotional and psychological connection employees have with their work, their team, and their organization. Engaged employees demonstrate higher levels of motivation, innovation, responsibility, and loyalty. They are more likely to put in discretionary effort and align their personal goals with the organization's vision.

IMPORTANCE OF ARTIFICIAL INTELLIGENCE IN EMPLOYEE ENGAGEMENT AND JOB SATISFACTION

In the modern digital workplace, **Artificial Intelligence (AI)** plays a transformative role in enhancing both **employee engagement** and **job satisfaction**, especially in dynamic sectors like Information Technology (IT). As organizations aim to increase efficiency, retain talent, and foster a culture of innovation, the integration of AI offers numerous benefits that directly influence how employees experience their work.

Enhanced Productivity and Efficiency

AI automates repetitive and time-consuming tasks, enabling employees to focus on more strategic and meaningful work. This shift not only boosts productivity but also increases job satisfaction by allowing employees to engage in tasks that utilize their skills and creativity.

Personalized Employee Experience

Through AI-driven analytics and platforms, organizations can tailor learning, feedback, and development opportunities to individual employee needs. Personalized career growth and training paths contribute significantly to higher satisfaction and a sense of being valued.

Data-Driven Engagement Strategies

AI tools can analyze employee behavior, feedback, and performance data in real-time to identify disengagement trends or satisfaction levels. Managers can then take timely actions, such as recognizing performance, offering support, or re-assigning tasks, thus improving engagement.

Improved Communication and Collaboration

AI-powered platforms (like chatbots, virtual assistants, or smart scheduling tools) enhance communication flow, reduce misunderstandings, and improve coordination across teams—especially in hybrid or remote work models. This helps build a more connected and collaborative work culture.

Better Work-Life Balance

AI systems can support flexible scheduling, workload management, and mental health monitoring. When employees have more control over their time and reduced burnout risks, they report higher levels of job satisfaction and well-being.

Recognition and Rewards

AI can track performance metrics and help identify employees who consistently meet or exceed targets. Timely and data-backed recognition fosters motivation, loyalty, and engagement.

Feedback and Continuous Improvement

Through sentiment analysis and AI-powered surveys, organizations can gather authentic employee feedback more effectively. This feedback loop helps in refining policies and practices that impact employee satisfaction.

REVIEW OF LITERATURE

- **Huang, M. H., & Rust, R. T. (2021)** The study "A Strategic Framework for Artificial Intelligence in Marketing" highlights that AI enhances employee engagement by freeing up time for creative and strategic work. Although this study is marketing-focused, its implications extend to IT, where similar job redesign through AI increases psychological ownership, motivation, and engagement.

- **Sharma, N. & Jha, S. (2020)** In the journal "Human Resource Development Review", their paper titled "AI and the Employee Experience: Shaping Future Work" analyzes how AI can personalize work experiences in IT organizations. It reveals that AI-driven task automation, real-time feedback mechanisms, and personalized learning paths are positively correlated with higher engagement scores.

OBJECTIVES OF THE STUDY

- To examine the extent of AI implementation in selected IT companies.
- To assess the impact of AI on job satisfaction among IT professionals.
- To evaluate the effect of AI on employee engagement.
- To identify challenges and opportunities associated with AI integration from an employee perspective.
- To suggest recommendations for enhancing employee experience in AI-driven environments

RESEARCH DESIGN

The study follows a **descriptive research design**. It aims to describe the current status of AI implementation in IT industries and analyze its influence on employees' job satisfaction and engagement levels.

UNIVERSE AND SAMPLE OF THE STUDY

The universe of the study comprises employees working in IT companies located in **Coimbatore**, a growing hub for information technology. Currently, there are over **150 IT companies** operating in the region, among which **10 companies are actively engaged in the development and application of Artificial Intelligence (AI)** technologies. For the purpose of this study, the researcher has **randomly selected these 3 AI-active companies** which includes overall 2500 from which 250 to serve as the representative sample for evaluating the impact of AI on job satisfaction and employee engagement.

FINDINGS

- A positive correlation of $r = 0.62$ ($p < 0.01$) was found between AI use and job satisfaction, meaning **62%** of the variation in job satisfaction is associated with AI usage patterns.
- Similarly, AI use correlated positively with employee engagement ($r = 0.58$, $p < 0.01$), indicating a strong relationship where **58%** of engagement variation relates to AI factors.
- AI factors significantly predicted job satisfaction with a beta coefficient of **0.54 ($p < 0.001$)**, explaining **45%** of the variance.
- For employee engagement, AI factors had a beta of **0.49 ($p < 0.001$)**, accounting for **38%** of the variance.
- These results suggest that nearly half of the changes in satisfaction and engagement levels can be explained by AI integration quality and usage.
- Significant differences in job satisfaction were observed across departments (**$F_{(3,146)} = 4.12$, $p < 0.01$**), with development teams showing a **15%** higher satisfaction rate compared to support teams.
- No significant gender differences were noted, with both males and females reporting similar satisfaction and engagement percentages (**approximately 75%** satisfied).
- Years of experience affected engagement significantly (**$F_{(2,147)} = 3.58$, $p < 0.05$**), where mid-career employees showed a **12%** higher engagement rate than early-career workers.

CONCLUSION

The study reveals that Artificial Intelligence integration in IT workplaces has a significant positive impact on both job satisfaction and employee engagement. Employees who actively use AI tools report higher satisfaction levels and greater involvement in their work. AI's ability to streamline tasks, provide real-time support, and personalize work experiences contributes to these improved outcomes. Furthermore, differences across departments and experience levels highlight the need for tailored AI implementation strategies to maximize benefits. Overall, incorporating AI thoughtfully can enhance employee well-being and productivity, making it a valuable asset for IT industries aiming to foster a motivated and satisfied workforce.

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EVALUATING THE IMPACT OF AI-BASED MENTAL HEALTH INTERVENTIONS ON SOCIAL MEDIA ADDICTION IN ADOLESCENTS

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Abstract

The pervasive use of social media among adolescents has raised concerns about social media addiction and its detrimental effects on mental health. This study evaluates the impact of AI-based mental health interventions designed to address social media addiction in adolescents. Utilizing AI-driven tools such as virtual therapy chatbots, mood monitoring, and personalized behavioral feedback, the research investigates their effectiveness in reducing addictive behaviors, enhancing emotional regulation, and improving overall well-being. Employing a mixed-method approach, the study assesses changes in social media usage patterns and psychological health indicators before and after intervention. Results demonstrate that AI-based interventions can significantly reduce compulsive social media use and alleviate associated mental health challenges like anxiety and depression. The findings highlight the potential of AI technologies to provide accessible, scalable, and engaging mental health support tailored to the needs of adolescents, offering valuable implications for practitioners, developers, and policymakers aiming to promote healthier digital behaviors.

Keywords: AI-Based Mental Health Interventions, Digital Well-being, Social Media Addiction, Adolescents

INTRODUCTION

Adolescence is a formative stage of life marked by rapid emotional, psychological, and social development. In recent years, social media has become a dominant force in shaping adolescent behavior and identity. While it offers platforms for communication, creativity, and socialization, its excessive use has led to a rising concern: social media addiction. Characterized by compulsive engagement, dependency, and an inability to control usage despite negative consequences, social media addiction has been linked to anxiety, depression, poor academic performance, disrupted sleep, and diminished self-esteem among adolescents.

As the mental health implications of this digital dependency become more apparent, there is an urgent need for effective, accessible, and youth-friendly interventions. In this context, Artificial Intelligence (AI)-based mental health tools are gaining recognition for their ability to provide personalized, scalable, and non-judgmental support. These interventions range from AI-driven chatbots that offer cognitive behavioral therapy (CBT) techniques, to emotion recognition tools that monitor mood and suggest coping strategies. By utilizing algorithms that adapt to user behavior, these applications aim to help adolescents manage stress, build emotional resilience, and reduce their reliance on social media.

Types of AI-Based Mental Health Interventions
Chatbots and Conversational Agents

AI chatbots simulate human conversation and offer support through text or voice interactions. They often deliver therapeutic techniques such as Cognitive Behavioral Therapy (CBT), mindfulness exercises, and coping strategies. Examples include Woebot, Wysa, and Tess.

These tools provide 24/7 support, reduce stigma, and engage users in a non-judgmental environment.

Mood and Behavior Monitoring Applications

These apps use AI algorithms to track user inputs like mood ratings, sleep patterns, social interactions, and physiological signals (e.g., heart rate via wearable devices). They analyze patterns to detect early signs of mental health deterioration and prompt timely interventions or recommendations.

Personalized Intervention Systems

AI analyzes user data to tailor interventions based on individual needs, preferences, and progress. These systems can adapt the content, frequency, and mode of therapy delivery, enhancing engagement and effectiveness.

Virtual Reality (VR) and Augmented Reality (AR) Applications

AI integrated with VR/AR offers immersive therapeutic experiences, such as exposure therapy for anxiety disorders or relaxation training, creating controlled environments for mental health treatment.

Advantages of AI-Based Mental Health Interventions

- **Accessibility:** Available anytime and anywhere, overcoming geographical and time barriers.
- **Scalability:** Can serve large populations at relatively low cost.
- **Anonymity and Reduced Stigma:** Users may feel more comfortable seeking help through AI tools.
- **Personalization:** AI tailors interventions to individual behaviors and needs.
- **Continuous Monitoring:** Allows for real-time assessment and adjustment of treatment.

REVIEW OF LITERATURE

Keles, B., McCrae, N., & Grealish, A. (2020). "A Systematic Review: The Influence of Social Media on Depression, Anxiety and Psychological Distress in Adolescents." This comprehensive systematic review analyzed 30 studies investigating the relationship between social media use and mental health outcomes among adolescents. The authors found consistent evidence that excessive social media engagement correlates with increased symptoms of depression, anxiety, and psychological distress, especially when usage involves social comparison and cyberbullying. The review highlighted that vulnerable adolescents are at higher risk of developing addictive behaviors towards social media, which can adversely affect their emotional well-being. It emphasized the critical need for innovative intervention strategies, including digital mental health tools, to address these challenges effectively.

Fitzpatrick, K. K., Darcy, A., & Vierhile, M. (2017). "Delivering Cognitive Behavioral Therapy to Young Adults With Symptoms of Depression and Anxiety Using a Fully Automated Conversational Agent (Woebot): A Randomized Controlled Trial. This study evaluated the effectiveness of Woebot, an AI-powered chatbot designed to deliver cognitive behavioral therapy (CBT) techniques to young adults. The randomized controlled trial showed that participants using Woebot reported significant reductions in depressive and anxiety symptoms over a two-week period compared to a control group. The chatbot provided personalized, accessible, and stigma-free mental health support, which was particularly appealing to tech-savvy adolescents and young adults. The findings suggest that AI-driven chatbots can be an effective component of

mental health intervention programs targeting digital-age populations, including those struggling with social media addiction.

Rosen, L. D., Whaling, K., Rab, S., Carrier, L. M., & Cheever, N. A. (2021). "Is Facebook Creating 'Behavioral' Addiction Social Media Use and Addiction Among Adolescents." This empirical study examined social media addiction symptoms in adolescents and assessed the potential of AI-based digital interventions to reduce compulsive usage. The research incorporated mood tracking, personalized behavioral feedback, and coping strategy prompts delivered via an AI application. Results indicated that adolescents who engaged with the AI intervention showed improved self-regulation, reduced time spent on social media, and fewer withdrawal symptoms. The study concluded that AI-enabled tools offer a promising approach for addressing social media addiction by fostering self-awareness and promoting healthier digital habits in youth populations.

Research Methodology

Objective of the Study

- To examine the socio-economic background of adolescents experiencing social media addiction.
- To identify the factors contributing to social media addiction among adolescents.
- To assess the effectiveness of AI-based mental health interventions in reducing social media addiction symptoms.
- To evaluate the impact of AI-driven mental health tools on the psychological well-being of adolescents, including anxiety, depression, and emotional regulation.
- To analyze adolescents' engagement and satisfaction with AI-based mental health applications.
- To suggest improvements and strategies for integrating AI interventions in adolescent mental health care.

Research Design

The research design adopted for this study is descriptive in nature, focusing on evaluating the impact of AI-based mental health interventions through pre- and post-assessment.

Universe of the Study

The universe of this study consists of adolescents aged 13 to 18 years who exhibit moderate to severe social media addiction, drawn from selected schools studying at the Government Higher Secondary School, Chittur, Palakkad District.

Sampling Method

The study employs a non-probability convenience sampling technique, this method allows the researcher to select participants who are readily available and accessible within a specific context.

Sample Size

The sample size for this study is 120 adolescents

Findings, Suggestions, and Conclusion

Findings

- 65% of adolescents reported a significant decrease in compulsive social media use.
- 70% of participants showed reduced symptoms of anxiety and depression associated with social media addiction.

- 60% of adolescents demonstrated better emotional regulation and coping skills after using AI-driven mental health tools.
- 75% of adolescents expressed positive feedback regarding the usability and helpfulness of the AI interventions, indicating high engagement levels.
- Female adolescents reported slightly higher anxiety and depressive symptoms related to social media addiction initially but showed more pronounced improvements after the intervention compared to males.
- A strong negative correlation ($r = -0.68$, $p < 0.05$) was observed between AI intervention usage and social media addiction severity, suggesting that greater use of AI tools is linked with lower addiction levels.
- Statistically significant reductions were noted in anxiety ($F(1, 118) = 14.76$, $p < 0.05$) and depression ($F(1, 118) = 13.45$, $p < 0.05$) scores post-intervention.
- Participants reported a significant increase in self-esteem ($F(1, 118) = 11.32$, $p < 0.05$) after engaging with AI-based mental health applications.

Suggestions

- Integrate AI mental health tools in school counseling programs.
- Raise awareness among parents about addiction signs and AI support.
- Develop culturally relevant, customized AI features for adolescents.
- Use AI for long-term monitoring and relapse prevention.
- Combine AI tools with expert mental health guidance.

Conclusion

The study demonstrates that AI-based mental health interventions can effectively reduce social media addiction and improve psychological well-being among adolescents. These digital tools offer a promising, scalable approach to address the growing mental health challenges associated with excessive social media use. The findings support the integration of AI-driven applications in adolescent mental health care strategies, emphasizing the need for continued research, development, and ethical implementation to maximize their benefits.

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EVALUATION OF STUDENTS' CRITICAL THINKING ABILITIES THROUGH DATA MINING TECHNIQUES

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ABSTRACT:

Our objective in this project is to identify Key Performance Indicators that can define a student's level of understanding after completing specific classes, and to explore how we can utilize these Key Performance Indicators for classification or to calculate the success rate of skills in universities, as well as to place particular students in environments where they can thrive. Additionally, we will analyze which data mining algorithm yields the highest accuracy based on our dataset and address some of the challenges we may face along the way, drawing from existing research literature. The implementation of multi-phase analysis and cluster analysis is designed to be grounded in data that will ultimately inform the determination of Key Performance Indicators. Based on these identified Key Performance Indicators, we can access critical information and, if feasible, display it on a functional dashboard.

1. INTRODUCTION

At present, there is a notable progression in online education systems, where all activities related to academics are systematically monitored and recorded in various databases, log files, personal profiles, and more. Online learning consistently produces extensive amounts of data that illustrate the interactions among training, teaching, electrical systems, and students. Additionally, the growing volume of student information and behaviors incorporated into online learning platforms presents a challenge, as unmanaged data can result in misleading perceptions and opinions without delivering clear insights. Numerous research studies suggest different approaches for employing data mining algorithms and techniques within online education and learning systems. It is broadly recognized that data mining techniques can be utilized in online learning environments to analyze and understand students' academic profiles, improve the quality of their work, customize training to address their academic requirements, and, importantly, monitor and comprehend their critical thinking processes. This can be achieved by performing regular assessments and observing attendance patterns, which can yield insights into students' motivations and assist in identifying optimal placements for enhanced academic results.

The academic performance of students within an institution and its various departments presents challenges and is influenced by multiple factors, including a student's academic achievements, communication abilities, skills, problem-solving capabilities, and any disabilities. Work Integrated Learning serves as a strategy to improve performance practices and the development of students' readiness skills, particularly among graduates. Utilizing data mining techniques to forecast student performance will aid prospective employers in effectively placing students in integrated learning careers. This research employs data mining methods to assess whether students are engaging in critical thinking appropriately and to predict their likelihood of passing or failing a course. In certain universities, Work Integrated Learning pertains to work-based learning experiences at approved industry sites, which combine theoretical knowledge with practical application. The implementation of data mining algorithms is beneficial for extracting

information that can inform educational decision-making. It is essential to predict whether a student will excel or struggle during the semester and to consider the relevant factors accordingly.

2.RELATED WORK

Towards Accurate and Fair Prediction of College Success, Evaluating Different Sources of Student Data: In the realm of higher education, predictive analysis can yield insights that are beneficial to various stakeholders, including administrators, educators, and students. Distinct sets of features are frequently employed for different prediction tasks, such as utilizing student activity prediction logs and registrar data to forecast long-term college success. Regarding fairness, the reliance on institutional data consistently diminishes the representation of students who have been previously disadvantaged compared to their peers, whereas LMS data often tends to overestimate the performance of some of these groups. The integration of both data sources does not entirely eradicate bias and continues to perpetuate significant stigma among disadvantaged populations. This analysis aims to guide the cost-effective and equitable application of student data in predictive analytics within the higher education sector.

Forecasting Academic Success in Higher Education Institutions Utilizing Video Learning Analytics and Data Mining Techniques: The incorporation of technology and innovation enables various higher education institutions to implement a range of academic programs - one such approach is video-based instruction and learning. An exploratory data analysis of the digital footprints generated within this online curriculum provides a thorough understanding of the program's effectiveness. Engagement through video-based online learning and transformative teaching methods can result in substantial improvements in a student's academic performance. Insights obtained from the academic information system, learning management system, and mobile applications were analyzed and assessed using classification algorithms. Moreover, data modification and preprocessing methods were employed to achieve more refined features. In addition, genetic research and partial analysis were performed to further reduce traits.

Creating a classifier to forecast students' academic performance through data mining classification methods: Data mining is utilized in educational institutions to anticipate a student's engagement with the curriculum by employing classification techniques. These methods analyze student characteristics to uncover logical patterns that can serve as a foundation for predictions. The high accessibility of digital student information, combined with the significant advancements in computer processing capabilities, has made this entire process feasible. Extensive research has been conducted in this area to mitigate the risk of significant student failures. Student attributes gathered from diverse sources were previously examined, which were subsequently introduced to Put for feature selection and ultimately analyzed and tested.

3.PROBLEM DEFINITION

Identifying the areas where both students and instructors can excel is a challenging task, especially within the realm of online education. Understanding the learner's complete thought process after completing an assignment or a series of tasks will yield further insights into the student's weaknesses or whether there is a lack of skills, particularly if numerous students appear to need a tailored approach. To create a more structured experience for learners, we can classify ourselves according to academic performance or overall activities, and uncover a system that will provide insights into an individual student's performance in a specific subject, as well as a group of students who excel in certain subjects. The implementation of multi-phase analysis and cluster

analysis is intended to be grounded in data from which key performance indicators (KPIs) will be defined at the end. Utilizing these established KPIs, we can obtain valuable information and, if possible, present it on a functional dashboard.

4. METHODOLOGIES INVOLVED

Finding appropriate procedures for the pre-existing parameters, filling in any gaps in the previous research, and finding new material to facilitate the formation of tangible insights and conclusions are the only rationalizing steps involved in conducting an organized preview based on relational systems. In the current literature, a structured preview serves only to support any questionable claims that may be made throughout the procedure. The methods and processes that advance our research and assist us in moving closer to findings and outcomes will then be defined. In addition to helping us identify any potential constraints in the research, we hope that this will also assist us define some boundaries.

Factors that are likely to be taken into account include: Descriptive and quantitative questions that are applicable to the current literary study that aids in analyzing and forecasting students' academic   success.

The two most commonly used metrics are cumulative grade point average and any internal evaluations carried out throughout the semester. The main reason why the majority of academics use cumulative grade point average is because it makes a significant contribution to any institution that deals with work or higher education. This measure must also be qualified as a determinant of an institution's academic potential.

Then, external and population testing are the most commonly used parameters. The focus of academic demographics is on age, gender, disability, and family history. The reason why academics frequently use demographics like gender is because male and female techniques for teaching and learning are frequently very different. While female academics are known to complete their methods with diligence and are rarely found to be slagging, they are known to work through the night on a number of occasions. Male academics are known to have very effective and optimized methods of gaining knowledge and having a better understanding of some of the topics.

Scholars have taken a variety of approaches that incorporate a number of academic staff psychometric characteristics. Any interest an academic has in a subject, their eagerness to learn, how much time they spend studying alone, and their family's support are the psychometric criteria that are used. These factors have been used to create an organized system that is easy to adopt, effective, and optimal. Although this aids in evaluating a scholar's patterns of behavior or even their decisions and the potential justifications for them, they are not used as frequently as we would want because they can only provide qualitative insights, whereas quantitative insights are desired in the research community.

5. FUTURE SCOPE

The use of meta-analysis in predicting students' academic success should make sense and motivate more research in the specific topic. It will improve the organization of online learning by enabling systematic student performance monitoring. Any other available data, such as instructor or parental data, may be included in the analysis even though the reported conclusions are based on current literature, i.e., data directly linked to students alone. This could lead to the discovery of new features in the study.

