



5TH STUDENT SYMPOSIUM 2025

EMPOWERING DIGITAL SOCIETY WITH
COMPUTATIONAL INTELLIGENCE TOWARDS
SUSTAINABILITY

STUDENT SYMPOSIUM ABSTRACTS

FACULTY OF COMPUTING
GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY



5th STUDENT SYMPOSIUM FACULTY OF COMPUTING

Empowering Digital Society with Computational Intelligence Towards Sustainability

ABSTRACTS

Faculty of Computing
General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka.

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Message from the Dean - Faculty of Computing



It is with great pleasure that I extend my warmest welcome to the participants, presenters, and distinguished guests of the 5th Student Symposium organized by the Faculty of Computing, General Sir John Kotelawala Defence University. This symposium is a significant milestone in our collective journey toward academic excellence, innovation, and social impact.

This year, we also celebrate the 10th anniversary of the Faculty of Computing, a decade of dedication to shaping the future of computing education and research in Sri Lanka. Over the past ten years, our faculty has grown into a dynamic hub of learning and innovation, fostering a culture of excellence and collaboration. This milestone is a testament to the unwavering commitment of our students, faculty, and industry partners.

The theme for this year's symposium, Empowering Digital Society with Computational Intelligence Towards Sustainability, is both timely and visionary. In an era where technology profoundly influences every facet of human life, the integration of computational intelligence to drive sustainable development is not just a necessity but a responsibility. This theme underscores the critical role that young researchers and innovators play in shaping a future that is both technologically advanced and environmentally conscious.

Our symposium serves as a vibrant platform for young minds to engage in meaningful discussions, share their research findings, and gain valuable insights from experts in the field. It is an opportunity for students to enhance their research and communication skills while addressing contemporary challenges in computing. By doing so, they contribute to the development of solutions that are practical, innovative, and sustainable. We are honored to have Dr. Upendra Pieris, the esteemed CEO of Orel IT, as our keynote speaker. His expertise and forward-thinking approach to leveraging computational intelligence for sustainability will undoubtedly inspire and enrich the discussions of

the day. We deeply appreciate his contribution to this event and look forward to the perspectives he will share.

As we embark on this journey of discovery and collaboration, I would like to express my gratitude to the symposium's Chairperson, Ms. Uma Meththananda, and the organizing committee for their dedication and hard work in making this event a reality. Your efforts are a testament to the Faculty of Computing's commitment to fostering a vibrant research culture and preparing our students to become leaders in the digital age.

To our student researchers, I encourage you to take full advantage of this opportunity to showcase your talents, exchange ideas, and build connections that will serve you well in your academic and professional endeavors. Remember, the insights and solutions you develop today have the potential to shape a better tomorrow.

I wish all participants a successful and enriching experience at the 5th Student Symposium. May this event inspire us all to continue pushing the boundaries of knowledge and innovation for the betterment of society and the world at large.

Dr. LP Kalansooriya

Dean - Faculty of Computing

General Sir John Kotelawala Defence University



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Integrating Retinal Image Analysis with Clinical Data for Enhanced Diabetic Retinopathy Classification: A Review of Machine Learning Approaches

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Abstract

Diabetic Retinopathy (DR) is one of the leading causes of blindness worldwide. Preventing severe vision loss requires early detection and accurate classification. Convolutional Neural Networks (CNNs), a recent advancement in machine learning, have greatly enhanced DR detection by recognizing retinal characteristics such as hemorrhages and microaneurysms in images. Nonetheless, many imaging models fail to consider important clinical parameters that contribute to the disease's progression, such as blood pressure, HbA1c, and diabetes duration. This review provides an overview of machine learning techniques combined with retinal images to extract clinically significant information. Through a comprehensive literature review, emerging technologies, including convolutional neural networks, random forest algorithms, and hybrid systems were analyzed. The focus was on how integrating basic imaging data with other clinical information enhances the classification of diabetic retinopathy. The findings indicate that CNNs play a crucial role in feature recognition from images. Additionally supplementing clinical data improves the precision and personalization of diabetic retinopathy (DR) models. The models integrated with clinical information are better positioned to stage disease severity and possibly enable targeted therapies. The discussion emphasizes the necessity of combining diverse data types to improve diabetic retinopathy (DR) management. Nonetheless, challenges remain, particularly the limited availability of diverse and large datasets. Future research should focus on developing robust methodologies that integrate clinical and imaging data, ensuring broader applicability across diverse patient populations.

Keywords: *Clinical data integration, Deep learning, Diabetic retinopathy classification, Machine learning, Retinal imaging*

Evaluating the Efficiency and Diagnostic Accuracy of Machine Learning Algorithms in Early Detection of Lung Cancer: A Systematic Review

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Abstract

Lung cancer is a leading cause of cancer deaths in the world with an estimated 2.09 million cases affecting both men and women worldwide. Diagnosis in an early stage is needed to improve the survival rate in lung cancer patients. With advanced diagnostic imaging and data-driven methods, Machine Learning algorithms have captured considerable interest to enhance the accuracy as well as efficiency of detecting lung cancer. This review discusses the performance of different ML algorithms, such as SVM, CNN, KNN, logistic regression, and hybrid models, applied in lung cancer diagnostics. This study comprises a systematic literature review which was conducted by reviewing the most important research papers after identifying 100 research papers related to the application of Machine learning in lung cancer detection. From these, 60 relevant papers were selected based on citation count and publication date, from 2019 to 2024. Further analysis narrowed the selection up to 27 papers that were critically reviewed for their contributions on algorithm accuracy, computational efficiency, and dataset usage. A critical literature review was performed, grouping the findings into topics. The key findings shows CNN models, especially those using transfer learning, reach the highest accuracy rates up to 98% for image-based detection. In resource-limited settings, hybrid models such as CNN-SVM provide an effective balance between accuracy and computational efficiency. However, class imbalance, lack of standardized datasets, and interpretability remain as some of the challenges. This review highlights the need for standardized protocols, better computational efficiency, and interpretable algorithm to improve the accuracy and clinical applicability of the lung cancer detection systems.

Keywords: *Lung cancer detection, Machine learning, Algorithms, Accuracy, Efficiency*

Advances in Multimodal AI for Breast Cancer Diagnosis: A Comprehensive Review

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Abstract

Breast cancer remains a leading cause of mortality among women worldwide. Early and accurate diagnosis is critical to improving survival rates, yet conventional diagnostic techniques, such as mammography, are often limited in integrating diverse clinical data sources. This review explores the transformative potential of multimodal artificial intelligence models, which combine Electronic Health Records (EHRs) and imaging data to enhance diagnostic precision and treatment planning. We analyze advanced architectures, including Convolutional Neural Networks (CNNs), transformers, and fusion layers, evaluating their strengths, limitations, and clinical applicability. Key challenges, such as data heterogeneity, computational demands, and the lack of standardized datasets, are identified and discussed. This review also highlights the gaps in current research, such as inconsistent evaluation criteria and suboptimal fusion techniques, while proposing innovative solutions, including adaptive fusion methods and lightweight architectures, to bridge these gaps. The findings emphasize the need for standardized datasets and efficient multimodal models to foster broader adoption in clinical settings. Future directions underscore the importance of developing scalable and interpretable systems that can integrate seamlessly into oncology workflows, paving the way for improved breast cancer diagnosis and personalized care.

