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Harnessing Artificial Intelligence for Inclusive and Sustainable Future

Book of Abstracts

Gyan Prakash, Amandeep Kaur
Editors

Harnessing Artificial Intelligence for Inclusive and Sustainable Future

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Preface

The International Conference on *Artificial Intelligence Driven Human-Centric Solutions and Sustainable Transformations* is hosted at ABV Indian Institute of Information Technology and Management Gwalior, bringing together researchers, industry experts, and practitioners to explore the role of artificial intelligence in addressing critical societal and environmental challenges. The conference is supported by the Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology, Government of India, and has Quality Circle Forum of India (QCFI) as its industry partner. This collaboration underscores the significance of interdisciplinary engagement in leveraging AI for sustainable and human-centric advancements. This book of abstracts compiles the contributions of scholars whose work reflects the latest advancements in AI applications for sustainable development, ethical innovation, and human-centric technologies.

The central focus of the conference is embedded in its very name: human-centricity and sustainable transformations. The conference aims to look at the role of Industry 4.0-based digital technologies in shaping value chains and transforming production systems. The conference aspirations are to examine the impact of digital technologies and how these may be leveraged to enhance productivity, flexibility, and agility.

In recent times, industry 5.0 blends sustainability, circularity, and human-centricity and involves interconnected machines that not only operate independently but also enable preventive maintenance and human-machine cooperation so as to capture and deliver value and respond to customer demands. Towards this, the conference is structured in four tracks, namely industry 5.0 in medical research, industry 5.0 in manufacturing and services, industry 5.0 in food processing, and the integration of emerging technologies. This conference endeavors to deliberate and explore the prospects of digital technologies along intersecting and interdisciplinary areas of manufacturing, healthcare, food processing, and services for the purpose of developing impactful and socially relevant solutions.

Prof. Gyan Prakash
Dr. Amandeep Kaur

Themes

Industry 5.0 in Medical Research

- Smart materials for manufacturing of personalised implants
- Collaborative robots (Cobots) for human surgery
- Additive manufacturing in medical industries
- Virtual Reality and Augmented Reality for medical research and training
- AI for sustainable healthcare supply chains
- Green AI in healthcare
- AI and circular economy in healthcare
- AI driven discovery and disease detection

Industry 5.0 in Food Processing

- Application of IoT technologies in food industry
- Cloud systems and blockchain for traceability and monitoring
- Reducing loss, waste and improving quality and safety
- Manufacturing, automation, and control of food quality
- AI applications for optimization, and decision-making
- Predicting sensory and consumer preferences
- AI for sustainable food supply chains
- Waste management and circular economy

Industry 5.0 in Manufacturing & Services

- Intelligent solutions for future smart industries
- Cobots in manufacturing industries
- AI-based big data analytics for supply chain management
- Optimization of supply chain management with Big-data
- Cobots for packaging and delivery
- Predictive maintenance for sustainable services
- Net zero energy transition and grid optimization
- Digitization in finance, education, infrastructure, and retail

Integration of Emerging Technologies

- AI and machine learning in smart industries
- IoT and IIoT in next-generation factories
- Ethical AI for sustainable technology innovation
- 6G networks and their potential for Industry 5.0

- Autonomous systems in industrial environments
- Quantum computing applications in industrial optimization
- Intelligent transportation and mobility solutions
- Blockchain for Secure and Transparent Industrial Ecosystems

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FLARE-HEALTH: An AI-Driven IoT-WSN Framework for Flood-Triggered Disease Surveillance and Contamination Risk Prediction

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Abstract: Stock price prediction has been a significant field of study for an incredibly long timeframe. Although proponents of the methodical market supposition maintain that it is preposterous to make precise stock price predictions, formal arguments show that proper variable design and accurate modelling can result in models that allow for highly accurate predictions of stock prices and movement patterns. With an accentuation on pertinent technology stocks which is Apple Inc. (AAPL), this study assesses the use of Long Short-Term Memory (LSTM) networks for market evaluation and prediction. Historical stock price data from the popular open-source website Kaggle spanning from 1980 to 2024 is analyzed. The primary objective of the research effort is to devise and assess a prediction model for future stock price forecasting based on LSTM. The Adam optimizer and mean squared error (MSE) loss function are employed to train the model. Evaluation of the non-hybrid LSTM model is done using the root mean squared error (RMSE) metric which is obtained as 4.178. The RMSE score of Recurrent neural network-LSTM, Convolutional neural network-LSTM and Gated recurrent unit-LSTM was obtained as 31.488, 18.835 and 9.253 suggesting that simpler datasets can be better generalized for predictions using simpler models. The results reveal the potential of LSTM models in apprehending complex patterns in stock price movements and making rationally accurate predictions. The nearly better performance of stacked LSTM models constitutes one of the best models to make predictions of short-term stock related data.

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Evaluation and Categorization of Mobile Payment Research: Insights from Past 18 Years

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Abstract: The present study aims to review and categorize the corpus of academic works on mobile payment that is published over the past 18 years from 2007 to 2024, using the Web of Science database. This publication conducted a thorough analysis of peer-reviewed articles and categorized them using the classification methodology. In addition, the articles are categorized by topic, year, nation and journal. The topic-based categorization of the articles led to their placement into four primary categories, which include adoption, technology & innovation, security and miscellaneous. This research will help the academicians, researchers and all those having interest in the mobile payment research to get the overview of recent publication, most sited topic in the current available literature. Based on our research, we have concluded that the majority of studies on mobile payments are conducted in the adoption domain, with China being the country with the greatest number of studies, as per the relevant database. Since it is built on the Web of Science database, upcoming researchers can utilize the Scopus or various other database to further classify their findings.

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Exploring Ethical AI and Innovation: A Comprehensive Bibliometric Analysis

Satyam Pathak, Amandeep Kaur
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Abstract: AI is changing industries and society, leading to important questions about its ethical implications and innovation role. Ethical AI is an approach that adheres to the principles of fairness, accountability, transparency, inclusivity, and respect for human rights in its application to society while mitigating potential risks. This paper conducts a bibliometric analysis of the literature on ethical AI and innovation, capturing a systematic overview of the research landscape, identifying key contributors, and showing thematic trends. Using a targeted search strategy, a dataset of 358 peer-reviewed articles published in English up to 2024 was extracted from the Scopus database. Descriptive metrics, keyword co-occurrence networks, and three-field plots were analyzed using tools such as VOSviewer and Biblioshiny. The paper contributes to a nuanced understanding of the role of ethical AI in innovation by bringing out the evolution of the discourse and its implications for technological advancement and societal impact.

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Predicting Cryptocurrency Prices with Sentiment Analysis and Deep Learning Models

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Abstract: Predicting cryptocurrency prices remains a challenging task due to the inherent volatility and diverse influencing factors such as social media sentiment, market trends, and technical indicators. This paper presents a new multiphased framework that combines long-term and short-term market dynamics with advanced natural language processing and deep learning techniques. During the feature preparation phase, FinBERT, which is a pre-trained financial text language model capable of capturing nuanced sentiment signals from social media platforms like Twitter and Telegram, extracts market data and sentiment features. Hybrid deep learning architectures that utilize transformer-based models are applied for modeling sequential dependencies and market fluctuations efficiently. In the fusion phase, an attention-based dynamic weighting mechanism is introduced in order to adaptively prioritize features according to the changing market conditions. This approach enables accurate forecasting of both short-term price fluctuations and longterm market trends, providing a comprehensive understanding of cryptocurrency market behavior. Experimental evaluations demonstrate significant improvements in prediction accuracy compared to baseline models, highlighting the effectiveness of combining sentiment-driven features with transformer-based architectures. The proposed framework aims to improve the reliability of cryptocurrency price forecasts by leveraging stateof-the-art NLP and deep learning methods, providing valuable insights for traders and investors.

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An Ensemble Machine Learning Approaches for Customer Purchasing Behaviour Prediction

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Abstract: In today's competitive retail sector, it is crucial to understand the customer behaviour to understand customer behavior to tailor marketing strategies and promotions to customized preferences. This research aims to analyze the behaviour of retail customers using ensemble Machine Learning (ML) models based on their purchase patterns. Using online retail dataset, we perform data pre-processing, RFM (Recency, Frequency and Monetary) analysis and K-means clustering algorithm for customer segmentation, and implement proposed ensemble ML techniques. The findings demonstrate that ensemble ML models can predict the customer's next purchase with higher accuracy as compared to baseline techniques. The experimental results corroborate the performance of proposed ensemble models to accurately predict the customer behaviour for retail decision-making and business profitability.

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Generalized AI Based Plastic Density Detection in River Ecosystems

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Abstract: Plastic pollution in aquatic environments is a global issue causing harm to human health, the environment, and the economy due to increased consumption and inadequate waste management practices in many countries. The invention proposes an AI-based generalized system to be applied on various rivers and waterways from vast geographies for detecting plastic density and displaying it in percentage. It also highlights water, vegetation, and sand regions. The idea can help avoid contaminated rivers and reduce litter clearance costs using fewer computation resources. Additionally, it offers numerous visualizations to plan the cleanup process in the most resource-efficient way. The invention uses a five-layer Convolutional-Neural-Network. It is applied to rivers from six different nations. Results are promising in terms of applicability and generalization. The system accurately marks plastic density, water, vegetation, and sand in all the provided images with more than 60% accuracy and raises alerts based on the pre-defined high-low threshold. This innovation can have a huge impact, mostly in developing and underdeveloped countries where emission and disposal protocols are still challenged. With the use of an AI enabled plastic density detection system, the government and other organizations accountable for cleaning up the rivers can operate more efficiently. A crew can be deployed to regions that have been informed by the system for high plastic density so that prompt action can be taken. This can be installed on an IoT device to track litter in large rivers, which is still difficult for people to keep an eye on.

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On-Device Financial Data Management Using ML and NLP: A Privacy-Focused Approach

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Abstract: Personal finance management has become more difficult due to the exponential rise of digital financial services, with SMS-based notifications being a crucial channel for transaction updates. However, the unstructured nature of SMS data poses challenges for users in organizing financial information effectively. This paper introduces a novel, privacy-preserving on-device financial data management system that makes use of natural language processing (NLP) and machine learning (ML). The proposed solution incorporates three core functionalities: SMS transaction classification, data extraction, and data categorization, complemented by a chatbot interface for user interaction. A Random Forest classifier achieves a remarkable 99.15% accuracy in transaction classification, while a Bi-LSTM-CRF model, combined with BERT embeddings, attains 99.61% accuracy in extracting transaction details. Transactions are categorized into spending categories facilitating detailed expense analysis. Optimized for mobile deployment, the system ensures data privacy and efficiency. This work bridges a critical gap in personal finance management by enabling users to securely track, analyze, and gain insights into their financial behaviour, laying the groundwork for future enhancements like real-time alerts and predictive analytics.

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Explainable AI in Psychology: Enhancing Transparency and Trust in Mental Health Applications

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Abstract: Integrating Explainable Artificial Intelligence (XAI) into psychology represents a transformational increase in diagnostics and psychotherapies. The research proposes a novel framework that extensively uses Tree SHAP, an XAI technique to enable global interpretability from ensemble models such as Random Forests. The framework addresses the evidence concerning the black-box-proof approach with AI systems: a transparent and interpretable framework. It is well suited to the utility of psychological practice and research. By providing intuition on the contribution of the features of the proposed model, clinicians can understand the possible reasons behind the predictions that engender trust and allow safe congruence with psychological theories. Upon validation of the psychological data sets, the framework demonstrated an increase in interpretability by 15% compared to the baseline methods. According to the survey, 92% of the clinicians found the explanations 'highly satisfactory.' The model achieved a 20% reduction in false positives, improving algorithmic reliability, and reducing misdiagnosis. These improvements underscore Tree SHAP's ability to boost model performance to assist reasoning and decision making in clinical examinations. In addition to application to diagnostics, this framework extends to applications in early intervention systems, personalized psychotherapy, and educational psychology. By integrating domain-specific interpretability, this framework ensures cross-cultural adaptability. This approach further manages ethical concerns, thus positioning it to operate well within a larger canvas for worldwide psychological application. Computational efficiency only helps its case for practicality in real-world clinical and research application settings. This new framework will establish high-level comfort in relation to scientific integrity while staying true to human values in the new premises of AI applications in psychology.

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Examining the Influence of Retail Investors Investment Behaviour and Investment Decision in India

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Abstract: The market share of retail Investors in India is 40.7 percent in the year 2022, and the retail investors parked their investments in the stock market due to its returns. Retail Investors are leveraging short-term loss and gains long-term financially with the help of their knowledge, attitude, and skill, which is the so-called financial literacy. The government of India launched the "Digital India" program in 2015, where the main objective of this program is to make faceless, paperless, and cashless. The government of India also continuously planted its efforts through specific programs and policies; some of the successful programs are Pradhan Mantri Jan Dhan Yojana (PMJDY), Banking the Unbanked Population, Retail Direct Scheme (RDS) allowing the participation of Retail Investors in Government Securities, and New Ombudsman Schemes which protect the retail investors. With the mounting efforts from the RBI, SEBI & Government of India, right now, the stock market in India is faceless (e-KYC & investment decisions – No need to visit the branches), paperless (e-KYC & other documents can be submitted through online), and cashless (Digital Payments in the investment process). Studies in India mainly concentrated on technical investment of stock selection, stock price movements, Fundamental analysis of stocks, participation of FIIs, IIs Mutual fund portfolio analysis, and Risk and return analysis of stocks. However, studies related to assessing the portfolio choices of retail investors are quite scarce, and the studies related to assessing the investment choices influence of retail investors is also quite unavailable. Further this study include variables like Financial literacy, Financial Planning, Risk, Personality types, and External Influence will measure the Investment decisions. The results unveiled that Investment decision influenced by Financial literacy, Planning, Personality type and External influence.

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An AI Powered Avatar Emulation for Conversation-A Realistic Interview

Valarmathi Natarajan, Amirtha C S, Keerthiga N, Jayashree S
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Abstract: AI-powered Emulator replicates real interviews to help users practice and improve their responses in a stress-free environment. NLP (GPT) and Speech recognition are the major technologies used to develop job interviews questions. Enabling the system to understand and analyze the meaning of user responses and converts spoken answers into text for analysis and feedback. Users receive actionable feedback to refine communication skills, improving interview performance. Increased clarity and confidence in responses. Users experience enhanced interview readiness and leading to a higher chance of success.

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Non-Invasive Detection of Diabetics Using CSRR At 2.45 GHz ISM Band

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Abstract: This paper is about development of a non-invasive diabetic detection sensor based on a Complementary Split Ring Resonator (CSRR) by using Ansys HFSS software. The sensor will be operating at the 2.45 GHz ISM band, and an FR-4 epoxy substrate with a copper transmission line will be used. It is mainly aimed at studying the shifts in S21 resonance frequency and return losses by simulating biological samples from healthy and diabetic people. There are two test cases in the study. In the first case, blood samples and skin samples were kept directly on the CSRR. In the second case, the urine samples were kept on lime soda glass, directly placed on the CSRR. Both test cases were run completely in simulation mode on HFSS software. Resonance frequency shifts and return losses were observed to be highly significant, showing distinct differences between the samples of healthy and diabetic subjects. Notably, diabetic samples Specifically, diabetic samples showed a shift in resonant frequency toward lower Side compared to healthy samples. Furthermore, the return loss decreased for diabetic samples in both test cases compared to healthy samples, reinforcing the sensor's sensitivity to permittivity changes. Sensitivity and permittivity calculations were included in the analysis to verify that an electromagnetic response of the samples is clearly differentiated between sample types. The project reveals that real-time health monitoring and biomedical diagnostics are possible through non-invasive diabetic detection by electromagnetic sensing.

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AI and Human Cognition: A Cognitive-Computational Synergy

Kanishthika K, T S Akarsh Velan, J Umamageswaran
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Abstract: Artificial Intelligence is not just reshaping industries but also reshaping how we think and solve problems, profoundly influencing the fabric of human cognition. The psychological implications of convenience go far beyond just that, revealing an often-blighted double-edged sword. As AI liberates more potential by easing complicated jobs, increasing accuracy, and offering intelligent solutions, it develops some serious risks by suppressing critical thinking and worsening mental health issues. Research reveals that 60% of professionals report decreased cognitive involvement as a result of AI dependence, and 45% of users feel stressed from constant exposure to AI systems. In this paper, we propose the AI-Human Cognition Framework; a model designed to redefine AI's role as a cognitive enhancer rather than a replacement. The framework integrates modular scaffolding, adaptive user interface, dynamic data-driven feedback loops to promote active engagement, foster long-term cognitive development, and over-reliance. Additionally, two-way diagnostic questionnaires for baseline cognitive abilities, iteratively refining user interactions. The alignment of AI with ethical design and mutual learning principles allows the approach to envision a future in which AI strengthens human reasoning, nurtures mental resilience, and fosters a balanced, trustworthy partnership between humans and technology.