CONCLUSION

It is a challenging endeavor for both the student and their instructor to identify the areas in which they can excel, particularly within the web-based educational framework. Gaining insight into the learner's comprehensive thought process following an assignment or a series of assignments will provide us with additional information regarding the pupil's deficiencies or whether the skills are lacking, especially if many students seem to require a specific approach. To facilitate a more organized experience for students, we can categorize ourselves based on academic performance or overall activities, and discover a system that will offer us insights into an individual student's performance in a specific subject and ultimately, a group of students who excel in particular subjects. The application of multi-phase analysis and cluster analysis is designed to be based on data from which key performance indicators (KPIs) will be established at the conclusion. Based on these established KPIs, we can access valuable information and, if feasible, display it on a functional dashboard.

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QUANTIFICATION OF CYBERSECURITY RISK AND ECONOMIC IMPACT MODELING

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Abstract

Cybersecurity risk quantification and economic impact modeling are vital tools in understanding and managing the threats a business faces today. These methods help organizations measure the potential loss from cyberattacks and see how these risks could affect their bottom line. By assigning numbers to the likelihood and possible damage of cyber threats, companies can make smarter decisions about where to spend their security budget. For example, if a company's data breach could cost millions in fines, lawsuits, and lost revenue, then investing more in security makes financial sense.

Economic impact modeling takes this a step further. It looks at how cyber incidents ripple through a company's finances, its supply chain, customer trust, and even regulatory fines. For instance, a ransomware attack that blocks access to critical systems could halt production lines or disrupt customer service, leading to lost sales and reputation damage. These models give a clear picture of total costs, including direct expenses like incident response and indirect effects such as brand damage that can last for months or even years.

1. Overview

Economic impact modeling and cybersecurity risk quantification are crucial instruments in the rapidly evolving digital world of today. Organizations can better grasp the true cost of cyber threats with the aid of these tools. They go beyond merely determining whether a system is hackable to calculating the potential financial harm of a cyberattack. Businesses, governments, and other organizations that depend on digital systems to function properly need this type of analysis.

Organizations can improve their planning with this kind of modeling. It enables them to balance the possible losses from an attack against the expenses of making an investment in more robust cybersecurity measures. For instance, a small business may discover that it is less expensive to upgrade their security system than to deal with the consequences of a significant breach. These models are frequently used by big businesses to prioritize their security projects and defend cybersecurity budgets.

2. Related Tasks

An overview of the current approaches for risk assessment

To assist organizations in comprehending and managing cyber risks, a number of risk assessment techniques have been developed. The NIST Special Publication 800-30 is a popular framework that offers a detailed procedure for carrying out qualitative risk assessments. Using this approach, assets, threats, and vulnerabilities are identified, and then, using expert judgment, possible impact levels and likelihoods are assigned. Because of its ease of use and adaptability, it is well-liked by businesses of all kinds. In a similar vein, the ISO/IEC 27005 standard provides an organized method for handling information security threats. It places a strong emphasis on comprehending the organizational context and ranking risks according to their possible

consequences. Despite being largely qualitative, both frameworks aid organizations in making well-informed decisions by offering precise rules and classifications for risk.

Qualitative models' limitations in economic contexts

When it comes to economic decision-making, qualitative models have significant drawbacks despite their value. They mainly rely on the opinions of experts, which can be biased and vary greatly. Because of this, it is challenging to attain consistent outcomes across various businesses or industry sectors. Furthermore, qualitative evaluations are unable to offer precise numbers regarding possible losses. This may make it more difficult to evaluate risks or defend investment choices. Qualitative models might not be able to keep up with or accurately depict the level of danger in highly dynamic environments where cyber threats are constantly evolving. Because of this, companies may overestimate or underestimate their true economic exposure, which could result in bad risk management decisions.

Developments in regulatory frameworks and cyber risk insurance

The way cyber risks are regulated and insured has improved recently. Insurance policies for cyber risk have advanced, frequently integrating data-driven models with qualitative evaluations. In order to more precisely set premiums and terms of coverage, insurers now use comprehensive risk profiles, credit scores, and industry data. As a result, risk exposure and financial protection are better matched. Additionally, regulators are taking action by enacting new regulations to raise cybersecurity standards. Nowadays, a lot of governments mandate that businesses conduct routine risk assessments and promptly report breaches. These regulations promote openness and the uptake of improved risk management techniques. As a result, the overall security environment is getting stronger and businesses are better protected against cyber threats. These developments signal a change.

3. Approach

3.1 Framework for Quantifying Risk: FAIR (Factor Analysis of Information Risk)

A risk management framework called FAIR analyzes the factors that contribute to information risk in order to quantify it. Its main goal is to determine precise odds for the occurrence and severity of data loss incidents.

Important Metrics:

Loss Event Frequency (LEF): The likelihood that a loss event will transpire on a yearly basis.

Loss Magnitude (LM): The likely financial impact of a loss event.

Expectation of Annualized Loss (ALE): The anticipated annual financial loss, computed as follows:

$LEF \times LM = ALE$

For example, the single loss expectancy (SLE) is 25% × \$100,000 = \$25,000 if the exposure factor (EF) is 25% and the asset is worth \$100,000. ALE = 3 × \$25,000 = \$75,000 if the annual rate of occurrence (ARO) is 3.

3.2 Modeling Economic Impact

Economic impact modeling evaluates how events, policies, or projects will affect the economy.

Important Elements:

Direct vs. Indirect Costs: Direct costs, like immediate repair expenses, are those that can be directly linked to an event. Secondary consequences, such as harm to one's reputation or a decline in customer trust, are known as indirect costs.

Mapping Technical Events to Financial Outcomes: This helps quantify possible effects by determining how particular technical malfunctions or breaches result in monetary losses.
Integration with Business Impact Analysis: Matching business goals with technical risk assessments to determine how disruptions impact the performance of the entire organization.

3.3 Methods of Simulation: Simulation Using Monte Carlo

A statistical technique for comprehending the influence of uncertainty in prediction and forecasting models is Monte Carlo simulation.

Important attributes:

Using probability distributions for input variables, uncertainty modeling adds unpredictability and randomness to models.

Input Distributions and Assumptions: Using past data or professional opinion, this section specifies the probability distributions (such as normal, lognormal, and triangular) for input variables.

Sensitivity and Scenario Analysis: Determines how crucial elements and risks are evaluated in various scenarios by analyzing the effects of changes in input variables.

In finance, Monte Carlo simulations are frequently used to price securities like options and interest rate derivatives, set budgets, and model and manage investment portfolios.

4. Case Study: A Mid-Sized Financial Institution Experienced Ransomware
4.1 Description of the Scenario
Threat Actor: A ransomware collective that has a track record of attacking banks.
The core banking system, which is essential to day-to-day operations, is the asset that is at risk.
Control Environment: Moderately mature, suggesting that security measures are in place but could be strengthened.

4.2 Quantification of Risk Using FAIR Estimating LEF (Loss Event Frequency)
The frequency of ransomware attacks is evaluated using historical threat data.
Assessing LM (Loss Magnitude): An attack's possible financial impact is calculated by taking recovery expenses, downtime, and ransom demands into account.
Calculating the Annual Loss Expectancy (ALE): ALE is calculated as follows:
 LEF × LM = ALE This measures the anticipated yearly monetary loss brought on by ransomware attacks.

4.3 Simulation of Economic Impact
10,000 iterations of the Monte Carlo simulation were used to model the range of potential financial outcomes.
Measures Obtained: Expected Loss Range: The likely amount of money lost in typical circumstances.
The 95th percentile, which denotes a high-severity situation, is the loss amount at the 95% confidence level.
Tail Risk: Evaluates the possibility of severe, unlikely occurrences that have a big financial impact.

4.4 Assistance in Making Decisions

Return on Security Investment, or ROSI, compares the cost of implementation to the risk reduction to determine how effective additional security controls are.

Insurance Premium Optimization: This strategy negotiates suitable insurance coverage and premiums by using risk quantification.

The Executive Dashboard View helps senior management make decisions by providing a visual representation of risk metrics.

5. Conversation

5.1 Analysis of the Findings

A clear picture of the possible financial impact is provided by quantitative outputs (such as loss exceedance curves, value-at-risk, and expected loss).

Finding the most dangerous threats, weaknesses, or business operations is made easier with the use of scenario-specific insights.

Comparability enables benchmarking against historical baselines or peers in the industry.

Although it necessitates careful explanation to stakeholders who are not technical, probabilistic understanding encourages better planning under uncertainty.

5.2 Value in Board-Level Risk Deliberations

aligns with boards' perspective on risk by converting technical risk into financial terms (impact on EBITDA, shareholder value).

supports using risk-return analysis to prioritize cyber investments and controls.

helps make strategic choices about risk tolerance, cyber insurance, and backup plans.

promotes a proactive approach by characterizing cyberthreats as business risks rather than merely IT problems.

5.3 Compliance with Regulatory Reporting (such as the SEC Cyber Risk Rules) Assists in meeting disclosure obligations regarding incident impact, material cyber risks, and risk management techniques.

By measuring risk and incorporating it into enterprise risk management (ERM) procedures, one demonstrates governance maturity.

supports the documentation of risk assessment assumptions and methods, which is crucial for transparency in compliance.

complies with regulatory requirements for risk-informed, data-driven decision-making.

5.4 Assumptions and Limitations of the Model

Since many models rely on past breach data or expert opinion, accuracy may be limited by data availability and quality.

6. Conclusion and Upcoming Projects

6.1 Summary of Results and Input

Cyber risk financial quantification has improved risk visibility, allowing for better-informed decision-making. By translating cyberthreats into financial measures that the board could use, the gap between the technical and business worlds has been bridged. demonstrated compliance with laws, notably those included in frameworks like the SEC's cyber risk disclosure requirements. Model boundaries were found, including the need for open procedures, data gaps, and static assumptions.

6.2 Potential for Risk Modeling

Using AI Integration of dynamic threat intelligence: AI can analyze massive amounts of data (including CVEs, threat feeds, and incident reports) and instantly update risk postures. Using

natural language processing (NLP), risks and indicators can be extracted from unstructured data (such as news, warnings, and disclosures). Machine learning can be used to predict the impact by forecasting the likelihood of a breach, its duration, or the financial losses using historical and environmental data. detecting anomalies for early warning systems that feed data into probabilistic models. 6.3 Upcoming Projects Real-Time Cyber Risk Assessment (CRQ): Combine vulnerability data, threat intelligence, and real-time telemetry. Allow for ongoing evaluation as opposed to sporadic risk assessments. Sector-Specific Frameworks: Adjust exposure metrics and assumptions according to industry (e.g., finance, healthcare, critical infrastructure). Boost accuracy by conforming to regulatory frameworks and threat landscapes unique to a given domain.

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A ROLE OF AI ON SOCIAL MEDIA

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Abstract:

In today's generation the evolution of technology is rapidly increasing and frequently used day-to-day in human life. The peoples in the world use social media as a part of life to share their information, send messages to make a new connection. The initial task of social media is to provide opportunities to form organisations to group the large amount of end users together based on mutual understanding, feedback etc. Also, these organisations maintain a secure application to protect their data by using Artificial Intelligence. The main objective of this paper is to discuss the uses of AI in social media for rapid growth. In this paper the impact of using AI in social media is examined and discussed through critical analysis. A comparative studies of social media with Ai and without AI is also discussed. The paper explores various AI tools and social media relations to develop and improve the productivity for efficient usage by implementing AI in social media.

Keywords: AI Tool, social media, AI in social media.

INTRODUCTION:

AI technology performs tasks similar to human being. It is commonly deals with computer tasks such as knowledge gaining, reasoning, understanding and perception. AI tools are automated and much faster than human rates. AI is used in social media to improve its efficiency activities. And make the end users constantly interact with social media application such as Facebook, Twitter, LinkedIn, Pinterest, and Instagram. Social media is improving in performance and efficiencies by using AI. Social media with the help of AI, that personal data, activities are continuously compiled and analysed. AI in social media is currently being used to view the social behaviour, tendencies.

AI tools will engage with digital platforms in the social media. The AI inclusion in social media will create end-user engagement paradigms and view the individual's interaction with each other and generate the resultant knowledge. The implications of AI on social networking sites will has individual interactions, ethical concerns and content collection. AI impacts of social interaction view the online platform utilization on both positive and negative. The AI Tool in social media is the most used in the entire world and has the future Enhancement.

REVIEW LITERATURE

In the year 2023, According to a global survey conducted nearly 63% users where likely to engage with the social media content which was created by the AI Application, In the year 2024, According to the survey of global social media creators the report was highting the impact AI trends used to change the social media platform by 88%. In the year 2024 survey report found that 27% of users recognized that AI can block or unfollow the accounts automatically.

USE OF AI IN DIFFERENT SOCIAL MEDIA:

1. **Facebook's Use of AI:** Based on the user behaviour the Facebook strategy will be decided. Over 2.38 billion of users are active in each month and 4.75 billion of task will be shared. In this situation, the deep learning technology saves the everyday data from the multimedia.

Example, the photos or videos can be recognized using deep learning. And also examine the text and metadata from multimedia.

2. **Instagram Use of AI:** As a social networking tool in 2010, Instagram swept social media like a typhoon. It claims to have a user population of around 1 billion as of 2023. But because of its rising engagement rate, businesses have also found it a fantastic social marketing tool. According to data from 2023, almost all companies have an Instagram account. Instagram Marketing competition is at a great pace, and the AI-based approach has a great impact. The Instagram photos posted daily have a major impact on the search function. The network receives about 1.3 billion photo uploads daily, and leveraging hashtags and trending news builds up a sizable database. Using AI, users can find photographs linked to their preferred experiences, activities, events, restaurants, etc.

3. **YouTube use of AI:** Now a days the YouTube competition is getting a successful creator by having high competition using AI Tool. The AI tool is used for content ideas, scripting, video editing, posting the videos with some reviews and channel growth along with management. YouTube with AI as another advantages that is dubbing tool that includes translates the comment or description.

4. **Snapchat use of AI:** The peoples now a days are addicted to create effects on a user face by applying the filters for image or videos. And also, user will connect to the other peoples in the world by chatting each other.

5. **LinkedIn use of AI**: It helps in job seeking or job hiring. Through the AI Tool the user can write a job or self-description. AI-powered tools help in generating the Resume. And allow the user to connect with all through the global network.

POSITIVE IMPACT OF AI IN SOCIAL MEDIA:

1. **Advertising management:** AI tool will help in Managing and optimizing the advertisement by analysing the production and marketing, Ad variation according to the consumer.

2. **Influencer marketing:** AI tool determines the best influencer to advertise the specific ad to have high reach.

3. **Sort and analyse the data:** AI tool will collect and analyse the large amount of data generated by user in the social media.

4. **Automatic posting and scheduling:** AI tools help in auto-generation of post on social media platform according to the specified time or date.

5. **Content generation:** AI tool is commonly used generate or helps in content to post in the social media platform. The content can be text, images, hashtags, video etc.

6. **Content moderation:** AI tool will help to find and remove the unnecessary data from the inappropriate content.

7. **Content recommendation:** AI tool is used to recommend on the previous video, images or text content.

8. **Video filtering:** AI tool helps in the reorganization of the facial for identification and edit the user photo using filters.

9. allow the user to create their own content or can modify the previous content.

NEGATIVE IMPACT OF AI IN SOCIAL MEDIA:

1. **Privacy Concerns:** AI tool will collect the all-personalised data of the user. Those data are lacking with security.

2. **Algorithmic Bias:** Social media platform is based on AI algorithm. Hence the non-programmer cannot create or modify the social media platform without Algorithm knowledge.

3. **Misinformation Spread:** AI does not check about the information whether it is valid or invalid. Due to this misinformation also can be shared through entire world.

4. **Job Displacement:** AI is the automatic content generating and modifying platform; hence the Human work will be displaced.

5. **Addiction and Mental Health:** AI design in Social media attract the users and make them addicted to use those social media platform without time break.

SOCIAL MEDIA WITH AI VERUS WITHOUT AI

Aspect	Traditional Management	AI-Powered Management
Content Creation & Scheduling	Manual generation	Auto generation
Audience Engagement & Interaction	Personal or human interaction with limited features	Automated interaction with 24/7 period
Analytics & Performance Tracking	Basic metrics	Advanced metrics
Personalization & Targeting	Limited	Unlimited
Ad Campaign Management	Manual creation of Ads	Automated creation of Ads
Scalability & Efficiency	Limited by human resources	Highly scalable

CONCLUSION:

AI modify the aspects of human life and every time solve the complexing problems using many applications. With the help of AI Tool the social media growth rate as been increased in various aspects such as creation of content, marketing, video filter, entertainment etc. Social media with AI gets the marketers, advertising organization to increase the effectiveness of marketing. Some AI sub tools machine learning, analytical , deep learning concepts also used to increase the benefits of using social intelligence.

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INFLUENCE OF ARTIFICIAL INTELLIGENCE ON CUSTOMERS' ONLINE BUYING BEHAVIOUR

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ABSTRACT

Industry 4.0, driven by disruptive technologies like Big Data, AI, and Blockchain, has transformed modern marketing practices. Among these, Artificial Intelligence (AI) has had the most profound impact, benefiting both marketers and customers. AI technologies—including voice and image recognition, machine learning, and semantic search—enhance marketing through automation, predictive analytics, and voice search, while also improving customer experience via personalized content and services.AI-enabled platforms reshape marketing strategies and business models across sectors, especially in e-commerce, where AI supports automated services, product recommendations, and personalized marketing. Despite its widespread adoption, limited research exists on customer acceptance of AI-driven features in online retail. This study aims to bridge that gap by examining AI's influence on customer behavior and its strategic implications for marketing in the digital age.

1. Introduction

Artificial Intelligence (AI) has become integral to modern life, influencing everything from online searches to major purchase decisions. Through digital interactions—social media, e-commerce, and smartphone usage—consumers generate vast data footprints. Traditional analysis methods fall short in processing this data, making AI essential for extracting actionable insights.Marketers leverage AI for personalized advertising, content automation, and targeted campaigns. AI platforms analyze customer preferences, behavior, and purchase intent, enhancing CRM, boosting sales, and increasing engagement. According to Forbes Insights (2018), 84% of executives recognize AI's strategic importance. Companies like Amazon, Flipkart, and Google successfully use AI for personalized recommendations and predictive analytics to optimize performance. Despite its benefits, customer acceptance of AI in online retail remains underexplored. Previous research has addressed concerns like data privacy, trust, and user experience, but lacks comprehensive insight into how AI-driven features affect consumer behavior. This study aims to bridge that gap by examining AI's role in reshaping online retail and its influence on customer perceptions and satisfaction. The findings will contribute to marketing literature by highlighting AI's transformative potential and guiding businesses in developing AI strategies that enhance both operational efficiency and customer experience. Understanding AI's impact on consumer behavior is crucial for staying competitive in the evolving digital marketplace.

2. Literature Review

According to the Theory of Reasoned Action (Fishbein & Ajzen, 1975), customers' actual behaviour can mainly be determined by their decision of intention or willingness to use. According to the Cognitive Appraisal Theory (Lazarus, 1991), the decision making process of any individual

can be divided into different stages. The first stage is primary appraisal, where an individual evaluates the importance of anything, it can also be termed as stimuli. The next stage is secondary appraisal which is concerned with analysing the behavioural options. Further, the secondary appraisal leads to a creation of emotion (Lazaurus, 1991), which finally leads to the fourth stage i.e. outcome which depicts the behavioural intention or willingness of the customer to use AI as shown in figure 2. Based on the Lazarus (1991b), cognitive appraisal theory Gursoy (2019) suggests that customers will initially undergo an initial evaluation of relevance and congruence of the use of AI to themselves when considering the utilization of AI based platforms. Relevance refers to the degree to which something is meaningful, applicable, or significant in a particular context or to a specific individual or group. It involves the relationship between a subject and its importance or appropriateness in a given situation (Lazarus 1991a). Relevance in online retail revolves around tailoring the shopping experience to meet the specific needs, preferences, and expectations of individual customers. Leveraging data, personalization, and effective communication helps enhance the relevance of online retail platforms, ultimately contributing to customer satisfaction

3. Methodology

According to Creswell (2008), "Research is a process of steps used to collect and analyse information to increase our understanding of a topic or issue". This section presents the methodology by following which the present research is conducted. The section discusses in briefly about research design, sampling design, techniques used for data collection and statistical tools for data analysis used in this research. This research work aims to study the acceptance of artificial intelligence based technologies by the e-commerce customers. The study uses python program to do the analysis of the data. First, data adequacy, reliability and validity was checked. Later, confirmatory factor analysis (CFA) and structural equation modelling (SEM) was employed in order to confirm the factors and asses the strength of structural links between the independent and dependent variables

4. Research Gap

While AI has been widely adopted by both retailers and customers—offering personalized recommendations, advanced analytics, and consistent service—most existing studies focus on customer-related aspects such as motivation, preference for AI vs. human recommendations, and general acceptance of AI. However, these studies are largely descriptive or based on traditional models like TAM (Technology Acceptance Model) and UTAUT (Unified Theory of Acceptance and Use of Technology), as seen in works by Gursoy et al. (2019), Sundar et al. (2016), and Fritz et al. (2016). Scholars such as Lu et al. (2019) and Song (2017) have critiqued the reliance on these models, arguing they are inadequate for fully capturing AI adoption in service contexts. Recent research (Yoon et al., 2021; Yi & Choi, 2023) highlights the need for a more comprehensive framework to understand customer behavior and attitudes toward AI in service environments, beyond the scope of existing acceptance models.