Keywords: *Multimodal AI, Breast cancer diagnosis, Electronic health records (EHRs), Vision-language models, Clinical oncology*

Comprehensive Review for Development of a Smart IoT Based Marma Foot Therapy Shoe

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Abstract

Pain in the feet, circulatory problems, and tension are some of the less noticed yet very basic parts of everyday health concerns. Traditional Marma therapy offers an effective treatment to alleviate these conditions through stimulation at specific pressure points. However, access to this therapy is highly restricted due to dependency on trained and qualified human practitioners. This study reviews how modern technology integrated into smart footwear products can facilitate personalized Marma foot therapy. This development combines the therapeutic benefits of traditional practices with the convenience of wearable devices, using pressure sensors to identify key Marma points, vibratory motors for targeted stimulation, and IoT technology for wireless control and real-time feedback via mobile applications. The study critically analyzes the IoT architecture, and the communication frameworks used in those systems, pointing out their functions in monitoring foot pressure distribution, adapting therapy to individual needs, and cost-effectiveness with components such as FSR sensors, DC vibration motors, and ESP32 microcontrollers. This covers challenges like the exact detection of Marma points, user acceptance, and feasibility for large-scale production, together with possible solutions. This review identifies IoT-based smart footwear technology as a game-changing tool in the advancement of foot health management and general well-being, thus paving the way for wider adoption of personalized therapeutic intervention.

Keywords: *IoT, Low-cost smart footwear, Marma points, Vibratory motors, Foot health*

Systematic Review on Early Detection of Diabetic Foot Ulcers Using Image Processing

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Abstract

Diabetic foot ulcers (DFUs) are serious complications of diabetes that reduce mobility and quality of life and increase the risk of lower-limb amputation. The early detection of DFUs is important to avoid serious outcomes, however, the diagnostic techniques presently used rely much on subjective methods, thus delaying early treatment. This review underlines the new developments regarding the detection of DFUs that are being addressed using image processing and AI in disciplines of thermal imaging, wearable sensors, and deep learning models like Convolutional Neural Networks (CNNs). Non-invasive thermography detects skin temperature abnormalities that herald early DFU formation, and wearable sensors track temperature, pressure, and moisture to monitor foot health continuously. Deep learning algorithms, especially CNNs, excel in the identification, classification, and segmentation of DFUs with a high degree of diagnostic accuracy, because they greatly reduce human error. Most AI-based models report a precision of over 90%, hence their potential to transform DFU detection and management. Challenges include the need for standardized diagnostic tools, improved sensor accuracy, and resolving issues related to limited datasets. Multidisciplinary collaboration is essential to develop explainable AI models, larger datasets, and reliable tools for clinical use. Moreover, patient education and engagement with wearable devices and mobile applications are crucial for preventing DFU progression. This research highlights the importance of combining AI and image processing to enhance early detection and management of DFUs, ultimately aiming to reduce the risk of limb loss. Future research should focus on incorporating these technologies into clinical practice and mobile platforms for real-time patient-centred care. Overcoming the existing barriers, AI-driven solutions can significantly reduce the global burden of DFUs and improve patient outcomes.

Keywords: *Diabetics foot ulcers, Image processing, Deep learning, Convolutional neural networks, Artificial intelligence*

Portable Heart Attack and Heart Wall Blockage Detection System with Mobile Application Integration: A Systematic Review

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Abstract

The leading causes of the sudden cardiac events which often occur suddenly and require immediate treatment include heart attacks and chronic obstructions to the heart walls. They are not easy to spot at an early stage because conventional diagnostic tools are only available for clinical use in developed countries, or in rural areas that have poor resources. The actual purpose of this study is to create a mobile application connected portable heart attack and heart wall blockage detection system. The system utilizes Electrocardiogram (ECG) and Photoplethysmography (PPG) sensors to constantly monitor cardiac activity in real-time. Support Vector Machine (SVM) is a supervised machine learning approach and Cross Wavelet Transform (XWT) that applies in data analysis for effective anomaly detection. The smartphone application also provides features such as real-time visualization of anomalous cardiac states, alerts, and the possibility to alert medical professionals. The system exhibited a high level, up to 70% endorsing the use of the combination of ECG and PPG and 85% saying that it is pertinent in the reduction of heart attack deaths, the study provides remarkable endorsement of using real-time cardiac monitoring. Based on the survey, 78% of the respondents supported SVM and XWT supervised machine learning methods, 72% preferred that the data be stored in the cloud, and 61% wanted an easy interface. To be able to perform effective cardiac care, more improvement on the sensor cost, privacy, and reliability is needed. More development will focus on the longevity of operating time, incorporating more sensors for enhanced prognosis performance, and extending the learning algorithm on larger databases. This system can reduce the number of hospital visits, enhance cardiac care for high-risk individuals living in rural communities, and facilitate earlier detection of cardiac events in areas where health services are lacking, catering to an urgent need in health care.

Keywords: *Portable heart monitoring, machine learning, real-time cardiac detection, heart attack, mobile health integration.*

Automated Bus Ticketing System for Enhancing Accessibility for Persons with Disabilities

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Abstract

Equitable access to public transportation poses significant challenges for individuals with disabilities, including those with visual impairments, mobility difficulties, and learning disabilities. Barriers such as lack of autonomy, inefficiency, and inconvenience disproportionately affect these individuals, who require clear communication and simplified processes to commute effectively. This study introduces an innovative RFID-based bus ticketing system aimed at enhancing inclusivity and fostering independence for passengers regardless of their physical abilities or social class. The proposed system provides each passenger with an RFID card to automate travel data recording and transmission, replacing traditional ticketing methods and manual expense tracking. This automation reduces both cognitive and physical barriers to transportation. For visually impaired users, the system integrates voice dialogue features, delivering real-time ticketing and travel information in an accessible and user-friendly manner. It also caters to individuals with Asperger's syndrome by offering clear and straightforward communication to ease interactions. Results demonstrate improved boarding efficiency, enhanced ticketing accuracy, and a more independent travel experience for disabled passengers. By leveraging radio-frequency identification technology, the system not only addresses accessibility gaps but also counters discriminatory practices and optimizes user experiences. This research advances inclusive transportation solutions, promoting equality and self-reliance for passengers with diverse needs while paving the way for more equitable public transit systems.

Keywords: *Automated ticketing, Disability accessibility, RFID technology, mobility impairments, Public transportation*

Artificial Intelligence Based Solution for Navigating Vision Impaired Individuals: A Review

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Abstract

Vision impaired individuals face difficult situations while they are travelling independently. The major issues include difficulty in reaching the destination location independently. This review aims to evaluate current solutions and propose an innovative solution to enhance the navigation of vision-impaired individuals. This research aims to systematically evaluate existing literature on assistive technologies for vision-impaired individuals and to introduce a novel solution with emerging technologies to enhance the navigation of them. As per the PRISMA guidelines, a comprehensive literature search was conducted by using multiple academic databases such as IEEE Xplore, Google Scholar, IJEECS, and MDPI. Studies were found for their relevance, focusing on assistive devices, technologies, and applications designed to aid vision-impaired individuals. Data were gathered and analysed for identifying the gaps. This review found the wide variety of technologies such as wearable devices, mobile applications, and mobility aids. However, there are significant gaps remaining in the integration of real-time navigation and personalized assistance. According to the findings, this paper proposed a new solution that combines computer vision (CV) and artificial intelligence (AI) based personalized assistant to create a real-time navigation system for vision-impaired individuals. The proposed solution aims to bridge the gaps in existing solutions and future studies should focus on implementing this technology in the real world.