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TruthTeller: A Machine Learning-Based Platform for Analyzing Political Narratives Line by Line to Uncover Factual Accuracy

Vijaylaxmi Bittal, Makarand Shahade, Hrushikesh Sonar, Harshada Dhakad, Sakshi Patil, Vaibhav Mahale
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Abstract: Today, in an information-driven world, Political narratives shape public opinion significantly. However, these are often full of biases, Misinformation, or inaccuracies and make it challenging for people to know what is factually correct. This paper presents TruthTeller, a machine learning-based platform that analyzes political narratives line by line, providing users with an objective assessment of their factual accuracy. Using advanced Natural Language Processing (NLP) techniques and machine learning algorithms, TruthTeller transcribes video or audio content into text, processes each statement, and classifies it as true, false, or neutral. The platform uses models like BERT for contextual understanding and uses a credibility scoring mechanism that checks claims against trusted sources. The system so far has been able to finish key foundational modules such as audio-to-text conversion, user interface design, and preliminary dataset preparation for classification tasks. Preliminary results show the feasibility of real-time fact-checking with promising accuracy in transcription and basic text analysis. Future work includes refining contextual analysis, adding Multilingual support and source validation towards setting new benchmarks in automated political fact-checking. TruthTeller aims at enhancing transparency, accountability and critical engagement with the political discourse while equipping users to make better decisions. It fights against the wide spread diffusion of misinformation through creating an analytically and informatively enlightened society.

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Ethical Guidelines for AI in Medical Image Analysis: Balancing Innovation, Responsibility, and Humanitarian Values

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Abstract: Using machine learning and artificial intelligence techniques in the domain of medical imaging has undergone considerable increase and, as a result, it is reasonable to regard data ethics as an important issue. The connection between data ethics and medical image analysis is inherent because of the failure to adequately apply a uniform ethical framework for data retrievals. At the same time, researchers, who are focused on the practical advancement of technology and the medical field as well, should acknowledge that the introduction of such technologies might come with ethical concerns and risks. The paper deals with a practical aspect of artificial intelligence (AI) in medical image analysis through a set of guidelines and critical reflections. It mainly considers ethical challenges related to data use. Resolving these problems as the premise, the ultimate goal is to promote responsible innovation that is first and foremost concerned with patients' welfare and adheres to ethical norms in devising and utilizing AI-based solutions.

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AI-Driven Smart HVAC Management: An IoT and Machine Learning-Based Approach to Energy- Efficient Building Automation.

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Abstract: In order to improve building efficiency and sustainability, this paper describes the construction of an AI-Driven Smart Heating, Ventilation, and Air Conditioning (HVAC) Management system. The proposed system collects real-time information on temperature, humidity, and solar intensity by utilizing Internet of Things (IoT) sensors both within and outside the structure. This is done by leveraging the synergy between Internet of Things (IoT) and Machine Learning (ML). In particular, Light Dependent Resistor (LDR) sensors track light intensity, and Digital Humidity and Temperature (DHT) sensors detect temperature and humidity. Using observed light intensity and humidity levels, the gathered data is used to train a supervised machine learning model that uses the Multiple Linear Regression algorithm to forecast interior temperature. Through an analysis of past data and weather forecasts, the system makes proactive recommendations for the best temperature settings to improve user comfort while decreasing energy consumption. The creation of a user-friendly interface for real-time temperature prediction, the integration of environmental sensing data with forecasting weather data, and the construction of an AI-driven climate control system constitute some of the research's major accomplishments. The suggested approach seeks to transform Heating, Ventilation, and Air Conditioning (HVAC) management by providing a cost-effective and environmentally friendly means of enhancing interior climate control in structures.

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Effective Content Moderation: A Framework for Toxic Comment Analysis Using Machine Learning

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Abstract: This work showcases toxic comment analysis using Natural Language Processing to estimate toxicity levels of user-generated comments on a scale from 0 to 1. By quantifying toxicity, the work addresses maintaining positive interactions in online environments. The benchmark output is the toxicity score as a regression task, with binary classification labeling comments as toxic (score > 0.5) or non-toxic (score ≤ 0.5) for additional insights. This research leverages the datasets with associated toxicity levels, making it suitable for supervised machine learning. In this work, we combine the strengths of TF-IDF and Bag of Words (BoW) in proposing optimized SGD Regressor and Decision Tree based model for toxic comment classification. The model achieved an accuracy of 96%, along with AUC of 92%. It outperformed previously implemented techniques and models. We can conclude that it emerges as a powerful technique to evaluate toxicity on social media, leveraging it in diverse linguistic and cultural contexts.

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A Review of AI-Powered Health Monitoring and Prediction Systems Using Deep Learning and Large Language Models

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Abstract: AI-powered health monitoring systems, which integrate deep learning (DL) and large language models (LLMs), have shown significant promise in revolutionizing preventive healthcare, personalized health management, and chronic disease monitoring. This review focuses on various AI driven health monitoring solutions, including systems that predict health risks, generate personalized diet and exercise plans, monitor sleep, and provide real-time feedback using neural networks and natural language processing (NLP) models. We analyze a range of methodologies, techniques, and algorithms, discussing their performance, limitations, and potential for advancing healthcare. The review highlights the application of AI in detecting and predicting conditions such as diabetes, cardiovascular disease, and sleep disorders, as well as its use in providing personalized health recommendations that enhance user engagement and long-term health outcomes.

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Skin Disease Classification Using Vision Transformer

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Abstract: Skin cancer is a complex ailment that encompasses several types, each requiring distinct treatment approaches. In recent years, machine learning techniques have been employed to create automated systems for skin diagnosis, utilizing processes of image segmentation and classification. Early detection of skin cancers can improve recovery chances significantly. Implementing preventive strategies has the potential to avert approximately 30% to 50% of cancer-related fatalities, as reported by the World Health Organization (WHO). This makes it crucial to develop a reliable system that can classify skin cancer autonomously. Convolutional neural networks (CNNs) have become increasingly popular in the last ten years for automating cancer detection. Considering this, the Vision Transformer (ViT) gained substantial popularity in recent years and has proven itself as a vigilant contender to Convolutional Neural Networks (CNNs) in the sector. Yet there are certain difficulties in correctly classifying such diseases, including poor model generalization, low detection accuracy, and a lack of labeled data for training. The suggested model demonstrates that this reliance on CNNs is unnecessary, and that a pure transformer implemented directly to sequences of image patches can work exceptionally well on image classification tasks. This research sets up a multi-class skin disease classification model based on a vision transformer (ViT) that outperforms other sophisticated heavy techniques. Furthermore, our model provides comparisons with some popular state-of-the-art and current models. The model achieves an accuracy of 99.45%, precision of 99.45%, f1 score of 99.44%, and recall of 99.44% on the ISIC 2019 dataset. The proposed model uses data augmentation techniques to address class imbalance multi-scale and overlapping sliding windows, and multi-scale patch processing to improve classification accuracy.

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Augmenting AI with Context: Hybrid Generative Models for Summarizing Complex Medical Texts

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Abstract: The rapid advances made in generative AI have thereby un- locked new avenues of text summarization. However, summarizing medical texts is challenging by most standards; it's very complex, highly technical, and contextual accuracy is required. Thus, this paper intro- duces a hybrid generative framework to combine pre-trained language models with external medical knowledge resources for improving the medical text summarization's accuracy, coherence, and contextual appropriateness. The proposed model thus expands on the limitations of standard generative approaches by using external data sources, such as clinical guidelines, ontologies, and patient- specific records. We evaluated the framework using metrics such as ROUGE, BLEU, BERT Score, and expert validation in order to test its performance compared to conventional models in medical summarization tasks. The results further emphasize the importance of context-aware systems within the healthcare domain, illustrating the promise of hybrid methods for enhancing either quality of summarization or their practical applicability.

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Seismic Data Analysis and Earthquake Magnitude Prediction Through Machine Learning Techniques

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Abstract: An earthquake is one of the natural disasters felt on the surface of the earth created by the movement of the major pieces of its outer shell. The Earthquake prediction is a crucial technique for reducing risks and improving preparedness. Till now, many papers have been uploaded on particular regions and with AI tools. Now, XG Boost, Lasso Regression and Random Forest these Machine Learning Algorithm helps to find the best accuracy rate in earthquake prediction. This study analyses seismic data and develops a model for earthquake magnitude prediction using machine learning methods. The model's accuracy is featured using metrics are Mean Absolute Error (MAE), Mean Squared Error (MSE), and R-squared (R^2). The analysis performs Visualization, Prediction and how they will occur. Patterns and Features in earthquake magnitudes across latitude regions are also widely processed, providing insights into how seismic activity varies across geographically. Additionally, the study examines the frequency of how earthquakes occur at different magnitude levels. Based on this, we aim to provide a more fine-reviewed and up-to-date process of the advancement in earthquake prevention and reduction based on ML. These findings help in improving our understanding of seismic behavior and demonstrate how machine learning contributed to be used to predict earthquakes more effectively, supporting better disaster preparedness and risk management.

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Enhancing Home Automation with Arduino: A Multi-Sensor Approach to Security and Energy Savings

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Abstract: A smart home automation system is designed to integrate multiple sensors, enhancing home security and energy efficiency. The system utilizes an Arduino microcontroller and includes a gas sensor (MQ6) for detecting gas leaks, a passive infrared (PIR) sensor for motion detection, an ultrasonic sensor for automatic door control, and a light-dependent resistor (LDR) for lighting control. Gas leaks trigger an alarm to alert the inhabitants, while the ultrasonic sensor opens the door automatically when someone approaches. The PIR sensor activates a fan upon detecting motion, and the LDR controls lighting by turning the bulb on at night and off during the day based on ambient light levels. A user-friendly interface provides real-time monitoring through the Arduino's serial output, enabling users to track sensor data and system status. The system improves safety, convenience, and energy efficiency.

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Enhanced Energy Consumption Forecasting: A Hybrid ARIMA and Explainable AI Approach with Real-Time Integration

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Abstract: Effective resource management is essential for sustainability as the world's energy demands increase, especially for educational institutions aiming for net-zero carbon emissions. Using the UNICON dataset—which consists of high-granularity meteorological data along with data on gas, water, and electricity usage—this study offers an improved predictive modelling framework for energy consumption. The integration of renewable energy data, real-time prediction capabilities, and multi-factor optimisation for resource allocation are just a few of the innovative improvements our study brings to the already-existing La Trobe Energy AI/Analytics Platform (LEAP). Explainable AI (XAI) methods like SHAP are used in conjunction with sophisticated machine learning models like LSTM, GRU, and hybrid ARIMA-LSTM to increase prediction accuracy and transparency. Predictive maintenance algorithms and IoT-based smart meter simulations are also integrated into the system to proactively monitor and manage infrastructure. Live energy projections, geolocation mapping, and interactive visualisation are all made possible by an extensive dashboard created with Plotly Dash. In order to meet sustainability objectives, cost analysis and carbon emission projections are also combined. Results from experiments show notable gains in energy conservation, resource optimisation, and prediction accuracy. This improved framework supports institutional and international sustainability initiatives by offering a scalable and workable way to implement AI-driven energy systems.

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AI-Innovated Legal Documentation Assistant

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Abstract: Legal documentation is cumbersome and time-consuming; hence, for many individual entities and small businesses in India, it is a nightmare to go through, especially when there is a lack of access to legal resources. The sets of intricate languages and jargon used in the legal documents act as a stumbling block, often leading to misunderstandings and mistakes among professionals unrelated to the legal field. The work presented here shows an AI-driven Legal Documentation Assistant, which may well simplify the process of creating legal documents for an average Indian citizen and a small business owner. It achieves this by applying natural language processing and machine learning techniques in generating automated yet customized legal documents in plain, easily understandable language.

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Unveiling AI as a General-Purpose Technology in Industry 5.0: Characteristics, Impacts, and Future Directions

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Abstract: The process of digital transformation is inextricably tied to the development and dissemination of a collection of General Purpose Technologies (GPTs), which serve as both the impetus and the means for both the transformation of already-existing industries and the emergence of completely new ones. The teamwork of people and machines is the main emphasis of the new production model known as "Industry 5.0.". This research paper aims to delve into the concept of Artificial Intelligence (AI) as a General-Purpose Technology and how it has an impact on Industry 5.0. The researcher has also explored its characteristics, implications, and prospects in the context of Industry 5.0. By examining the versatility, impact, and transformative potential of AI across the industries, this study seeks to shed light on the role of AI as a technology with wide-ranging applications and societal implications through a comprehensive literature review. AI automates jobs, streamlines processes, enhances decision making and optimizes resource allocation. It has proven its potential to improve productivity and transform industries on a large scale. The findings highlight AI's versatility, productivity improvements and economic impact. This research paper aims to provide valuable insights into the evolving landscape of AI as a GPT and its implications for the future in the industry 5.0 era.

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Advancing MCX Commodity Price Prediction: A Study on Supervised Learning, Deep Learning, and Econometric Models

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Abstract: This research discovers the application of supervised machine learning practices to estimate commodity prices, using eight years of data from the Multi Commodity Exchange. The exploration employs four Managed Machine Learning replicas, Autoregressive Integrated Moving Average (ARIMA), Extreme Gradient Boosting (XG-Boost), Long Short-Term Memory Recurrent Neural Networks (LSTM RNN) and Support Vector Regression (SVR)) to foresee the prices of Natural Gas, Kapasa, Zinc and Silver. Among the mockups, LSTM RNN confirmed greater performance, reliably accomplishing the maximum accuracy in price forecasts across all commodities. This model outclassed ARIMA, SVR, and XG-Boost, with its capability to capture long-term dependencies and composite temporal patterns being key to its success. LSTM RNN revealed the lowest error rates and the highest association with actual market values, making it mainly effective for estimating in the volatile commodity marketplace. The results underscore the potential of LSTM RNN for real-world applications in commodity price estimation, offering valuable insights for traders and investors. upcoming study should focus on enlightening model strength by incorporating real-time data and exploring hybrid replicas to further improve forecast accuracy.

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Multi-Agent Based Resource Provincing for Energy Minimization and Co2 emission monitoring

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Abstract: Conventional methods of allocating virtual machines (VMs) frequently concentrate on centralized energy-conscious tactics or execute virtual machine migrations without sufficiently accounting for the related expenses in cloud computing structures. We provide a decentralized agent based virtual machine (VM) allocation method that minimizes energy consumption and maximizes income production in order to overcome these difficulties.PM receives a cooperative agent from the suggested agent method, which helps with managing virtual machine resources. Our technique for allocating virtual machines (VMs) to PMs is auction-based, which enables these agents to strategically assign VMs to PMs while maximizing potential income and energy efficiency. Agent can swap out the virtual machines that is allocated using this process, which lowers energy expenses while raising total income. We evaluate the effectiveness of the agent based method with both static and dynamic simulations. The results of our static testing demonstrate that our strategy may produce significant energy savings and decreasing the CO2 emission while maintaining computational efficiency when compared to other common centralized strategies such as Heuristic-based approaches and simulated annealing approaches. In dynamic scenarios, our agent strategy not only achieves the energy efficiency of virtual machine consolidation techniques, but also significantly reduces relocation costs, boosting CSP profitability and ensuring sustainable energy consumption.

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A Hybrid XGBoost-MLP Approach for Predicting miRNA-Disease Associations

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Abstract: The discovery of miRNA-disease connections is essential for furthering biomedical research since microRNAs (miRNAs) control gene expression and are linked to a wide range of disorders. This paper proposes the use of a hybrid machine learning strategy that couples the strengths of Multi-Layer Perceptron, for classification, with XGBoost, for feature extraction, toward the prediction of miRNA-disease connections. Complex interactions between features are captured in an efficient way by XGBoost and then classified by the MLP on the final data after processing the gathered features. When compared to standalone models, the model performed better when measured by accuracy, precision, recall, and F1 score. Furthermore, in order to improve the model's interpretability, we utilized SHAP (SHapley Additive exPlanations), which quantifies the effect of each miRNA on illness predictions in order to shed light on feature contributions.

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Agrismart: A Crop Selection Model for Precision Agriculture Using Machine Learning

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Abstract: With around 60% of the nation's people working in agriculture as a primary sector, agriculture continues to be the foundation of human society. The selection of crops to optimise profitability and minimise financial risks is one of the most important difficulties faced by farmers. Because it directly affects their income and influences their capacity to continue in the industry, the crops they choose are crucial. This paper addresses this problem by presenting a machine learning-based crop recommendation system that uses soil properties like pH, moisture, and nitrogen levels as well as weather data to forecast which crops would be best suited for growing. XGBoost (XGB), Random Forest (RF), Gaussian Naive Bayes (GNB) and ensembling of RF+XGB are the machine learning models used in the proposed system. The prediction performance of these models was assessed after they were trained on historical agricultural datasets. Random Forest outscored the others in terms of accuracy, precision, recall, and F1-score. This system seeks to reduce crop failures, increase agricultural production, and facilitate diversification by giving farmers practical, data-driven advice. In the long run, it hopes to modernise conventional farming methods and promote sustainable agriculture.