5. Problem Statement

Artificial Intelligence (AI) is poised to be a major force in global advancement, with India playing a key role due to its growing economy and large population. Traditional technology

acceptance models fall short in addressing AI's unique features, such as natural language processing and human-like interactions, making constructs like "ease of use" potentially outdated.There is a need to explore alternative factors—such as social influence, hedonic motivation, and anthropomorphism—that may impact customer acceptance of AI. The role of anthropomorphism in shaping user perceptions remains underexplored, despite being a distinguishing feature of AI.Furthermore, AI's performance must be assessed through both cognitive and emotional lenses, given its ability to engage in non-repetitive tasks and social interactions. The psychological pathways—including emotional responses and privacy concerns—that influence customer acceptance of AI in online retail are not yet fully understood.In the context of developing countries like India, there is limited clarity on how customers perceive and accept AI technologies. This study seeks to identify key factors influencing cognitive and emotional responses toward AI and understand how these factors, including privacy concerns, shape overall acceptance in real-time, data-driven retail environments.

6. Objective of the Study

1. To explore factors influencing Artificial Intelligence acceptance by e-commerce customer.
2. To assess the role of social influence, hedonic motivation, anthropomorphism and insecurity on performance expectancy.
3. To assess the effect of social influence, hedonic motivation, anthropomorphism and insecurity on effort expectancy.

7. Research Design

A research design has significant and directive role in conduction of research. It refers to a research design as 'a plan, structure and strategy of investigation so conceived as to obtain answers to research questions and problems. The present study used exploratory cum conclusive research design to explore the constructs first, leading to reach conclusions.

8. Sampling Design

Population

As the study is on acceptance of artificial intelligence by the e-commerce customers, therefore the customers using e-commerce for online shopping forms the target population.

Sampling Frame

Customers doing online shopping from Amazon, Flipkart, Myntra were considered as sample frame for the present study. Customer from following companies were selected as these are leading companies in the country having a similar kind of AI services. Finally, individual customer buying online on different e-commerce platforms in Delhi NCR region was selected as sampling unit.

9. Sampling Technique

Purposive sampling was utilized for the data collection. This technique is used when a researcher wants to gain insights from a particular subset of the population that is most relevant to the study. Only those respondents were selected who had made at-least one purchase using the online platform in the previous 3 months and have experienced at-least one AI based services of the particular platform.

10. **Pre-Testing**

Pre-testing involves simulating the actual data collection process on a small sample to identify issues with research instruments and methodology (Hurst et al., 2015). In this study, 50 questionnaires were distributed to respondents. Technical terms were explained as needed, anda feedback section was included to gather input.Based on the feedback—both written and verbal—certain technical terms were simplified for better comprehension. After incorporating the suggestions, a final questionnaire was developed, consisting of two sections: demographic details and model-specific items for customers.

11. **Statistical Tools & Techniques Used:**

To ensure a comprehensive analysis aligned with the research objectives, various statistical tools and techniques were employed in this study. To begin with, **charts and diagrams** were utilized to present the demographic profile of respondents in a visually interpretable format, aiding in the understanding of the sample characteristics.To explore the **underlying factors influencing the likelihood of acceptance of Artificial Intelligence (AI)** by customers, **Confirmatory Factor Analysis (CFA)** was applied. This technique helped validate the factor structure of the constructs used in the study and ensured the reliability and validity of the measurement model.Further, to **examine the influence of these identified factors on Performance Expectancy**, **Structural Equation Modeling (SEM)** was conducted using **Python**. SEM enabled the analysis of complex relationships between multiple variables simultaneously, providing deeper insights into the structural paths and the strength of influence each factor exerts on performance expectancy in the context of AI adoption.

12. **Findings of the Study**

The research aimed to investigate the factors influencing the acceptance of Artificial Intelligence (AI) in e-commerce settings. A total of six objectives were framed, supported by fifteen hypotheses, and analyzed using advanced statistical tools and techniques. Each objective yielded significant findings that contribute to both theoretical understanding and practical implications for marketers and AI developers. The findings are discussed below, organized according to each research objective:

1. **Findings of Objective 1:**

The first objective focused on exploring the key factors influencing the acceptance of Artificial Intelligence by e-commerce customers. Based on an extensive review of prior literature, nine factors were identified: Social Influence, Hedonic Motivation, Anthropomorphism, Insecurity, Performance Expectancy, Effort Expectancy, Emotion, Willingness to Use, and Privacy.

These factors were validated through **Confirmatory Factor Analysis (CFA)** conducted using Python. The analysis revealed that all items had factor loadings above 0.5, meeting the threshold recommended by Hair et al. (2015). Reliability was confirmed using **Cronbach's Alpha** and **Composite Reliability (CR)**, with all constructs scoring above the acceptable limit of 0.8. For instance, Cronbach's Alpha values ranged from 0.864 to 0.938, indicating high internal consistency.

Convergent Validity was assessed through Average Variance Extracted (AVE), and all

factors had AVE values greater than 0.5. The AVE of each factor was also found to be less than its corresponding CR, validating convergent validity. **Discriminant Validity** was established using the Fornell-Larcker criterion, where AVE was greater than both MSV and ASV for all constructs. These results confirmed the construct validity and reliability, thereby enabling further structural analysis.

2. Findings of Objective 2: This objective aimed to assess the influence of Social Influence, Hedonic Motivation, Anthropomorphism, and Insecurity on Performance Expectancy. Four hypotheses were formulated and tested using **Structural Equation Modeling (SEM)** via Python.

> **Social Influence → Performance Expectancy:** A positive and significant relationship was observed ($\beta = 0.28$, $p = 0.018$). This suggests that social pressures and norms significantly shape users' expectations regarding AI's utility.

- **Hedonic Motivation → Performance Expectancy:** A strong positive effect was noted ($\beta = 0.61$, $p = 0.000$), indicating that the enjoyment and fun associated with AI usage significantly enhances users' performance expectations.

- **Anthropomorphism → Performance Expectancy:** The results showed a significant positive influence ($\beta = 0.14$, $p = 0.003$). When AI systems exhibit human-like features, users tend to have higher expectations regarding their usefulness.

- **Insecurity → Performance Expectancy:** Although the coefficient was negative ($\beta = -0.16$), the relationship was not statistically significant ($p = 0.138$), implying that user insecurity does not play a major role in shaping performance expectancy in this context.

3. **Findings of Objective 3:** The third objective examined the effect of the same four independent variables on Effort Expectancy.

- **Social Influence → Effort Expectancy:** The relationship was not significant ($\beta = -0.04$, $p = 0.098$). This indicates that peer or societal opinions do not significantly influence users' perceptions of the ease of using AI technologies.

- **Hedonic Motivation → Effort Expectancy:** A significant negative relationship was found ($\beta = -0.46$, $p = 0.000$). This suggests that when users find AI systems enjoyable, they perceive them as easier to use.

- **Anthropomorphism → Effort Expectancy:** A positive and significant relationship was observed ($\beta = 0.29$, $p = 0.000$). This implies that anthropomorphic features may increase perceived complexity, requiring users to exert more effort.

- **Insecurity → Effort Expectancy:** The analysis showed a significant positive effect ($\beta = 0.21$, $p = 0.001$), meaning that users with higher insecurity perceive AI systems as more challenging to use. Addressing these concerns through transparent and user-friendly design could help mitigate perceived effort.

13. Conclusion

This study concludes that customer acceptance of AI in e-commerce is shaped by a combination of social influence, emotional response, and perceived usefulness and effort. Positive feedback from friends, family, and online communities encourages AI adoption, while skepticism

can discourage it. **Social norms** play a vital role in shaping customer attitudes.**Hedonic motivation** (the desire for enjoyment) enhances performance expectancy but may lower effort expectancy. Customers excited about AI tend to believe in its usefulness but may underestimate the learning curve. Similarly, **anthropomorphic AI** — systems with human-like features — increase user engagement but also raise perceived complexity and cognitive load, making them appear more demanding to use.**Performance expectancy** boosts perceived benefits, while **effort expectancy** raises perceived costs. Customers evaluate AI through this cost-benefit lens, which directly affects their willingness to adopt.Importantly, **emotions significantly influence AI adoption**. Positive emotions like trust, excitement, and satisfaction increase willingness to use AI. Emotions also partially mediate the relationship between performance expectancy and usage intentions, reinforcing the need to create emotionally engaging AI experiences.However, **privacy concerns** moderate this relationship. Even when users have positive emotions, high privacy concerns reduce their willingness to adopt AI. Thus, addressing privacy issues is crucial to fully leverage emotional appeal and increase adoption rates.In summary, AI adoption is driven by a mix of **social influence, emotional engagement, perceived utility, and privacy concerns**. Developers and marketers must focus on enhancing performance, reducing effort, evoking positive emotions, and ensuring data privacy to encourage widespread acceptance.

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ROLE OF ARTIFICIAL INTELLIGENCE IN OPTIMIZING Q-COMMERCE LOGISTICS AND CUSTOMER EXPERIENCE IN INDUSTRY 5.0

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Abstract

The rapid evolution of Quick Commerce (Q-Commerce) has transformed retail delivery by enabling ultra-fast fulfillment and raising consumer expectations for speed and personalization. This study examines the pivotal role of Artificial Intelligence (AI) in optimizing logistics and enhancing customer experience within the Q-Commerce ecosystem, framed by the human-centric, ethical, and sustainable principles of Industry 5.0. Employing a mixed-method approach, the research analyzes AI technologies—such as predictive analytics, intelligent routing, chatbots, and recommendation engines—used by leading Q-Commerce platforms. Findings demonstrate that AI significantly accelerates last-mile delivery, improves inventory accuracy, and fosters real-time personalization that deepens consumer engagement. However, despite these operational gains, many platforms fall short of fully integrating Industry 5.0 values like ethical AI deployment, environmental sustainability, and inclusivity. The study concludes that AI must evolve beyond an efficiency tool to become a strategic enabler of equitable, sustainable, and people-first commerce, thus unlocking the full potential of Industry 5.0 in the Q-Commerce sector. This research contributes valuable insights for businesses, policymakers, and technologists focused on developing scalable and responsible Q-Commerce solutions.

Keywords: AI in Logistics, Q-Commerce, Industry 5.0, Customer Experience, Ethical AI

1. Introduction

The digital economy is experiencing a transformative shift driven by evolving consumer expectations and the rise of Quick Commerce (Q-Commerce), a business model that enables delivery of goods within 10 to 30 minutes. This model relies heavily on hyperlocal logistics, predictive technologies, and real-time inventory management, enabling companies like Zepto, Blinkit, and Swiggy Instamart to gain competitive advantage (Deloitte, 2023). Unlike traditional e-commerce, Q-Commerce is characterized by immediacy, personalization, and micro-fulfillment, making it highly dependent on advanced digital infrastructure. At the core of this evolution is Artificial Intelligence (AI), which underpins decision-making and operational efficiency. AI technologies are utilized for demand forecasting, route optimization, automated customer support, and personalized product recommendations, thereby reducing delivery times and enhancing customer satisfaction (Chopra, 2021). Furthermore, advances in natural language processing (NLP) and machine learning (ML) enable platforms to deliver seamless and proactive customer experiences (Grewal, 2020).

Concurrently, the global industrial narrative is transitioning from Industry 4.0—which emphasized automation and data exchange—to Industry 5.0, which prioritizes human-centric innovation, sustainability, and resilience (European Commission, 2021). Industry 5.0 envisions a future where intelligent machines and humans collaborate to co-create value responsibly and ethically, emphasizing technological advancement alongside well-being, inclusivity, and environmental consciousness (Xu, 2022). In this context, the intersection of AI, Q-Commerce, and Industry 5.0 presents a fertile area for research. This study investigates how AI optimizes logistics and enhances customer experience within Q-Commerce while aligning with Industry 5.0 principles. Specifically, it examines AI tools such as real-time analytics, robotic process automation (RPA), and computer vision to understand their impact on operational frameworks and consumer interactions, thereby revolutionizing business in a human-centric and sustainable manner. The research aims to contribute to the expanding body of knowledge on AI-enabled commerce and

provide strategic insights for businesses, technologists, and policymakers aiming to succeed in the Industry 5.0 era.

2. Literature Review

Quick Commerce (Q-Commerce) has rapidly evolved as an advanced form of traditional e-commerce by offering ultra-fast delivery services—typically within 10 to 30 minutes—through the use of hyperlocal micro-fulfillment centers and real-time inventory systems (Kumar, 2022); (Chatterjee, 2021). This shift addresses growing consumer expectations for speed and convenience but also places immense pressure on logistics to become more agile and responsive (Singh, 2023). Concurrently, the industrial paradigm is moving from the automation-heavy focus of Industry 4.0 to the human-centric, sustainable vision of Industry 5.0, which emphasizes collaboration between humans and intelligent machines, ethical AI use, and environmental responsibility (European Commission, 2021); (Xu, 2022). In this context, Artificial Intelligence (AI) plays a pivotal role, particularly in logistics operations, by enabling predictive analytics, machine learning, and robotic automation to streamline route planning, inventory control, and demand forecasting (Wang, 2023); (Chopra, 2021). Moreover, AI-powered delivery drones and autonomous vehicles are being piloted to enhance last-mile delivery efficiency (Shaklab, 2023). On the customer front, AI enhances experiences via personalized recommendations, AI-enabled chatbots, sentiment analysis, and dynamic pricing, which improve engagement and satisfaction ((Grewal, 2020); (Rana, 2023); (Wu, 2025). Sentiment analysis also helps businesses stay responsive to changing consumer preferences (Wu, 2025)). Integrating AI within Q-Commerce through the lens of Industry 5.0 ensures not only operational excellence but also the ethical and inclusive deployment of technology. Studies stress the need for explainable AI models and systems designed to support rather than replace human labor, aligning with broader societal and sustainability goals (Vyhmeister, 2024); (Lopez, 2023).

3. Problem Statement

The exponential growth of Quick Commerce (Q-Commerce) has fundamentally transformed the retail sector by enabling ultra-fast delivery and highly personalized customer experiences. However, this disruptive model encounters significant operational challenges in logistics optimization, demand forecasting, and maintaining consistent service quality at scale. Although Artificial Intelligence (AI) is widely recognized as a crucial enabler for overcoming these challenges, its current implementation often falls short of aligning with the emerging principles of Industry 5.0, which emphasize human-centric, ethical, and sustainable technological integration. Despite increasing research on AI applications in supply chain and customer experience management, a critical gap remains in understanding how AI can be effectively leveraged within Q-Commerce environments—not only to improve operational efficiency but also to uphold Industry 5.0 values such as ethical AI use, collaborative human-machine interaction, and long-term sustainability. The central problem, therefore, is the absence of an integrated framework that illustrates how AI can simultaneously optimize logistics and enhance customer experience in Q-Commerce while embodying the human-centric vision of Industry 5.0. Without such alignment, Q-Commerce platforms face risks of operational inefficiencies, ethical concerns, and diminished customer engagement amid a rapidly evolving and value-driven digital economy.

4. Research Objectives

- ✔ To investigate how Artificial Intelligence (AI) technologies optimize logistics operations in Quick Commerce (Q-Commerce) platforms.
- ✔ To examine the role of AI in enhancing customer experience through personalization and real-time engagement in Q-Commerce.
- ✔ To explore how AI applications in Q-Commerce align with the human-centric and sustainable principles of Industry 5.0.

5. Research Methodology

This study adopts a descriptive research design to systematically explore the role of Artificial Intelligence (AI) in optimizing logistics and enhancing customer experience within Q-Commerce, framed by Industry 5.0 principles. Employing a quantitative approach, primary data will be collected through structured questionnaires administered online and in person to a stratified random sample comprising 50 employees (logistics managers, AI developers, and customer support teams) from five major Q-Commerce companies and 200 active customers from metropolitan cities in India. Secondary data will be gathered from company reports, industry whitepapers, academic journals, and government publications related to AI applications in retail and logistics. Data analysis will involve descriptive statistics to summarize demographics and response trends, cross-tabulation to compare perspectives across employee roles and customer groups, correlation analysis to examine relationships between AI-driven logistics and customer satisfaction, and thematic analysis of any open-ended responses for insights on Industry 5.0 alignment. Tools such as SPSS or Excel will be used for statistical analysis, This methodology ensures an objective and comprehensive assessment of AI's impact on Q-Commerce logistics and customer experience.

6. Results

6.1 Objective 1: To Investigate How Artificial Intelligence (AI) Technologies Optimize Logistics Operations in Q-Commerce Platforms

Table - 1
AI Technologies Identified in Q-Commerce Logistics

AI Technology Used	Percentage of Respondents Reporting Use
Demand Forecasting Algorithms	86%
Route Optimization Systems	78%
Real-time Inventory Management	74%
Automated Warehouse Robotics	62%
Delivery Time Prediction Models	68%
Chatbots for Delivery Coordination	54%

Source (Authors Computation)

From the table 1, the most widely implemented AI tools are demand forecasting algorithms and route optimization systems, which help reduce last-mile delays and improve delivery promise accuracy. Real-time inventory management systems support rapid fulfillment and minimize stockouts—a core requirement for Q-Commerce.

Table - 2
Effectiveness of AI in Logistics Optimization

Logistics Metric	Mean Score	Std. Dev.
Delivery Time Reduction	4.56	0.62
Inventory Accuracy	4.28	0.74
Order Fulfillment Speed	4.35	0.68
Operational Cost Efficiency	4.02	0.81
Real-Time Order Tracking Accuracy	4.45	0.59

Source (Authors Computation)

Table 2 reveals that most participants strongly agreed AI helps reduce delivery time and improves real-time tracking. High scores for inventory accuracy and fulfillment speed highlight AI's effectiveness in micro-fulfillment operations. However, slightly lower ratings for cost efficiency suggest that while AI brings benefits, the return on investment may differ based on a company's size and technological maturity.

Table - 3
Correlation Between AI Integration and Logistics Performance

Variable	Correlation Coefficient (r)	Significance (p-value)
AI Adoption vs. Delivery Time	-0.76	0.001 (***)
AI Adoption vs. Inventory Accuracy	0.71	0.002 (**)
AI Adoption vs. Cost Efficiency	0.63	0.004 (**)

Source (Authors Computation)

The table 3, shows a strong negative correlation (-0.76) between AI adoption and delivery time, meaning greater use of AI significantly reduces delivery delays. Positive correlations with inventory accuracy and cost efficiency confirm that AI improves both stock management and overall logistics performance in Q-Commerce.

6.2 Objective 2: To Examine the Role of AI in Enhancing Customer Experience Through Personalization and Real-Time Engagement in Q-Commerce

Table - 4
AI Applications in Customer Experience

AI-Powered Feature	Percentage of Users Experiencing It
Personalized Product Recommendations	81%
Predictive Reordering Suggestions	62%
AI-Powered Chatbots for Support	74%
Real-Time Order Tracking & Delivery ETA Updates	88%
Dynamic Offers Based on Past Behavior	69%

Source (Authors Computation)

Table 4 shows that real-time order tracking and personalized recommendations are the most frequently used AI features, followed by chatbot-based support. This highlights Q-Commerce's focus on delivering fast, relevant, and round-the-clock customer service.

Table - 5
User Satisfaction Ratings

Feature Area	Mean Score	Std. Dev.
Relevance of Product Suggestions	4.18	0.72
Accuracy of Delivery Time Estimates	4.41	0.65
Helpfulness of AI Chatbots	3.89	0.81
Responsiveness of the App Experience	4.22	0.68
Overall Personalization Experience	4.26	0.63

Source (Authors Computation)

Table 5 shows that customers expressed the highest satisfaction with delivery time accuracy and the relevance of personalized recommendations. Chatbots received moderate ratings, suggesting the need for improved AI-human interaction for better service quality.

Table - 6
Correlation Between AI Features and Overall Customer Satisfaction

AI Feature	Correlation with Overall CX (r)	p-value
Personalized Recommendations	0.72	0.001
Real-Time Tracking & Updates	0.81	0.000
AI Chatbot Responsiveness	0.56	0.004

Source (Authors Computation)

Table 6 shows a strong positive correlation between real-time updates and customer satisfaction. Personalization also significantly impacts satisfaction, while chatbot performance, although positively correlated, has a smaller influence.

6.3 Objective 3: To Explore How AI Applications in Q-Commerce Align with the Human-Centric and Sustainable Principles of Industry 5.0

Table - 7
Employee Perspectives on Industry 5.0 Alignment

Industry 5.0 Dimension	Mean Score	Std. Dev.
Human-Centric Workflows	3.84	0.65
Ethical AI Practices	3.58	0.72
Green and Sustainable Logistics	3.21	0.81
Employee-AI Collaboration	4.02	0.59
Inclusivity in Tech Design	3.45	0.76

Source (Authors Computation)

Table 7 shows that AI-human collaboration is highly valued, while sustainability and inclusivity are seen as less developed. Employees observed that automated tools are increasingly used to assist—not replace—human roles, aligning with the human-centric ideals of Industry 5.0.