Keywords: *Assistive device, Assistive software, Computer vision, Object detection, Vision impaired*

Computer Vision for Object Detection in Assistive Technologies: A Comparative Review

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Abstract

This paper aims to identify the major object detection techniques performed on assistive technologies for visually impaired individuals, with a particular focus on the shift from conventional computer vision methodologies to current deep learning frameworks. The most popular object detection models under discussion are single-stage detectors: Single Shot Detector (SSD) and You Only Look Once (YOLO), and two-stage detectors: Faster R-CNN and RetinaNet, all evaluated in terms of performance in per-pixel accuracy on the COCO dataset, expressed through mean Average Precision (mAP) and inference time on GPU. The proposed models are discussed in the context of their practical applicability for assistive purposes by considering problems such as small object recognition, time constraints, fluctuations in the environment, energy demands, limitations of devices, and interfaces. Observations show that single-stage detectors such as the SSD and YOLO can provide faster inference time, which is ideal for real-time application at 22ms and 29ms, though with lower mAP performance than two-stage detectors in research with 23.2 and 33.0, respectively. The two-stage detectors such as Faster R-CNN and RetinaNet are more accurate with 36.2% and 37.8% mAP respectively, but have higher inference times of 200ms and 73ms for real-time assistive tasks. The study also highlights the issues in small and occluded object detection, that can be detected in diverse lighting and weather conditions, and power and hardware constraints of wearable technology. These problems must be addressed by optimizing the model and enhancing the hardware and software of assistive technologies for the visually impaired.

Keywords: *Computer vision, Object detection, SSD, YOLO, Faster R-CNN*

Enhancing Cultural Relevance in Mobile Health Application Through AI Driven Content Personalization

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Abstract

Mobile health (mHealth) applications offer significant potential to address healthcare disparities in rural areas, where access to traditional healthcare is often limited or unavailable. The effectiveness of these applications, however, relies heavily on the delivery of context-sensitive content that aligns with cultural and individual usage patterns. This study investigates the theoretical role of AI-driven content personalization in enhancing the cultural relevance of mHealth applications, with a focus on rural Sri Lanka. By examining critical cultural factors such as language preferences, literacy levels, traditional healthcare practices, and community specific beliefs, the research proposes a framework for dynamically tailoring health content to meet diverse user needs. The anticipated outcomes of this approach include a 40% increase in user engagement and a 35% improvement in adherence to health recommendations. These projections are from findings identified in similar studies and applied to their contexts of Sri Lankan environment. Furthermore, culturally tailored content is expected to significantly enhance user satisfaction and improve the overall efficiency of digital health interventions. This study emphasizes the transformative potential of AI-driven personalization in bridging healthcare gaps and addressing inequalities in underserved regions. The proposed framework also offers actionable recommendations for designing and deploying culturally adapted mHealth solutions to serve rural populations on a global scale.

Keywords: *mHealth, AI-driven personalization, Cultural relevance, Content adoption*

A Comprehensive Review of Modern Technologies in Waste Collection: Driving Smarter and Greener Solutions for a Future-Ready Approach

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Abstract

Urbanization and Population Explosion are rapidly increasing challenges, for waste collection methods that struggle with inefficiency and environmental impact due to their reliance on fixed schedules and limited data utilization. This study tries to overcome these limitations and offers a comprehensive review of emerging technologies such as Internet of Things (IoT) based smart bins, Artificial Intelligence (AI) supported route optimization, Geographic Information System (GIS) applications in promoting waste collection effectiveness through green approach. Through these next generation technologies, cities can shift from outdated systems toward smarter, more efficient solutions that react dynamically based on real-time data. A systematic review of recent literature, from the last five years, on scholarly sources and academic databases was the research methodology. The concept was derived from case studies, which emphasized how modern technologies align and collaborate effectively mainly in lowering operational costs, optimizing resource usage, and improving sustainability. The key takeaway from this review is that the combined use of these modern technologies, the waste collection problem, is appropriately addressed through real-time monitoring, routing optimization and user engagement. A review points out the benefit of introducing such innovations into adaptive and eco-friendly waste collection systems in line with the objectives of smart cities. Although a few steps have been made forward in this regard, much more needs to be done on practical implementation, scalability, and representative precincts, therefore, requiring ample research opportunities in the future. This study offers a strategic roadmap for municipalities to adopt modern solutions, driving smarter and greener waste collection practices.

Keywords: *Waste collection, Modern technologies, Real-time monitoring, Route optimization, Environmental sustainability*

Systematic Review of Investigating Decision Making Models to Minimize Risks in Tourism

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Abstract

Tourists often encounter various risks during trip planning and execution, primarily due to limited access to accurate information about actual conditions. Such risks increase their vulnerability, leading to suboptimal decisions, including missed opportunities for rewarding experiences or the selection of unsuitable destinations. This systematic review explores the impact of perceived risks on tourist decision-making, examines existing risk-reduction models, and investigates whether risk influences tourist satisfaction. Following the PRISMA-2020 methodology, this study systematically reviewed literature on tourism decision-making, risk, and satisfaction using five academic databases from August to November 2024. An analytical framework was employed to assess the relationship between decision-making, risk reduction, and satisfaction. A total of 21 relevant articles were included in the review. The findings reveal a strong correlation between tourist satisfaction and the risks associated with their journeys. The review also indicates that effective decision-making can mitigate these risks. Among the existing models, the Protection Motivation Theory and the Consumer Decision Process Model demonstrate significant potential as foundational frameworks for developing practical decision-making models that enhance tourist satisfaction. Despite these insights, the review highlights limitations such as the scarcity of practical contributions to the field and restricted access to relevant studies. Nonetheless, the findings underscore critical implications for advancing decision-making frameworks to minimize risk and maximize tourist satisfaction.

Keywords: *Tourism, Risk reduction, Decision-making, Satisfaction*

The Impact of Green ERP Systems on Sustainable Supply Chain Management: With Special Reference to Sports Equipment Manufacturing Market

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Abstract

The manufacturing industry for sports equipment, apparel, and fitness technology devices faces significant sustainability challenges due to the use of petrochemical-based materials and high energy consumption. This review highlights the application of green enterprise resource planning (ERP) tools to enhance sustainable supply chain management. Key benefits include a 30% reduction in carbon footprint and a 25% improvement in resource utilization efficiency. Stakeholder surveys reveal critical issues such as high costs and integration difficulties, particularly for small and medium enterprises (SMEs). This study employs a systematic literature review and qualitative analysis to examine existing research, synthesize findings, and identify gaps in the adoption and effectiveness of green ERP systems. The review identifies several research gaps, including the limited availability of affordable solutions for SMEs, insufficient exploration of real-time data sharing for supplier relationship management, and inadequate studies on the long-term impacts or adaptability of green ERP systems in industries beyond sports equipment. Green ERP systems, adapted from conventional ERP systems, aim to optimize efficiency, reduce waste, and quantify emissions, thereby enabling energy conservation and proper waste management. However, their scalability is hindered by high implementation costs and integration challenges for SMEs. Future research should focus on developing cost-effective solutions, implementing real-time data sharing mechanisms, and expanding the adoption of green ERP systems across other industries. By addressing these challenges, green ERP systems can emerge as a vital tool for advancing sustainability and operational performance in the sports equipment sector and beyond.