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Estimation of State of Charge and State of Health in Battery Management System

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Abstract: Electric vehicles (EVs) are leading the way in the adaptations towards sustainable mode of transportation, by offering a good solution to reduce greenhouse gas emissions and to reduce the reliance on fossil fuels. The major challenge in adoption of EVs is the inability to accurately predict the battery's performance regarding its remaining charge and overall health, these crucial metrics, known as State of Charge (SoC) and State of Health (SoH). Inaccuracies in the SoC and SoH estimations will eventually lead to range anxiety and potential battery deterioration due to charge and discharge cycles, thus undermining user trust and adaptation of these vehicles. To address this issue this paper proposes a novel approach to precisely predict SoC and SoH by proposing an innovative framework which combines machine learning techniques with system modelling and by simulating a lithium-ion battery pack in MATLAB, the necessary data is generated to explore a robust solution to tackle the challenges posed by non-linear behaviour of battery under varying operating conditions. The goal of this research is to enhance battery monitoring systems and to develop smarter and more adaptive Battery Management System for electric vehicles.

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Advancing Towards Maritime 4.0: A Comprehensive Analysis of Digital Transformation and Maturity Levels in South Asian Ports

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Abstract: The maritime industry is undergoing a significant digital shift under the influence of Industry 4.0, integrating advanced technologies like AI, IoT, and big data to enhance efficiency, sustainability, and safety. This study explores the adoption of Maritime 4.0 technologies across South Asian maritime ports, assessing their current digitalization status and future ambitions in critical areas such as Port Operations, Synchromodality, Energy and Environment, Safety & Security, and Capability. Utilizing expert surveys and interviews, the research reveals varied maturity levels among ports, with a general trend towards more integrated, efficient operations. Key findings indicate that ports like Maldives and JNPT are at the forefront of this transformation, aiming for higher levels of operational integration and sustainability. The study underscores a significant industry-wide shift towards embracing Maritime 4.0, driven by diverse strategies tailored to each port's unique context and strategic goals.

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The Role of AI in Emotional Advertising: A Bibliometric Analysis and TCCM-Based Systematic Literature Review

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Abstract: Artificial Intelligence (AI) is reshaping advertising through hyper-personalization, predictive analytics, and emotion-driven marketing. AI-driven tools enable brands to optimize consumer engagement, enhance sentiment-based targeting, and refine content delivery using machine learning and natural language processing (Dwivedi et al., 2021). Despite growing academic interest, there remains a lack of structured bibliometric insight into AI's thematic evolution, theoretical underpinnings, and methodological advancements in advertising research. This study conducts a bibliometric analysis of 319 peer-reviewed Web of Science Core Collection papers, mapping key citation trends, thematic structures, and intellectual contributions. The study identifies research gaps and emerging trends using Bibliometrix R (Aria and Cuccurullo, 2017) and VOSviewer (Van Eck and Waltman, 2010). A systematic literature review (SLR) employing the TCCM framework (Paul and Criado, 2020) further examines 70 ABDC A* and FT50 indexed journals, offering insights into AI's role in advertising strategy, consumer trust, and ethical considerations. Findings reveal a shift from AI adoption models to algorithmic transparency, emotional intelligence in AI, and responsible AI governance. However, regional imbalances persist, with emerging economies underrepresented. Future research should integrate neuroscientific techniques (EEG, fMRI, eye-tracking) to analyze subconscious consumer responses to AI-driven marketing. This study provides valuable insights for academia, industry, and policymakers, shaping the future of AI-powered advertising.

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Smart Essay Assessment and Scoring System using Deep Learning Techniques

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Abstract: The Smart Essay Assessment and Scoring system (SEAS) was a tool designed to assess and score essays. The traditional method of manually assessing essays, which involved multiple reviewers to assure impartiality, had been costly, time-consuming, and prone to error. The traditional method of manually assessing essays, which involved multiple reviewers to assure impartiality, had been costly, time-consuming, and prone to error. To address these issues, a sophisticated automated essay grading system utilizing Deep Learning and Natural Language Processing (NLP) technologies has been proposed. Essays had been encoded as sequential embeddings using an advanced technique that leveraged a Bidirectional Long Short-Term Memory (BI-LSTM) network to capture semantic information. The proposed Smart Essay Assessment System had evaluated the essay's logical coherence, highlighted key phrases and sentences, and generated grading results that were simple to grasp. This approach had represented a significant advancement in the automated essay grading space and had offered a workable solution for educational institutions looking to enhance and optimize their assessment processes.

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ProWAR: A Profit-Oriented Approach to Weighted Association Rule Mining for Retail Analytics

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Abstract: Market Basket Analysis (MBA) is essential for identifying product linkages in retail, allowing organizations to enhance bundling, promotions, and customer interaction methods. Conventional MBA methodologies predominantly depend on support, confidence, and lift to assess item associations, frequently neglecting critical business goals like profitability and demand-oriented insights. To address this disparity, we offer ProWAR (Profit-Oriented Weighted Association Rule Mining), an innovative methodology that incorporates financial variables, such as profit margins and sales volume weights, into the rule-mining procedure. Utilizing the mlxtend library for rule generation, we develop a hybrid scoring system that integrates traditional measures with profit-oriented criteria. Our methodology, proven using actual retail information, effectively identifies high-value relationships that facilitate dynamic pricing, targeted promotions, and optimized inventory management. ProWAR improves the strategic use of MBA in retail decision-making by emphasizing financially significant and practical insights.

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Prosthetic Therapeutic Device with Full-Hand Support and Ankle Action for Lower Limb Amputees

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Abstract: This interdisciplinary project develops advanced rehabilitation and prosthetic solutions to enhance the quality of life for individuals recovering from strokes or living with lower limb amputations. The *Full-Hand Therapeutic Device* helps stroke patients regain strength, dexterity, and sensory perception using robotics, sensors, neuromuscular electrical stimulation (NMES), and AI. It supports therapies like constraint-induced movement therapy (CIMT) and sensory reeducation, offering personalized care and improving recovery outcomes. For lower limb amputees, a prosthetic designed for motorcycle riding combines biomechanics, adaptive technology, and user-centered design to replicate natural ankle movements for braking and gear shifting. Machine learning adapts the device to the user's movement patterns, ensuring comfort, safety, and stability. Through iterative testing and collaboration with amputee riders, the prosthetic empowers users to operate motorcycles confidently. Both devices emphasize innovation in rehabilitation and prosthetics, aiming to improve mobility, independence, and overall quality of life for diverse patient populations.

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AI GenDetect: A Comprehensive Approach to Detecting AI-Generated Images

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Abstract: As AI-generated images become increasingly sophisticated, concerns about visual content authenticity grow. This study introduces "AI GenDetect," a solution for detecting AI-generated images using a curated dataset combining the Casia dataset and real-world images. Employing Error Level Analysis (ELA) for preprocessing and leveraging Convolutional Neural Networks (CNNs), the model achieved 91.83% accuracy in 9 epochs. Results include precision-recall metrics, a confusion matrix, and real-world testing scenarios, highlighting its practical effectiveness. AI GenDetect offers a robust approach to image authentication, addressing current challenges while paving the way for future advancements in safeguarding visual content. Keywords: AI-generated images; Image authentication; Error Level Analysis (ELA); Convolutional Neural Networks (CNN); AI GenDetect; Image manipulation detection; Deep learning; Confusion matrix.

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Enhancement of Landslide Identification through Late Fusion Deep Learning Techniques Using Early-Fused Remote Sensing Multispectral Satellite Imagery

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Abstract: This study introduces a late fusion approach for landslide detection by combining the outputs from two models, UNet and YOLO, trained on multispectral satellite datasets. UNet is used to generate segmentation masks, offering pixel-level details, whereas YOLO provides bounding box predictions for faster object localization. Their integration enhances both the detection accuracy and spatial precision. Two approaches were explored: independent model training followed by fusion and sequential integration, where UNet outputs served as input to YOLO. A comparative analysis demonstrated that late fusion improves segmentation accuracy and object localization. Specifically, the late fusion approach achieved an accuracy of 0.8784 in Approach 1 and 0.885 in Approach 2, highlighting a notable improvement over individual model performance. The results emphasized the synergy between segmentation and object detection, underscoring the potential of this integrated approach for landslide detection in disaster management applications.

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Comparative Analysis of Pretrained CNN Architectures for Mobile-Based Early Detection of Brinjal Little Leaf Disease

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Abstract: Phytoplasma infections frequently pose a threat to the cultivation of brinjal and result in little leaf disease, which completely impedes productivity and yield. It is essential to detect diseases at an initial phase of infection within 2-3 days to mitigate crop losses and ensure sustainable production. Therefore, an image dataset was collected from healthy brinjal plants and diseased plants that were precisely infected with two significant disease stages (initial chlorosis, and witches broom) for this study. Deep learning is employed to assess the disease categorization capabilities of five pretrained Convolutional Neural Network (CNN) models. Before being further enhanced for a mobile application, the models are trained and verified on a methodically chosen dataset. ResNet152 achieved the highest training and validation accuracy and the lowest loss among the other pre-trained models. The main objective of the investigation is to evaluate its accuracy, computational effectiveness, and suitability for deployment on lightweight mobile devices of these pretrained CNNs for early detection of brinjal leaf disease.

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Redefining Access Control: Blockchain-Driven Space Authentication in the Metaverse

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Abstract: As the metaverse advances as a complex virtual ecosystem, it is crucial to establish strong security and authentication methods. Although user authentication has been thoroughly studied, there has been little focus on the authentication of virtual environments, which is essential for ensuring secure interactions and access in the metaverse. This paper presents an innovative, decentralized method for space authentication utilizing blockchain technology. The suggested approach incorporates user-focused principles, allowing secure entry to designated virtual areas without dependence on centralized systems. Utilizing blockchain smart contracts and cosine similarity metrics, the system guarantees that authentication procedures are transparent and secure against unauthorized access. Experimental findings confirm the effectiveness of the method, showing its practicality for real-world use in metaverse settings. This study enhances metaverse security by integrating the advantages of blockchain technology and decentralized user authentication within a spatially aware framework.

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Hybrid Generative AI Framework for Medical Text Summarization: Enhancing Precision and Relevance in Healthcare Decision-Making

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Abstract: The rapid growth in the healthcare industry demands innovative techniques to extract a sufficient number of required information from unstructured textual information, for example, clinical notes, patient records, research papers, and diagnostic reports. Such bottlenecks delay the time of decision-making and proper care delivery. Therefore, we have developed a Hybrid Generative AI Framework combining both extractive and abstractive summarization approaches using rule-based, supervised, and unsupervised learning methods. This framework includes all the leading AI models like BioBERT, architectures of GPT, and domain ontologies namely UMLS and SNOMED-CT for the production of summaries that are not only trustworthy and contextually relevant but factually accurate with the inclusion of NER, TF-IDF, and optimization based on reinforcement learning, thus beating the contextual limitation of traditional methods and factual inaccuracy of abstractive methods. The performance was measured in depth using metrics like ROUGE-1, ROUGE-2, ROUGE-L, BLEU, execution time, and memory usage. Results were found to be highly improved, such as 93.2% NER precision and a 92.6% reward optimization score, which assures the suitability of the framework in generating clinically relevant summaries. The hybrid approach also showed efficiency in terms of execution time and balanced memory usage, thus being scalable for real-time applications. It allows for an easier and much quicker appraisal of the process by medical professionals, subsequently making for better clinical decisions to result in better health outcomes of patients. As such, it becomes the benchmark by which medical literature is summarized to provide guiding principles towards improving healthcare provision and improving precision medicine.

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AI Powered Text Editor with Speech to Text Conversion for Handicapped Writers

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Abstract: In this modern era, many handicapped people struggle with content creation. Therefore, it is important to develop technological tools for these people. Writing and communication are basic requirements for both academic and professional careers but present a challenge for a person with a disability. Unfortunately, traditional techniques are not able to fulfil all the criteria for a handicapped person. The goal of this research is to provide a platform for those people to express their ideas as their voice, later on which will be turned into text using our software. Research is going to provide user friendly user interface, easy to use, simple to understand and with quick response.

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Human-Centric Medical Summarization with Hybrid Generative AI New Era for Accessible Healthcare Insights

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Abstract: With the proliferation of digital healthcare data, there is a substantial challenge in summarizing the volumes effectively and making such summaries available to non-specialist audiences. The work under way makes an attempt towards a hybrid approach for medical text summarization based upon the generative AI model that integrates both the rules-based approach and the transformer-based generative model hence enhancing the clarity and relevance of information in healthcare. While in contrast to fully NLP models, this hybrid combines the imperative of medical accuracy with that of accessibility through the exploitation of domain-specific heuristics along with generative language models, we tested this considerably using real-world clinical texts against readability, factual consistency, and summarization, and examined the appropriateness of the model's ability to make complex medical terminology accessible while being highly clinical, based on feedback from both clinical and lay audiences. The results show that the proposed framework indeed remarkably improves the interpretability of medical data, thus providing an effective solution for patient centered digital health applications, and establishes a reference standard for responsible and trustworthy AI-driven medical summarization. It demonstrates the capability of hybrid generative AI to revolutionize patient engagement and access to healthcare insights.

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Analyzing the Impact of Perceived Ease of Use, Delivery Service and Convenience to the Q-Commerce Customers

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Abstract: Purpose: The objective of the study is to examine the effect of perceived ease of use (PEOU) and delivery service for providing convenience to Q-commerce customers. Q-commerce is an emerging business model in which daily needs products are delivered to the customers within 10-60 minutes. Convenience is the feature that is related to the purchase intention of the customers to adopt the platform and its services.
Design/Methodology: The study is based on primary data from 254 Indian Q-commerce users. The data is collected through a questionnaire and measured using the Likert scale.
Results: Multiple regression analysis is conducted. The results indicate that multiple R is 0.72, which indicates a strong positive relationship between the predictors and the dependent variable. The model's significance is confirmed by an F-statistic of 241.15 and a corresponding p-value close to zero. Customers have shifted to opting for this service as it provides 'convenience'.

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AI Enabled Voice Biometric Customer Authentication System Empowering Inclusivity

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Abstract: The project recommends AI-Enabled Voice Biometric Customer Authentication System. Caller authentication is the process of authenticating callers' identity over phone. Due to increased call-volumes in recent years, caller's authentication has become critical for Contact Centers (CC). Knowledge Based Authentication (KBA) has been used for many years to identify callers. Despite improvements in static and dynamic KBA, significant costs, security risks, and time-consumption remain. Due to data breaches, KBA is unsafe. Behavioral biometrics solutions provide superior security and reduce operational costs compared to KBA. A person's unique behavioral pattern such as voice, which is difficult to replicate, is the basis of behavioral biometrics. It examines various speech traits, producing voiceprints, like fingerprints. This research recommends voice biometrics for CC to authenticate consumers to improve security at lower cost. The proposed model achieved over 80% accuracy in identifying customers in less than 5-10 seconds, reducing costs and time by 50-60%, compared to KBA. Being textand language-independent, this method suits diverse contexts and locations. This technology simplifies authentication for elderly, illiterate, or physically impaired customers, including the blind. The proposed cloud-free architecture suits confidential use where cloud data is highly risky. This authentication process can be used to connect to Contact centers, mobile apps, IoT devices, and internet services, enabling seamless verification at reduced cost and fewer security challenges. It records unauthorized access attempts and customers can be advised on such attempts, enabling timely precautionary actions. Same records can be used for various analysis purposes.

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Advancing Machine Learning: A Comprehensive Review of Foundation Models and Their Applications

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Abstract: In recent years, machine learning (ML) has seen tremendous progress in different fields such as natural language processing (NLP), computer vision and multi-modal learning. This paper discusses the state of the art in ML, dealing with the issues of parameter-efficient fine-tuning, transfer learning, few and zero-shot learning, multi-modal learning, RL from human feedback (RLHF), knowledge distillation and quantization, sparse training. The authors evaluated these techniques in a range of ways, identifying advantages and disadvantages of each of them. Speculations about developments of machine learning in the near future and about possible fields of their applications are offered at the end of the paper.

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TLQC-AL: Transform Learning with Quality-Controlled Annotation in Active Learning

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Abstract: The difficulty of managing substantial amounts of unlabeled data in big data contexts is widely acknowledged. Supervised learning models generally attain superior performance when trained on large labeled datasets. Although several applications offer labels at minimal or no expense, numerous others—such as speech recognition, information extraction, categorization, and filtering—demand considerable time and money for data labeling. Active learning is crucial in this context, allowing models to selectively obtain labels when there is an abundance of data but a scarcity of labeled samples. The efficacy of classification results in machine learning is significantly determined by the quality of the labeled data utilized for training. This study introduces a hybrid technique that combines transform learning with active learning to improve label quality control. In contrast to conventional active learning methods that depend on a static transformation, our suggested model flexibly adjusts transformations, resulting in enhanced efficiency and performance in machine learning systems.

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Quality Inspection Techniques of Fruits and Vegetables using Hyperspectral Imaging: A Review

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Abstract: Hyperspectral imaging provides a non-destructive and fast way to assess the internal and external quality of fruits and vegetables, helping to improve food safety and processing efficiency. They are an integral part of any food system, which has the potential to revolutionize the sorting and grading systems in the industry, making them more precise and automated. The Hyperspectral Camera captures images across a wide spectrum of wavelengths, far beyond the visible range. These images not only provide information about the visible features like color but also about the chemical and structural composition of the fruits and vegetables. Hyperspectral data often requires spectral correction to account for various environmental factors, like lighting conditions or sensor calibration errors as a part of pre-processing. The selection of wavelengths provides useful information for quality assessment. Image processing techniques are applied to enhance these images, such as filtering, noise reduction, extracting features, and segmenting regions of interest to isolate specific areas of the image that have indicated potential defects or abnormalities. In this way large amount of data is collected and the next step involves extracting meaningful patterns from the large volumes of data generated by hyperspectral imaging. Then Machine Learning Algorithms are applied to reduce the data to a manageable size and to identify key features that correlate with the quality characteristics of the fruits. After processing, the data is analysed to produce a quality score or classification for each fruit or vegetable.