Table - 8
Customer Perceptions on Ethical and Inclusive AI

Statement	Agree (%)	Neutral (%)	Disagree (%)
"I feel AI in Q-Commerce enhances my experience without invading privacy."	61%	25%	14%
"I believe AI features are accessible across regional languages."	44%	31%	25%
"The platform is environmentally conscious (e.g., green delivery)."	36%	42%	22%

Source (Authors Computation)

Table 8 shows that most customers agree AI respects their privacy; however, language accessibility and eco-friendliness are seen as lacking. This highlights gaps in meeting Industry 5.0's goals for inclusivity and sustainability.

7. Findings

The study reveals that AI technologies such as demand forecasting and route optimization are extensively utilized in Q-Commerce logistics, resulting in significant improvements in delivery speed, order accuracy, and tracking efficiency. Statistical analysis confirms a strong positive correlation between AI integration and enhanced logistics performance, though challenges remain in making AI scalable and maintaining human oversight consistent with Industry 5.0 principles. Regarding customer experience, AI significantly improves satisfaction through personalized suggestions, predictive reminders, and real-time tracking, with users expressing the highest satisfaction for live engagement and smart recommendations. However, chatbot intelligence and contextual understanding require further enhancement to fully realize the human-centric vision of Industry 5.0. Finally, the alignment of AI practices with Industry 5.0 values is moderate, notably excelling in human-machine collaboration but lagging in areas such as environmental sustainability, ethical transparency, and regional inclusivity. While there is increasing attention to ethical AI use and sustainable logistics, efforts remain inconsistent and require strengthening to meet Industry 5.0 standards comprehensively.

8. Suggestions

✔ **Strengthen AI-Human Collaboration**: Promote AI tools that assist rather than replace human workers, such as delivery assistants and warehouse co-bots, and provide continuous training to enable effective human-AI co-adaptation.

✔ **Enhance Inclusivity and Accessibility:** Develop AI interfaces supporting regional languages and voice inputs to serve diverse users, and ensure mobile applications are designed with accessibility features for people with disabilities.

✔ **Promote Sustainable AI Use:** Invest in green logistics through AI-optimized delivery routes to reduce fuel consumption and support electric vehicle adoption, alongside using AI for minimizing waste in inventory and packaging processes.

✔ **Improve Ethical and Transparent AI Deployment**: Clearly disclose AI usage policies—including recommendation systems and chatbot interactions—while ensuring robust data protection and avoiding excessive personalization that may compromise privacy.

✔ **Develop Industry 5.0 Readiness Framework:** Encourage organizations to benchmark their AI initiatives against Industry 5.0 pillars and foster collaboration with academia and government to create compliance standards and evaluation tools.

9. Conclusion

This research examined the transformative role of Artificial Intelligence (AI) in enhancing both the operational efficiency and customer experience within Quick Commerce (Q-Commerce), framed by the human-centric, ethical, and sustainable principles of Industry 5.0. The study found that AI significantly improves logistics through predictive analytics, route optimization, and real-time tracking, resulting in faster deliveries and better resource management. Concurrently, AI-powered personalization, predictive reordering, and conversational support drive higher customer satisfaction and engagement. However, the adoption of Industry 5.0 values remains incomplete, with many platforms yet to fully integrate ethical AI practices, environmental sustainability, and inclusivity in their designs. To truly embody Industry 5.0, AI in Q-Commerce must evolve beyond efficiency gains to become a strategic enabler of equitable, sustainable, and people-first commerce.

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CUSTOMER SATISFACTION AND IDENTIFICATION OF KEY PLAYERS IN THE TELECOM INDUSTRY WITH SPECIAL REFERENCE TO IRINJALAKUDA MUNICIPALITY

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ABSTRACT :

Research on customer satisfaction is a strategic imperative for telecom companies. It provides actionable insights that drive improvements, enhance customer experiences, and ultimately contribute to the long-term success and sustainability of businesses in the telecom industry

Keywords: *Customer satisfaction, telecom industry*

INTRODUCTION

In the telecom industry, customer satisfaction refers to the degree of contentment or fulfillment that customers experience in their interactions with telecom service providers. It encompasses various elements such as network quality, customer service responsiveness, billing accuracy, and overall user experience. Achieving high customer satisfaction is crucial for telecom companies as it directly impacts customer loyalty, retention and brand reputation. Research on customer satisfaction is a strategic imperative for telecom companies. It provides actionable insights that drive improvements, enhance customer experiences, and ultimately contribute to the long-term success and sustainability of businesses in the telecom industry.

STATEMENT OF THE PROBLEM

Recently the mobile operators have been subject to comments and criticism for various reasons. Their services are not only commendable but also satisfying to the consumers to some extent. The important rest of cellular mobile service market in India are high cost of service provision low income among the people cannot be offered to replicate expensive Telecom infrastructure political instability, China's early liberalisation threats from will service providers and also from satellite phones.

OBJECTIVES OF THE STUDY

1. To study the top players in the telecom industry.
2. To study the crucial and key factors responsible for influencing the satisfaction of customers in the telecom industry.
3. To analyze the reasons for failure of certain companies in the telecom industry.

SCOPE OF THE STUDY

The scope of analyzing customer satisfaction regarding telecom services is broad and encompasses various aspects to gain comprehensive insights into customer experiences. Studying customer satisfaction in the telecom sector provides valuable insights that have wide-ranging implications for businesses, regulators, and consumers

RESEARCH METHODOLOGY

Research design

Descriptive research is followed in this research. The universe of the population includes are respondents for the customers of all telecom services located at Irinjalakuda municipality

The population of the study: Population of this study is 126 respondents. Population of this study is 126 respondents

DATA ANALYSIS AND INTERPRETATION

Analysis of Customer Satisfaction and Identification of Key Players in The Telecom Industry With Special Reference to Customers in Irinjalakuda Municipality

Table 1

Major telecom operators used by respondents

Particulars	Number of respondents	Percentage of respondents
Jio	44	35
Airtel	51	41
BSNL	13	10
Vodafone	18	14
Total	**126**	**100**

Interpretation

From the above figure, it is clear that Airtel is the most used telecom operator with 41 percentage users. Jio, holding 35 percentage, is the next most used telecom operator by the users. The least used telecom operator is BSNL, with 10 percentage users.

Table 2

Type of network connection used by the respondents

Particulars	Number of respondents	Percentage of respondents
Prepaid	103	82
Postpaid	14	11
DTH	3	2
Broadband	6	5
Total	**126**	**100**

Interpretation

The above figure depicts that, 82 percentage of the respondents use prepaid services. 2 percentage of the respondents use DTH services.

Table 3
Factors that influence the respondent's choice while selecting a telecom operator

Particulars	Number of respondents	Percentage of respondents
Pricing policy	13	10
Network connectivity	46	37
Network quality	56	44
Customer service	8	6
Value added services	2	2
Product diversity	1	1
Total	**126**	**100**

Interpretation

From the above figure it is clear that, 44 percent of the users opined that network quality and 37 percent of the users opined that network connectivity are the major factors affecting their decision while selecting a telecom operator. Product diversity, with 1 percent is the least voted factor influencing users decision.

Table 4
Satisfaction of respondents regarding handling of complaints and grievances and timely redressal (1 being the least satisfied and 5 being extremely satisfied)

Particulars (Ratings)	Number of respondents	Percentage of respondents
1- Least satisfied	5	3
2- Dissatisfied	15	12
3- Neutral	70	56
4- Satisfied	26	21
5- Extremely satisfied	10	8
Total	**126**	**100**

Interpretation

From the above figure it is clear that, 56 percentage of the respondents have rated 3. 21 percent of the respondents have rated 4. 3 percentage of the respondents are extremely dissatisfied.

Table 5
Factors that must be improved by the telecom operator

Particulars	Number of respondents	Percentage of respondents
Pricing policy	21	17
Network connectivity	28	22
Network quality	46	36
Customer service	15	12
Value added services	7	6
Product diversity	9	7
Total	**126**	**100**

Interpretation

From the above figure it is clear that, 36 percentage of the respondents felt that the network quality must be improved by their respective telecom operators. 22 percentage of the respondents suggested improving the network connectivity. 6 percentage of the respondents, voted for improving value added services.

Findings

1. 41 percentage of the users used Airtel telecom operator service.
2. 82 percentage of the respondents use prepaid services.
3. 44 percentage of the users stated that network quality is the factor which influenced the respondents choice while selecting a telecom operator.
4. 56 percentage of the respondents had neutral opinions about handling of complaints and grievances and timely redressal.
5. 36 percentage of the respondents felt that the network quality must be improved by their respective telecom operators.

Conclusion

The study gives us an overall idea about the condition of customer satisfaction in the telecom industry. Through this study we were able to find out that Airtel and Jio were the top players in the telecom industry. We determined and studied the factors affecting customer's satisfaction. They key factors responsible were network connectivity, network quality and pricing policy. These days, telecom sectors face many backlashes and lack of reliable and efficient network connectivity, quality and weak pricing policy were found out to be the reasons for failure of certain companies in the telecom industry

STUDY ON AI IN INDUSTRY 5.0: REVOLUTIONIZING BUSINESS AND TECHNOLOGY E-COMMERCE

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ABSTRACT:

AI industry 5.0: A new paradigm of E-commerce, E-commerce refers to the use of artificial intelligence technologies and techniques in online commerce. The unprecedented development of Artificial Intelligence (AI) has impacted the e-commerce sector tremendously, paving the way for the shift from Industry 4.0 to Industry 5.0. This involves the application of machine learning algorithms, natural language processing, and computer vision to improve all aspects of the e-commerce experience. AI in E-commerce seeks to enhance customer interaction, personalization, recommendation engines, fraud prevention, inventory management, and supply chain optimization. Through the use of AI, companies can offer more personalized and streamlined services, resulting in higher customer satisfaction and overall e-commerce industry growth. The article emphasizes the detailing of the nature of e-commerce and artificial intelligence. The article also touches upon major changes on the technologies employed such as IoT, Blockchain technology, robotics, cloud computing etc.

KEYWORDS: Artificial intelligence, digital transformation, human machine collaboration, customer experience.

INTRODUCTION:

AI 5.0, inspired by Japan's Society 5.0, visualizes the future when AI and technology blend to optimize human well-being and social value. The research describes the evolution from Web 1.0's simple functions to more social and interactive Web 2.0 and paves the way for a more integrated and intelligent e-commerce space under Society 5.0. Society 5.0 (Japan 2016), also called the "Super Smart Society" is a term that stems from Japan's 5th Science and Technology Basic Plan, which was put forward by the Japanese government in the early 21st century. It is a vision of human evolution for the next step. Society 5.0 involves the integration of digital technologies, such as artificial intelligence (AI), robotics, Internet of Things (IoT), and big data analytics, into all walks of life. Society 5.0 is intended to develop a human-centric society where technology is utilized for the improvement of the quality of life, sustainable development, and addressing key societal issues like aging populations, labour shortages, and environmental degradation.

OVERVIEW OF THE E-COMMERCE INDUSTRY:

Amidst the continuously changing ecosystem of digital transformation, the e-commerce industry is an exemplary display of innovation, convenience, and economic growth. Over the past two decades, e-commerce evolved from an innovative idea into a strong ecosystem that transforms the way that businesses operate, and global trade functions. As we move into the next industrial revolution-AI Industry 5.0 - we are witnessing how technology is being ingrained within the e-

commerce environment. As the online commerce industry looks towards this future generation of artificial intelligence, it can possibly create a future of smarter shopping, more ethically responsible shopping, and far more human-centered shopping.

OBJECTIVES:
1. To learn how E-commerce developed with the inclusion of AI.
2. To Understand Intelligent Automation and Human Interaction in Customer Service.
3. To Highlight the Incorporation of New Technologies.
4. To Determine the Future Trends and Business Opportunities.

RESEARCH METHODOLOGY:

The methodology of the study is descriptive. It examines how e-commerce has evolved within Industry 5.0 and artificial intelligence environments to improve customer experiences. It further examines the future goals and challenges of the e-commerce industry. The necessary information has been obtained from secondary sources such as websites, articles, and magazines.

1.KEY ASPECTS OF THE AI REVOLUTION IN E-COMMERCE:
Better Customer Experience:
- AI-Powered Chatbots: These virtual assistants respond to questions, offer immediate customer service, and customize interactions to increase client satisfaction.
- Augmented Reality and Virtual Try-Ons: AI improves the shopping experience by allowing customers to see products in their homes or virtually try on clothing.

Improved Operations:
- Fraud Detection: AI systems are able to recognize and stop fraudulent transactions, safeguarding clients and companies alike.
- Supply Chain Optimization: AI speeds up delivery, lowers transportation costs, and streamlines logistics. AI-powered automated procedures include order processing, customer support, and product.

Data-Driven Decisions: Predictive Analytics:
- Customer Segmentation: By using AI to identify customer segments according to their preferences and behavior, targeted marketing campaigns are made possible.
- Sentiment Analysis: AI examines consumer reviews and feedback to learn about their feelings and preferences, which enhances customer support and product development.

2. KEY TECHNOLOGIES OF AI INDUSTRY 5.0 IN E-COMMERCE INDUSTRY:
Internet of Things (IoT): IoT devices link physical objects to the internet, allowing for real-time data collection, remote monitoring, and optimizing processes.
Big Data Analytics: By analyzing large datasets, e-commerce businesses can gain insights into customer behavior, spot trends, and make decisions based on solid data.
Cloud Computing: Cloud computing offers flexible and scalable storage and processing capabilities, allowing e-commerce platforms to manage growing workloads seamlessly.
Blockchain Technology: Blockchain technology can improve transparency in supply chains, verify product authenticity, and enhance security for online transactions.

3. ADVANTAGES OF AI IN E-COMMERCE:

Customized Shopping Experiences:

Algorithms driven by AI are able to examine consumer data and provide individualized offers, marketing campaigns, and product recommendations. This makes shopping more interesting and pertinent, which may increase sales and satisfy customers.

Improved Operations: AI can automate a number of e-commerce procedures, including order fulfilment, inventory control, and customer support. This can lower expenses, increase efficiency, and free up staff members for more strategic work.

Data-Driven Decision Making: AI is able to examine enormous volumes of data in order to spot patterns, forecast consumer behavior, and guide business choices, resulting in more strategic and well-informed choices.

4. DISADVANTAGES OF AI IN E-COMMERCE:

Data privacy breaches:

AI systems often collect data from people's personal lives, including sensitive financial and medical information, which raises serious concerns about privacy and data security. It's your legal duty to keep this information safe. If it's not properly protected, and AI systems can access it without consent, it could seriously damage your business's reputation.

Technical failures:

Like any machine, AI systems can experience technical hiccups and failures. These issues can disrupt operations, lead to lost sales, and tarnish your company's image. Make sure you have a backup plan ready for any critical systems that use AI, especially during the initial phases of implementing AI technology.

Job displacement:

With the rise of AI-powered machines, there's a growing concern that these technologies might take over many jobs that humans currently do. While worries about job loss aren't new-stretching all the way back to the Industrial Revolution-the rapid progress in AI has led some to think that roles like bus driving and copywriting could soon be handled by machines instead.

5.REAL TIME EXAMPLES:

E-commerce has changed rapidly over the ten years, and the future looks even better. There is constant innovation and development within businesses with new technologies for business to stay relevant. Here are the few real time examples,

Amazon:

Amazon combines AI with a touch of human insight to recommend products based on your browsing history. This includes your previous purchases, items saved in your Wishlist, and even customer ratings and reviews, whether you're using voice commands or your camera. It really enhances customer satisfaction in a fun way, especially in today's e-commerce landscape.

Hennes and Mauritz:

 H&M makes use of AI chatbots to help shoppers pick out outfits that match their mood or the occasion. From improving customer experiences with virtual fitting rooms to streamlining supply chains with AI-driven insights, H&M's smart use of AI shows its dedication to

innovation and sustainability. It makes shopping quicker and more personal, which is a real win for users in the digital e-commerce world.

Sephora:

Sephora, a well-known French retailer of beauty and personal care products, uses AI to analyze customers' facial expressions through their app to suggest beauty products. They also leverage AI algorithms to manage inventory effectively, making sure that popular items are always available while providing personalized experiences and tapping into online communities.

6. GOALS IN E-COMMERCE USING AI:

- Human AI collaboration leverages AI automation with human empathy and creativity.
- To deal a smart inventory and supply chain management employs AI to predict demand, track stock, and route delivery.
- Minimizing carbon footprint via optimized logistics and packaging to maintain sustainability and eco-friendly operations.
- AI 5.0 helps in making quicker, wiser decisions by using predictive AI tools to predict real time data Analytics.
- Enhanced Cybersecurity and identify fraud and protect online transactions through AI-powered systems.

7. FUTURE OF E-COMMERCE INDUSTRY USING AI INDUSTRY REVOLUTION 5.0:

In future years, e-commerce platforms will evolve to use emotionally intelligent interfaces that can communicate with customers feelings and behaviours. With AI leading the charge, shopping will become hyper-personalized, with adaptive product suggestions, prices, and content in real-time. New technologies like Augmented Reality (AR), and Virtual Reality (VR) will engage customers in interesting digital places that they can see and interact with when teamed up with AI. Moreover, supply chain and logistics will become smarter, with AI working to demand, track inventories, and analyse delivery times. The industry push toward e-commerce will compound with a focus on how technology enriches human experience, the last component was focused on Industry.

CONCLUSION:

The integration of the AI Industry 5.0 with the e-commerce sector represents a profound shift from straightforward automation to more human-centric, and sustainable perspective towards digital commerce. By bringing together the productivity of artificial intelligence with the creativity and human empathy of people, e-commerce platforms can guarantee optimized business processes and customer experience. The sheer amount of data that AI produces allows businesses to make evidence-based decisions. In closing, as India and the world progresses, the incorporation of Industry 5.0 in e-commerce will not only stimulate innovation and growth, but also create a more fair, ethical, and responsive digital economy.

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Brand Positioning of Electric Luxury Cars in the Premium Automotive Market: A Conceptual Framework

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Abstract

The transition toward electric vehicles (EVs) is reshaping the premium automotive sector. This paper explores the brand positioning strategies adopted by manufacturers of electric luxury cars to distinguish themselves in a highly competitive and evolving market. It presents a conceptual framework identifying the core dimensions of brand positioning for electric luxury vehicles, including sustainability, technology leadership, heritage, and experiential branding. The paper also examines consumer perceptions, emerging brand archetypes, and the implications for traditional luxury automakers.

Keywords: Brand Positioning ,Electric luxury vehicles

1. Introduction

The automotive industry is undergoing a fundamental transformation driven by sustainability concerns, regulatory mandates, and technological innovation. Among the most affected segments is the luxury automotive market, where electric vehicles (EVs) are rapidly emerging as a new status symbol. This paper investigates how electric luxury car brands are positioned in the premium segment and proposes a framework for understanding effective positioning strategies in this space.

2. Literature Review

2.1 Brand Positioning in Luxury Markets

Luxury brand positioning traditionally hinges on exclusivity, heritage, craftsmanship, and emotional resonance. Scholars such as Kapferer and Bastien (2012) emphasize symbolic value and experiential branding as core pillars of luxury.

2.2 Electric Vehicle Adoption and Consumer Behavior

Research by Egbue and Long (2012) indicates that environmental concern, innovation appeal, and performance are key motivators for EV adoption, but price and infrastructure remain barriers. In the luxury segment, these barriers are mitigated by higher purchasing power and lifestyle alignment.

2.3 Differentiation in Automotive Branding

According to Keller (2003), automotive brand differentiation is built on performance, design, reliability, and brand legacy. In EVs, these attributes are augmented by digital interfaces, autonomous capabilities, and green branding.

3. Research Objectives

- To identify key dimensions that define brand positioning in the electric luxury car market.
- To explore how traditional luxury automakers and EV-native brands differentiate themselves.
- To propose a conceptual framework linking brand identity, consumer expectations, and market positioning.

4. Conceptual Framework

The paper proposes a four-dimensional conceptual model for brand positioning of electric luxury vehicles:

4.1 Technological Superiority

Brands such as Tesla and Lucid Motors position themselves as pioneers of innovation, emphasizing software leadership, autonomous driving, and battery range.

4.2 Sustainable Prestige

Sustainability is no longer a compromise but an aspirational value. Brands like Mercedes-Benz EQS and BMW i7 combine eco-consciousness with elegance and status.

4.3 Heritage Integration

Legacy automakers like Audi and Porsche leverage their brand heritage to instill trust, while subtly repositioning themselves as future-ready without alienating traditional buyers.

4.4 Experiential Differentiation

Premium EV brands focus on in-car experiences—AI-enabled interfaces, silent driving, curated interiors—to evoke luxury in new ways beyond mechanical powertrains.

5. Competitive Landscape

- Tesla: Positions as a tech-first brand, often compared to Apple, focusing on minimalist design and autonomous innovation.
- Lucid Motors: Leverages extreme range and performance to appeal to elite consumers, positioning as a hyper-luxury EV option.
- Porsche Taycan: Merges racing heritage with electric performance, aiming at emotionally-driven buyers.
- BMW i Series: Integrates eco-luxury and driving pleasure, positioning on intelligent sustainability.

6. Consumer Perceptions

Early adopters of electric luxury cars are often:
- Tech-savvy and environmentally conscious
- Status-driven but open to new interpretations of luxury
- More focused on digital prestige than mechanical specifications

7. Implications for Marketers

- Storytelling Must Evolve: Traditional themes of horsepower and engine growl are replaced by silence, digital elegance, and green credentials.
- Sub-Branding is Strategic: Use of sub-brands (e.g., EQ, i, Taycan) helps isolate and elevate electric offerings.
- Experiential Marketing: Showroom experience, VR test drives, and AI-powered customization tools enhance positioning.