Keywords: *Green ERP systems, Sustainable supply chain management, Green supply chain integration, SME challenges, Energy efficiency*

The Role of Blockchain in Enhancing Transparency and Sustainability in Ethical Sourcing within Decentralized Supply Chain Management: A Systematic Literature Review

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Abstract

Blockchain technology has emerged as a transformative solution for decentralized supply chain management, addressing the growing need for transparency, accountability, and ethical practices. This systematic literature review examines studies from 2004 to 2024 to explore blockchain's role in promoting sustainable and ethical sourcing across various industries. The findings underscore blockchain's ability to leverage decentralized and immutable ledger systems to reduce fraud, prevent data manipulation, and address information asymmetry, thereby fostering trust and compliance among supply chain stakeholders. The research highlights blockchain's effectiveness in real-time tracking and product traceability, which supports adherence to sustainability goals and ethical labor standards. However, the study also identifies significant challenges to blockchain adoption, including regulatory hurdles, integration with existing systems, and scalability limitations, especially in processing large transaction volumes. Furthermore, the paper explores blockchain's potential to bridge transparency gaps, enhance data security, and ensure compliance through advanced protocols, particularly in sectors such as fashion, food, and diamonds. The findings emphasize the need for further research, particularly through industry-specific case studies, to better understand the unique risks and opportunities blockchain presents. Such investigations could provide deeper insights into its broader impact on sustainable supply chain practices and its role in fostering ethical sourcing across diverse industries.

Keywords: *Blockchain, Ethical sourcing, Transparency, Sustainability, Supply chain management*

A Comprehensive Review: Enhance Logistics Performance by Optimizing Supply Chain Routes with Dynamic Factors using Genetic Algorithm

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Abstract

As supply chain networks become increasingly complex, optimizing logistics is critical for industries to maintain competitiveness and adapt to dynamic market demands. Traditional route optimization methods often struggle to address real-time variables such as traffic congestion, unpredictable weather, and evolving customer requirements, resulting in inefficiencies. This study investigates the potential of Genetic Algorithm (GA) as a robust solution for multi-objective route optimization. A thematic literature review was conducted, to evaluate existing algorithms and identify their limitations in managing dynamic, multi-factor logistics environments. The findings highlight that Genetic Algorithms excel in integrating real-time data, enabling more efficient and adaptable delivery route optimization. Real-world applications across various industries demonstrate notable reductions in delivery times, improved resource utilization, and enhanced customer satisfaction. This study underscores the scalability and intelligence of GA as a solution to modern logistics challenges, providing valuable insights for advancing supply chain management practices. The implications suggest that GA offers a transformative approach to addressing inefficiencies in complex logistics networks and improving overall operational performance.

Keywords: *Supply chain management, Route optimization, Genetic algorithm, Real-time logistics, Dynamic factors*

Advancing Secure E-voting Systems: A Systematic Review of Blockchain Applications

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Abstract

The potential of blockchain technology to improve electronic voting systems' security, transparency, and election integrity is examined in this systematic research. Blockchain's decentralized architecture offers a revolutionary response to the ongoing problems related to voter fraud and manipulation in conventional voting procedures. The study's findings highlight the latest significant developments in protecting voter privacy, guaranteeing data integrity, and enhancing accessibility using blockchain frameworks, smart contracts, and cryptographic techniques through a thorough examination of recent research works. It is identified that encouraging openness and inclusion, along with blockchain-based voting systems, greatly reduces the possibility of election tampering and also increases public confidence. Additionally, voter involvement is increased by decentralized platforms and intuitive user interfaces, opening the door for digital democracy. Scalable, safe, and transparent elections are among the practical ramifications; nonetheless, issues like technology accessibility and regulatory compliance need more research. To overcome current constraints and fully achieve blockchain's potential for updating electoral procedures, future research should concentrate on optimizing these systems, as highlighted in this study.

Keywords: *Blockchain technology, Electronic voting, Voter anonymity, Data security, Smart contracts*

Transforming Banking with Data Lakehouse Architecture: Overcoming Integration Challenges to Enhance Analytics and Decision-Making

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Abstract

The banking sector faces integration challenges with traditional data systems, such as data warehouses and data lakes, which hinder real-time analytics and actionable insights. This review addresses a critical research gap in the adoption of Data Lakehouse architectures within financial institutions. A systematic literature review of empirical studies from five major databases including IEEE Xplore, SpringerLink, ResearchGate, Semantic Scholar, Google Scholar spanning 2015–2024 highlighted that Data Lakehouses can enhance analytics speed by up to 30%, improve data governance by 25%, and reduce operational costs by 20%, compared to legacy systems. By seamlessly integrating structured and unstructured data, while ensuring Atomicity, Consistency, Isolation and Durability (ACID) compliance, Data Lakehouses eliminate data silos and enable real-time decision-making. These improvements directly translate into faster decision-making, more accurate risk assessments, and better customer experiences, giving banks a competitive edge. However, further empirical research, particularly longitudinal case studies, is required to validate these findings and optimize implementation strategies within the banking sector and beyond. This study underscores the strategic value of adopting Data Lakehouse platforms to modernize data infrastructure and enhance operational efficiency in a rapidly evolving market.

Keywords: *Data Lakehouse, Banking, Integration, Analytics, Governance, Decision-Making*

Enhancing Customer Engagement in E-Commerce through Neuromarketing Driven UX Design - A Systematic Review

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Abstract

Neuromarketing, an interdisciplinary approach combining neuroscience and marketing, examines the subconscious responses of consumers to various stimuli. This systematic review explores the application of neuromarketing techniques to explore how consumers subconsciously respond to different design elements using tools like eye-tracking, electroencephalography (EEG), functional magnetic resonance imaging (fMRI), and emotional analytics to enhance user experience (UX) design in e-commerce, aiming to boost customer engagement and influence purchasing decisions. By collecting real-time data on how consumers react to visual elements in UX, neuromarketing helps identifying key factors like focus, emotional response, and ease of use which impact engagement. Eye-tracking stands out as the most effective method for e-commerce, as it creates heatmaps and gaze paths that show where users focus most, helping designers optimize layouts and call-to-action (CTA) placements to improve conversion rates. This review highlights critical research gaps, including the need for studies involving diverse user groups, evaluations of long-term impacts on customer loyalty, and the development of ethical guidelines for transparent data handling. By aligning UX design with subconscious consumer behavior, neuromarketing offers the potential to create more personalized, engaging, and trustworthy online shopping experiences. Future research directions are proposed to address these gaps and advance the integration of neuromarketing in UX design.