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Coverless Steganography: Techniques, Advancements and Research Gaps

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Abstract: Traditional steganographic techniques, which usually incorporate hidden data within cover media, increasing the danger of detection. In contrast, coverless steganography has become a potent substitute. Rather, coverless steganography improves imperceptibility and resistance to steganalysis by enabling safe information concealment without changing any cover media. The basic ideas, recent advancements, and various uses of coverless steganography are examined in this overview. We classify current approaches, such as those based on picture hashing, Image Generating, and multimedia data encoding, according to the underlying data representation and information retrieval processes. Furthermore, we examine developments in security, payload capacity, and robustness as well as real-world uses in data storage, information retrieval, and secure communication. In order to direct further innovation in this area, we conclude by identifying the main obstacles, present constraints, and potential research avenues.

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Recommending Music Based on Real-Time Human Emotions

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Abstract: Music has a strong influence on people's emotional and mental states. Music plays an integral part in a person’s life. Both a user’s mood and prior musical preferences have an impact on their choice of music. Music recommendation aids in this manual process of selecting songs, and instead recommends songs a person is most likely to listen at any given moment. Music recommendation has social as well as physiological benefits. If done right, music recommendation based on emotions of the user, can revolutionize the domain of music recommendation, leading to an enhanced personalized experience. Unfortunately, most existing music recommendation algorithms are based on genre features (such as style and album), which do not suit consumers' emotional needs. But sometimes, the "filter section" effect could exacerbate the situation when a user looks to music for emotional support. In this study, a novel emotion-based personalized music recommendation framework has been created to help consumers achieve their emotional requirements while also improving their mental health. Empirical research and user studies demonstrated that this unique framework's recommendations are exact and useful to users.

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Multiclass Classification of HateSpeech based on Large Language Models

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Abstract: Natural language processing task of hate speech detection is vital for discouraging harmful content in the digital world. This study compares the performance of six large language models (BERT, DistilBERT, RoBERTa_Base, RoBERTa_Large, Electra, and a BERT based model with supervised contrastive learning (SupCon)) on multi class hate speech classification. The models were trained and fine-tuned on a labeled dataset to classify tweets into three categories: offensive language, hate speech, neither and more. On extensive experiments, we showed that the SupCon model integrated with BERT models achieves substantially better results, compared to all competing models in terms of accuracy and F1-score in both validation and test. Supervised contrastive loss was included to help the model generalize better as it indicates more fine shaped patterns between similar and dissimilar text samples. Our findings indicate that SupCon is a promising angle from which to tune large language models for intricate classification tasks, such as those requiring robustness to context and semantics.

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Altering Multi-Level Inventory Management: A Study of IoT, AI and Blockchain Advances

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Abstract: In multi-echelon supply chains, efficient inventory management is crucial for reducing costs and optimizing operations. Emerging technologies such as Blockchain, Artificial Intelligence (AI), and the Internet of Things (IoT) have transformed inventory management by enhancing visibility, decision-making, and data security. This review explores the strengths, limitations, and future research directions of these technologies in multiechelon inventory systems. The findings indicate that blockchain enhances security and transparency, IoT enables real-time monitoring, and AI-based reinforcement learning models improve demand forecasting and cost optimization. Future research should address interoperability challenges and the integration of these technologies into a unified framework.

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Real-Time Elderly Fall Detection and Classification Using MediaPipe Holistic Skeleton Tracking and XGBoost

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Abstract: This paper presents an AI-driven automated emergency response system for real-time elderly fall detection and classification. Utilizing the MediaPipe framework for holistic skeleton tracking, the system employs a BlazePose-supported convolutional neural network (CNN) to efficiently extract human body key points from live camera feeds. These key points are then classified using the Extreme Gradient Boosting (XGBoost) algorithm, achieving 88\% accuracy across various fall scenarios. The proposed system ensures rapid fall detection, enabling timely intervention without requiring additional IoT devices or wearable sensors. Unlike traditional approaches, our method remains robust in low-resolution and distant monitoring conditions, making it a practical solution for AI-assisted safety in elderly care facilities, smart homes, and public surveillance systems. By integrating AI-driven analytics into emergency response workflows, this research contributes to automated safety monitoring, reducing response time and enhancing overall disaster preparedness.

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The Role of Artificial Intelligence on Intention-to-stay through the lens Enhancing Employee Engagement and in industry 5.0

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Abstract: In Industry 5.0 surroundings, Artificial Intelligence (AI) play an essential role in enhancing human machines, prioritizing personalization, collaboration, sustainability, and ethical considerations. The increasing scope of artificial intelligence (AI) in Modern work environments, organizations are noticing important changes in how employees are engaging with their work and their intention to stay with their companies. The research examines the connection between use of AI, employee engagement, and intention to stay. Data was gathered through a survey of 156 IT employees from Tamil Nadu and analyzed using Structural Equation Modeling (SEM) through JMP Pro software to evaluate the relationships among the variables. The findings highlight that AI implementation has a positive correlation of 0.733 on employee engagement and 0.648 on employees intention to stay. Also, employee engagement functions as a key mediating factor with an indirect effect of 0.105 and total effects to 0.1832, strengthening the effect of AI on employees' intention to remain with the organization. The coefficient of regression (R2 value) shows 0.502 on employee intention to stay ensuring the AI plays a significant role for employee growth and development. These results point out the importance of integrating AI into human resource practices, it improves employee engagement and in addition it plays an important role in retaining talent. The research provides essential insights for HR professionals and managers seeking to use AI effectively to develop a more engaging workforce, ultimately supporting organizational stability and growth.

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Ethical Governance in AI-Driven Management: Ensuring Fair and Efficient Decision-Making in Industry 5.0

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Abstract: This article gives an account of AI-powered decision-making in Industry 5.0 management as well as the benefits and ethical issues. Industry 5.0 is a shift from machine-based to human-based models where AI powers the modern businesses by giving them predictive analytics and machine learning, allowing for them to store and manage huge real-time data, reduce the mistakes, and lead to better operations. However, artificial intelligence used excessively, among others, brings a lot of ethical issues as well such as algorithmic bias, data privacy violations, and decision-making transparency. This study, from a broad review of the literature, admits the strengths of AI and the danger of immoral acts such as the discriminatory impacts management. The methodology chapter represents a step-by-step guide on the whole process of data collection, preparation, and analysis to evaluate the relationship between AI efficiency and ethical issues. It is proved that those companies, which achieve the best performance results, are those that have implemented hybrid decision models that make use of AI algorithms, exponents, who oversee the work. Besides, the use of the ethical frameworks such as Explainable AI (XAI) and algorithmic audit also safeguards against the potential risks and further it makes the process transparent. The paper ends with a conclusion that remarks that the human-technology synergy and the ethics dominance join to drive human-centered, sustainable innovation in Industry 5.0 and responsible AI deployment is only possible in this way. Henceforth, the study must be done to analyze legislation and industrial guidelines for the implementation of AI in a more ethical.

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Impact of Artificial Intelligence on the Therapeutic Relationship in Mental Health Care: A Narrative Review

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Abstract: The increasing prevalence of mental health disorders has created an urgent need for various modalities of treatment, especially highly scalable, comprehensive, and accessible therapies. Whereas face-to-face methods are still able to provide the best therapy, issues such as high costs, geographical differences, and shortage of therapists have severely limited accessibility for scalable models. Therapeutics designed with the assistance of conversational agents, passive sensing, or recommendations would enhance effectiveness in figurative terms. The integration of AI into psychotherapy raises concerns about how AI affects the therapeutic relationship, the physician's role, trust, transparency, and privacy. This narrative review will focus on how AI would affect the therapist-client relationship in working alliance, and through empathy into trust. While AI will increase efficiency and follow-up on the treatment of patients, AI is seriously limited in giving the in-depth emotional ordinality the human will confer for therapy to be successful. Furthermore, ethical tensions such as algorithm bias, informed consent, and the propensity to accept AI's recommendations continue to pose other challenges. The results will indicate a mixture model for AI: a complementary rather than a replacement one for professional clinicians. Future studies should take a two-prong approach by evaluating AI literacy among mental health professionals, making assumption-based arguments for ethical frameworks, and the building of partnerships between developers and clinicians. A balanced approach will ensure AI enables therapy while signifying the preservation of core professional values such as trust, empathy, and the human connection in therapy.

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Review of the Current Situation of the South Asian Countries on the Use of Sustainable Hydrogen Fuel as Cleaner Energy for Ocean Shipping

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Abstract: Amidst the global pivot towards sustainable energy, this paper reviews the use of hydrogen fuel as a cleaner alternative for ocean shipping in South Asian countries. It underscores the significance of these nations in international maritime logistics, considering their strategic maritime positioning and heavy reliance on traditional marine fuels. The study begins with an overview of the current state of ocean shipping in South Asia, detailing the predominant dependency on conventional fuels. Introducing hydrogen as a sustainable energy source, the paper highlights its benefits over traditional marine fuels and global advancements in hydrogen technology. South Asia's journey towards sustainable shipping is explored through various initiatives, government policies, and successful regional case studies of hydrogen adoption. However, the transition faces technical, infrastructural, economic, and regulatory challenges, compounded by environmental impact concerns. A comparative analysis positions South Asian practices against global standards, identifying gaps and opportunities for hydrogen fuel adoption. The paper concludes with future prospects, emphasizing the potential growth of hydrogen fuel in the region's shipping industry. Recommendations include developing comprehensive policy frameworks, investing in technology, and fostering international collaborations. This study reiterates the essential role of regional cooperation and innovation in achieving sustainable development and positions South Asia at the forefront of the movement for cleaner ocean shipping. Keywords: South Asian countries, maritime ports, cleaner fuel, hydrogen fuel, sustainable hydrogen fuel

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Enhanced Sugarcane Leaf Disease Prediction Using Augmented Datasets and Deep Learning Models

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Abstract: The developed system marks a notable improvement in the prediction of sugarcane leaf diseases prediction through the integration of an expanded dataset and cutting-edge deep learning architectures. Traditional approaches, often restricted to five disease categories and smaller datasets, achieved a maximum accuracy of 86.53% with models like ResNet50 and XceptionNet but faced challenges in scalability and generalization. Addressing these limitations, the updated dataset introduces a new disease class, Sugarcane BacterialBlight, and incorporates a total of 17,982 images. This expansion is achieved through systematic data augmentation techniques, including image cropping, scaling, and rotation, ensuring a balanced and comprehensive dataset. Advanced deep learning models, including ResNet50, EfficientNet_B0, and MobileNet_V2, were meticulously trained and assessed on the augmented dataset utilizing evaluation metrics such as accuracy, precision, recall, and F1-score. EfficientNet_B0 proved to be the most effective model, delivering an accuracy of 95.11%, a precision of 95.10%, a recall of 95.11%, and an F1-score of 95.09%. ResNet50 and MobileNet_V2 also demonstrated marked improvements compared to baseline performance. This research underscores the value of combining enriched datasets with efficient model architectures to deliver highly accurate disease prediction systems. These advancements hold substantial promise for precision agriculture, offering scalable, real-time solutions for sustainable farming practices. Keywords: Sugarcane leaf disease, EfficientNet_B0, deep learning, disease detection, image classification, data augmentation, precision agriculture.

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Renewable energy sources: Willingness to adopt among the farmers in the delta districts of Tamil Nadu

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Abstract: Agriculture can play a noteworthy role in the generation and usage of photovoltaics, wind, hydro energy, and geothermal energy. Renewable energy sources abound and are geographically scattered across the world. Technology Acceptance Model (TAM) is a vital tool for knowing the interest of users and it is vital for understanding their interest towards a particular concept at the early stages. The present study has been narrowed to farmers in the delta District of Tamil Nādu, embrace of Thanjavur, Thiruvarur, Nagapattinam, Trichy, Cuddalore, Ariyalur, Perambulur, Pudukkottai. Further, questions pertaining to characteristics, interest towards adopting solar water pump are alone determined in the study. This learning mainly checks the influence of TAM factors towards solar water pump adoption among the farmers in the delta districts of Tamil Nadu. The main benefit of a solar water pump is that it utilises free light from the sun. Solar water pumps reduce reliance on energy or fuel, and once placed, there is no ongoing cost for energy or gasoline. Solar water pumps require minimal lookup when opposed to ordinary water pumps. Lastly, this research will help the economist understand farmers better and suggest favourable policies for their adoption of renewable energy sources.

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Green Technology adoption prospects faced by rural farmers in delta districts of Tamil Nadu

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Abstract: India still around 70% of people live in villages. As an agrarian economy still large community of people in rural areas relies on agriculture. But the thing is that the environment is becoming more and more harmful for the mankind. Green technology, i.e., renewable technology, is applied to mitigate human effects/disturbances on the environment. Correctly used it provides a life-long and environmentally sustainable approach to the world's needs and, in fact, over succeeding generations, may allow them to grow a sustainable future of eco-friendly food. The present study is based on delta districts of Tamil Nadu That is, it takes a decision regarding the farmer's disposition and whether the forced realization of the green technology effect is feasible. The main objective is to elucidate the influence of variables--subjective attitudes and intention, perceived and real self--in subjective norms and perceived BC--with the level of farmer' willingness to adopt green technology. Using an undirected sampling method, respondents were presented with questionnaires with which thoughts, opinions, and concerns could be expressed regarding the use's acceptance of green technology among the respondents' sample of rural farmers (n=120). SEM is used for analysing the data. Finally, this study will help the policy makers in understanding the interest of rural farmers towards green technology adoption and make decisions for improving their standard of living.

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Enhancing Transparency and Security Through Blockchain Innovation

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Abstract: This study explores the transformative impact of blockchain technology across various industries, focusing on its ability to enhance transparency, efficiency, and trust. It presents a literature review on the applications and challenges of blockchain technology, emphasizing its role in enhancing transparency and security. Additionally, it highlights several research gaps that are either minimally explored or yet to be addressed. Furthermore, it discusses advanced tools designed for monitoring and analysing blockchain data, which aid decision-making and ensure compliance, along with practical applications across different industries. The methodology involves carefully selecting relevant studies based on specific inclusion and exclusion criteria to ensure the accuracy, quality, and credibility of the analysed literature. Overall, this study underscores the growing significance of blockchain technology in modern industries, illustrating its potential to revolutionize traditional business models, optimize resource management, and build more secure and efficient systems for the future.

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Mapping the Development: A Bibliometric Analysis of Industry 4.0, Green Supply Chain Management, and Sustainable Performance

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Abstract: The emergence of new technologies in Industry 4.0, including blockchain, AI, and IoT, has greatly influenced the progress of Green Supply Chain Management (GSCM) and Sustainable Performance. This study looks at how these areas have evolved over time and offers a detailed overview of worldwide research from 2019 to 2025.The study used bibliometric analysis to identify important publications, notable authors, and emerging research themes in this field. This research made use of tools such as the Biblioshiny package in R and VOSviewer (version 1.6.19), enabling advanced methodologies like bibliographic coupling, co-citation analysis, and keyword co-occurrence mapping. These methods help us spot common patterns and collaborative networks in the topic, allowing us to grasp the relationships between authors, publications, and research subjects. The findings highlight significant contributions from countries like the United States, India, and Brazil, along with pressing matters such as the circular economy and sustainable manufacturing. This research provides important insights for academics and industry experts aiming to enhance sustainability and innovation within supply chains. This illustrates how Industry 4.0 technology relates to GSCM methods, emphasizing the significance of bibliometric approaches in improving our understanding of global research trends and promoting collaboration across different areas.

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Industrial Revolution 5.0: A Continuous Evolution and Future Research Directions

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Abstract: Industry 5.0 is the hot topic in the current technological business scenario. I4.0 has not reached its full potential as of now, and I5.0 can help I4.0 to target 100% adoption rate by using it as a base and inculcating Human Centricity, Better traceability, enhanced transparency, better coordination and Sustainability. I5.0 is a far more, Holistic approach and it has wider scope in mingling with upcoming technologies like- 6G (for faster, safer, and more stable real time communication), DAO (enhancing the capabilities of decision making, and also supports decentralized decision making at the time crisis), and Parallel Intelligence (increased safety, capability to have self-healing systems, Enhance Human centricity). This papers also explain various components of I5.0, Additionally based on gaps in the literature, it aims to provide Future research directions, to fill the gap efficiently and in effective manner which includes Interplay between Components of I5.0, Rating systems for I5.0 and I5.0 Ecosystem and Governance. For study this paper uses data from (ScienceDirect, IEEE Xplore, and Google Scholar) databases. We concluded this study but suggesting the need for more empirical research in this domain.