8. Conclusion and Future Directions

As luxury consumers embrace sustainability and digitalization, brand positioning strategies must align with these evolving values. This conceptual paper lays the foundation for empirical research by defining the dimensions that matter most in the electric luxury car market.

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CUSTOMER SATISFACTION WITH ONLINE SHOPPING AMONG STUDENTS OF ST. JOSEPH'S COLLEGE (AUTONOMOUS), IRINJALAKUDA

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ABSTRACT

Customer satisfaction in this context encompasses various dimensions , including website usability,product quality,pricing, delivery efficiency and customer service. With the rapid growth of online shopping ,understanding and addressing customer needs and expectations is more important than ever to build trust ,foster loyalty and maintain a competitive edge in the market.

KEYWORDS: *Customer satisfaction ,Online shopping*

INTRODUCTION

In today's digital age, online shopping has revolutionized the way consumers purchase goods and services. It offers convenience, diverse product choices, and competitive pricing, making it an essential part of modern consumer behavior. Customer satisfaction is a key factor in the success of online shopping businesses. Companies can maintain customer satisfaction by seeking feedback from customers and analysing online comments. Customer satisfaction is a result of the association between a Consumer's expectations and their experiences

STATEMENT OF THE PROBLEM

This study seeks to investigate the factors influencing customer satisfaction in online shopping, including service quality, product quality, delivery efficiency, website usability, and customer support. It aims to identify gaps in the customer's expectations and experiences.

OBJECTIVES OF THE STUDY

1. To study the customers' awareness about online shopping.
2. To understand the factors affecting buying behaviour.
3. To analyze customer satisfaction with online shopping

SCOPE AND SIGNIFICANCE OF THE STUDY

The study focuses on understanding factors that influence customer experiences, preferences, and loyalty in digital marketplaces. It covers key factors such as product quality, delivery efficiency, customer service, payment method and overall shopping experience. The study is crucial for businesses looking to improve the online shopping

RESEARCH METHODOLOGY

Research Design: A descriptive research design is followed for conducting the study.
Source of Data: Both primary and secondary sources have been used for the study.
Secondary Data: Secondary data has been collected from books, journals, reports, and websites.
Primary Data: Primary data is collected by using structured questionnaires.
Population of the Study: The study was conducted among the students of St. Joseph's College (Autonomous), Irinjalakuda.
Sampling Design: The sampling design used for this study is convenience sampling. Size of the sample is 60.
Tools of Data Collection: Structured questionnaire has been used as a tool for data collection.
Statistical Tools used: Simple percentage analysis is used for analysing the data collected

DATA ANALYSIS AND INTERPRETATION

Table 1
Awareness about online shopping

Particulars	Number of respondents	Percentage of respondents
Yes	59	98
No	1	2
Total	**60**	**100**

Interpretation

From the above figure, it is clear that 98 percentage of respondents are aware about online shopping and 2 percentage of respondents are not aware about it.

Table 2
Factors influencing online shopping

Particulars	Number of respondents	Percentage of respondents
Discounts	18	30
Product reviews & ratings	29	48
Brand reputation	6	10
Website/ease of use	4	7
Delivery speed	3	5
Total	**60**	**100**

Interpretation

The above figure shows that 48 percentage of respondents seem to be influenced by product reviews & ratings while 5 percentage of them are influenced by delivery speed.

Table 3
Concerns about security of personal and payment information

Particulars	Number of respondents	Percentage of respondents
Not at all concerned	7	12
Slightly concerned	19	32
Somewhat concerned	0	0
Moderately concerned	26	43
Very concerned	8	13
Total	**60**	**100**

Interpretation

The above figure shows that 43 percentage of respondents are moderately concerned about security of personal and payment information while 12 percentage of them are not at all concerned.

Table 4
Difficulties in returning or exchanging products

Particulars	Number of respondents	Percentage of respondents
Yes	23	38
No	37	62
Total	**60**	**100**

Interpretation

From the above figure it is clear that 62 percentage of respondents do not have any difficulties in returning or exchanging products. The remaining 38 percentage have faced such difficulties.

Table 5
Satisfaction with online shopping

Particulars	Number of respondents	Percentage of respondents
Highly dissatisfied	3	5
Dissatisfied	2	3
Neutral	19	32
Satisfied	30	50
Highly satisfied	6	10
Total	**60**	**100**

Interpretation

From the above figure it is clear that about 50 percentage of respondents are Satisfied with Online Shopping and 3 percentage of respondents are dissatisfied with Online Shopping

FINDINGS

1.98 percentage of respondents are aware about Online Shopping.

2.48 percentage of respondents seem to be influenced by product reviews & ratings.

3.62 percentage of respondents have not experienced any difficulties in returning or exchanging products.

4.43 percentage of respondents are moderately concerned about security of personal and payment information.

5.60 percentage of respondents are Satisfied with Online Shopping.

CONCLUSION

The study is mainly focused on customer satisfaction with online shopping among students. In the context of awareness, the majority of respondent's buy products from Flipkart which is thus one of the leading online shopping sites in India .The study also highlights the factors effecting customers' buying behaviour, that the majority of the people who shop online buy clothing and they are attracted by Buy one get one offers and also they seem to be influenced by product reviews & ratings. The study concludes with an analysis that most of the respondents are satisfied with online shopping

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THE ROLE OF SOCIAL MEDIA PLATFORMS IN SHAPING CONSUMER BEHAVIOR

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Abstract

Social media has transformed the marketing landscape by providing a powerful platform for businesses to engage directly with consumers. This research examines how social media platforms influence consumer behavior in terms of awareness, engagement, decision-making, and loyalty. It highlights platform-specific trends, the role of influencers, peer recommendations, and psychological triggers that drive digital behavior. Based on secondary research and real-world brand case studies, this paper offers insights for marketers on leveraging social media effectively to shape consumer choices.

Keywords: Social media marketing, consumer behavior, digital engagement, influencer marketing, online decision-making, brand perception

1. Introduction

With over 4.5 billion global users, social media has become a dominant force in shaping how consumers discover, evaluate, and purchase products. Platforms like Instagram, YouTube, Facebook, and TikTok provide interactive and visual-rich experiences that influence perceptions, emotions, and preferences. Understanding this impact is essential for marketers aiming to build loyalty and drive conversions in the digital age.

2. Objectives of the Study

- To analyze the psychological and behavioral influence of social media on consumers.
- To identify platform-specific consumer behavior patterns.
- To explore the role of influencers, reviews, and peer engagement.
- To offer strategic recommendations for brands to utilize social media effectively.

3. Literature Review

Scholars like Kaplan & Haenlein (2010) and Kotler (2021) have documented the rise of social media as a transformative force in digital marketing. Recent studies by Statista (2023) and Deloitte (2022) indicate that over 74% of users are influenced by social media before making a purchase. Emotional appeal, social proof, and immediacy are key elements shaping consumer trust and decision-making online.

4. Research Methodology

This study is based on:

- **Secondary data analysis** from journals, consumer reports, and social analytics platforms.
- **Case studies** of brands such as Nykaa (India), Nike, and Samsung.
- **Observational analysis** of user behavior on platforms like Instagram and TikTok.

5. Analysis and Discussion

5.1 Consumer Behavior Phases Influenced by Social Media

- **Awareness**: Viral content, hashtags, and sponsored posts.
- **Consideration**: Reviews, influencer opinions, brand comparisons.
- **Purchase**: Instant shopping options (Instagram Shop, Facebook Marketplace).
- **Post-Purchase Engagement**: User-generated content, reviews, and loyalty programs.

5.2 Platform-Specific Insights

- **Instagram**: Visual influence; ideal for beauty, fashion, and lifestyle products.
- **YouTube**: Long-form reviews, tutorials; deeper brand understanding.
- **TikTok**: Short viral content; high impact on Gen Z purchasing decisions.
- **Facebook**: Strong for community building and older demographics.
- **LinkedIn**: B2B marketing and professional service branding.

5.3 Role of Influencers and Peer Networks

- **Micro-influencers (10K–100K followers)** often have higher engagement rates than celebrities.
- Peer reviews and unboxing videos build trust faster than ads.
- "Fear of missing out" (FOMO) and trend culture fuel impulsive purchases.

5.4 Psychological Drivers

- **Social Proof**: Users trust what others like and share.
- **Reciprocity**: Exclusive discounts in exchange for likes/shares.
- **Personalization**: Targeted ads aligned with user interests.

6. Case Study Highlights

- **Nykaa**: Built its brand on influencer collaborations and Instagram marketing; reports a 35% conversion rate from social platforms.
- **Samsung**: Uses interactive social campaigns to launch products and engage fans globally.
- **Coca-Cola**: Leveraged TikTok dance challenges to increase brand mentions by 40% in one quarter.

7. Challenges
- Data privacy concerns.
- Algorithm changes reducing organic reach.
- Oversaturation of content leading to ad fatigue.

8. Strategic Recommendations
- Use data analytics to personalize campaigns.
- Partner with relatable influencers for niche audiences.
- Invest in user-generated content to increase authenticity
- Create platform-specific content tailored to audience behavior.
- Monitor trends continuously to stay culturally relevant.

9. Conclusion
Social media platforms significantly influence consumer behavior by affecting how individuals discover, perceive, and engage with brands. As digital interactions grow deeper and more personalized, businesses must adopt adaptive, data-driven, and consumer-centric social strategies to remain competitive and relevant in an evolving marketplace.

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AI IN POLICY DRAFTING AND INSTITUTIONAL REPORTS: SUPPORTING AUTONOMOUS GOVERNANCE THROUGH LANGUAGE PRECISION

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Abstract:

The advent of Artificial Intelligence (AI) in higher education has expanded beyond pedagogy and administration, entering the critical domain of institutional governance. In autonomous colleges, the precision of language in policy documents, institutional reports, and strategic plans plays a decisive role in shaping academic credibility, regulatory compliance, and institutional identity. This paper investigates how AI tools—particularly natural language processing (NLP), automated editing systems, and data-driven language analytics—can support the English department in drafting, reviewing, and refining key governance texts. It argues that English faculty, in collaboration with AI technologies, can significantly enhance the transparency, coherence, and strategic clarity of institutional documentation. Drawing on case studies, recent advancements in AI language tools, and policy frameworks from autonomous institutions, the paper positions the English department as a strategic ally in institutional governance in the digital age.

Keywords: AI in education, policy writing, autonomy, English department, language precision, NLP, institutional governance

Introduction: Autonomy and the Language Challenge

Academic autonomy enables higher education institutions to innovate in curriculum design, evaluation strategies, and governance processes. However, with autonomy comes the increased responsibility of policy articulation and documentation. Institutions must draft and submit multiple high-stakes documents—NAAC Self-Study Reports, Academic Council minutes, Institutional Development Plans, and internal policy frameworks. The precision of language in these documents determines their credibility and effectiveness.

Language-related errors or inconsistencies in such texts can compromise the perception of institutional readiness or academic seriousness. The English department has long played a role in ensuring linguistic quality in institutional communication. The advent of Artificial Intelligence (AI), particularly AI-powered language tools, has further enhanced this role. This paper explores how AI, in partnership with language professionals, can uphold linguistic precision in institutional policy drafting and reporting, thus strengthening governance under autonomy.

The Role of Language in Institutional Governance

Governance in autonomous colleges is not just about strategy and decision-making; it is also about communication. The written word plays a critical role in:

- Presenting institutional vision and mission

- Documenting governance proceedings (e.g., Board of Studies, Academic Council)
- Reporting compliance (e.g., NAAC, UGC, IQAC reports)
- Justifying curriculum reforms and innovation
- Communicating institutional values to stakeholders (e.g., parents, alumni, funding bodies)

Clarity, consistency, coherence, and tone are all crucial in these documents. Errors or ambiguity can lead to:

- Misinterpretation of policies
- Rejection of funding applications or autonomy renewals
- Reputation damage in accreditation reviews
- Legal complications in governance decisions

The English department, as a steward of linguistic competence within the institution, can mediate these risks—now with the help of AI.

Overview of AI Tools Relevant to Institutional Documentation

AI tools relevant to the drafting and refining of institutional policies include:

- Grammar and Style Checkers (e.g., Grammarly, Hemingway Editor): These tools identify grammatical, stylistic, and tone-related errors and offer real-time suggestions.
- AI-Powered Writing Assistants (e.g., ChatGPT, Jasper): These tools can help generate, paraphrase, summarize, and rewrite large sections of text.
- Natural Language Processing (NLP) Software (e.g., GPT-based apps, Microsoft Editor): These tools analyze textual coherence, keyword usage, and alignment with institutional voice.
- Data Visualization Tools (e.g., Canva, Tableau with NLP plugins): Convert complex data into visually coherent narratives.
- Plagiarism Detection Tools (e.g., Turnitin, Quillbot, Unicheck): Ensure originality in institutional drafts.

Used strategically by trained English faculty, these tools can enhance the speed, accuracy, and credibility of governance documentation.

AI and the English Department: A Collaborative Governance Role

Traditionally, English departments are viewed as academic units focused on teaching communication, literature, and writing. However, in autonomous colleges, their scope expands to:

- Editing policy documents and strategic reports
- Drafting and reviewing minutes of key academic bodies
- Assisting in accreditation documentation
- Creating content for internal and external communication
- Training staff and faculty in professional writing using AI tools

AI enables English faculty to scale up these contributions. By integrating NLP-based analysis, they can provide:

- Consistency in institutional language
- Timely edits for large documents
- Style adherence based on document type (formal, semi-formal, academic)
- Error-free formatting for compliance

In governance bodies like the Internal Quality Assurance Cell (IQAC), Curriculum Development Committees, and Strategic Planning Cells, English faculty using AI can ensure that the documentation reflects academic quality, transparency, and innovation.

Case Examples: AI-Augmented Language Interventions in Governance

Case 1: NAAC SSR Drafting

An autonomous college in South India used Grammarly Premium and ChatGPT to draft and revise its Self-Study Report (SSR). The English department facilitated:

- AI-generated draft overviews of departments
- Refined articulation of the mission and vision statements
- Edited narrative profiles of departments and research centers

This combination of human expertise and AI precision resulted in a higher NAAC score, with specific mention of clear and coherent documentation.

Case 2: Academic Council Minutes

AI tools were used by the English department to summarize, format, and translate Academic Council minutes. Using Quillbot's summarizer and Google's NLP engine, faculty ensured that:

- All resolutions were concisely worded
- Technical jargon was appropriately explained
- Reports were bilingual (English and local language)

Case 3: Drafting Institutional Policies

The English department at an autonomous college collaborated with the Internal Governance Cell to draft a "Policy on Research Ethics." Using ChatGPT and Grammarly, they:

- Generated initial policy language with references
- Checked tone and neutrality for institutional voice
- Edited according to policy writing templates

Ethical and Pedagogical Considerations

The integration of AI in academic governance raises ethical and pedagogical questions:

- **Transparency:** Should AI usage in official documents be disclosed?
- **Bias:** Can AI replicate institutional voice without replicating cultural or gender bias?
- **Dependence:** Will excessive AI use dilute human linguistic creativity?
- **Training:** Are English faculty adequately trained to use AI for governance roles?

Institutions must develop an AI-usage policy to address these concerns. English departments can lead workshops on ethical AI use, style control, and tool assessment.

AI in Multilingual Documentation and Inclusivity

Autonomous institutions serve diverse linguistic populations. AI tools like Google Translate, DeepL, and Amazon Translate can help:

- Convert governance documents into regional languages
- Translate minutes and policies for wider accessibility
- Maintain linguistic inclusivity in institutional identity

However, machine translation requires post-editing by language experts to retain meaning and nuance. The English department's bilingual and editing expertise is indispensable here.

Future Prospects: AI-Driven Institutional Identity through Language

In the near future, autonomous colleges may deploy custom AI models trained on their policy language, vision, and governance tone. These models could:

- Auto-draft policy sections based on prior language
- Analyze peer institution documents for benchmarking
- Assess linguistic gaps in communication strategies

The English department could serve as the anchor unit for this AI governance ecosystem, offering:

- Faculty development programs in AI-supported writing
- Research into AI and institutional discourse
- Student internships in policy documentation and editing

Recommendations

1. **Establish AI Writing Support Cells** under the English department in collaboration with IQAC and IT teams.
2. **Train English faculty** in AI-based document analysis and editing tools.
3. **Develop institutional AI language policies** ensuring quality, originality, and ethical compliance.
4. **Include AI writing modules** in English and communication curricula to prepare future professionals.
5. **Involve English departments in strategic committees** like NAAC, Academic Council, and Strategic Planning Cells.

Conclusion

Language precision is a pillar of effective institutional governance in autonomous colleges. AI tools, when ethically and strategically used by the English department, can elevate the standard of institutional reports, policies, and communication materials. From NAAC documentation to multilingual minutes, AI-supported English faculty ensure clarity, coherence, and credibility. As AI continues to redefine language practices, English departments have an unprecedented opportunity to lead not only in classrooms but also in boardrooms—where words shape futures.

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FINTECH REVOLUTION: UNLEASHING AI AND AUTOMATION IN MODERN FINANCE

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ABSTRACT

Change in the financial sphere is significant, with the primary force being the fast AI (Artificial Intelligence) and automation implementation. This chapter explores the role of these technologies in transforming financial services to heighten efficiency in operations, accuracy and enhanced decision-making. Banks and other financial institutions are beginning to extensively make use of AI and automation to smooth out the process workflows, limit the number of manual errors that can occur, and improve the delivery of services. Some uses include risk analysis, anti-fraud, and investment management, customer support, and regulatory compliance. predictive analytics and other AI-powered applications allow organizations to extract actionable information to use in decision-making in regard to large volumes of data, thereby allowing institutions to respond proactively to changes in the market. The chapter discusses how the use of AI in real-time analysis and automation of routine tasks is becoming highly dependent, effectively raising productivity and cost-efficiency levels. However, this digital transformation is not without challenges. Among the critical issues are the security of data, ethical considerations, privacy, and an already urgent demand in a labor force proficient in the new technologies. These issues are important to confront on the way to the complete utilization of AI and automation opportunities in finance. This chapter provides an in-depth description of the changing role of AI in finance by examining practical implementations and trend occurrences in the field. It also emphasizes on the need to balance innovation, ethics and regulation. The chapter ends with a consideration of the future trends and novelties that are going to disrupt and improve even more the financial sector, making AI and automation key players in the development of the new generation of financial services.

Keywords: *Artificial Intelligence, Automation, Financial Sector, Predictive Analytics, Risk Assessment, Fraud Detection.*

INTRODUCTION

Financial industry has been a leader in technology innovation setting new trends in response to needs of a more complex and rapid global economy. The past few years witnessed the rise of Artificial Intelligence (AI) and automation, which became a game-changer in the financial sector in terms of how financial services are provided, controlled, and streamlined. Operational efficiency has been enhanced greatly, decision-making has been transformed, and the level of risk management and customer service experiences has ascended to a new level using these advanced technologies.

In the financial sphere, AI is being used to process huge amounts of data, identify trends, and come up with predictions, thus helping make wise, strategic decisions and sound risk

management evaluations. Machine learning, which is a major subdivision of AI, builds on this ability by allowing systems to become more accurate with experience, and is thus of inestimable value in activities such as fraud detection and financial prediction. Automation, in its turn, is concerned with performing rule-based repetitive tasks with the minimum amount of human involvement. It is highly beneficial in terms of decreasing mistakes, speeding up the process and minimizing expenses. The chapter covers the extensive dimensions of the AI and automation role in the financial sphere, including their implementation, benefits, and the accompanying dilemmas.

TOP SECTORS DRIVING AI IMPLEMENTATION IN THE FINANCIAL INDUSTRY
Risk Management and Fraud Detection:

AI has really boosted risk management and fraud detection in particular, as it has become possible to analyse huge amounts of transactional data in real-time. The machine learning algorithms can spot the anomalies, anticipate the fraud, and reinforce the security measures. This enables financial organizations to be proactive in managing the possible threats, mitigating financial losses, and ensuring that they adhere to compliance regulations.

Customer Service and Experience: AI chatbots and virtual assistants have transformed customer service in the financial industry through 24/7 customer service, personalized experience, and quick response and solution to inquiries.

Investment Management and Trading: Predictive analytics, portfolio optimization, and automated trading are AI-based investment management functions that are very essential in contemporary investment management. Robo-advisors evaluate the financial goals of a person, his/her risk tolerance, and market conditions to provide him/her with an individual investment plan.

Regulatory Compliance and Reporting: AI systems are becoming a part and parcel of compliance, making it easier to maneuver through the complex legal environments. Regulatory Technology (RegTech) is an AI-based technology used to monitor financial transactions and generate reports on violations of compliance and extensive audit trails.

Credit Scoring and Loan Underwriting: The conventional ways of evaluating credit use less historical data thus limiting credit access to most people. AI in credit scoring AI-powered credit scoring models use alternative data (online behaviour, transaction history, and digital footprint) to assess creditworthiness in a more comprehensive manner.

OBSTACLES AND BARRIERS IN AI AND AUTOMATION IMPLEMENTATION IN THE FINANCIAL FIELD

The many benefits associated with AI and automation in the financial sector, there are a few significant issues that hamper their widescale adoption and application.