Keywords: *Neuromarketing, Eye-tracking, User experience, e-Commerce, Call-to-Action Buttons*

Advancements in Location-Based Job Search Platforms: Integrating Natural Language Processing, Intelligent Agents, and Geolocation Technologies for Enhanced User Experience

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Abstract

The increasing complexity of job searching, particularly for part-time positions, presents significant challenges for job seekers, including the need for localized job listings and timely notifications. This study addresses these issues by developing a Location-Based Part-Time Job Search Platform that integrates geolocation technologies, intelligent agents, and Natural Language Processing (NLP) to enhance the job search experience. The rationale for this research is based on the growing demand for efficient job matching systems that cater to user preferences and market dynamics. The platform should consist with Google Maps API for visualizing job opportunities, real-time notifications for job listings, and personalized job recommendations based on user profiles and preferences. Preliminary results indicate that the platform significantly improves user satisfaction and engagement by providing tailored job matches and reducing search times. The implications of this research extend to the fields of human-computer interaction and employment services, contributing to a deeper understanding of how technology can facilitate job searching in a dynamic market. Ultimately, this study highlights the potential for future enhancements, including addressing privacy concerns and improving data management, to further optimize the platform's effectiveness.

Keywords: *Location-Based Services, Part-Time Job Search, Geolocation, Google Maps API, Natural Language Processing*

A Systematic Review of Personality Prediction Systems in E-Recruitment: Analyzing CVs and Personal Statements for Enhanced Candidate Screening

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Abstract

E-recruitment has revolutionized the hiring process, enabling organizations to efficiently identify and evaluate candidates through digital platforms. Recently, personality prediction systems have emerged as a crucial tool in this domain. Powered by AI and machine learning, these systems analyze candidates' CVs and personal statements to infer personality traits such as extroversion, conscientiousness, and creativity, aligning job roles with personality profiles. This review examines current research on the methodologies employed in AI-based personality prediction systems, their predictive accuracy, and the ethical considerations surrounding their use. Findings highlight that while these systems offer benefits like enhanced candidate screening and decision-making efficiency, they face challenges, including moderate accuracy due to data variability, algorithmic bias, and privacy concerns in data processing. The review underscores the need for ethical guidelines and diverse datasets to improve these systems and advocates for balancing human judgment with AI-driven assessments. Future recommendations include enhancing model accuracy, addressing biases, and fostering transparent, non-discriminatory e-recruitment practices. This study bridges knowledge gaps by exploring the potential and limitations of personality prediction systems in modern recruitment, contributing to the development of fair and effective AI-driven hiring processes.

Keywords: *E-recruitment, CVs, AI-based, AI-driven, Personality profiles*

Technologies and Methods to Enhance the Effectiveness of Product Search and Recommendations in E-commerce Systems

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Abstract

E-commerce marketplaces heavily rely on advanced product search and recommendation technologies to enhance user experience, improve customer satisfaction, and drive sales. However, when businesses transition to e-commerce marketplaces, they face unique challenges in product searching and recommendation systems compared to traditional physical stores. This review investigates the effectiveness of various search and recommendation techniques in addressing these challenges, specifically focusing on issues like diverse product catalogues, complex product attributes and compatibility of selected products or items related to searching functionality, and issues like data sparsity, cold start, and limited user history related to product recommendations. The study aims to analyse how different techniques and methods, including Natural Language Processing (NLP), machine learning, data analysis, collaborative filtering, content-based filtering, user queries, search algorithms, catalogue navigation, information retrieval, and other techniques (e.g., transformer models, Siamese networks, Word2vec) are used in product searching and recommendation. This study outlines how these technologies and methods contribute to effectiveness, customer confidence, and personalization. The review findings highlight how integrating various search methods and utilizing hybrid recommendation strategies for businesses can significantly improve user experience, enhance customer satisfaction, and drive higher conversion rates. Including Q&A functionalities further enriches the user experience and provides valuable insights for both customers and businesses. These findings have significant implications for the design and development of future e-commerce platforms, guiding the creation of more effective and user-centric systems and enhancing the overall shopping experience for online consumers.

Keywords: *Search algorithms, Natural Language Processing (NLP), Machine learning, Hybrid integration, Q&A functionality*

Customer Purchasing Behavior Analytics: Enhancing Digital Marketing in Small and Medium Enterprises

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Abstract

Small and medium-sized enterprises (SMEs) in the textile industry often face significant challenges in adopting effective digital marketing strategies due to limited access to technology and resources. This study seeks to address these gaps by analysing customer buying behaviour to propose actionable strategies. Through a PRISMA-based systematic review of existing literature, the findings highlight that location-based advertising and special discounts are highly effective in enabling SMEs to retain customers and foster loyalty. A deeper understanding of customer behaviour equips SMEs with the ability to design tailored marketing strategies, ensuring relevance to their target audience. Such strategies not only enhance business survival and continuity in the digital marketplace but also strengthen competitiveness and promote long-term sustainability. The insights provided by this research offer valuable implications for SMEs seeking to overcome barriers, establish a strong market presence, and achieve sustainable development in an increasingly dynamic digital environment.

Keywords: *Digital Marketing, SMEs, Textile Industry, Customer Behaviour, Sustainable Development*

Enhancing Customer Engagement in Banking: Transforming Customer Satisfaction and Retention with Multilingual Support

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Abstract

The research is on the role of AI-powered voice assistants to enhance the experience of the customer and the retention rate of clients of banking applications in Sri Lanka by overcoming elements such as language barriers, excessive waiting periods, and weak security systems. To overcome the language barrier, the - AI assistant enables customers to use the mobile banking application in the Sinhala, Tamil, and English languages. The barriers are together put aside as the customers speak to the application and their problem is solved. Presenting instructions in a structured format allows the users to eliminate several rudimentary tasks of interacting with pivotal services including, checking account balances, sending money, and paying bills. The results show that voice-driven interactions with AI chatbots guarantee improved presence of users in the system and, such advances help users to resolve fundamental problems caused by low literacy levels and lack of assistance at critical times. This study offers significant insights to banking institutions that aim at enhancing their AI-powered voice assistants to provide a more holistic and effective digital ecosystem for the clients in the said country.

Keywords: *AI chatbots, Multilingual support, Banking apps, Sri Lanka banking, Data privacy, AI ethics.*

Identification of Modern Techniques in Project Management of Software Development Companies

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Abstract

In today's rapidly changing software development environment, project management technologies are crucial to ensuring projects are managed effectively. The primary objective of this study is to identify modern-day tools, methods, frameworks, and techniques that enhance project outcomes. A systematic review was conducted on 100 research papers, from which 50 were selected based on inclusion and exclusion criteria. After further evaluation, 25 key studies were chosen for analysis to assess their relevance, quality, and applicability. The findings of the study highlight the importance of Agile and Lean approaches and identify Scrum and Kanban as the most effective frameworks. It also discusses the innovative potential of combining Cloud Computing and Artificial Intelligence (AI) with Lean and Agile methodologies. These integrations are identified to increase project efficiency, speed up decision-making, optimize resources, and provide better scalability. The study specifically reveals how cloud-based platforms and AI-powered data analysis allow real-time project monitoring, contributing to data-driven decision-making and enhancing resource allocation. It also examines how modern technologies transform traditional project management practices, addressing the challenges of resource management and project complexity. Furthermore, the study proposes future research directions, such as the exploration of limitations of Lean and Agile methodologies, the growth of AI-based solutions, and the application of Cloud Computing across different organizational types.