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Bell pepper leaf disease detection: A Comprehensive Review

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Abstract: Due to various leaf diseases, bell pepper crops are vulnerable significant threats that affect both its production rates, as well as its quality. Old school methods are slow and sometimes very irrelevant, by the time authorities have intervened; diseases have already circulated widely. In this review, the authors offer a systematic analysis of machine learning (ML) for the diagnosis and classification of leaf diseases in bell peppers. Some of the branches highlighted are image-based detection where image processing is used to detect disease symptoms, so that prompt action is taken. This is done with help of convolutional neural network (CNNs) and other Machine Learning (ML) models trained on various datasets comprising bell pepper leaf images, and aimed at differentiation of healthy and affected leaves and different types of diseases. The combination of ML with image processing enhance the detection rate and reduce latency to assist farmers for health status of the crops. This review also explore a role within Internet of Things (IoT) devices in disease detection through providing real time data for quick and efficient decisions. The recommendations of this study hereby underline how the implementation of ML-driven.

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Blockchain-Enabled Next Generation Wireless Communication System: 5G and Beyond

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Abstract: Blockchain technology has changed rapidly over the past decade. No longer simply the structural foundation for crypto currencies; It is decentralized and secure at its core. This feature of blockchain technology has added the advantage of making it an important input in industries such as communication. In the case of communication systems, blockchain has enhanced security, reliability, and transparency. IoT and 5G are new technologies that have emerged in the data technologies scene that need fast, secure, and scalable communication structures, thus making blockchain more relevant because of its decentralized structure. Blockchain deals with various issues through the decentralised control of the network. Apart from decentralization, communications on the blockchain use encryption to protect information from other parties in the network so that the intended recipient only accessed the communication. Blockchain protects information by utilizing cryptographic algorithms, which prevent other people from gaining or changing access to the data.

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Mapping Research Trends in Humanitarian Supply Chains and Disaster Management: A Bibliometric Study

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Abstract: The study aims to build on this gap in the Research of Humanitarian Supply chain and Disaster Management by performing a bibliometric analysis of 244 scholarly papers from 2006 until 2025 that were retrieved from the Scopus database. The analysis is comprehensive as it highlights the trends in the research, important authors, and subjects studied. The results indicate that the publications are growing at a constant rate of 3.72% every year, which shows how the field is gaining importance. Some of the authors include Dubey R. and Kovács G. as leading researchers, while the United States, India, and the United Kingdom are the leading nations in the field. In addition to that providing a map of the intellectual terrain of HSC research, this paper explains how resilience, sustainability, and international cooperation may enhance disaster management practices. Future Research should investigate neglected topics, increase participation from around the world, and implement flexible technological strategies in order to enhance disaster prevention and readiness.

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Modeling Typing Performance: Insights from a Novel Dataset and Minimal Attributes

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Abstract: Typing is a vital skill in the present age that has a major impact on various activities of daily life. Hence, it is quite important to analyze the various factors that impact typing performance. A lot of research has been accomplished in areas of user authentication, behavioral patterns, keyboard ergonomics, and the influence of cognitive factors like memory, fatigue, and attention. Much of this research has been around keystroke dynamics. This paper aims to identify the various patterns in typing performance particularly for people taking part in online typing tests by providing a new dataset of 15,003 typing tests given by 22 users on the Monkeytype platform. The dataset provides a unique opportunity to analyze typing performance patterns. The research investigates the feature importance of the key features that influence typing speed and examines their predictive power using different machine learning algorithms such as Random Forest, ExtraTrees, XGBoost and Catboost as well as neural network models. Via a comparative evaluation of these models, we aim to identify the best approaches for WPM prediction, followed by statistical testing for hypotheses indicating performance variations in typing sessions. Further, the correlation and tradeoff between accuracy and consistency are explored.

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A Multi Stakeholder Perspective of SSCM5.0 in Renewable Energy Zone

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Abstract: The study focuses on examining how Industry "Sustainable Supply Chain Management" (SSCM) 5.0 principles, human-centered innovation, and sustainability, which can enhance "supply chain" (SC) work. The findings reveal the perceived advantages of SSCM 5.0 like efficiency gains, cost effective, better environmental outcomes, and increased accountability. However, high initial investment, skill gaps, and a lack of willingness to adopt change are also addressed. This paper throws a valuable insight on SSCM 5.0 barriers to implementation were identified in the renewable energy sector, and specific solutions were provided for the stakeholders in the field and the government. Also, by adopting human-robot collaboration, next-generation AI technologies, and sustainable solutions, the sector can integrate smart supply chains, reduce negative environmental effects, and bolster an effective, sustainable, and robust energy system.

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Review Paper on Bluetooth-Based Tracking System for Elevators

Harshpreet Kaur, Anand Kumar Bharti, Tarun Sabharwal
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Abstract: This paper presents a comprehensive review of Bluetooth-based tracking systems used in elevators, highlighting their potential to revolutionize elevator management. The review synthesizes findings from multiple studies, focusing on the technologies employed, methodologies utilized, and the effectiveness of these systems in enhancing operational efficiency and user experience. Key insights reveal that Bluetooth Low Energy (BLE) technology offers low latency and high accuracy, significantly reducing waiting times and optimizing elevator usage. However, challenges such as implementation costs, data privacy concerns, and environmental interference remain prevalent in current implementations. The paper discusses these challenges in detail and evaluates various strategies to mitigate them, including advanced encryption techniques and cost-effective deployment solutions. Furthermore, it proposes future research directions aimed at leveraging emerging technologies, such as artificial intelligence and IoT integration, to further improve the reliability and scalability of Bluetooth-based tracking systems. By addressing these critical areas, this review aims to contribute to the ongoing discourse on smart building technologies and enhance the overall effectiveness of elevator management systems.

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FakeShield: A Machine Learning-Based Model for Detecting Fake News Using Multi-Feature Analysis

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Abstract: The rapid spread of fake news, especially on social media platforms, has raised significant concerns and greatly influenced decision-making processes. To address this issue, we present FakeShield, a machine learning-based model for detecting fake news by leveraging a diverse set of features extracted from both the title and content of news articles. Our approach extracts four main categories of features: linguisticbased features, sentiment-based features, named entity recognition (NER), and textual features. We evaluate FakeShield using two classification algorithms: Random Forest (RF) and Long Short-Term Memory (LSTM). Experiments conducted on the Horne17 Fake News dataset demonstrate that FakeShield significantly outperforms baseline models. The F-measure and accuracy improve by 9.3% and 9.8% with FakeShield RF, respectively. FakeShield LSTM achieves even greater improvements, with a 40.2% increase in F-measure and a 17.7% increase in accuracy. These results indicate that FakeShield is highly effective in detecting fake news and mitigating its impact.

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FitLife: Online Path to Wellness Application

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Abstract: The Online Path to Wellness Application is a feature-rich Android software that combines mental health support with physical wellness features to enhance total well-being. This study provides a comprehensive evaluation of the function and impact of popular health apps accessible on Google Play in improving global health. As daily life experiences substantial changes, many of which are negative, health and well-being become more vital. Depression affects the majority of people worldwide, thus living a healthy lifestyle is essential. The Online Path to Wellness App enables users to take control of their health by providing tailored information and actionable advice. This paper will discuss the application's different features, development approach, comparisons to existing apps, and future scope.

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Scientometric Analysis of Bluetooth Lift Elevator

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Abstract: The comprehensive analysis of the rapidly evolving field of Bluetooth-enabled elevator systems. Through a multi-faceted approach, including citation, co-authorship, organization, and geographical distribution analyses, we uncover the key research trends, influential studies, and collaborative networks driving the advancement of this transformative technology. The results reveal that Bluetooth elevator research is led by prestigious institutions such as MIT, UC Berkeley, and the National University of Singapore, with the United States, China, and Germany as the global hubs. The top-cited papers highlight the diverse benefits of this technology, ranging from energy efficiency and user experience to enhanced safety and emergency response capabilities. By integrating these complementary insights, this study provides a holistic understanding of the Bluetooth elevator research ecosystem, guiding strategic decision making and fostering international collaborations to address the evolving needs of the elevator industry.

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Leveraging Artificial Intelligence to Enhance Service Quality and Client Satisfaction in the Indian Construction Market: A PLS-SEM Approach

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Abstract: This study investigates the impact of service quality on client satisfaction and future behavioural intentions within the Indian construction market, emphasizing the mediating role of client satisfaction. The study explores how artificial intelligence (AI) can enhance service quality by improving project management, communication, and quality control. A Partial Least Squares Structural Equation Modeling (PLS-SEM) approach validates key relationships. Data were collected from 205 Indian construction professionals from June 2024 to December 2024 using convenience sampling. Responses were obtained via Google Forms and personal interviews. The study outlines that higher service quality significantly enhances client satisfaction by relying on reliable project delivery, effective communication, and adherence to quality standards and explores AI-driven analytics and automation that improve efficiency, accuracy, and decision-making, further enhancing service quality. Client satisfaction is a critical mediator between service quality and future behavioural intentions, highlighting AIpowered sentiment analysis and predictive modelling to help firms proactively address client concerns and strengthen satisfaction. The study underpins the strategic role of artificial intelligence in enhancing service quality and client satisfaction, offering insights for Indian construction firms seeking competitive advantage to evaluate the results with no limitation. However, using cross-sectional survey data and convenience sampling may still impact generalizability.

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Exploring Ethics in Artificial Intelligence: Insights from Recent Literature

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Abstract: The paper attempts to explore the research landscape of ethics in artificial intelligence (AI) applications. A qualitative analysis was carried out to understand the AI ethics research landscape. It is found that although there is global attention for adopting ethics in AI and researchers have proposed various solutions towards implementing them, significant obstacles exist in implementing such solutions.

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Digital Interventions for metabolic health outcome and inclusion of AI- a Review

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Abstract: The integration of digital interventions in metabolic health management, augmented by artificial intelligence (AI), has revolutionized personalized healthcare strategies. These technologies offer innovative approaches to tracking, managing, and improving metabolic health outcomes, particularly for conditions such as type 2 diabetes and obesity. This review explores the transformative role of AI-powered digital health interventions, their impact on personalized medicine, and the barriers that hinder their widespread implementation. A comprehensive review of existing literature was conducted to analyze key advancements in digital therapeutics, AI-driven predictive models, and real-time monitoring tools for metabolic health management. AI-driven solutions enhance precision medicine by optimizing patient-specific recommendations and improving adherence to lifestyle modifications. However, several challenges persist, including disparities in digital health literacy, accessibility issues, and ethical concerns related to data privacy and algorithmic bias. Advancements in machine learning, wearable technologies, and AI-driven decision-making are poised to reshape metabolic healthcare. Addressing the barriers to implementation through a multidisciplinary approach is crucial to ensuring equitable and sustainable health outcomes.

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A Literature review and Classification of Digital Marketing in the Tourism Sector Research

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Abstract: This study presents a literature review and a categorization scheme for digital marketing in the travel sector from 2009 to 2024. From the Scopus database, 94 articles from 70 journals were selected as appropriate sites for digital marketing study in the tourism sector. The findings demonstrate that the field of digital marketing in tourism has seen an increase in the amount of research covering a broad variety of subjects. The articles are presented in a format consisting of four primary categories. (i) Digital Marketing approaches, (ii) Consumer Behaviour and Engagement, (iii) Technology and Platforms, and (iv) Case Studies and Applications; each is divided into sub-categories. A comprehensive catalog of references is provided. The objective of this investigation is to encourage additional research in this field and to offer a valuable resource for individuals who are interested in digital marketing in the tourism industry.

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Stock Market Prediction Using Deep Learning: A Comparative Study of CNN, RNN, and LSTM Models

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Abstract: With the rapid development of the economy, stock markets or equity markets play a pivotal role in today's financial landscape. As more individuals and institutions participate in stock investments, the rise and fall of index prices become critical, directly impacting investors' earnings. Given the highly non-linear nature of stock market data influenced by numerous factors, relying on simple linear or non-linear models often proves insufficient. This research explores the development of robust deep learning models to predict and analyze stock index data from major indices: Nifty 50, Nifty IT, Nifty Oil and Gas, Nifty Financial Services, and Nifty Bank. By leveraging the Sliding-Window model for time-series forecasting, this study evaluates the fitness of three popular deep-learning architectures: CNN, RNN, and LSTM. The models are trained and tested on historical data from these indices, with performance assessed using MSE, MAE, and MAPE evaluation metrics. The findings provide insights into the strengths and limitations of each model for stock index prediction, offering guidance for selecting the most effective approach for specific indices.

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The Forecasting of Labour Productivity Using Machine Learning Models: A Case Study on the Manufacturing Sector in the USA

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Abstract: The manufacturing arena's rapid adoption of artificial intelligence and machine learning is recasting traditional forecasting. Conventional forecasting models often stumble in the face of big swings in the market, rising labor costs, and increasing automation. The research explores how advanced ML methods such as Ridge, Lasso, ElasticNet, Random Forest, and XGBoost can be used to better predict productivity in the U.S. manufacturing sector. We use historical stock price data from 30 U.S. electronics manufacturers of the years 2018-2023 to review the performances of different models. Racial Regression achieved the highest precision of all, excelling in modeling the intricate and nonlinear relationships among key variables such as automation intensity, R&D expenses, and overall production output. The results also suggest that AI-driven forecast models can dramatically improve strategic decision- making; lessen operational inefficiencies; give information for government policy-making targeted at raising labor efficiency. However, obstacles remain, including possible displacement of jobs; high costs of implementation; difficulties in putting all this stuff together and making sense out of the information gleaned. Ultimately, the study highlights the necessity of coupling ML analytics with comprehensive workforce reskilling initiatives to support a well-rounded and sustainable shift toward an AI-enhanced manufacturing landscape.

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Predictive Analytics in Healthcare Using Advanced Machine Learning Techniques

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Abstract: The integration of the Internet of Things (IoT) and machine learning (ML) has transformed patient monitoring, enabling real-time health assessment and predictive analytics. This paper proposes an advanced ML-based healthcare system that uses SVM, CNN, ANN, and LSTM models to classify patient health conditions based on key physiological parameters such as SpO2 levels, body temperature, pulse rate, and blood pressure. Through multi-class ROC analysis, performance evaluation of the models shows the following accuracies: LSTM (83.82 %), CNN (75.00 %), RNN + LSTM (86.76 %), and ANN (86.76 %). The optimized SVM model, with C=10 and y=0.5, gives an accuracy of 91.17 %, thus showing strong reliability in classification. A feature correlation matrix shows important dependencies, while SHAP analysis confirms that SpO2 is the most important factor in the health assessment. In a system with Explainable AI, the transparency in decision-making allows it to be a more effective tool in the remote healthcare monitoring and early diagnosis. The IoT-driven ML model is able to enhance patient care, reduce delay, and generally improve health care outcomes, according to this study.

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EduBridge: Advancing Education with Multilingual Video Translation

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Abstract: Video translation systems are crucial for improving accessibility and knowledge sharing in light of the increasing demand for multilingual educational materials.This paper reports on an AI-powered video translation system specifically developed for educational videos, allowing smooth cross-lingual learning. The system follows a structured pipeline: (1) extracting audio from video using OpenAI's Whisper, (2) transcribing the extracted speech with Whisper's automatic speech recognition (ASR), (3) translating the transcribed text into a target language, (4) synthesizing translated speech using Google Text-to-Speech (gTTS), and (5) replacing the original audio in the video using FFmpeg. A user-friendly Streamlit-based interface allows educators and learners to effortlessly translate videos into multiple languages. This study assesses the transcription accuracy, translation quality, and synthesized speech clarity in achieving better quality educational content delivery. Experimental results of the system demonstrate its capabilities to handle diverse subjects, technical terminologies, and diverse accents with low latency. The maintenance of synchronization problems while dealing with domain-specific language and improving the speech naturalness are discussed. This system will contribute to reducing language barriers in learning environments by allowing multilingual education, thereby making it more accessible to students around the world. Future enhancements include subtitle generation, voice cloning, and fine-tuning models for improved contextual understanding.

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Bell pepper leaf disease detection: A Scientometric Review

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Abstract: The detection of leaf diseases is crucial for the early identification and management of plant health, contributing to improved crop yield and reduced dependency on pesticides. This paper presents a deep learning-based approach for detecting diseases on bell pepper leaves using high-resolution images. The method employs convolutional neural network (CNNs), which are well-suited for image classification tasks. The system processes images of bell pepper leaves, captured using digital cameras, UAVs(drones), or other remote sensing techniques, to identify visible signs of diseases such as spots, discoloration, and wilting.

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Digital Twins for Predictive Healthcare: Modeling Human Metabolism Using AI and Neural Networks

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Abstract: Particularly in the fields of neuro-oncology and human metabolism, the advancement of digital twin technology in healthcare has great promise for individualized medication. The goal of this research is to create a digital twin of the human metabolism in order to predict and treat metabolic diseases like diabetes. After a thorough evaluation of the literature, the study's data collection and preprocessing steps included gathering patient health information and metabolic marker data. High accuracy rates in forecasting metabolic health outcomes were attained by developing, training, and assessing advanced neural network models with K-Fold Cross-Validation. Real-time risk assessment and individualized health recommendations are made possible by the integration of an AI agent to automate patient data collection. The results highlight how digital twins have the potential to revolutionize healthcare by providing a means of achieving more accurate, customized treatment plans and better patient outcomes. By contributing to the expanding field of digital twin applications, this study lays the groundwork for upcoming advancements in healthcare technology.