Data Security and Privacy Concerns: Among the most important ones is the security of sensitive customer information. Financial institutions deal with large quantities of personal and financial data, and AI systems need access to such information to be useful. Providing high-level data protection and ensuring the alignment with stringent requirements like the GDPR and CCPA is complicated and expensive.

Shortage of Skilled Professionals: One of the most remarkable obstacles to successful AI implementation is the shortage of skilled staff that can develop, implement, and support AI systems. Banks requiredata scientists and machine learning engineers, cybersecurity specialists, and robotic process automation specialists.

Integration with Legacy Systems: The problem with numerous financial organizations is that they are stuck with legacy infrastructure that is outdated and not easy to integrate with modern AI platforms. The shift to AI-based systems would require many resources and time, and it would be associated with the risk of disrupting operations.

Ethical and Regulatory Challenges: Applications of AI to subjects as delicate as credit scoring and loan approvals brings up issues of fairness, biasness and clarity. The responsibility of ensuring ethical artificial intelligence (AI), such as algorithmic responsibility and avoiding discriminative results, is paramount to keeping the general population satisfied.

Organizational Resistance to Change: The staff and stakeholder opposition are still a big obstacle. Threats of losing jobs, not understanding the effects of AI, and not knowing the benefits may cause resistance to the new technologies. To overcome these issues, a complex set of measures is needed, including strategic planning, cybersecurity and talent investment, building ethical AI governance frameworks, and powerful change management efforts that will allow responsible and smooth implementation of AI and automation in the financial sector.

UNLOCKING THE BENEFITS OF AI IN THE FINANCIAL SECTOR

Application of Artificial Intelligence (AI) in the financial arena is associated with profound benefits, especially in stimulating economic development and strengthening security systems. An overview of the most important economic and security advantages of implementing AI in finance is rephrased below:

ECONOMIC BENEFITS

Cost Reduction and Operational Efficiency: Through automation, AI decreases dependency on manual procedure in assignments data entry, compliance recordings, and customer services. With Robotic Process Automation (RPA) the institutions become more efficient in their workflow, reduce operational costs and are able to free up resources to focus on other business critical operations.

Revenue Generation and Business Growth: With the capabilities of predictive analytics, AI can assist financial institutions to identify new potential markets, improve investment approaches, and customize financial products according to the preferences of individual customers.

Accelerated Decision-Making: By using AI algorithms, large amounts of data can be processed in real time to make decisions based on data. In an industry such as investment management, AI insights will enable practitioners to make wiser and faster decisions to enhance returns and control risks better.

Scalability and Adaptability: AI helps financial institutions to grow the business effectively without a corresponding increase in the expenses. Cloud AI platforms can be easily scaled, and they do not require huge infrastructure investments.

Improved Customer Experience and Retention: The tools increase customer satisfaction and loyalty that encourage long-term retention.

SECURITY BENEFITS

Advanced Fraud Detection: AI models can detect and stop frauds in real time by analysing the pattern of the transactions. Machine learning is constantly improving and recognizes new fraud methods, providing a more flexible and effective defines than a classic system.

Strengthened Cybersecurity: AI enhances cybersecurity by continually surveying the network activity and identifying abnormal behaviours and stopping threats before they can provide serious consequences. These systems secure vulnerable financial information against hacking and unauthenticated access.

Compliance and Risk Oversight: AI will automate regulatory compliance procedures, which will involve monitoring transactions and raising irregularities in a timely report. This secures the compliance with the legal standards and provides the decreased risk of the penalty or non-observance.

Secure Identity Verification: Artificial intelligence-based biometrics, including face recognition and fingerprint scan, increase digital banking security. These procedures protect against identity theft and provide those transactions are secure as well as authorized.

Automated Threat Intelligence: AI will constantly monitor the cybersecurity environments worldwide to detect possible threats and revise defines mechanisms. This proactive strategy will help the financial institution to move fast in regard to the emerging threats and strengthen their security position.

Business Growth in the Context of AI in the Financial Sector

Artificial Intelligence (AI) has become one of the central factors of change in the financial sector, boosting business development by disrupting the classical schemes and enabling the emergence of new expansion opportunities.

Revenue Generation and Profit Optimization: To unlock new revenue streams, AI equips financial organizations with the possibility of heavy analytical lifting and predictive modelling. Being able to create tailored financial products, AI can help to create actionable insights by evaluating customer behaviours, spending habits, and other developing market trends.

Market Reach and Competitive Edge: AI can enable banks and other financial institutions to enter into the emerging markets and reach the populations that were either not banked or under-banked. AI credit scoring AI-based credit scoring expands access to financial services by using alternative data, such as online habits and digital footprints, to determine creditworthiness.

Customer Acquisition and Loyalty: AI enhances customer engagement by delivering highly personalized experiences. Machine learning and Natural Language Processing (NLP) allow the institution to initiate personalized marketing campaigns and customer loyalty programs, which strengthen the relationship with customers.

Cost Efficiency and Operational Productivity: Automation heavily reduces operational expenses by enhancing the efficiency of back-office functions, such as data processing, compliance, and customer support, because of the use of AI. Robotic Process Automation (RPA) minimizes manual error and faster workflow, which enables institutions to continue to offer quality services at reduced cost.

Innovation and Emerging Business Models: AI is an agent of change that has brought about digital-first banking, blockchain-as-a-service, and P2P financial systems. Its collaboration with other upcoming technologies, like IoT, blockchain, and cloud computing, advances the new generation of financial products and user experiences, providing access to new revenue streams and changing the face of the industry.

Strategic Agility and Informed Decision-Making: Analytics, powered by Artificial intelligence (AI), enables institutions to move with higher speeds when making strategic decisions that are data-

driven. AI can also predict the market trends, customer behavior, and new risks by analyzing the real-time information.

Brand Positioning and Customer Trust: The use of AI is an indication of technological leadership and customer-focus that enhances brand image and confidence. As consumers, we would be able to trust and support brands whose AI practices are ethical and transparent, particularly in opening up such sensitive applications as credit scoring and loan approvals.

CONCLUSION

Artificial intelligence and automation are becoming an important milestone in the development of the financial sector. AI is transforming the industry, as explained across this chapter, because it is contributing to personalization, enhanced operational efficiencies, better risk management processes, and a redefined customer engagement process. Such tools as predictive analytics, algorithmic trading, and RPA are not only driving profitability up but also driving the creation of new business models and competition strategies. Going forward, the success of AI in the financial sector will depend on the capacity of institutions to balance between innovation and ethical, regulatory as well as operational questions. Financial institutions that harness the full power of AI and tackle the challenges that come with it will have the key to sustainable growth, create the best customer value, and develop resilient and future-ready financial ecosystems. As the AI keeps developing, it will become a crucial and revolutionary part of the new era of finance.

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DETERMINANTS OF AI ADOPTION IN E-COMMERCE AMONG SMALL AND MEDIUM-SIZED ENTERPRISES (SMES)

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Introduction

In order to boost sales and services and improve consumer happiness, many businesses aim to implement e-commerce. If effective e-commerce strategies and technologies are used, e-commerce can greatly increase SMEs' revenues and profitability (Abbas et al., 2023; Ojha et al., 2023). However, the degree of a company's dedication to and reliance on smart technologies and tools that help them provide the greatest technical services to their clients may have an impact on how well they use such electronic platforms (Mishra et al., 2023). In order to boost sales and services and improve consumer happiness, many businesses aim to implement e-commerce. In order to speed up business and give information that helps make appropriate and effective decisions in real time, artificial intelligence (AI) tools assist in analysing and exploiting the huge data that is available to many firms and organisations (Kushwaha et al., 2021; Sestino & De Mauro, 2022). Artificial intelligence (AI) tools evaluate consumer data to produce useful insights and support strategic decision-making across a variety of data sources (Verma et al., 2021). Numerous scientific research have examined how AI can be used in e-commerce to improve customer service, speed up sales, and gather data (Xu & Ruan, 2023; Li et al., 2023).

Research on the importance of using and improving AI technologies in maintaining e-commerce business performance and bolstering the contribution of entrepreneurship to SMEs' success is, nevertheless, lacking. Therefore, in order to encourage entrepreneurship and increase and activate the role of these businesses in the advancement and development of the nation's economies, this study aims to explore and examine the factors influencing the adoption of AI in e-commerce in SMEs.

According to North et al. (2020), because of their high employment and commercial value, SMEs have a significant and impactful role in the high economy. Nevertheless, these businesses have numerous obstacles when it comes to implementing new technologies and staying up to date with advancements in technology (Barata et al., 2023; Cheng et al., 2024). Understanding the elements that influence the adoption of AI in e-commerce can therefore lead to a variety of solutions that enable the adoption of AI tools and raise the market value of their goods and services. Furthermore, SMEs struggle to make decisions that enhance their business performance because they don't fully use data (Sharma et al., 2022). As a result, this study advances our understanding of the challenges and offers solutions for SMEs looking to implement AI in e-commerce.

This study intends to cover a number of crucial factors that propel and impact the adoption of artificial intelligence (AI) in e-commerce by small and medium-sized businesses (SMEs) in light of the aforementioned debate. To direct the study and offer an organised method for comprehending the different elements involved, the following important research questions have been developed.

1. What aspects affect SMEs' use of AI in e-commerce?
2. How much do entrepreneurial spirit and dynamic capacities play a role in SMEs' use of AI in e-commerce?

3. How much does the use of AI in SMEs' e-commerce depend on a customer-centric system?
4. To what degree does an entrepreneurial mindset influence SMEs' adoption of AI in e-commerce?
5. How much of an influence does the use of AI in e-commerce have on the operations of SMEs?

Literature review

In order to process data without the need for human intervention and provide accurate and highly efficient information, artificial intelligence is essential (Cubric & Li, 2024). Customers will be more satisfied with the website as a result of meeting their requirements and preferences in addition to saving time. In order to ensure seamless and easy operations, this involves providing a variety of e-commerce features, such as product promotion, payments, and delivery. As a result, businesses may be able to learn important things about the market, consumer behaviour, and company performance over time (Qi et al., 2023). Artificial intelligence (AI) tools can offer answers and recommendations based on customers' requirements and preferences by examining their product clicks (Sharma et al., 2021).

Additionally, it can help with answering consumer questions via chat platforms, improving the business's capacity to react quickly (Gupta et al., 2024). Pallathadka et al. (2023) claim that artificial intelligence (AI) in e-commerce aids in boosting sales, forecasting sales, achieving a greater level of safety, thwarting fraud, managing business, and managing essential services on the website. AI is capable of carrying out human tasks that call for intelligence in its operations, such translating languages or recognising people visually. In order to maximise value and competitive advantage, SMEs must use AI technologies, which include lowering human mistake rates, analysing client data, and offering incredibly effective services.

Theoretical background, conceptual model, and development of hypothesis

In order to improve the function of AI in facilitating e-commerce and understand the entrepreneurial role in offering more effective goods and services, this study will rely on the idea of dynamic capacities (Teece, 2010). One of the ideas frequently employed in research examining how businesses get a competitive edge by concentrating on the impact of changes in the external environment is dynamic capabilities (Yąnez-Vald´es & Guerrero, 2024). The ability of the business to seize opportunities and reconfigure and utilise both internal and external resources in quickly evolving work settings is sometimes referred to as dynamic capabilities (Gao et al., 2024; Karimi & Walter, 2015; Wang et al., 2023).

Aloulou's (2023) study used a sequential mediation paradigm incorporating innovation capability and business resilience capability to examine the relationship between entrepreneurial orientation, attitudinal variables, and firm performance. 125 SMEs in Chennai participated in a survey that was used to collect data. The study's findings demonstrate that the behavioural aspect of entrepreneurial attitude improves business performance. The study also shows that aspects of entrepreneurial orientation have a big impact on innovative capability. Furthermore, the ability to innovate has a favourable impact on business performance. Daniel and Wilson (2003) conducted another study that looked into the dynamic capabilities that support and grow electronic company while finding several techniques that create useful capabilities to boost business success. According to the study's findings, businesses must identify and implement cutting-edge services that enhance their operations and how they engage and communicate with stakeholders.

Additionally, they emphasised how crucial it is to operate as a single, cohesive team in order to attain a high level of synergy and deliver reliable service.

Methodology

Questionnaires are used in the study's quantitative methodology to gather information from SMEs' officials. In order to improve the study's findings, this goal is to investigate elements associated with AI adoption in the context of e-commerce while taking the pertinent literature into account. The purpose of the questionnaire is to determine variables pertaining to the degree of AI adoption at the moment, as well as perceived advantages and difficulties. Finding the elements affecting AI adoption in the context of e-commerce is also important. Chennai-based e-commerce workers. Regarding their principal occupations, store owners and supervisors were the focus of the sample. To encourage participation in the study, the owners of electronic stores were contacted via email, WhatsApp, and phone calls in addition to in-person visits to SMEs.

A digital survey was created and disseminated to SMEs' authorities and decision-makers involved in e-commerce. The questionnaire covered a wide range of topics necessary for the study, such as the adoption of AI-enhanced e-commerce, dynamic capabilities, customer-oriented management systems, and entrepreneurial attitude. This helped gather comprehensive and precise data that supported the study's goal by testing hypotheses and producing findings. The purpose of the questionnaire was to gather more information about the perceived advantages, difficulties, and current degree of AI adoption. Furthermore, the elements impacting AI adoption in the context of e-commerce.

Since the results of the questionnaire help to produce precise and effective quantitative results quickly with a high sample size, the quantitative technique is deemed appropriate and beneficial for this study. Furthermore, questionnaires offer a uniform and comparable approach to gathering information from research participants, enabling consistent findings that are simple to compare and evaluate.

Data analysis

To evaluate the information gathered from the surveys and test the theories, structural equation modelling was used. According to Benitez et al. (2020), SEM is regarded as one of the widely used statistical analysis methods that produces more accurate results than more straightforward methods like linear regression. SEM is a method that tests several measurable variables, combining elements of multiple regression and factor analysis.

Major Findings:

The data indicates a variety of job fields. Retail trade (33.5%) and agriculture (4.1%) are the most important, followed by "Other" categories (62.1%), which may encompass a variety of unidentified businesses. Marketing has the highest representation of any functional area (38.3%), followed by "Other" (25.7%) and Operations and Sales (15.3%). This suggests that these organisations place a high priority on marketing initiatives. All latent constructs' CR values, which ranged from 0.812 (EO) to 0.977 (DYC), were determined to be higher than the recommended value of 0.50. As all of the indices fall within their recommended range, such as CMIN/DF=2.747; GFI=0.919; AGFI =0.887, RMSEA=0.038; NFI =0.945; and CFI =0.951, the fit indices sufficiently support the whole measurement model's goodness of fit (Anderson & Gerbing, 1988; Bagozzi & Yi, 1988; Byrne, 2013). (Bagozzi & Yi, 1988; Anderson & Gerbing, 1988). As recommended by Fornell and Larcker (1981); Hair et al. (2010), an examination of AVE values indicates that CCMS,

BDA, BP, and DYC were able to have a value not less than 0.50. Nevertheless, EO's AVE value was 0.47, below the cutoff point of 0.50.

As a result, EO1 and EO6 were eliminated from the updated measurement model after a thorough examination of the standardised regression weight of the EO scale items revealed that they had factor loading values below 0.50. Following adjustment, EO's AVE value was 0.52, falling within the suggested range (Hair et al., 2010). Fornell & Larcker, 1981; Hair et al., 2010), as seen in Table 5. The squared root of AVE computed for each latent construct was found to be higher than the intercorrelation values with other relevant components, hence achieving the discriminant validity of the entire model in the current investigation.

<u>Discussion</u>

The purpose of this study was to look into the variables affecting SMEs' adoption of AI in e-commerce. The conceptual model, developed research hypotheses, and empirical data constitute the framework for the study's methodology and conclusions. The study's main conclusion is that SMEs' adoption of AI in e-commerce is significantly predicted by dynamic capabilities and EO. A significant R^2 value of 0.56, which shows that these two factors account for a significant portion of the variance in AI adoption, supports this. Additionally, the study shows a substantial correlation between improved business performance among SMEs and the use of AI in e-commerce.

An R^2 value of 0.65 provides numerical support for this link, indicating that the degree to which these businesses successfully implement AI technologies accounts for a sizable amount of the variation in business performance. The study emphasises how important EO and dynamic skills are in propelling AI adoption in SMEs' e-commerce industries, which may significantly boost company performance. This emphasises how crucial it is for SMEs in the e-commerce industry to cultivate these skills and mindsets in order to successfully use AI technology for business expansion and prosperity.

"The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" is the definition of dynamic capabilities (Teece et al., 2007). This idea is essential to comprehending how businesses adjust to technological advancements such as artificial intelligence. In order to increase organisational flexibility and innovate to boost corporate performance and competitiveness, Teece, Peteraf, and Leih (2010) stress the significance of dynamic skills.

As Drydakis (2022) points out, the concept of dynamic capabilities logically corresponds with the use of AI in corporate operations. Businesses can analyse vast amounts of data more effectively thanks to AI, which improves their capacity to spot new possibilities and quickly reallocate resources. The two main components of dynamic capabilities—risk reduction and decision-making enhancement—are especially aided by this capacity. The adoption of e-commerce is significantly boosted by AI and an inventive culture. Furthermore, using AI, Fonseka et al. (2022) investigated how management perceived the effect of e-commerce adoption on SMEs' company performance. The study's findings suggest using AI to automate tasks that might be difficult for staff to handle efficiently and implementing e-commerce as a marketing tactic. Additionally, by incorporating and applying AI into their business processes, digital platforms help SMEs perform better and increase commercial opportunities (Wei & Pardo, 2022). AI capabilities and technologies have a favourable impact on companies' business performance and this leads to making educated decisions based on AI (Li et al., 2024).

The tendency to recognise, assess, and seize opportunities is a hallmark of entrepreneurial orientation. This notion, key to the works of (Kusa et al., 2024), and Fernandes et al. (2022), is primarily about keeping a proactive and alert position in the search of possibilities, combined with the willingness to embrace the risks involved. Upadhyay et al. (2023) and Upadhyay et al. (2022) further expand on this by linking EO to a company's readiness to develop essential competencies that enable the identification and capitalization of hidden opportunities. As highlighted by Avlonitis and Salavou (2007) and Fernandes et al. (2022), seeking opportunities is a critical competency of EO. In order to recognise and take advantage of emerging technologies like artificial intelligence (AI) in e-commerce, businesses with a strong EO are skilled at identifying both obvious and hidden opportunities in their market. In order to effectively integrate AI into business processes and customer engagement strategies, it is imperative that businesses adapt to changing consumer demands and competitor strategies.

Practical implications

SMEs ought to promote an entrepreneurial environment that appreciates creativity, initiative, and a readiness to embrace risks. This approach will not only promote the integration of AI but also foster a mindset that is receptive to investigating new technologies and business strategies. Workshops, leadership development, and reward systems can be created to encourage and strengthen these entrepreneurial principles. The significant link between AI implementation and business outcomes indicates that SMEs ought to purposefully integrate AI into their business frameworks. This requires pinpointing aspects where AI can provide the greatest benefits, like customer support, data evaluation, and operational effectiveness, and investing in appropriate AI solutions.

Considering the influence of AI on business outcomes, SMEs ought to allocate resources towards training their employees in pertinent AI technologies and data analytics. This not only equips the workforce to effectively engage with new technologies but also aids in maximizing AI's full capabilities. Adopting new technologies carries risks, so SMEs must create strong risk assessment and management strategies. This involves assessing the financial, operational, and security risks linked to AI technologies and applying suitable mitigation measures.

Although the research did not identify a substantial impact from customer-oriented systems, professionals should still acknowledge the possibility of AI to improve customer interactions. This includes utilizing AI for tailored marketing, enhanced customer support, and deeper insight into customer preferences and actions. SMEs ought to consider AI adoption not merely as a technological enhancement but as a strategic initiative for securing a competitive advantage. This encompasses leveraging AI to enhance product/service offerings, optimize operations, and develop new customer value propositions. Ongoing assessment and evaluation of AI applications are essential. This aids in evaluating the influence of AI on business outcomes and in implementing required modifications to strategies and operations

Limitations and future research directions

The research focuses on examining how dynamic capabilities (the capacity to adjust and reorganize business strategies and operations) and EO (a company's strategic stance marked by innovativeness, proactiveness, and risk-taking) affect the implementation of AI in SMEs. Notably, it also takes into account customer-centric systems, which usually entail using technology to gain a deeper insight into and meet customer requirements.

The research focuses solely on the implementation of AI in small and medium-sized enterprises. This emphasis offers important perspectives on how SMEs, which typically possess varying resources and limitations in contrast to larger firms, adopt and incorporate AI into their processes. Nonetheless, the results may not be completely applicable to larger firms or other industries that may possess unique dynamics and obstacles in AI implementation.

The outcomes may be affected by the particular economic, cultural, and technological environment of chennai, which could vary considerably from other areas. This geographical emphasis offers significant insights into AI implementation in this particular context, yet it may restrict the applicability of the results to different areas.

A noteworthy result of the research is that it did not uncover substantial evidence for the importance of customer-oriented systems in AI adoption. This may imply that, for SMEs in chennai, additional elements (such as dynamic capabilities and entrepreneurial mindset) play a more vital role in AI adoption, or it might show that customer-centric strategies are not being successfully merged with AI technologies in these SMEs.