Keywords: *Project management, Agile methodology, Lean methodology, Artificial Intelligence, Cloud Computing*

Study on Automated Real-time Crop Health Monitoring and Management

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Abstract

Crop health monitoring and management involve tracking and managing crop conditions throughout their growth cycle using advanced technologies such as remote sensing devices, drones, satellite imagery, soil moisture sensors, and data analytics platforms. These tools provide real-time insights into crop health, enabling the detection of diseases, pests, water stress, and nutrient deficiencies. Proactive responses to these issues help prevent significant yield losses, enhance productivity, and optimize resource use. By enabling precise application of inputs like pesticides and fertilizers only when necessary, crop health monitoring minimizes environmental impact and reduces production costs for farmers. This review paper explores the application of automated, real-time crop health monitoring and management systems, emphasizing technologies such as IoT, UAVs, multispectral and hyperspectral imaging, and artificial intelligence in precision agriculture. It highlights recent advances in machine learning for disease detection and crop health assessment, focusing on the integration of sensor data, cloud computing, and imaging techniques to enable early problem detection and efficient resource management. While these technologies have demonstrated improved accuracy and efficiency, challenges remain in affordability, rural connectivity, and data integration. This review identifies critical gaps in the literature, including the need for low-cost solutions, improved AI model generalization, and standardized data processing frameworks. It also addresses regulatory and operational limitations, particularly in UAV usage and associated environmental concerns. To overcome these barriers, the study emphasizes developing scalable, cost-effective systems, enhancing connectivity, and providing farmer training on adopting such technologies. By addressing these challenges, this research contributes to the development of sustainable and accessible crop health management systems, fostering the growth of precision agriculture and supporting global food security in a changing climate.

Keywords: *Automated crop health monitoring, IoT in agriculture, Smart farming, Agricultural technology, Artificial intelligence in farming*

Integrated Approach for Early Detection and Management of Coconut Pests and Diseases: Focusing on Stem and Bud, with Precautions for Prevention

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Abstract

Coconut production is a cornerstone of agriculture in tropical regions, significantly contributing to national economies. However, coconut trees are increasingly vulnerable to pests and diseases, which critically impact productivity. This research proposes a comprehensive framework for the early detection of major coconut diseases, including stem bleeding, bud rot, and bud root dropping, as well as pest infestations, particularly from coconut caterpillars. Utilizing image processing and deep learning technologies, the study focuses on the stem and bud regions, achieving a detection accuracy exceeding 90%. The research methodology incorporates a systematic literature review and surveys to analyze existing detection techniques and management practices. The literature review identifies gaps in current studies, revealing that fewer than 20% focus specifically on stem and bud regions and that over 75% rely on traditional methods. Surveys with farmers and agricultural experts provide insights into practical challenges in disease detection and pest management, guiding the design of the proposed framework. This integrated approach not only ensures timely and accurate identification but also reduces disease and pest spread by up to 50% compared to traditional methods. The study also emphasizes pest prevention strategies and practical management solutions, combining biological and chemical control measures. The research highlights the critical need for advanced technologies such as deep learning and real-time monitoring for early detection and integrated management. It provides actionable management strategies to mitigate damage, enhance plantation health, and improve overall productivity. This work serves as a valuable resource for farmers, researchers, and policymakers, contributing to the protection and sustainability of coconut cultivation against pests and diseases.

Keywords: *Coconut pests and diseases, Image processing, Deep learning, Component, Artificial intelligence (AI)*

A Review on AI Techniques for Identifying Pest-Related Diseases in Coconut Leaves

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Abstract

Coconut farming faces significant threats from pest-related diseases, which are challenging to identify and manage manually due to the height of trees and the intricate structure of their leaves. Traditional inspection methods, achieving accuracy rates of about 60-80%, are labor-intensive and often unreliable. This systematic review investigates the application of Artificial Intelligence (AI), particularly Convolutional Neural Networks (CNNs), to enhance pest detection in coconut leaves. Following PRISMA guidelines, this study analyzed 50 research articles published between 2010 and 2024, sourced from ResearchGate and ScienceDirect. Among these, 22 studies focused on symptoms such as leaflet damage, caterpillar infestations, yellowing, drying, and flaccidity. EfficientNetB7 was identified as a top-performing model, achieving an accuracy 93.72%, thereby demonstrating substantial improvements in detection accuracy and potential for real-world applications. Conversely, ResNet50 and VGG16 exhibited limited effectiveness compared to more advanced architectures. Key Challenges include misclassification due to symptom overlap, limited dataset diversity, and environmental variability. This review emphasizes the importance of explainable AI, domain adaptation, and scalable models to enhance pest detection systems. Future research should focus on developing real-time diagnostic tools and integrating AI-driven approaches into sustainable pest management practices to improve efficiency and optimize resource utilization.

Keywords: *Coconut leaf disease classification, Artificial Intelligence, Machine Learning, Deep Learning, Image Processing*

Innovative Approaches to Protect Farms from Monkey Threats Using Smart Technologies: A Review

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Abstract

Human-monkey conflict in Sri Lanka poses a significant challenge to wildlife conservation and human livelihoods. In recent years, the threat posed by monkeys has escalated. Among the culprits, the Sri Lankan Toque macaque (*Macaca sinica*) emerged as the most destructive, contributing to an annual loss of US\$19.3 million in coconut production alone. In response, the government proposed exporting 100,000 macaques to China, but the plan was abandoned due to objections from conservation groups. Instead, smart technology has been identified as a promising alternative to address this issue. Innovations such as real-time monitoring and automated prevention systems offer the potential to detect and deter monkey incursions while safeguarding crops and preserving wildlife. This research explores the use of low-cost, eco-friendly solutions leveraging the Internet of Things (IoT), deep convolutional neural networks, transfer learning, and ultrasonic sound waves. These technologies enable the creation of virtual fences and provide early, non-invasive warnings of monkey activity, significantly enhancing crop protection. Through surveys and literature reviews, the study highlights the limitations of traditional methods such as manual field protection and chemical repellents, which are neither effective nor sustainable. The findings indicate that integrating IoT with image processing and sound-based deterrents offers a scalable and sustainable approach to mitigating human-monkey conflicts. Such innovations not only protect agricultural productivity but also contribute to broader wildlife conservation efforts.

Keywords: *Smart monkey repellent, IoT-based animal detection, Convolutional neural network (CNN), Ultrasonic deterrence, Crop protection.*

Enhancing Rainfall Forecasting Accuracy: A Review of Current Models and Parameters

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Abstract

Rainfall plays a vital role in agriculture, water management, and disaster preparedness, yet accurate prediction remains a challenge due to the complex and non-linear nature of weather patterns. Traditional models like ARIMA and MLR often fail to address these complexities, while machine learning models, such as Random Forest and LSTM networks, offer higher accuracy but require extensive datasets and computational resources. This review identifies key models and parameters for rainfall forecasting and explores strategies to enhance prediction precision. Through a systematic review of studies from IEEE, ScienceDirect, Springer, and MDPI, models like stacking ensemble learning, LSTM, and ARIMA were analysed, alongside critical parameters such as temperature, humidity, and wind patterns. Techniques like particle swarm optimization and fuzzy rules were also reviewed for their ability to improve performance. Findings reveal that LSTM networks achieve the highest accuracy, up to 94%, effectively capturing long-term dependencies in weather data, while hybrid models combining traditional and machine learning methods address individual model limitations. This study emphasizes the need for scalable frameworks that integrate real-time data and diverse parameters to reduce forecast errors, offering reliable solutions for practical applications in weather-dependent sectors.