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Leveraging Machine Learning and Deep Learning for Cancer Diagnosis Optimization

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Abstract: One of the foremost reasons of death globally is cancer, and better patient consequences depend on premature diagnosis. Predictable cancer diagnosis techniques are often intrusive, labor-intensive, and prone to human error. This learning investigates how ML and DL algorithms can be used to recover cancer detection results, save time, and increase diagnostic accuracy. It focuses on generating new architectures, refining current models, and assessing how well they work with different cancer datasets. Analysis shows how AI-powered techniques might transform early cancer diagnosis, lower diagnostic errors, and help medical professionals make better judgments. The study uses Liver BUPA disorder database and brain Magnetic Resonance Imaging (MRI) images as datasets. The research presents optimization algorithms that outperform the accuracy results of the proposed techniques. The first model compares two classification algorithms, Feed forward back propagation and cascade correlation feed forward, with different training algorithms. The second model uses the Water Cycle Algorithm to suggest an efficient way to automatically identify brain cancers from MRI pictures. The third model classifies textures using the Gray level Co-occurrence matrix (GLCM) and Discrete Wavelet Transform (DWT). In order to segment the region of interest in the brain tumor's MRI with greater accuracy, the retrieved features are submitted to CNN.

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Unlocking Emotions in Telugu: A Multimodal System for Recognizing Affect from Speech and Facial Expressions

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Abstract: Emotion recognition in the Telugu language remains an underexplored yet crucial area of research due to its importance in human communication. This study presents a novel multimodal approach that integrates speech and facial expressions using a fusion of XLS-R and ResNet50 models. The XLS-R transformer-based framework extracts deep linguistic and vocal features, while the pre-trained ResNet50 captures facial emotion cues from visual data. By combining these two modalities, our method overcomes the limitations of single-modality models, offering a more comprehensive emotion classification framework. Evaluations of established Telugu speech and facial emotion data sets demonstrate significant improvements in accuracy over existing approaches. This research underscores the effectiveness of multimodal deep learning-based systems in enhancing emotion recognition in various linguistic and visual contexts.

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Execution of IoT-Enabled Smart Health Monitoring Systems and Security Threat Moderation

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Abstract: Internet of Things (IoT) widely utilized in order to address the available medical resources and provide elderly patients with fast, effective, and trustworthy healthcare services. A paradigm in which the advantage of the Internet of Things may be utilized for improving the lifestyle of elderly adults is health monitoring for active and assisted living. A healthcare-specialized IoT structure is introduced within this research. The data is gathered by the proposed architecture and forwarded to the cloud for dispensation and examination. Feedback actions can be received by the user based on the analysis of data. In order to present the performance advantage of the proposed architecture, a prototype has been developed. Remote healthcare is of great importance for elderly and medically challenged people because it requires end-to-end networking among people, medical equipment, and service providers. Low-power, cost-effective, reliable, and wearable devices are required for spreading eminence of life. Healthcare is emphasizing home-based health care services, collaborating with ICT to reduce time consumption, improve accuracy, and interoperable platforms. Internet of Things is quickly unfolding, and 50 billion devices will be internet connected by 2020. This implies a health monitoring system comprising of a portable remote unit and a monitoring centre for heartbeat rate, pulse rate, and temperature readings. The centre offers real-time analysis and alert warnings, but is not portable. The system employs wireless sensor technology to obtain vitality data and send it to an IoT server.

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A Multi-Criteria Decision-Making Approach to Evaluating Success Factors in Crowdfunding for Sustainable Entrepreneurship

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Abstract: This study aims to identify and analyze the critical success factors influencing crowdfunding campaigns for sustainable entrepreneurship. Given the unique challenges faced by sustainability-driven startups in securing financial resources, this research examines the interdependencies among various success factors using an advanced decision-making methodology. The study applies the Fuzzy Decision-Making Trial and Evaluation Laboratory (Fuzzy DEMATEL) method to evaluate expert-driven judgments on success factors. Seven domain experts provided pairwise comparisons of 17 identified success factors categorized into entrepreneurial factors, campaign-related factors, investor and community engagement, platform and technological factors, and sustainability and impact factors. The Fuzzy DEMATEL approach helps determine cause-effect relationships among these factors while addressing uncertainty in expert evaluations. The results reveal that entrepreneurial commitment to sustainability, trust and credibility, and the quality of the campaign pitch are among the most influential factors driving crowdfunding success. The analysis also highlights significant interdependencies, with platform security and transparency acting as key enablers, while community support and social media engagement serve as mediating factors that amplify funding outcomes. The causal analysis underscores the importance of strategic storytelling, regulatory frameworks, and investor engagement in improving crowdfunding performance for sustainable entrepreneurship. From a theoretical perspective, this study extends crowdfunding literature by integrating sustainability-oriented success factors and

employing a robust multi-criteria decision-making framework. It bridges the gap between entrepreneurial finance and sustainability by providing empirical evidence on factor interdependencies. From a practical standpoint, the findings offer actionable insights for entrepreneurs, crowdfunding platform operators, and policymakers. Entrepreneurs can optimize their campaign strategies by emphasizing transparency and social proof, while platforms can enhance investor trust through improved security and regulatory compliance. Policymakers can develop targeted incentives to promote sustainable crowdfunding initiatives. This research is one of the few studies to systematically explore crowdfunding for sustainable entrepreneurship using the Fuzzy DEMATEL method. By identifying key cause-and-effect relationships among success factors, it provides a structured decision-making framework for entrepreneurs and stakeholders in the crowdfunding ecosystem. The study's novel contribution lies in its integration of financial, technological, and sustainability-oriented determinants, offering a holistic understanding of what drives successful crowdfunding for green and impact-driven ventures.

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Artificial Intelligence enabled Transparency Traceability and Performance Framework for Dairy Supply Chain Networks for Industry 5.0

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Abstract: Artificial Intelligence (AI) plays a crucial role in enhancing transparency, traceability, performance, and information flow within the dairy supply chain—key indicators for ensuring safety, quality, and efficiency. AI-enabled sensors, tools, and methods significantly improve visibility and efficiency across the entire dairy network. The global sourcing of dairy products, coupled with increasing consumer awareness of safety concerns and emerging risks, has created a need for robust, accurate, and precise frameworks.

This paper presents a comprehensive AI-driven framework for managing dairy supply chain networks to enhance safety, quality, and minimize losses. AI facilitates descriptive, predictive, and prescriptive analytics, serving as a powerful force multiplier. It improves the speed and accuracy of analytics, which is critical for cattle health management, regulatory compliance, and sustainable milk production.

Micro, Small, and Medium Enterprises (MSMEs) can leverage AI to meet national and international standards, ensuring safety and quality through transparency and traceability from farm to consumer. AI-powered systems streamline traditionally complex and time-consuming tasks, improving efficiency across the supply chain. At the farm level, AI enables real-time monitoring of cattle behaviour and health, allowing for early disease detection, optimal feed management, and reproductive health monitoring, thereby ensuring sustainable milk production and profitability for small farmers.

AI-driven tracking systems, such as Radio Frequency Identification (RFID)-enabled solutions, enhance transparency, optimize resource utilization, and reduce waste in milk collection and transportation. Government agencies can use AI for data collection, predictive analysis, disease monitoring, breed

selection, and farmer training. Cooperative societies can apply AI for milk yield enhancement through predictive analytics based on genetic, behavioural, and environmental data. Regulators can use AI tools to analyse milk testing data, ensure compliance with safety standards, and educate farmers on best practices. By integrating AI across the dairy supply chain, the industry can achieve greater efficiency, safety, and sustainability, contributing to the advancement of Industry 5.0 in food processing.

Extended Abstracts

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Enablers of Digital Transformation in Manufacturing SMEs: Insights from Digital Twin Implementation in the UK

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Introduction

Digital transformation has become a critical driver of change in small and medium-sized enterprises (SMEs), particularly in the manufacturing sector. With increasing competition and the need for operational efficiency, SMEs must adopt digital technologies to remain viable (Benitez et al., 2020). Industry 4.0 technologies, such as Manufacturing Execution Systems (MES) and Warehouse Management Systems (WMS), have enabled SMEs to optimise production processes, enhance inventory management, and improve overall productivity (Malakar et al., 2025). However, despite its potential, digital transformation adoption remains inconsistent, with many SMEs struggling to identify the key enablers that facilitate successful implementation. This paper addresses the gap by systematically identifying and analysing these enablers.

Literature Review

Industry 4.0 integrates cyber-physical systems, the Internet of Things (IoT), artificial intelligence, and advanced analytics to create interconnected, intelligent, and decentralised supply chain networks (Benitez et al., 2020). The shift towards digital transformation has significant implications for SMEs, extending beyond internal operational efficiencies to impact supply chain relationships, customer engagement, and supplier interactions (Jones et al., 2021; Dalenogare et al., 2018). The literature highlights that digital transformation can enhance sustainability by improving resource utilisation, reducing waste, and increasing transparency in supply chain operations (Malakar et al., 2025). Given the regulatory and market pressures on SMEs to become

more sustainable, digital transformation emerges as a viable strategy to integrate environmental and economic sustainability within their operations (Birkel & Müller, 2021; Srhir *et al*., 2023).

Despite the benefits, SMEs face barriers to digital transformation, including technological readiness, cost constraints, and resistance to change. Existing studies suggest that successful implementation is driven by specific enablers, such as leadership commitment, infrastructure readiness, workforce capability, and industry collaboration (Benitez et al., 2020). However, empirical evidence on how these enablers function in practice remains limited, calling for further investigation.

Methodology

This study builds upon an Industry 4.0 implementation case study in a UK-based manufacturing SME to provide practical insights into key enablers of digital transformation. The case study examined the impact of adopting a digital twin alongside simulation, virtual reality (VR), and augmented reality (AR) technologies. The implementation of the digital twin enabled real-time monitoring and optimisation of production processes, integrating data from Enterprise Resource Planning (ERP) systems, Quality Management Systems (QMS), and Programmable Logic Controllers (PLCs). The adoption of these technologies resulted in improvements across key performance metrics, including a 15% increase in overall equipment effectiveness (OEE), a 20% reduction in changeover times, improved predictive maintenance accuracy, and enhanced workforce training through immersive VR-based simulations (Panchal et al., 2024). These findings serve as a foundation for an extended literature review to validate and refine the enablers identified in prior research.

A systematic secondary data analysis approach is employed, synthesising findings from peer-reviewed operations and supply chain management journals. A meta-analysis of existing case studies further supports the identification of enablers, allowing for a comparative evaluation of digital transformation initiatives across different manufacturing SMEs. The study also references established frameworks, such as Quality Function Deployment (QFD) and the Technology Acceptance Model (TAM), to assess the impact of digital transformation on SME performance.

Findings and Implications

The study identifies key enablers that influence the success of digital transformation in manufacturing SMEs. Leadership commitment is found to be essential for fostering a culture of innovation and guiding the organisation through digital change. Technological

readiness, including the availability of robust digital infrastructure, significantly affects the adoption rate of Industry 4.0 technologies. Workforce capability, particularly digital literacy and training programs, plays a critical role in ensuring the effective use of new technologies. Collaboration with industry stakeholders, including technology providers and supply chain partners, facilitates knowledge exchange and resource sharing, further enhancing digital transformation outcomes.

From a practical perspective, these findings offer actionable insights for SME decision-makers aiming to implement digital transformation strategies. Understanding these enablers allows for more targeted interventions, ensuring a smoother transition towards digital operations. For researchers, this study contributes to the existing body of knowledge by providing empirical evidence on the factors influencing digital transformation in SMEs, thereby supporting future investigations into sustainable and resilient business models.

Conclusion

Digital transformation is an imperative for manufacturing SMEs seeking to remain competitive and sustainable. This study highlights the critical enablers that facilitate successful digital transformation, providing both theoretical insights and practical recommendations. By aligning digital transformation strategies with sustainability goals, SMEs can enhance their operational resilience and long-term viability. Future research should explore industry-specific challenges and best practices for overcoming barriers to digital adoption.

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An investigation into clinician-AI decision- making process risks

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Abstract:

Industry 5.0 prioritizes the synergy between humans and AI systems, focusing on augmenting and supporting human capabilities through automation rather than replacing them. In the healthcare sector, AI-driven systems are being increasingly adopted, with both novice and experienced clinicians demonstrating strong interest in utilizing these tools for diagnosis and treatment planning. However, these systems also introduce various risks and unintended consequences. While extensive research has highlighted the advantages of AI across different diagnostic domains, studies investigating its potential challenges remain scarce and fragmented.

Given the limited understanding of how AI tools are used in clinical settings and related risks, we took an inductive approach to explore how clinicians apply AI in disease diagnosis. To do this, we conducted semi-structured interviews with eight expert clinicians who have experience working with AI tools. Our study aimed to identify the various types of AI applications in clinical practice and assess the associated risks and challenges that could impact the reliability of AI-assisted diagnoses. Our findings contribute to the broader understanding of Industry 5.0's evolution, especially in terms of human-machine collaboration and the risks tied to AI-based tools. Furthermore, they offer valuable insights to clinical decision-makers for developing effective and responsible strategies and guidelines for integrating AI into healthcare services.

Keywords: Artificial Intelligence (AI), Clinician-AI, Decision-making, Industry 5.0, Risks.

Introduction

The evolution of Industry 5.0 has introduced a transformative paradigm where maximizing productivity depends on Human-AI symbiosis in systems. This shift highlights the significance of socio-technical factors and underscores the necessity of human-centric design principles to enhance decision-making processes (Zafar et al., 2024). While the integration of AI presents immense opportunities, it also comes with notable challenges, including technostress, trustworthiness (Tarafdar et al., 2015), privacy concerns, and uniqueness neglect (Barari et al., 2024).

In healthcare, the symbiosis between humans and AI has demonstrated substantial benefits, such as improving workflow efficiency and enhancing patient outcomes (Yin et al., 2021). However, it also raises critical questions about how clinicians interpret and utilize AI-generated insights. Prior research has investigated these challenges, including how clinicians assess AI-generated recommendations (Jussupow et al., 2021) and how discrepancies between AI and human diagnoses are resolved (Abdel-Karim et al., 2023). However, these studies have not progressed beyond this point to offer a comprehensive understanding of the risks associated with AI applications. While acknowledging potential risks is essential for effectively incorporating AI into clinical decision-making within a socio-technical framework, existing research has not fully addressed this concern (Ameen et al., 2022). To address these gaps, this study aims to identify the symbiosis between AI and clinicians and investigate the potential negative aspects of AI integration disease diagnosis applications. Therefore, the research question is:

RQ1) How does different type of AI-clinician interactions for disease diagnosis introduce risks in decision-making?

Application of AI in disease diagnosis

The review of existing literature has identified the various types of Point-of-Care technology systems, their users, and associated applications. These applications are categorized into two primary areas. The first is automation, where AI systems create automated disease diagnoses and predictions without human intervention. This application stems from the growth of EHRs, which capture patient data and necessitate extracting hidden knowledge to detect early signals of complex diseases such as cancer (Waring et al., 2020). It encompasses analysing X-ray images and pattern recognition, simplifying complex data and their relationships by providing a "one-size-fits-all" approach to streamline the decision-making process (Aldoseri et al., 2024).

The second category involves AI augmenting clinicians' decision-making. In this context, AI reduces the exclusivity of physicians as the sole decision-makers in clinical

practices (Jussupow et al., 2021). This application assumes that AI can outperform humans in disease diagnosis and monitoring (Mayo & Leung, 2018). While these systems are not intended to replace humans, they aim to provide constructive collaboration with clinicians, leading to high-quality decisions. This approach complements the insights generated by both clinicians and machines (Lu & Zhang, 2024), where AI enhances decision-making accuracy, and clinicians apply their knowledge to develop deeper insights (Amit & Sagiv, 2013). The assessment of these applications has highlighted several general risks associated with AI implementation in clinical practice, including unclear definitions of effective AI utilization, reliance on extensive training datasets, low technology acceptance, and the absence of a suitable business model (Ranschaert et al., 2019).

Methodology

In this study, we took constructivist perspective, which suggests that social experiences provide multiple avenues for understanding and evaluation (Drisko, 2013) and employed a qualitative research method, conducting semi-structured interviews with eight clinicians from different fields, including radiology, orthopaedics, ophthalmology, and pathology, who use AI tools. The goal was to investigate how clinicians' use of AI in disease diagnosis introduces associated risks—an area that has been insufficiently explored in existing research. The interviewees were selected from LinkedIn, which is one of the potential social media platforms for conducting qualitative research (McKenna et al., 2017).

To analyse the semi-structured interviews a thematic analysis is used, which is defined as “a method for identifying, analysing and reporting patterns (themes) within data” and has the potential to provide a rich and detailed analysis, especially for complex amount of data (Braun & Clarke, 2006; Vaismoradi et al., 2013). To accomplish this, Corley and Gioia, (2004) approach was used (Corley & Gioia, 2004).