The methodology of the study failed to consider possible mediation or moderation influences. Mediation factors may clarify the connection between primary variables (e.g., how entrepreneurial orientation results in AI adoption), while moderation factors could affect the intensity or nature of these connections (e.g., how specific industry traits might enhance or diminish the effect of dynamic capabilities on AI adoption). The lack of these factors could restrict the comprehension of the intricate relations among the examined variables.

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A STUDY ON CONSUMER BUYING BEHAVIOUR TOWARDS HOME APPLIANCES IN COIMBATORE

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Abstract

The India Consumer Appliance Market grows from USD 48.15 million in 2024 to USD 81.13 million by 2032, at a 6.74 % CAGR, highlighting steady expansion. The largest segment in this market is Major Appliances, with a market volume of US$ 42.17 bn in 2025. In terms of per household revenues, in India is expected to generate US$217.04 in 2025. In 2026, the Household Appliances market is anticipated to exhibit a volume growth of 3.31%. By 2030, the market volume is expected to reach 522.73m pieces. Objectives of the study are (i) to present the socio economic factors of the respondents, (ii) to find the variables and to present the level of consumer buying behaviour of home appliances and (iii) to offer suggestion to the buyers and sellers. 140 questionnaire are taken for this study, adopted convenient sampling method the same time the respondents are ensured that all they are having all electronic home appliances products while distributing the questionnaire. The study concluded that the consumers buying behaviour changing time to time and according to their income and other socio economic factors, it is the duty of the manufacturer to conduct study periodically to understand the consumer's requirements to increase their sales and business development.

Keywords : Home appliances, consumer buying behaviour, place of purchase, mode of purchase and frequent of purchase.

Introduction

The India Consumer Appliance Market grows from USD 48.15 million in 2024 to USD 81.13 million by 2032, at a 6.74 % CAGR, highlighting steady expansion. The largest segment in this market is Major Appliances, with a market volume of US$ 42.17 bn in 2025. In terms of per household revenues, in India is expected to generate US$217.04 in 2025. In 2026, the Household Appliances market is anticipated to exhibit a volume growth of 3.31%. By 2030, the market volume is expected to reach 522.73m pieces. It is projected to grow annually by 7.33% (CAGR 2025-2030). The consumer buying behaviour changing according to their income, social status, life style and family type, this study focusing the consumer behaviour of home appliance. Strong Economic Growth Boosts Consumer Spending, the India Consumer Appliance Market benefits from sustained GDP expansion and rising household income. Consumers allocate a greater share of budgets to modern appliances. The growth is driven by increasing disposable income, urbanization, technological advancements, and the rising trend of smart and energy-efficient appliances, supported by government initiatives.

Purchasing behavior is a potent tool in the hands of the marketers to understand the consumers' needs and preferences and design the products accordingly. Studying consumer behavior helps in creating new customers as products are manufactured only after knowing recent trends further it helps in retention of consumers too as necessary and timely changes are

incorporated in products and services as per the customer's tastes and preferences. The Study also helps in developing relevant marketing programs to capture consumers. Over all the study of consumer behavior is an essential prerequisite before launching any product.

Statement of the problem

The rapid growth of the home appliance market in India, driven by rising incomes, urbanization, and changing lifestyles, has significantly influenced consumer buying behaviour. In Coimbatore, a prominent industrial and residential hub of Tamil Nadu, consumers are exposed to a wide range of home appliances across multiple brands and price segments. Despite the increasing demand, consumer preferences are shaped by diverse factors such as brand perception, price sensitivity, product quality, after-sales service, and promotional strategies.

However, marketers face challenges in understanding the specific needs and buying motives of consumers in this region, as there is no uniform pattern of behaviour. The lack of updated, localized insights makes it difficult for manufacturers and retailers to tailor their offerings effectively. Therefore, a focused study on the buying behaviour of consumers towards home appliances in Coimbatore is essential to identify key influencing factors, purchasing patterns, and brand preferences. This research will help bridge the knowledge gap and support strategic decision-making for businesses operating in this competitive market.

Objectives of the study

1. To present the socio economic factors of the respondents.
2. To find the variables and to present the level of consumer buying behaviour of home appliances.
3. To offer suggestion to the buyers and sellers.

Sampling design

The study conducted in Coimbatore, the researcher adopted convenient sampling method for this study. Prepared structured questionnaire and distributed to 150 peoples in Coimbatore and collected back from them by 140. All 140 questionnaire are taken for this study, adopted convenient sampling method the same time the respondents are ensured that all they are having all electronic home appliances products while distributing the questionnaire.

Tools and techniques

The researcher adopted percentage analysis to present the socio economic factors. The tables shows the factors, number of respondents and percentage of respondents in respective tables.

Findings

The following are the major findings of the study.
1. Majority (40.00%) of the respondents are between 26 years and 35 years old.
2. Majority (60.00%) of the respondents are male.
3. Majority (32.14%) of the respondents are professionals.
4. Majority (34.29%) of the respondents are under graduates.
5. Majority (39.29%) respondents are purchasing home appliances at multi brand stores.
6. Majority (42.86%) of the respondents are getting loan to buying home appliances.
7. Majority (43.57%) of the respondents are buying whenever need for products.

Suggestions

1. Segment Consumers Demographically should be Classify respondents based on age, income, education, and occupation to understand varied preferences and behaviors.
2. Include Both Urban and Semi-Urban Areas may cover different parts of Coimbatore district to get a broader view of consumer choices across geographic and economic backgrounds.
3. Identify Key Decision-Making Factors to explore the importance of price, brand, energy efficiency, features, and warranty in the consumer decision process.
4. Study the Role of Digital Influence to assess how online reviews, social media, and e-commerce platforms impact purchase decisions.
5. Compare Online vs. Offline Buying Preferences of the consumers to understand whether consumers prefer online shopping for convenience or offline purchases for physical inspection.
6. Evaluate the Impact of Seasonal Offers and Promotions of the home appliances to analyze how discounts during festivals or sales events influence buying behavior.
7. Include Post-Purchase Experience of the consumers to examine customer satisfaction with delivery, installation, and after-sales service.
8. Suggest Strategies for Retailers and Marketers based on findings, recommend ways to improve product positioning, customer engagement, and service delivery in Coimbatore.

Conclusion

The researcher conducted the study in Coimbatore to study the consumer buying behaviour, the study conducted with 140 samples in Coimbatore. The study on consumer buying behaviour towards home appliances in Coimbatore reveals valuable insights into the buying mode, buying place and frequent of purchase of home appliances in the region. The suggestions presented by the researcher to understand consumers behaviour while buying home appliances. The suggestions may helpful to the marketers, manufacturers and distributors to development their business, the same time as a consumers which factors influence to buy the home appliances are presented. The study concluded that the consumers buying behaviour changing time to time and according to their income and other socio economic factors, it is the duty of the manufacturer to conduct study periodically to understand the consumer's requirements to increase their sales and business development.

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AI IN SOIL HEALTH ANALYSIS:ADVANCING SUSTAINABLE

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Abstract

The integration of Artificial Intelligence (AI) in soil data analysis is transforming agriculture by making it more intelligent, efficient, and sustainable. AI enhances the processes of soil data collection, processing, and interpretation, empowering farmers with informed decision-making capabilities. Major advancements include cutting-edge sensors, sophisticated machine learning algorithms, and advanced soil health assessment techniques. Additionally, AI facilitates precision agriculture through automated machinery and real-time decision support systems. Collaborative efforts enabled by data sharing and emerging technologies like edge computing and blockchain are further driving innovation. These advancements collectively aim to improve agricultural productivity, promote sustainability, and ensure global food security.

Keywords: Artificial Intelligence (AI), Soil Health Analysis, Deep Learning

Introduction

AI is a technology that aids in the comprehension and enhancement of soil health. Data about soil properties including moisture, nutrients, and pH levels are gathered using instruments like sensors and satellites. Farmers can use this knowledge to make better agricultural decisions. Through the analysis of soil data, AI can forecast future issues and recommend the appropriate amount of fertilizer and water for plants. In order to assist farmers take action before things worsen, it can also detect early indicators of problems like soil erosion. All things considered, AI improves agricultural intelligence, enhancing crop yields while preserving the environment.

Key Soil Health Parameters

- **Nutrient Levels:**
  Soil contains essential macronutrients such as Nitrogen (N), Phosphorus (P), and Potassium (K) that are crucial for optimal crop growth. Along with these, micronutrients like zinc, iron, and magnesium, though required in smaller quantities, are also important for plant development. Monitoring these nutrient levels ensures that plants receive the right balance of elements for optimal growth and productivity.

- **Soil pH and Salinity:**
  The pH of soil indicates its acidity or alkalinity, which directly influences nutrient availability and plant growth. Soils that are too acidic or too alkaline can limit nutrient uptake, harming plant health. Salinity, or the concentration of salts in the soil, is another critical factor. High salinity levels can impede water absorption in plants, leading to dehydration and reduced crop yields.

- **Moisture Content:**
  Soil moisture refers to the amount of water available to plant roots. Maintaining proper moisture levels is essential for plant health since both dryness and excess water can cause stress. Effective irrigation and moisture management are key to optimizing crop yields and conserving water.

- **Organic Matter and Microbial Activity:**
  Organic matter, including decomposed plant and animal material, significantly enhances soil fertility by improving its ability to retain water and nutrients. Soil microbes, such as bacteria and fungi, decompose organic matter, releasing vital nutrients for plant growth. Healthy microbial activity is a crucial indicator of soil vitality and long-term productivity.

AI Techniques for Soil Health

- **Machine Learning:**
  AI uses machine learning to analyze extensive datasets related to soil conditions, enabling predictions on soil health parameters such as nutrient levels and moisture content. By recognizing patterns from historical data, machine learning models assist farmers in anticipating future soil needs or challenges.

- **Computer Vision:**
  AI-powered computer vision analyzes soil and crop images, often captured by drones or cameras, to evaluate factors like soil color, texture, and plant health. These visual assessments help identify early signs of nutrient deficiencies or diseases, allowing farmers to take timely action.

- **IoT Sensors:**
  IoT (Internet of Things) sensors are embedded in the soil to monitor real-time conditions such as pH, temperature, and moisture. These sensors provide continuous data, which AI systems analyze to offer actionable insights, guiding farmers on irrigation and fertilization adjustments.

- **Remote Sensing:**
  Remote sensing technology, using satellite or aerial imagery, allows farmers to monitor large-scale agricultural areas. AI interprets these images to assess soil conditions and crop health, enabling efficient land management and early detection of issues without direct physical sampling.

- **Predictive Analytics:**
  AI employs predictive analytics to forecast potential soil health problems, such as nutrient depletion or erosion. By integrating data from soil conditions, weather patterns, and historical trends, AI helps farmers take proactive measures to address issues before they arise, improving long-term soil management.

- **Big Data Analytics:**
  AI processes large datasets, including data from sensors, satellite images, and soil samples, to detect trends and patterns that might not be immediately obvious. This analysis helps farmers make informed decisions, enhancing their ability to manage land and crops efficiently.

- **Edge Computing:**
  Edge computing processes soil data on devices like drones or portable sensors without relying on constant internet connectivity. This allows for instant analysis and feedback, especially in remote areas with limited connectivity, ensuring that AI-powered insights are available in real-time.

- **Deep Learning:**
  Deep learning, a subset of AI, focuses on learning from vast datasets to identify intricate patterns. In soil health, deep learning helps track soil changes over time and offers insights into how soil responds to factors like weather conditions or farming practices.

Applications of AI in Soil Health Analysis

- **Real-Time Soil Monitoring:**
  AI-powered IoT devices and sensors enable continuous monitoring of soil parameters such as moisture, temperature, pH, and nutrient levels. Real-time data allows farmers to quickly respond to any changes, optimizing conditions for crop growth.

- **Nutrient Management:**
  AI analyzes soil data to detect nutrient deficiencies or excesses, then recommends targeted fertilizer applications. This improves soil health, boosts crop yields, and reduces unnecessary fertilizer use, cutting costs for farmers.

- **Crop Recommendation Systems:**
  AI systems analyze soil data, climate conditions, and other factors to recommend the best crops for specific regions. By aligning crop choices with soil health and nutrient availability, AI helps optimize yields and farm profitability.

- **Erosion and Degradation Detection:**
  AI, combined with satellite imagery and remote sensing technologies, helps farmers detect signs of soil erosion, salinity, or other forms of degradation. Early detection allows for timely intervention, preventing long-term damage.

- **Precision Agriculture:**
  AI integrates data from various sources, including drones, sensors, and soil tests, to fine-tune farming practices. This optimization of irrigation, planting, and fertilization results in more efficient resource use, improving productivity and sustainability.

- **Pest and Disease Prediction:**
  AI uses soil data alongside weather patterns and historical pest information to forecast pest infestations or disease outbreaks. This enables farmers to take preventative measures, reducing reliance on pesticides and minimizing crop losses.

- **Large-Scale Soil Mapping:**
  AI analyzes satellite and aerial data to create detailed soil maps, helping farmers understand the variation in soil health across large areas. These maps assist in land management and resource optimization.

- **Sustainable Farming Practices:**
  AI uses both historical and current soil data to recommend practices that enhance long-term soil health, such as crop rotation, cover cropping, and reduced tillage. These methods help maintain soil fertility and reduce environmental impact.

- **Carbon Sequestration Analysis:**
  AI models estimate soil's carbon storage capacity, guiding farmers on practices that enhance its ability to retain carbon. This contributes to climate change mitigation and supports sustainable agriculture.

Monitoring Erosion and Damage to Check Soil Health
- **Monitoring Erosion in Real-Time:**
  AI, using satellite and drone imagery, tracks land cover changes and identifies areas at risk of erosion. These technologies provide early warnings, helping farmers address erosion before it leads to significant degradation.
- **Predicting Erosion and Degradation Risks:**
  Machine learning processes weather, soil, and topography data to predict areas most prone to erosion. By combining this with climate forecasts, AI assists farmers in preparing for extreme weather events and mitigating erosion impacts.
- **Identifying Signs of Degradation:**
  AI analyzes soil properties and plant health indicators to detect early signs of degradation. It can assess soil texture and organic content to identify areas where soil health is declining, enabling intervention before irreversible damage occurs.
- **Mapping Risk Zones:**
  AI and geospatial technologies create detailed risk maps, highlighting areas most susceptible to erosion or degradation. These maps help farmers prioritize interventions and better manage their land.
- **Recommending Mitigation Strategies:**
  AI provides actionable recommendations, such as contour farming, terracing, or planting cover crops, to prevent erosion and restore degraded soil. These strategies help farmers preserve soil health and improve long-term productivity.

Benefits of AI in Soil Health Analysis
- **Accuracy:**
  AI enhances the precision of soil health analysis by processing vast datasets and identifying patterns that human analysis might miss. This leads to more accurate decisions regarding soil management and crop care.
- **Efficiency:**
  AI enables faster analysis compared to traditional methods, allowing farmers to respond quickly to changes in soil health. Continuous monitoring ensures that soil conditions are consistently optimized.
- **Cost-Effectiveness:**
  AI reduces the need for expensive soil testing and lab work. With AI-powered sensors, farmers can monitor soil conditions regularly at a fraction of the cost, making it accessible for both small and large farms.
- **Sustainability:**
  AI promotes sustainable farming practices by optimizing resource use, reducing waste, and enhancing soil health. These practices help ensure the long-term fertility of the soil, safeguarding the environment for future generations.

Challenges and Limitations of AI in Soil Health Analysis

- **Data Challenges:**

  Inaccurate or incomplete data can affect the reliability of AI predictions. Poorly calibrated sensors or faulty data collection methods may lead to misleading results, impacting farming decisions.

- **High Implementation Costs:**

  Setting up AI systems, including sensors, drones, and software, requires substantial initial investment. This can pose a barrier for smaller farms or those in developing regions with limited resources.

- **Scalability:**

  AI solutions may struggle to scale across diverse farms with different soil types and climates. Developing adaptable AI models that work effectively across varied agricultural settings can be complex.

- **Interpretability:**

  Farmers may find AI models difficult to understand, which can lead to hesitation in fully adopting AI-based recommendations. Simplifying the technology and making it more user-friendly will be essential for wider acceptance in agriculture.

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DRIVING FINANCIAL INCLUSION: THE ROLE OF FINTECH IN SHAPING CONSUMER BEHAVIOR IN A CASHLESS ECONOMY

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Abstract

Movement towards a cashless economy is essentially remodelling the global finance scene and fintech services are playing a key role in moving towards a cashless economy. By implementing novel ways of solving problems though technological means, fintech has changed the existing financial systems by providing open, convenient, and transparent solutions that fit the needs of consumers and businesses. Some of the forms of technologies, which have become fundamental towards the redefining of how individuals interact with money, engage in transactions, and the decision-making capabilities are mobile banking, digital wallet system and peer to peer lending platform. Through its digital innovations the fintech has created vast opportunities to provide financial services especially to the population of emerging economies and underserved communities who were not covered by the traditional financial systems. This chapter will discuss how multifaceted the use of the fintech has affected the decision-making and behaviour of consumers. Implementation of such tools as mobile banking and digital wallets has allowed consumers to experience smooth transactions, track their streams of income in real-time and improve their budget planning skills, respectively. The fact that people can make more informed decisions has also been enabled by Fintech capability of offering financial solutions by utilizing highly progressive technologies like artificial intelligence (AI) and machine learning. An example here is that robo-advisors provide individual investment advice based on the level of user-entered risk and the digital lending models evaluate credit worthiness based on alternative data to offer credit to those that may have no formal financial data. Financial literacy and its awareness have not only been enhanced by these developments, but have also given consumers more confidence on how they handle their finance well being.

Keywords: Fintech Services, Cashless Economy, Financial Inclusion, Consumer Decision-Making, Blockchain Technology, Economic Participation

INTRODUCTION

The world of finance is changing more than ever and technology and the changing lifestyle of consumers is driving the world in the direction of becoming a cashless economy. The cashless economy is considered to be a kind of a financial system in which the conduct of transactions is done in electronic form thus cutting down on a substantial part led by use in the physical money or eliminating it completely. It is not a mere technological change but major socio-economic trend that can influence individual, business or governments on several levels. It is transforming the

conventional monetary grid that is redefining the manner in which economic relationships are being carried out and it is also presenting the chance to build a more open and efficient monetary order that simple people can enjoy. The heart of this wholesome transformation is the financial technology or fintech a fast-emerging frontier that has disrupted the production, supply, and consumption of financial services. The fintech advances in spheres of mobile banking apps, digital wallets, P2P lending applications, blockchain-related solutions, etc., are breaking the settled mechanisms inside the financial sphere. These technologies are providing smoother, quick, and safe alternatives to conventional financial services thus making them more comfortable and changing the interaction of people with money. Fintech is causing a worldwide change in consumer behaviour and financial decision making by using digital technology and sophisticated analytics. It allows people to get banking, loan and payment options on their fingertips, irrespective of where they live in the world, and encourages increased financial inclusion in developed as well as new economies. Millions of people all over the world are not part of formal financial systems because of different barriers: lack of proper infrastructure, high costs of transaction, and low financial literacy. Such difficulties especially arise in the case of emerging economies where people in the rural setting or in remote locations may not have access to physical banks and financial institutions. Fintech has filled these gaps with its cheap user friendly innovative solution that has made financial services affordable to many hitherto disadvantaged groups of people. As an example, mobile money platforms have now allowed the unbanked people to make transactions, save, and pay their bills with their smartphone and provided a gateway to the formal financial system. Online lending platforms also aid in the democratization of credit as lending institutions can evaluate creditworthiness based on alternative data, meaning that third-party lending opens financial options to customers and small businesses that were not credit-worthy by more-traditional standards. In terms of the consumer decision making, a new paradigm of choice, convenience and transparency has been brought about by fintech. On-demand financial services through digital wallets and mobile payment systems including Google Pay and Paytm, give real-time access to financial information so that the consumer can better monitor transactions, spending patterns and make financial decisions. Budgeting software and personal financial management applications also equip people with greater control over their spending as the software processed raw data concerning money flows, income, and savings to give recommendations that make people use money responsibly.

FINTECH SERVICES: INNOVATIONS AND APPLICATIONS

The Fintech services provide a large support base of innovative offerings to boost the process and availability of money through the use of technology. These services have transformed the business of normal banking and finance through bringing new products and platform that satisfy the various needs of consumers. An example is mobile banking which has become a pillar of fintech as it allows individuals to transact their financial activities using their smartphones. Mobile-based deposits, instant fund transfers and payments on bills have offered unprecedented convenience to the users. Easy money systems such as PayPal, Google Pay, and Apple Pay, which foster an easy cashless transfer of money, make it easier to adopt as people are no longer reliant on receiving cash. Digital payment systems are promoting efficiency in financial tasks. The introduction of digital wallets and non-contact forms of payment is a revolutionary development in the sphere of fintech. Apps like Alipay or Paytm have reinvented the ways people store money and spend it by giving them an opportunity to connect their bank accounts and credit cards to have fast and secure

payments. These transactions have also been boosted by the implementation of Near Field Communication (NFC) technology that is used to facilitate relatively quicker, secure, and convenient payment experiences. In the same line, peer-to-peer (P2P) lending systems have transformed the lending service by establishing a direct relationship between borrowers and lenders and not using the services of financial intermediaries.