Keywords: *Rainfall, Prediction models, Forecasting parameters, ARIMA, Weather prediction.*

A Systematic Review on Mobile-Based Garbage Collection and Decomposition System

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Abstract

Garbage disposal and collection continue to pose significant global challenges, especially in developing countries, due to factors like rapid population growth, inadequate public awareness, and inefficient infrastructure. This review explores the potential of mobile-based garbage collection and decomposition systems that leverage cutting-edge technologies such as the Internet of Things (IoT) and artificial intelligence (AI) to optimize waste management. The paper analyses systems that incorporate smart bins with integrated sensors, AI-powered chatbots for enhanced public engagement, and GPS-enabled real-time route optimization. It examines the effectiveness of advanced algorithms, including Large Neighbourhood Search (LNS) for vehicle routing and Node2Vec for path optimization, in reducing travel time and fuel consumption. The review also evaluates how these solutions promote public participation in waste management through features like chatbot-based issue reporting and sustainable waste practices guidance. By integrating IoT and AI technologies, these systems present a cost-effective and environmentally sustainable approach to transforming urban waste management practices.

Keywords: *Mobile application, IoT-based waste management, Route optimization, Smart bins, GPS tracking*

Flexible and Adaptive Anxiety Management Therapeutic Strategies for Children with Autism Spectrum Disorder: A Systematic Review

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Abstract

Autism Spectrum Disorder (ASD) often involves challenges in emotional regulation, heightened stress responses, and sensory processing difficulties, particularly in children ages 10- 12. While mindfulness exercises, music therapy, and sensory integration are useful therapeutic modalities, they are not personalized to meet the unique needs of each patient on an individual basis. The shortcomings of existing techniques for managing anxiety are spotlighted in this review to make an earnest appeal for flexible individualized approaches to fill the gaps. In the analysis of the interviews with parents and medical specialists, an overwhelming percentage (100%) of the children diagnosed with ASD exhibited aggression towards others. Other behavioral traits included temper outbursts (87.5%), repetitive behaviors (37.5%), and social withdrawal (37.5%). Therapeutic strategies like breathing exercises, music therapy, sensory activities, and mandala coloring have been proven to work well in lowering stress and anxiety of autistic children. Also, parents have shown a reasonable degree of interest in technology-aided, home-based applications that would enhance the convenience of use. To address the gaps opened, a novel solution was introduced: a portable wearable device incorporating behavioral approaches, such as guided deep breathing exercises and mandala coloring; to provide real-time, adaptive support based on the individual child's sensory profile and stress levels. This methodology is intended to have immediate feedback and personalization to improve mental health and overall wellness for children with ASD. Further, the potential of the solution is described as complementing the existing therapeutic footprint of making it accessible, feasible, and effective for diverse needs in the ASD population.

Keywords: *Autism spectrum disorder, Anxiety management, Adaptive therapies, Mindfulness, Sensory processing.*

Use of Affective Computing and Wearable Technologies for Mental Health Management of University Students: A Review

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Abstract

Mental health challenges among university students have become a significant concern, with academic workload, social isolation, and personal issues being major contributing factors to mental disorders. This review aims to analyze existing studies on wearable technologies and affective computing to detect mental disorders among university students and identify the primary factors contributing to these issues. The review explores concepts such as affective computing, a key area of Human-Computer Interaction (HCI), and the application of machine learning algorithms, including Support Vector Machines (SVM) and Deep Neural Networks, for effective data processing and feature extraction. Following the PRISMA 2020 guidelines for meta-analysis, the study includes research sourced from various academic databases. The findings indicate that academic workload is the most significant stressor for university students, particularly those living in boarding houses. Additionally, inadequate sleep exacerbates negative emotions, highlighting the importance of features such as sleep tracking and heart rate monitoring to track physiological signals. Behavioral patterns, such as reduced SMS usage among highly stressed individuals, were also identified as potential indicators of emotional well-being. By synthesizing diverse approaches to managing mental health, the study identifies gaps in current capabilities, such as the contextual challenges of distance learning, and limitations like the high power consumption of wearable devices. These insights are categorized under themes of affective computing and wearable technologies. The study emphasizes the critical role of wearable technologies and affective computing in accurately diagnosing and monitoring mental health. The implications provide strategic guidance for future research to develop optimal solutions for managing the mental health of university students.

Keywords: *Physiological factors, Machine learning, Mental health, Wearable devices, Affective computing.*

Enhancing Early Detection of Dementia through Risk Factor Aggregation: Leveraging AI-Driven Knowledge Management Solutions

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Abstract

Dementia represents a significant public health issue, characterized by cognitive decline that disrupts daily activities and the ability to live independently. With the global population aging, the number of individuals affected by dementia is expected to rise, necessitating innovative approaches for diagnosis and care. This study addresses the critical need for early detection of dementia, which is essential for timely treatments that enhance patient outcomes and improve the quality of life for both patients and caregivers. This research explores the integration of artificial intelligence (AI) into knowledge management systems, leveraging machine learning (ML) and deep learning (DL) techniques to analyze multimodal data from diverse sources, including electronic health records, genetic information, and lifestyle factors. Using a systematic review methodology, the study synthesizes existing literature on AI-driven approaches for dementia detection, highlighting their effectiveness in identifying risk factors and early symptoms. The analysis compares various AI techniques, such as Convolutional Neural Networks (CNNs) for image analysis and Natural Language Processing (NLP) for symptom extraction. Findings reveal that integrating diverse data sources such as clinical, behavioural, and neuroimaging significantly enhances the accuracy of early dementia detection. AI technologies are shown to uncover complex patterns and connections that traditional diagnostic methods often overlook, thereby improving diagnostic precision and patient outcomes. Future advancement may include real-time monitoring via wearable technology and enhanced multimodal data integration to refine predictive models. These developments hold potential for addressing the growing burden of dementia and improving patient care.

Keywords: *Dementia, Risk factor, Artificial intelligence, Knowledge management*

A Review on Evaluating the Effectiveness of Mobile Health Interventions Surrounding an Underserved and Stigmatized Population

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Abstract

Mobile Health (mHealth) applications have emerged as viable solutions for managing depression, offering scalable and accessible mental health care. These tools leverage technology to address limitations in traditional mental health services, providing cost-effective and accessible interventions. Despite their promise, significant gaps remain in the systematic evaluation of their effectiveness, particularly for underserved populations and individuals facing stigma or social dysfunction. This systematic review, conducted using the PRISMA framework, analyzed 40 studies published between 2010 and 2024. The review highlights the diversity of mHealth approaches, including chatbots, cognitive-behavioral therapy (CBT) modules, mood tracking, and gamification features. While these tools have demonstrated potential, many studies rely heavily on user engagement metrics and subjective feedback, lacking standardized clinical outcome measures to assess long-term improvements in depression symptoms. The findings indicate that mHealth tools have increased accessibility to mental health resources by 68%, particularly for vulnerable groups such as individuals from low-resource settings and those experiencing stigma or social challenges. However, the therapeutic impact and overall effectiveness of these interventions remain unclear due to the absence of validated clinical assessments. Future research should focus on integrating standardized measures to evaluate the clinical efficacy of mHealth applications and their role in addressing mental health disparities.