Results

The analysed data identified various types of risks, categorized according to the nature of clinician-AI interactions. These interactions fall into two main scenarios: instances where AI tools generate final outputs for clinicians' decision-making and situations where AI and clinicians collaborate as a team. The first category includes applications such as radiology and imaging, where AI highlights abnormalities using heatmaps. The

second category involves the use of Large Language Models (LLMs), where clinicians engage with AI systems to seek insights and recommendations on specific disease cases. These findings align with the Industry 5.0 perspective on human-machine collaboration, which classifies these interactions into automation and augmentation (Leng et al., 2022).

As illustrated in Figure 1, while both types of AI-clinician interactions share certain challenges—such as the lack of governance and policy development—each interaction presents distinct risks and potential drawbacks. For example, when clinicians passively rely on AI systems, they may use models trained on inadequate data, leading to inaccurate results. On the other hand, when clinicians actively interact with AI, the accelerated disease diagnosis enabled by AI could overwhelm subsequent treatment planning, such as surgical scheduling, by generating a large influx of patients awaiting the next stage of care. Additionally, if clinicians input incorrect prompts, the AI system may generate inaccurate responses, increasing the risk of misdiagnosis.

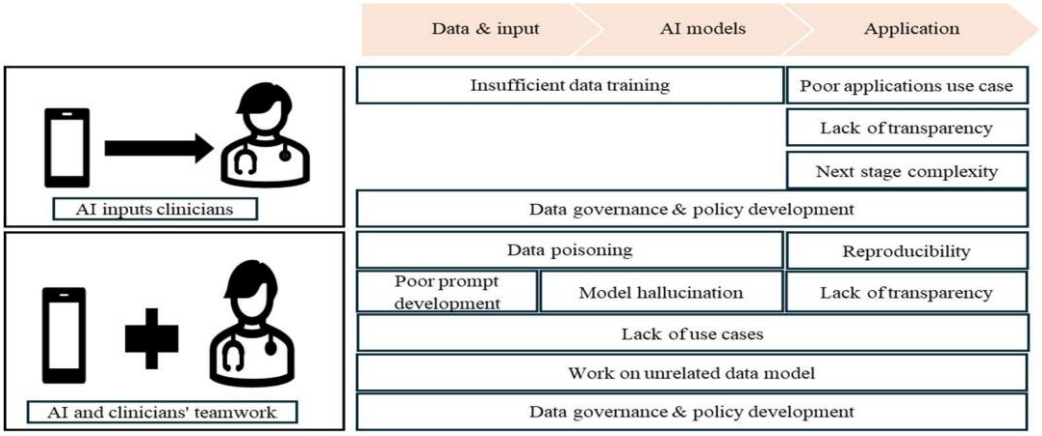

Figure 1. AI risks divided by clinician-AI interaction

Implications

AI has increasingly been integrated into advanced disease diagnosis across various fields, including imaging and radiology, ophthalmology, orthopaedics, urology, and cancer diagnosis. While many studies emphasize AI's ability to generate accurate and timely results, it is equally important to examine its potential drawbacks and unintended consequences (Rai, 2020). This study primarily focuses on anecdotal evidence suggesting that, alongside its benefits in disease diagnosis, AI systems can also introduce various risks. This research expands our understanding of how AI applications can lead to challenges and risks, depending on the nature of interactions between AI tools and

clinicians. It distinguishes between passive and active AI users, highlighting that each category encounters different risks, such as inadequate data governance and policy frameworks, ineffective use cases, and data poisoning, among others (see Figure 1). From a managerial perspective, this study provides valuable insights for decision-makers to develop strategies and solutions that promote the responsible adoption of AI. For instance, updating current use cases based on the specific AI applications within different medical fields (e.g., ophthalmology, orthopeadics) could help mitigate risks and enhance the effective deployment of AI in healthcare.

Conclusions

This study focuses on exploring an important pillar of Industry 5.0 evolution, the AI and clinician symbiosis in healthcare, by identifying two distinct modes of clinician interaction with AI tools: passive and active applications (Xu et al., 2021). In the passive approach, clinicians utilize AI-generated outputs to support and enhance their diagnostic performance. Examples of these applications include the use of imaging outputs in ophthalmology and radiology, such as stroke detection or bone imaging analysis, where abnormalities are highlighted using heatmaps. Conversely, the active approach involves clinicians engaging with AI systems, such as Large Language Models (LLMs), to seek a second opinion on patient cases.

Additionally, we identified the risks associated with each type of application. In the passive format, most challenges are tied to the accuracy and reliability of the AI-generated results. In contrast, in the active format, risks extend across multiple dimensions, including data input, model integrity, and application usage. Moreover, we observed several common risks shared between both types of AI applications, as illustrated in Figure 1.

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Exploring Digital Twins Challenges and Benefits in Healthcare: A Systematic Literature Review

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Abstract: Industry 5.0 concept such as Digital twins (DTs) enhance processes and services by creating a virtual bridge between the physical and digital worlds. In healthcare, DTs involve generating virtual copies of physical products or processes associated with patients or hospital environments. Healthcare organizations and clinicians can utilize DTs through digital technologies, including big data and analytics, electronic health records, and augmented physical products. Insights derived from DTs facilitate the customization of healthcare systems based on each patient interaction, offering personalized treatment and medicine. Although DTs offer various benefits, they also present several challenges that must be addressed. The successful adoption of DTs in healthcare depends on overcoming these challenges and ensuring the technology is used responsibly and equitably.

This study aims to identify the challenges and benefits of DTs in healthcare. To achieve this, a deductive and systematic literature review approach was adopted. Both a review of reviews and a review of empirical studies were conducted to answer the research questions.

The study's key findings highlight the issues, benefits, and healthcare areas where DTs have been implemented. As a main contribution, a categorization consisting of five dimensions was developed for DT challenges in healthcare, including ethical and social challenges, data privacy and security concerns, technical issues, organizational hurdles, and regulatory barriers. Additionally, a category with three dimensions was developed for the benefits: benefits for healthcare providers, benefits for patients, and benefits for healthcare facilities.

Keywords: Digital twins, Digital health, Healthcare, Industry 5.0, Systematic literature review

Introduction

The increasing demand for personalized healthcare necessitates advanced technologies that not only meet individual patient needs but also enhance medical decision-making and treatment precision (Maddikunta et al., 2022). Industry 5.0, which emphasizes human-centric, intelligent, and sustainable solutions, plays a crucial role in enabling this transformation. Emerging technologies such as the Internet of Things (IoT), big data, cloud computing, and Artificial Intelligence (AI) are driving the development of digital twins (DTs), bridging the physical and digital worlds (Khan et al., 2023). DTs are already widely used across industries—including aerospace, manufacturing, energy, transportation, and construction—to create precise digital representations of physical entities and simulate real-world processes (Menon et al., 2023). In healthcare, a DT refers to a virtual replica of a patient, organ, or hospital system, continuously

updated with real-time data (Armeni et al., 2022). These digital models are revolutionizing healthcare by enabling personalized treatment plans, predictive diagnostics, and enhanced operational efficiency (Balasubramanyam et al., 2024). However, the adoption of DTs in healthcare faces several challenges. Data privacy, regulatory uncertainty, and integration complexities remain major obstacles (Popa et al., 2021).

Additionally, the healthcare sector is experiencing a global workforce crisis, with the WHO predicting a shortage of 10 million workers by 2030, exacerbated by burnout, resource constraints, and insufficient training investment (WHO, 2023). In the UK, the National Health Service (NHS) faces similar issues, including underfunding, staff shortages, and rising patient expectations (Khan et al., 2023). Patients increasingly seek personalized care over standardized treatment pathways (EY, 2022), yet healthcare systems still struggle with a lack of emphasis on prevention.

DTs have the potential to address these challenges by streamlining healthcare operations, optimizing resource allocation, and empowering healthcare professionals to focus on complex decision-making. They can enhance patient experiences, improve clinical outcomes, and provide governments with measurable healthcare improvements (Hinterhuber et al., 2021). Despite these advantages, significant challenges remain, including data security risks (Menon et al., 2023), data quality and validation (Mohammed et al., 2020), and socio-ethical risks (Popa et al., 2021). Given these considerations, it is crucial to assess both the benefits and obstacles associated with DTs in healthcare. This study conducts a systematic literature review (SLR) to examine the challenges and benefits of DT adoption, addressing the following research questions:

- What are the potential benefits of implementing DTs in healthcare systems?

- What are the challenges and obstacles of using DTs in healthcare systems?

Methodology

An SLR was conducted on the papers that have been published about the challenges and benefits of DTs in healthcare. A transparent and reproducible methodology was used to search the existing literature, assess its quality, and synthesize its content (Kukushkin et al., 2022). To ensure a robust and transparent review process, the PRISMA framework was applied, which outlines the preferred reporting items for systematic reviews in medical research (Elkefi & Asan, 2022). A well-defined search strategy, incorporating inclusion/exclusion criteria, keyword combinations, and snowballing techniques, were used to select studies. To maintain rigor, the Joanna Briggs Institute (JBI) (Barker et al., 2023) quality appraisal tools were applied to assess the credibility of included studies. This stricter evaluation yielded 47 papers including review, empirical and conceptual papers. To extract challenges and benefits, a thematic analysis was conducted. This method helps researchers recognize, analyze, and report patterns and themes within the data (Braun & Clarke, 2006).

Results

DTs in healthcare have become an important topic, attracting considerable attention from both academics and industry professionals (Sharma et al., 2024). Analyzing various articles, from review papers to empirical studies, reveals that research on the use of DTs in healthcare and the analysis of related issues and benefits still require further exploration. DTs are still in their infancy (Lu et al., 2020)(Boyes & Watson, 2022), and existing research is fragmented, with not all healthcare areas being fully explored.

DTs benefits in healthcare

By examining final papers, the benefits of DTs were categorized into three aspects: patients, healthcare providers, and healthcare facilities according to the category developed by (Mohammed et al., 2020). Figure 1 illustrates the benefits for each category, including predictive healthcare, personalized medicine, individualized models to optimize treatment plans, and virtual testing of new therapies.

DTs enable personalized prevention by merging various data sources to create comprehensive virtual models of individuals, allowing healthcare providers to refine

screening strategies and predict disease onset or progression (Coorey et al., 2022). Additionally, DTs support clinical decision-making by reconstructing and simulating organs and tissues, analysing disease progression, and forecasting patient outcomes (Vallée, 2023). Surgical planning is another area where DTs offer significant benefits. They allow for the creation of highly detailed 3D models of a patient's anatomy, enhancing surgical planning, improving lesion localization, and reducing the risk of complications (Sahal et al., 2022). Personalized treatment is also possible with DTs, as they can create detailed virtual representations of patients and simulate different treatment options to predict responses (De Maeyer & Markopoulos, 2021). DTs can also support clinical decisions, optimize resource allocation, and improve overall efficiency (Popa et al., 2021). Furthermore, DTs can be used for medical training, such as simulating the effects of new drugs before human trials (Sarp et al., 2023).

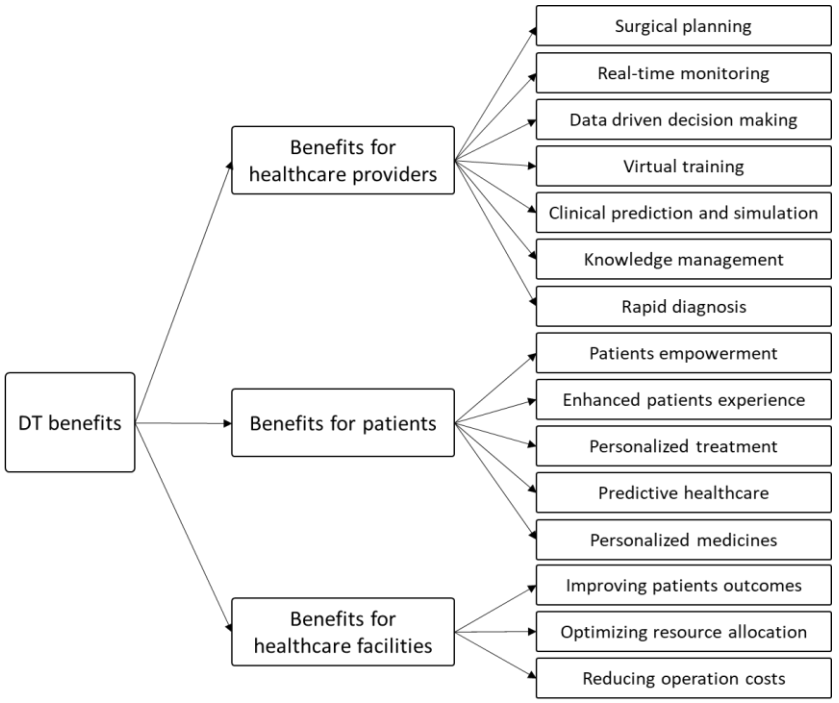

Figure 1: DT benefits classifications

DTs challenges in healthcare

The implementation of DTs in healthcare presents numerous challenges. DT challenges were categorized into five categories based on the types of issues (Figure 2). Primarily, data privacy and security pose significant risks due to the extensive collection of personal health information required for DT development (Popa et al., 2021). Ensuring robust

data protection measures is crucial to prevent unauthorized access and misuse of sensitive data (Grieb et al., 2023). Additionally, addressing ownership and intellectual property concerns arising from big data analysis is essential.

Data quality is another critical factor influencing the accuracy of DT models. Poor data quality can lead to unreliable predictions and hinder the interpretability of complex models. Collecting sufficient, standardized data for complex conditions is challenging, and even with large datasets, understanding the intricacies of machine learning models can be difficult (Sahal et al., 2022). Ethical and social challenges also arise from the collection and analysis of patient data. DT models can perpetuate biases present in the training data, leading to unequal healthcare outcomes (Popa et al., 2021). Obtaining informed consent from patients and ensuring transparency in data-sharing procedures are essential to maintain trust and autonomy. Furthermore, the development and implementation of DTs must be guided by principles of equity and accessibility to prevent exacerbating existing healthcare disparities (Kamel Boulos & Zhang, 2021).

Organizational challenges include potential job displacement, resistance to change, and the need for staff training. Integrating DTs into existing healthcare practices requires strong leadership and a supportive environment. Addressing liability concerns arising from errors in DT predictions or diagnoses also necessitates clear legal frameworks (Corral-Acero et al., 2020). Technical challenges include the need for powerful computing resources, data integration, and effective communication between devices. The development of user-friendly DT tools requires collaboration among healthcare providers, patients, policymakers, and governments (Grieb et al., 2023). Regulatory challenges involve navigating various frameworks governing healthcare, data protection, and medical devices. Adhering to existing regulations and ensuring data privacy while facilitating data sharing across countries are essential considerations (Sahal et al., 2022).

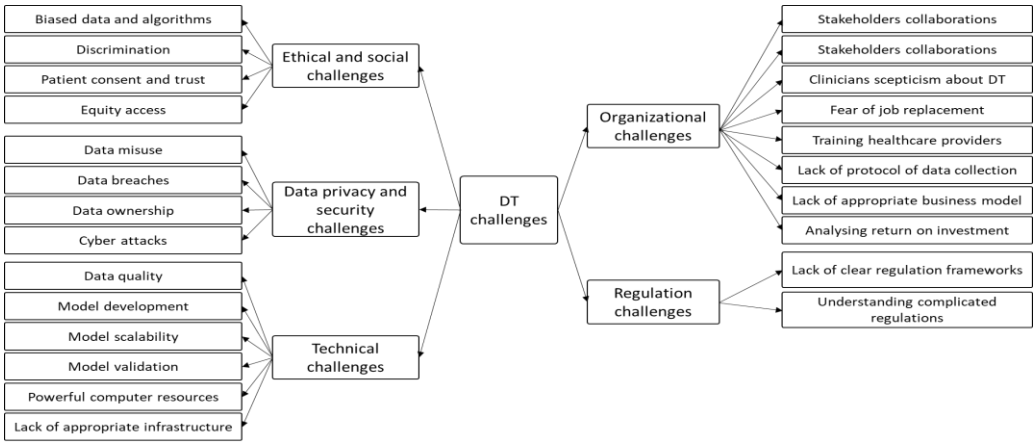

Figure 2: DT challenges classifications

Implications

This research provides a comprehensive understanding of the challenges and benefits of DTs by analyzing both empirical studies and review papers. Most DT applications identified in this review operate at the micro level, focusing on improving hospital processes or enhancing specific departments. However, unlocking the full potential of DTs in healthcare requires a systems-level approach, ensuring seamless integration across people, processes, and technologies within the entire healthcare ecosystem (Liu & Tian, 2023). This approach would enhance interoperability, optimize resource utilization, and improve patient outcomes (Popa et al., 2021). In the context of Industry 5.0, where digitalization fosters intelligent and human-centric innovation, DTs can drive holistic improvements in healthcare by enabling real-time decision-making and predictive analytics (Maddikunta et al., 2022). Healthcare organizations can use the proposed categorization of DT challenges and benefits as a strategic tool for planning and implementation. By understanding DTs' impact on patient care, facilities management, and workforce training, organizations can develop targeted strategies to optimize operations and enhance overall system efficiency.