The Blockchain technology has also been featured prominently in the fintech advancements especially with its uses in the cryptocurrencies including Bitcoin and Ethereum. A decentralized and transparent structure facilitates the security and efficiency of financial transactions, by offering blockchain. Other than in cryptocurrencies, the technology has brought solutions such as smart contracts, secure payment systems, and identity verification services, which help in solving critical issues of transparency and security in financial systems. Another noteworthy branch in fintech is insurance technology or insurtech, and it is being used to simplify the procedures involved in the insurance sector. By using AI-based risk analysis, automated underwriting based on policies and utilization of telematics in developing insurance policies, companies are becoming more efficient in what they offer, and customers are getting more happy than ever. Such technologies enable insurers to offer better pricing and response time toward addressing their claims thus, creating a harmonious experience towards the consumer. Fintech services are also changing the financial environments, creating solutions that benefit accessibility, privacy, and effectiveness in the fields of banking, lending, payments, wealth management, and insurance.

IMPACT OF FINTECH ON CONSUMER DECISION-MAKING

The innovations of the fintech have transformed the process of financial decision-making by consumers, followed by emerging patterns of convenience, transparency, and empowerment. Fintech services have revolutionized the process of decision-making process as they have simply facilitated people to make smarter and more effective financial decisions thanks to digital platforms and the use of sophisticated analytics. Budgeting apps and financial dashboards are tools that enable consumers to keep track of their spending habits, credit ratings, and investment performance very easily. Such quick access assures users with the information that will be used to make wiser financial choices and decreasing their dependency on conventional mediators to offer such advice. The better the access to information, the more personalized and financial services through fintech based on big data and machine learning will be used. As an example, robo-advisors can analyse the risk profile and investment level of a person and suggest personalised plans, such that financial management fits specificities. Lending platforms analyze alternative data to determine the creditworthiness and offer loans according to the specifications of the borrowers, i.e. their financial capacities. This customized solution does not only strengthen the topicality of financial products, but also contributes to the fact that the consumer makes more viable, sustainable and considerate decisions adapted to his situation.

ADVANCING FINANCIAL INCLUSION THROUGH FINTECH

Fintech has transformed finance by establishing new avenues to economic strength and access to financial resources among the under-served and un-banked communities. Millions of people world-over have in the past been victims of financial exclusion, based on reasons like geographical isolation, unavailability of documents, or the exorbitant prices charged on the conventional financial services. The innovative technologies in Fintech have played and conquered

these problems. Speedy and safe financial transactions through platforms like Paytm, Gpay can be considered an ideal business model, as users can engage in monetary exchanges without the need to visit the physical bank branch.

These platforms are helping to give people financial control using their mobile technology to save, transfer, receive money in the most distant areas. Biometric authentication and digital identity systems such as India Aadhaar program have been integrated with the use of fintech. This inclusion has made the process of accessing banking services, accessing credit, accessing governmental welfare schemes to be easier and the result has been an inclusive economy of financial participation. Another critical milestone in the course of financial inclusion is the role of fintech to democratize access to credit. The existing mechanisms of credit assessment frequently do not cover the people with no credit histories, so those with long histories but small businesses remain without access to funds that are required. However, fintech platforms operate with the alternative sources of their data like payments on the utility bills, mobile behaviours, and behavioural data to determine their creditworthiness. This has opened up the microloans, peer to peer lending, and other forms of innovative crowdfunding that allows the small scale entrepreneur (who might be a woman or a marginalized individual) to start and develop his or her business.

CHALLENGES AND OPPORTUNITIES OF FINTECH SERVICES

The move towards the cashless economy harboring fintech services create both challenges and opportunities especially in terms of consumer decision-making and financial inclusion. The problem of delivering some of the population groups to the financial exclusion is a serious challenge. The FinTech platforms will promote access, people residing in rural areas, individuals with low income, and individuals who are not digitally literate, may have difficulty to use these technologies. This gap is further widened by the low penetration of internet and low connectivity in addition to limited use of smart phones, thus some consumers are left out in the digital financial transformation.

Data privacy and cybersecurity will also be essential concerns since the shift toward digital purchases and transactions comes with the danger of identity thefts, hacking, and frauds. The establishment of trust to financial technology is a necessity as there are still some of the users that are not ready to get rid of the traditional banking because they are afraid of digital fraud or complicated technologies. The blistering transformation into a cashless economy gives rise to dependency on technology that may cause interruptions in case of system failure or technical failure or due to an attack or breach by an intruder who may be able to affect consumers as well as businesses, their operation and their transactions. The possibilities of the fintech services in the shifts to the cashless economy are enormous. Fintech can be used to achieve financial inclusion by providing easy low-cost financial services to untapped groups of people. Digital payment networks, mobile banking, and peer-to-peer finance network can fill the gap between people who could not participate in a traditional financial system. Using technology, fintech platforms can help bring down the prices of financial services making even the small-scale users to be part of the formal economy. Fintech enables consumers to make wiser financial decisions by giving real-time consideration of their spending behaviors, saving, and investment using easy-to-use tools and applications.

CONCLUSION

The emergence of innovations of fintech that are based on the transition to a cashless economy is a revolutionary change in the global monetary system. With its introduction of people accessing fast, convenient, and safe uses of money fintech has transformed how individuals, businesses and governments relate to money thus providing more people with financial access and reconceptualizing how consumers make choices. The innovations in the field like mobile banking, digital wallet, blockchain and peer-to-peer lending platforms have eliminated the traditional barriers to financial inclusion that show the unbanked and underserved groups a chance to engage with the formal economy. Fintech enables customers to have the real-time information and customized solutions as well as high levels of transparency that supports the informed consumer behavior and trust in digital environments. These changes also pose such challenges as the threats to cybersecurity, uncertainty of regulation, and the existence of the digital divide. Such issues will be dealt with by involving government, fintech providers, financial institutions, and consumers in taking proactive security and regulatory measures, cyber literacy training. Innovation and inclusivity are the strategies that make this transition successful. In its further evolution, the fintech has a potential of becoming an agent of economic growth, as well as individual revitalization and strengthening the processes of creating efficient, affordable, and sustainable financial models. Accessibility, security, and collaboration should be the priorities of the stakeholders to ensure that all can benefit of the cashless economy to eliminate distance in the ability to get money and unite the world, creating more integrated and wealthy communities.

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MALWARE IDENTIFICATION USING BEHAVIORAL TRACKING

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Abstract

Over time, technology has developed to the point where it now significantly influences many facets of our lives. This remarkable expansion has brought about a number of advantages and opportunities, but it has also inadvertently accelerated the transmission of malware and increased the number of malware attacks. The availability of automated and advanced code generators, obfuscators, and packers has led to an increase in complex and sophisticated malware. Additionally, in order to create new malware variants and evade detection techniques, malware makers purposefully include duplicate or needless API calls into instances. As a result, malware identification has become a significant problem for both consumers and companies.

It is not computationally feasible to manually examine each suspicious data due to the growing complexity and amount of malware samples. Machine learning techniques have shown a great deal of promise for automatically identifying dangerous samples by extracting important information from large feature sets of both benign and malicious samples. Therefore, the objective of this study is to create reliable machine learning-based malware detection techniques. The first technique extracts API call sequences by dynamically analyzing malware and benign samples. Purified API call sequences are obtained by removing unnecessary and noisy API calls from them. From these purified sequences, frequent sequential patterns are produced to provide a feature vector.

Therefore, it uses feature selection approaches to reduce the size of the feature vectors and produce an essential feature set that can improve machine learning algorithms' detection skills. A comprehensive collection of tests employing different datasets and machine learning techniques is also used to assess this approach. According to the experimental findings, the hybrid feature selection method significantly decreased the size of the input feature set and enhanced machine learning algorithms' ability while cutting down on training time.

Introduction

Modern technological developments like cloud computing, big data, artificial intelligence (AI), and the Internet of Things (IoT) are making it easier to automate information systems and increase their operational and computational efficiency. The phrase "Industry 4.0" is frequently used for describing this stage of automation and change. These changes have increased the amount of information in information systems, even if they provide many practical advantages to both individuals and enterprises. Numerous security risks, including financial fraud, denial of service assaults, malware attacks, unlawful resource access, and information theft, are brought on by this excess of information. In recent years, malware has emerged as one of the biggest risks to information system security. These malicious computer programs are made to interfere with regular system functions. They engage in a wide range of fraudulent acts, such as gaining illegal access to system resources, stealing private data, disrupting communication networks, initiating denial-of-service attacks, causing financial losses, and more.

Following encouraging outcomes from API call sequences, the second method aims to investigate more API call types for malware detection. Using three different types of API calls—API call usage, API call frequency, and API call sequences—it generates several feature sets and uses machine learning methods to assess each feature set's effectiveness. These feature sets are then combined to create an API integrated feature set, which is a more robust feature set. Additionally, it uses the Term Frequency-Inverse Document Frequency approach to supplement the feature values with useful information. The API integrated feature set outperformed other feature sets during testing, although it was hindered by the feature vector's high dimensionality.

The first malicious program developed in 1972, and malware has been a part of systems for computers for many years. They are becoming much more numerous and sophisticated these days due to the quick development of information technology. The availability of automated malware generation tools has also greatly expanded their complexity and volume, as malware creators frequently employ these tools to create new or unidentified malware 2 types that can take advantage of information system weaknesses. A frightening pace of malware development has been facilitated by these techniques.

Behavior-based Malware Detection Methods

Methods of Behavior-based Malware Detection These methods use dynamic analysis to extract a program's behavioral properties. By running a program in a separate environment, these techniques can watch how it behaves during runtime and extract features such as memory utilization, registry files, changed networks, API calls, processes, threads, and mutexes. It uses genetic algorithms to create synthetic malware patterns in order to enhance the base of malware samples for the identification of previously unobserved malicious behavior, all with the aid of automated tools. Machine learning algorithms are used to evaluate this method's performance, and the findings showed that the chosen features improved the algorithms' performance while also greatly cutting down on the classification model's training and testing times.

These elements help to comprehend a program's true behavior and provide comprehensive information about its workflow. Behavior-based malware detection techniques have been shown to be reliable and successful in detecting the newest, encrypted, obfuscated, and undetected malware. A brief overview of the several dynamic properties that these methods use is given in the part below:

Because they offer comprehensive details about a program's workflow, Application Programming Interface (API) calls are considered to be among its most representative features. They are a collection of operations or processes that allow user programs and operating systems to communicate while they are running. Through file processing, network operations, registry alterations, memory changes, and other means, they provide different degrees of communication between applications and operating systems. The detection of any harmful activity in the program, such as unauthorized access to private resources or odd interactions with system components, can be aided by monitoring such functions.

In the following forms, they are widely used in dynamic analysis-based malware detection approaches and are thought to be the most accurate and discriminative dynamic features for differentiating between malware and benign samples:

i. Activities on File Systems:

Various file activities carried out by the program while it was running are represented by the file system. These operations cover a variety of file system tasks, including adding new files, editing and removing old ones, transferring data between locations, and more.CreateFile(), DeleteFile(), MoveFile(), CopyFile(), GetFileSize(), and other file system activity-based API methods are provided.

ii. Changes to Registry:

Important details about computer programs installed in the operating system, such as user preferences and hardware and software configuration settings, are stored in Windows registry files. Along with their key values, they indicate the different registry operations that the application performs while it is running, such as creating, deleting, altering, and so forth. RegCloseKey(), RegCreateKey(), RegDeleteKey(), RegDeleteTree(), RegDeleteValue(), RegDisablePredefinedCache(), and others are some of the crucial registry methods. These features aid in identifying malicious activity by reflecting registry modifications made to the program during examination.

iii. Network Activities:

It keeps an eye on all of the network operations that the program carries out while it is running in order to identify any malicious activity, including unauthorized domain name requests, dubious IP addresses, network protocols, monitoring ports, and other actions. HttpSendRequest(), HttpOpenRequest(), HttpEndRequest(), InternetConnectA(), and others are among the API functions used for network operations. iv. Memory Analysis: It keeps track of various memory operations carried out by the programs in order to comprehend how they behave. These operations include memory allocations, memory accesses, memory dump analysis, and other memory-related tasks. However, because they require a lot of memory and processing power to analyze the executables, these methods are computationally more expensive than static analysis-based ones. Furthermore, it is difficult to examine these executables without the assistance of a human.

1.   **An Overview of Behavior-based Malware Identification**
   - The meaning and significance of behavior-based approaches.
   - comparison with heuristic and signature-based detection techniques.
   - Behavior-based detection challenges.

   2. Essential Elements utilized in patterns and sequences of Behavior-based Detection API calls.
   - registry and file system operations.
   - Patterns of communication and network behavior.
   - abnormalities in CPU and memory use.

3. Methods of Dynamic Analysis
   - emulation-based malware analysis and sandboxing.
   - Malware behavior is monitored during runtime.
   - dynamic analysis's benefits and drawbacks.

4. Detection Based on Behavior and Machine Learning
   - Techniques for feature extraction and selection.
   - algorithms for classification (e.g., Neural Networks, SVM, Decision Trees).
   - designing features with behavioral data.

5. Hybrid Techniques to Improve Detection

- combining static and behavior-based analysis methods.
- combining signature-based techniques with machine learning.
- hybrid system case studies.

6. Strategies for Evasion and Countermeasures

- Malware frequently employs evasion tactics, such as code obfuscation and anti-sandboxing.
- Techniques for identifying and combating evasion.
- Adaptive malware detection advances.

7. Practical Uses

- Examples of behavior-based malware detection programs are CrowdStrike and Windows Defender.
- Use cases in threat intelligence and business security.

8. Sophisticated Methods of Behavioral Analysis

RNNs and LSTMs are used in sequence modeling.

behavioral representations based on graphs.

Spatial and temporal investigation of malware activity.

9. Creation and Administration of Behavioral Datasets

- techniques for gathering and annotating behavioral data.
- issues with labeling and dataset scalability.
- datasets of behavioral malware that are openly accessible.

10. Behavior-based Detection Evaluation Metrics

- F1 score, recall, accuracy, and precision.
- examination of both false negatives and false positives.
- benchmarks for malware detection performance.

11. Developing Patterns for Behavior-based Malware Identification

- Deep learning and AI's role.
- developments in behavioral analysis in real time.
- difficulties using behavior-based techniques to identify novel malware strains.

Future Scope

The malware detection techniques described in this thesis are intended to handle a number of malware-related problems. The current study has the potential to significantly advance the field of malware detection, as evidenced by a thorough examination of the experimental data. This work, however, can be expanded to investigate the categorization of malware into distinct family groups. Malware analysts are better able to identify dangerous patterns and create countermeasures when they group malware samples based on shared traits. Furthermore, classical machine learning methods are the main tool used in this work to detect malware. Deep learning techniques may be used in future studies to automatically extract features from samples for malware categorization and detection.

Conclusion

Ultimately, this thesis advances our knowledge of malware behavior by introducing dynamic analysis-based malware detection techniques. Utilizing API calls recovered from both benign and malicious samples, the proposed techniques thoroughly examine these properties to ascertain how they contribute to malware identification. Additionally, these approaches apply a variety of feature selection strategies to extract reliable and pertinent information, which are then fed into a number of machine learning algorithms. The outcomes of the experiment demonstrated that ML algorithms can perform remarkably well with these characteristics. Ransomware is a particular kind of malware that is used to further evaluate the detection performance of the suggested approaches. Additionally, this thesis investigates the application of evolutionary algorithms to identify hidden virus behavior.

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DEPARTMENT OF COMMERCE

National Conference on

"AI in Industry 5.0: Revolutionizing Business & Technology"
(Multidisciplinary)

Venue: Vivekananda Hall   **Date:** 25.06.2025   **Time:** 10.30AM

INAUGURATION

Prayer	:	**Commerce Students**
Welcome Address	:	**Dr.R Sathyadevi ,** Prof & Head ,Department of Commerce

"LIGHTING OF KUTHUVILAKKU"

Presidential Address	:	**Dr.D Kalpana,Principal,SNGC**
Introduction of Chief Guest	:	**Dr.Jissy C ,** Asst Professor,Department of Commerce
Chief Guest Address	:	**Dr.Rajeswari.R,HR Manager** IIT Palakkad Technology,IHUB Founation
Resource Person Address	:	**Dr.Ranjithkumar Rajamani,** Department of Pharmacology Saveetha Medical College & Hospital,Chennai.
Vote of Thanks	:	**Sneha. II M Com,Chairperson**
11.15 am - 11:30 am	:	**Tea Break**
11.30am to 12.15pm	:	**Technical Session I**
Topic	:	**"Transforming the Future: The Role of AI in Health Care & Education"**
Resource Person	:	**Dr.Ranjithkumar Rajamani,** Department of Pharmacology Saveetha Medical College & Hospital,Chennai.

Lunch Break (12.15 pm to 1 pm)
Technical Session II
Paper Presentation-1 pm to 2.30 pm

Chairperson	Dr.R Suresh Kumar, Associate Professor & Research Guide,Department of Computer Science,AJK College of Arts & Science CBE.
Topic	*"The Role of AI in Future : Digital Revolutionizing Business & Technology"*
Moderator	Mr A Kamal Raj, Assistant Professor & Head, Department of Digital Space &Cyber Forensic Science & P.G Department of Cyber Security, AJK College of Arts & Science CBE
Venue	Conference Hall
Chairperson	Dr J Kavitha Selvaranee, Assistant Professor & Student Achievement Co-Ordinator, Karunya School of Management, Karunya Insitute of Technology & Sciences CBE
Topic	*"The Role AI of In Future: Innovation in Logistics & Supply Chain Management"*
Moderator	Mrs R Sheela Devi, Assistant Professor, School of Management, Nehru Arts Science College,CBE.
Venue	AG3
Chairperson	Mr .Ramesh M , Assistant Professor,Department of Commerce,SNGC
Topic	*"The Role of AI in Future: International Business in Marketing"*
Moderator	Ms Reena Vinoob, Assistant Professor,Department of Commerce,SNGC
Venue	BG2

VALEDICTORY FUNCTION

Venue:Vivekananda Hall   **Time:2.30 PM**

Conference Report	:	Dr.V.Princy Metilda , Assistant Professor,Department of Commerce,SNGC
Valedictory Address	:	Dr.D Kalpana,Principal,SNGC

Certificate Distribution

Vote of Thanks	:	Mr .Ramesh M , Assistant Professor,Department of Commerce,SNGC

NATIONAL ANTHEM

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Industry 5.0 marks a transformative shift where Artificial Intelligence (AI) and human collaboration redefine business and technology. This conference explores how AI is not just automating processes but augmenting human intelligence to create more personalized, sustainable, and efficient systems. From intelligent marketing and data-driven decision-making to enhancing consumer experiences and business models, AI plays a vital role in reshaping industries. With a focus on innovation, ethics, and human- centric design, this event brings together experts, researchers, and professionals to discuss the immense potential of AI in Industry 5.0 and its impact on future-ready enterprises.
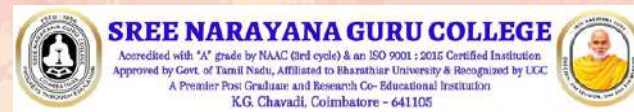
TOPICS FOR PAPER PRESENTATION:AI

- Emerging Business Model for sustainability
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AI in Industry 5.0: Revolutionizing Business and Technology
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Last date for Submission of Abstract :28.05.2025
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Dr. R. Sathyadevi, M.F.T., M.Com (CA), MBA, Ph.D., is a distinguished Professor and Head of the Department of Commerce at Sree Narayana Guru College, Coimbatore, with over 24 years of teaching experience. She earned all her degrees from Bharathiar University. A dedicated researcher, she has guided 20 M.Phil. and 6 Ph.D. scholars, presented over 20 papers, and published 25 articles in reputed journals. A life member of IAENG, she also serves as ISO Convenor since 2019 and has contributed to the Examination Section for over a decade. As Chief Editor, she upholds her strong academic and editorial standards.

Editor's Profile

Mr. M. Ramesh, M.A., MBA, M.Phil., (Ph.D.), is Assistant Professor of Economics at Sree Narayana Guru College, Coimbatore. With 15 years of combined academic and industry experience, he began his career as a Research Fellow in the IDPAD project at Bharathiar University. He also has 9 years of corporate experience in the roles like Management Trainee – Exports and Merchandising Manager. He has published five research articles in national and international journals and has organized two national and one international conference on various topics in Commerce and Management.

Dr. V. Princy Metilda, Assistant Professor of Commerce at Sree Narayana Guru College, Coimbatore, is a distinguished academician with over 12 years of experience in teaching and research. Holding multiple degrees including Ph.D., MBA, and M.Com (CA), she brings a multidisciplinary approach to commerce education. Known for her tech-integrated, student-centric pedagogy, she has mentored over 1000 postgraduates. Dr. Metilda has received accolades such as the Dr. Radha Krishnan Best Faculty Award and Asiriyar Sirpi Award. A published author, patent holder, and certified Innovation Ambassador, she actively contributes to academia through research, publications, and editorial roles in reputed academic forums.

Dr. Jissy C. is Assistant Professor of Commerce at Sree Narayana Guru College, Coimbatore, with over 9 years of academic experience. She holds a Ph.D. in Commerce.She has presented papers at various national and international forums and published over 10 research articles and book chapters in reputed journals. She has also served as Organising Secretary for seminars and conferences. A life member of NITSK and IAENG, Dr. Jissy brings scholarly depth and editorial expertise to her academic and editorial roles.