Conclusion

Industry 5.0 leverages digitalization to address wider issues related to environmental sustainability, energy management, and social challenges (Barata & Kayser, 2023). As part of this transformation, DTs have emerged as a powerful tool in healthcare, enabling real-time monitoring, predictive analytics, and personalized treatment. However, the implementation of DTs faces significant challenges due to the novelty of the concept and the absence of a well-defined regulatory framework (Popa et al., 2021). These challenges must be carefully evaluated before developing models and frameworks to ensure their effectiveness and ethical deployment (Barata & Kayser, 2023).

While the benefits of DTs and their potential for improving healthcare outcomes have generated enthusiasm among researchers and industries, certain risks may be overlooked. A systematic analysis of DT challenges and benefits across various healthcare domains provides valuable insights for researchers, policymakers, and healthcare providers. Understanding these complexities is crucial for formulating strategies that overcome obstacles and maximize DTs' potential in enhancing patient care and healthcare system efficiency (Sun et al., 2023). This systematic literature review offers a comprehensive examination of DTs in healthcare, highlighting their

transformative impact within the broader context of Industry 5.0 while acknowledging the challenges that must be addressed for successful implementation.

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Lean 4.0 in Healthcare Manufacturing: Harnessing the Synergy of Lean Production and Industry 4.0 for Operational Excellence

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Abstract: The integration of Lean production principles with Industry 4.0 (I4.0) technologies represents a significant opportunity for healthcare product manufacturing to achieve Operational Excellence (OpEx). This study explores how the synergy between Lean principles and I4.0 technologies can enhance efficiency, quality, and regulatory compliance in healthcare product manufacturing. A sequential exploratory mixed-methods research design was employed, incorporating qualitative data from in-depth interviews with professionals in healthcare manufacturing and quantitative analysis of performance metrics. The study examined the maturity of Lean practices and the adoption of I4.0 technologies across three case study organisations within the UK healthcare product manufacturing sector. The research identified that while healthcare manufacturers have begun integrating I4.0 technologies, there is variability in the maturity of their Lean practices. Successful implementation of Lean 4.0 strategies requires foundational maturity in Lean principles. Organisations with higher Lean maturity are better positioned to leverage I4.0 technologies to enhance operational efficiency, quality, and regulatory compliance. This study contributes to the existing body of knowledge by offering a conceptual framework that integrates Lean practices with I4.0 technologies, tailored specifically to the healthcare manufacturing sector. The proposed Safety- Integrated Lean-I4.0 Cycle (SiLIC) model offers a structured approach to achieving Operational Excellence in highly regulated environments.

Keywords: Healthcare manufacturing, Industry 4.0, Industry 5.0, Lean 4.0, Operational Excellence, Smart manufacturing.

Introduction

Industrial revolutions have significantly altered the tools and processes used in production. During these transformative eras, the ways in which we live, and work have evolved, driven by advancements in production systems and communication technologies (Trubetskaya et al., 2023). The Fourth Industrial Revolution is one that "marries advanced production and operations techniques with smart digital technologies to create a digital enterprise" (Cotteleer & Sniderman, 2017) – such advanced digital technologies include the Internet of Things (IoT), artificial intelligence (AI), machine Leaning (ML), robotics and automation, big data analytics, and digital twins. Whilst Industry 4.0 (I4.0) represents a shift towards smart manufacturing, Industry 5.0 (I5.0) is moving manufacturers into an era of leveraging data and information for good; considering environmental, social, and governance issues (Kyriakakis, 2024). Lean 4.0 is another key trend that is reshaping the manufacturing environment. The convergence of Lean principles with I4.0 technologies offers a promising pathway for achieving Operational Excellence in manufacturing. Healthcare manufacturing is an industry marked by strict quality standards, regulatory compliance, complex and fragile supply chains, and a need for continual innovation. Compliance with these regulations is essential, but it can complicate manufacturing processes and significantly increase operational costs. While Lean 4.0 has been proven to mitigate these challenges, there remains a significant gap in understanding how varying levels of Lean maturity within an organisation impact the successful integration of I4.0 technologies. This study aims to investigate the relationship between Lean maturity and the adoption of I4.0 in healthcare manufacturing by assessing Lean maturity levels across organizations, identifying barriers and enablers to I4.0 adoption, and proposing a structured framework for Lean 4.0 implementation.

This study provides empirical insights into the synergy between Lean and I4.0, offering a structured model—the Safety-Integrated Lean-I4.0 Cycle (SiLIC)—to guide healthcare manufacturers in achieving Operational Excellence while adhering to stringent regulatory frameworks. A refined version of the model can also facilitate the transition from Industry 4.0 to Industry 5.0, as a solid Lean 4.0 foundation can streamline and ease this transformative shift in manufacturing eras.

Methodology

The study adopted a sequential exploratory mixed methods research design, incorporating qualitative and quantitative techniques to develop a comprehensive understanding of Lean 4.0 implementation. Given the nature of this research and the time constraints imposed on it, a cross-sectional study was employed, spanning over a three-month period.

The research design includes multiple case studies focusing on three healthcare manufacturing organisations in the UK. The research process was conducted in three phases, starting with qualitative data collection, followed by quantitative data collection, and finally, supplemented with additional industry expert interviews to enrich the findings (Figure 1). Qualitative data collection involved one-on- one semi-structured interviews within each of the three organisations – these were conducted with one senior professional from each company (i.e., individuals holding high-ranking positions in the Operations Department, such as Directors of Operations), and lasted approximately 60 minutes. Ninety percent of these interviews were conducted online, while the remaining ten percent were conducted in person.

Qualitative data collection also involved a set of follow-up interviews (which were more refined) and were conducted within two out of the three organisations. Participants of these interviews were from different job roles within the company, such as Planning, or Continuous Improvement teams.

Observational studies were also conducted in the gemba to assess operational workflows, Lean maturity levels, and technological readiness.

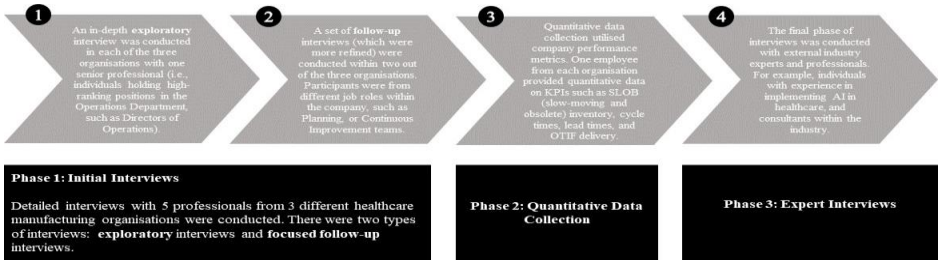
This phase was followed by quantitative data collection using performance metrics from company records. One employee from each organisation provided this numerical data through a form which was given to them to fill out, which included data on cost-savings, SLOB (slow-moving and obsolete) inventory, cycle times, lead times, and OTIF delivery, to name a few. These performance metrics were used to identify patterns between the organisations' performance levels and the maturity and advancement of their I4.0 technologies and Lean practices.

To further enrich the findings, a final phase of interviews was conducted with industry experts and professionals external to the initial organisations. For example, individuals with experience specifically in implementing AI in healthcare, and consultants within

the industry. These interviews sought to gather broader opinions on the phenomenon under study, offering additional perspectives to support and validate the findings from the earlier phases.

The data analysis for the entire study was conducted manually. All interviews were audio-recorded (with participants' consent) and later transcribed and thematically analysed to identify patterns in Lean implementation, technological adoption, and regulatory challenges. To ensure a comprehensive understanding of the data, the transcripts were coded by highlighting relevant sections and assigning labels that represented the emerging themes. These codes were then grouped into broader categories, allowing for the identification of common patterns and relationships across different interviews. This mixed-methods approach provides a holistic understanding of Lean 4.0 by combining subjective insights with empirical evidence.

Figure 1. A Sequential Exploratory Mixed Methods Research Design



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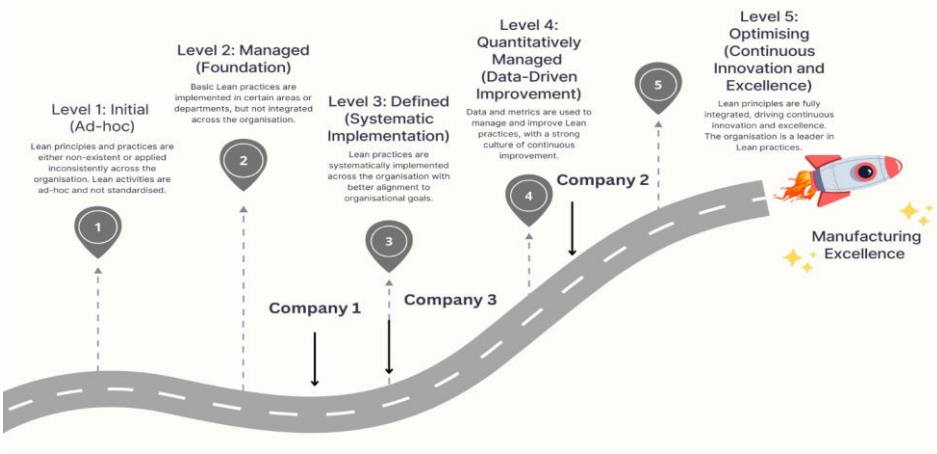
Results

The findings of the study reveal significant variability in Lean maturity among the studied organisations, impacting their ability to successfully integrate I4.0 technologies. A Lean Maturity Model was developed as a measure for assessing this, focussing on five levels: Initial (Ad-hoc), Managed (Foundation), Defined (Systematic Implementation), Quantitatively Managed (Data-Driven Improvement), and Optimising (Continuous Innovation and Excellence). The figure below illustrates the journey organisations undertake to achieve manufacturing excellence and shows the current position of the studied companies on this journey (Figure 2).

Figure 2. A Roadmap to Lean Maturity and Manufacturing Excellence



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Organisations with higher Lean maturity were found to be better positioned to leverage I4.0 for process optimisation, quality assurance, and regulatory compliance. Key enablers of successful Lean 4.0 integration included leadership commitment, employee engagement, and investment in digital infrastructure. In contrast, common barriers included resistance to change amongst staff, lack of cross- functional collaboration, and limited expertise in digital transformation.

Additionally, the study found that organisations that prematurely adopted advanced technologies without a mature Lean foundation experienced inefficiencies and operational bottlenecks. These companies struggled with issues such as data silos, misalignment between technology adoption and process improvement, and increased operational complexity without corresponding performance gains. For example, the study found that without strong Lean foundations, technology implementations risk automating existing inefficiencies rather than eliminating them, therefore highlighting the importance of healthcare manufacturers prioritising Lean maturity before embarking on extensive digital transformation efforts. Conversely, companies with advanced Lean practices benefited most from I4.0 technologies, as they had already established a culture of continuous improvement and standardised processes that allowed them to effectively integrate digital solutions.

Implications

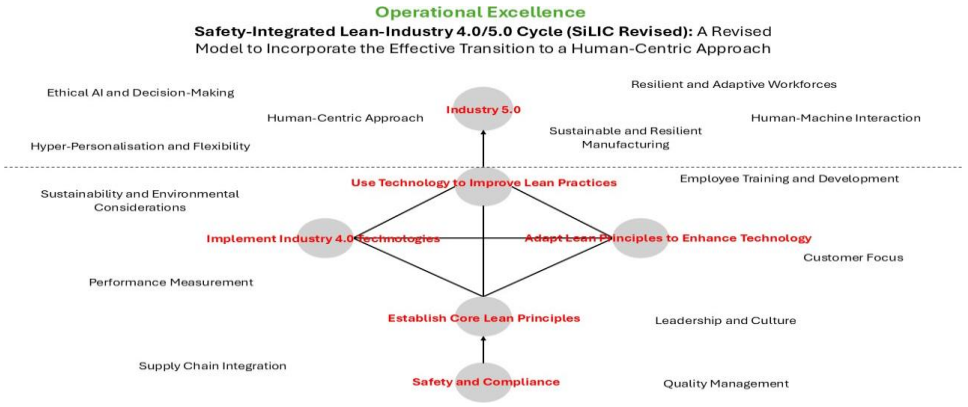
The results of this study have significant theoretical and practical implications. Theoretically, the study contributes to the existing body of knowledge on Lean 4.0 by demonstrating how Lean maturity influences the effectiveness of I4.0 adoption in healthcare manufacturing. It provides empirical validation for the role of Lean principles in facilitating digital transformation. Practically, the study offers actionable insights for healthcare manufacturers seeking to implement Lean 4.0 effectively. The proposed SiLIC model provides a structured approach for organisations at different Lean maturity levels to systematically adopt I4.0 technologies while ensuring compliance with stringent industry regulations.

As healthcare manufacturers advance in their Lean 4.0 practices and as the digital and manufacturing landscapes continue to evolve, it is crucial to recognise that they are now beginning to explore Industry 5.0. This includes enhancing human-machine collaboration, customising patient-centric products, and improving sustainability within production processes. Therefore, whilst the SiLIC model was developed in this study to guide businesses through their Industry 4.0 transition, it can also be adapted to facilitate and support businesses progression to Industry 5.0, by ensuring that digital transformation efforts are strategically aligned with foundational Lean principles. Essentially, Lean 4.0 can be seen as a critical success factor (CSF) for a successful transition to I5.0 (Figure 3), along with other CSFs such as top management support, employee acceptance, and sufficient funding (Bishal Dey Sarkar et al., 2024).

Industry 5.0, unlike its predecessor, prioritises not only efficiency but also the role of humans in the manufacturing process (Nahavandi, 2019). The SiLIC cycle facilitates this transition by ensuring that Lean principles, particularly the "Respect for People" philosophy (originating from the Toyota Production System), remain integral as organisations adopt more advanced automation. This includes AI-human interaction, sustainable manufacturing driven by efficiency improvements, and the deployment of collaborative robots (cobots) that enhance – rather than replace – human labour. Lean human resource management represents the ‘soft’ aspect of the Lean system that binds everything together – Total Quality Management (TQM) is unattainable without effective people management. Ultimately, people are the only source of long-term competitive advantage, as they are the thinkers within the organisation – they generate innovations and ideas for continuous improvement (kaizen) – which is at the heart of the

Lean approach. Therefore, it is crucial to adapt this model to reflect the current transition to the new I5.0 era.

Figure 3. SiLIC (Revised): A Perpetual Improvement Model for Manufacturing Excellence



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Furthermore, it is anticipated that companies that have established a strong Lean culture are better equipped to maintain workforce adaptability and engagement while integrating automation. The structured approach of the SiLIC model provides a roadmap for achieving this balance, ensuring that Lean maturity supports a seamless transition from I4.0 to I5.0. Ultimately, the human aspect of Lean, with its emphasis on continuous learning, employee involvement, and adaptability, is key to successfully navigating the next phase of industrial evolution.

Conclusions

In summary, this research highlights the critical integration of Lean principles with I4.0 technologies in healthcare manufacturing, demonstrating that organisations with established Lean foundations are better positioned to successfully adopt smart manufacturing solutions. The findings indicate a significant correlation between an organisation's Lean maturity and its ability to leverage I4.0 technologies effectively.

As a contribution to existing knowledge, the study introduces the Safety-Integrated Lean-I4.0 Cycle (SiLIC) model, which provides a structured framework for guiding healthcare manufacturers through digital transformation while ensuring alignment with

Lean principles. The model emphasises the necessity of understanding I4.0 components and their implications, enabling manufacturers to optimise their resource allocation effectively. As a further contribution, a revised model has also been developed in light of the current and ongoing transition to I5.0, which reinforces the importance of maintaining a human-centric focus during the transition, ensuring that technological advancements enhance rather than replace the human element in manufacturing processes.

Future research should evaluate the SiLIC model in practice within organisations navigating both Industry 4.0 and 5.0 transitions, particularly those operating at various levels of Lean maturity. Case studies examining the model's application will provide deeper insights into its effectiveness and practicality, revealing how different organisational contexts can influence outcomes. Ultimately, this research sets the stage for a more profound understanding of how Lean and I4.0 can synergise to foster operational excellence, paving the way for sustainable, innovative manufacturing practices in the future.

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Harnessing Artificial Intelligence for Inclusive and Sustainable Future

The International Conference on AI-Driven Human-Centric Solutions and Sustainable Transformations is hosted at ABV Indian Institute of Information Technology and Management Gwalior. The conference is supported by the Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology, Government of India. The Quality Circle Forum of India (QCFI) is the industry partner of the conference.

The central focus of the conference is embedded in its very name: human-centricity and sustainable transformations. The conference aims to look at the role of Industry 4.0-based digital technologies in shaping value chains and transforming production systems. The conference aspirations are to examine the impact of digital technologies and how these may be leveraged to enhance productivity, flexibility, and agility.

In recent times, industry 5.0 blends sustainability, circularity, and human-centricity and involves interconnected machines that not only operate independently but also enable preventive maintenance and human-machine cooperation so as to capture and deliver value and respond to customer demands. Towards this, the conference is structured in four tracks, namely industry 5.0 in medical research, industry 5.0 in manufacturing and services, industry 5.0 in food processing, and the integration of emerging technologies. This conference endeavors to deliberate and explore the prospects of digital technologies along intersecting and interdisciplinary areas of manufacturing, healthcare, food processing, and services for the purpose of developing impactful and socially relevant solutions.

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