Keywords: *Mobile health for depression, Stigmatized population, Mobile health applications, Underserved population*

A Review of Machine Learning Driven Automated Ethical Hacking: Proactive Defense and Vulnerability Mitigation in Wi-Fi and LAN Networks

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Abstract

The increasing reliance on Wi-Fi networks has raised significant concerns over network security, with vulnerabilities such as de-authentication, man-in-the-middle (MITM), and denial-of-service (DoS) attacks persisting despite advancements like WPA2. Tools like Aircrack-ng and Wireshark require significant technical expertise and primarily focus on vulnerability identification without offering automated feedback or proactive defenses, limiting their accessibility. This study addresses these limitations by integrating machine learning algorithms, including anomaly detection and classification models, into penetration testing. Machine learning enables the automation of vulnerability assessments, real-time threat detection, and delivery of actionable security recommendations. By analyzing network patterns and identifying irregularities, these algorithms can predict potential threats and proactively mitigate risks. Survey findings reveal a strong user preference for automated tools with intuitive guidance and proactive features like automatic hacker blocking. Based on these insights, the proposed ML-driven ethical hacking tool simplifies network security for both technical and non-technical users. The tool leverages ML to not only detect vulnerabilities but also provide dynamic remediation strategies, bridging the gap between technical complexity and usability. Result of this review emphasizes the transformative potential of machine learning in modern network security by automating processes, enhancing accessibility, and improving proactive defenses for Wi-Fi and LAN networks. By addressing key gaps in current penetration testing approaches, this research contributes to the development of innovative and efficient solutions for mitigating network vulnerabilities in an increasingly connected world.

Keywords: *Wi-Fi security, Machine learning, Ethical hacking, Automated vulnerability assessment, Proactive defense*

Addressing the Fragmentation in Criminal Detection: The Need for Integrated Data Systems

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Abstract

Law enforcement agencies in Sri Lanka face significant challenges in detecting and apprehending criminals due to the absence of integrated data systems. Fragmented data across national identity management systems, customs records, financial institutions, and criminal databases create silos that impede effective criminal investigations. These information gaps delay access to crucial data, enabling criminals to exploit these weaknesses and evade detection. The objective of this research is to examine the barriers caused by disconnected data systems and their impact on criminal detection. A mixed-methods approach was used, involving qualitative interviews with law enforcement officials and quantitative analysis of crime data. The results reveal that fragmented data systems lead to operational inefficiencies, delays in criminal investigations, and missed opportunities for interagency collaboration. Technological limitations, lack of standardized protocols, and legal and privacy concerns were identified as key barriers to data integration. The research also highlights the urgent need for a unified data system that can improve the efficiency of criminal detection and enhance public safety. This study offers recommendations for overcoming these challenges, including the establishment of standardized data formats, enhanced collaboration between agencies, and technological advancements to address the existing limitations. The findings contribute to the growing body of knowledge on how integrated data systems can improve law enforcement practices and ensure more effective criminal detection.

Keywords: *Criminal detection, Integrated data systems, Data fragmentation, Law enforcement challenges, Interagency collaboration*

Unveiling Hidden Threats: A Comprehensive Review of Host-Based Intrusion Detection, Risk Dynamics, and Proactive Defense

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Abstract

Advancements in Information Technology have given rise to an increasingly interconnected global landscape, simultaneously elevating the criticality of cybersecurity due to the growing sophistication of cyber threats. Exploiting vulnerabilities within systems and networks, cybercriminals pose significant risks to confidentiality, integrity, and availability cornerstones of modern digital infrastructure. Among the various defense mechanisms, Host-Based Intrusion Detection Systems (HIDS) have emerged as pivotal tools for detecting and mitigating these evolving threats. Nevertheless, traditional signature-based detection approaches remain inadequate in addressing contemporary challenges, including zero-day exploits, ransomware, and Distributed Denial of Service (DDoS) attacks. This study conducts a systematic review of recent advancements in HIDS technologies, emphasizing the integration of Machine Learning and Artificial Intelligence (AI) for anomaly detection and predictive analytics to enable real-time threat responses. Utilizing PRISMA guidelines, the research synthesizes findings from the literature to identify key limitations and propose enhancements to HIDS performance. The analysis reveals that AI-driven models, such as ensemble learning techniques and adaptive algorithms, significantly enhance detection accuracy, reduce false positive rates, and improve incident response times. Furthermore, the review underscores the importance of integrating HIDS with Next-Generation Firewalls (NGFW) to create a multi-tiered defense framework. NGFWs effectively filter known threats, while HIDS specialize in identifying complex and sophisticated attack patterns, thereby fostering resilience against dynamic cyber threats. This paper also outlines future research directions, including advanced AI integration, cross-network intelligence sharing, and proactive risk management frameworks, to enhance HIDS capabilities and adapt to the continuously evolving cyber threat landscape.

Keywords: *Risk dynamics, Cybersecurity, Host-based intrusion detection system, Anomaly detection, Artificial intelligence*

Phishing Email Mitigation Through Gmail Plugins: A Review of Current Technologies and Future Trends

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Abstract

Phishing attack is a chronic cybersecurity threat, particularly in popular platforms like Gmail, where traditional rule-based systems often struggle to detect evolving phishing tactics. This review examines effectiveness of the approaches of AI/ML-based Gmail plugins focusing on supervised learning and NLP techniques. These technologies increase the accuracy and flexible of phishing email detection while fixing the issues with traditional methods. The literature review was conducted by considering publications between 2015 and 2024 and the materials retrieved from trusted cybersecurity websites and other scholarly sources. The research points out the strengths and weaknesses by contrasting them with alternative approaches, so the use of AI/ML-based plugins enhances e-mail security, which is an advantage over rule-based, static systems. This research highlights that the Supervised Learning and NLP improve the detection of phishing emails by focusing on patterns of the email content where traditional methods are failed to identify. Future research is required to carryout overcome the constraints of real-time automatic responses for more flexibility. This review recommends for future developments with the combination of deep learning and privacy-preserving federated learning to improve real-time response capabilities. The circle of usage could be increased by developing better user interfaces, user alert systems, and reporting tools. These would make email security solutions with more agile and efficient, while improving phishing detection, and also improving the security of the email ecosystem.

Keywords: *Phishing detection, AI techniques, Machine learning, Email security, Anti-phishing*

Systematic Review on Analyzing the Most Effective Method for Deepfake Detection of Images Generated by AI

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Abstract

The rapid advancements in Artificial Intelligence and Deep Learning have revolutionized synthetic media creation, with Deepfakes emerging as a significant societal threat. These manipulated images and videos, often generated using Generative Adversarial Networks (GANs) and Diffusion Models (DMs), now turn out increasingly realistic due to modern technologies, making their detection more challenging and critical. Deepfakes cause serious risks to privacy, cybersecurity, and the spread of misinformation, especially across platforms like social media, where their rapid dissemination serves to undermine trust and public discourse. This systematic review, conducted in line with the PRISMA framework, examines over 50 research papers on Deepfake detection methods, focused on Convolutional Neural Networks (CNNs), frequency-based approaches, and hybrid models. The findings admit that CNNs excel in controlled settings, providing high detection accuracy, but poor generalization when applied to diverse and evolving Deepfake datasets. Hybrid models, while more adaptable to new manipulations, face significant limitations due to high computational costs, impeding their scalability for real-time applications. This study underscores the critical need for robust and scalable detection systems that are capable of performing well in real-time to support applications like social media moderation, cybersecurity defenses, and misinformation prevention. The insights aim to guide future research toward developing versatile and high-accuracy detection frameworks to neutralize the escalating threats posed by increasingly realistic Deepfakes.

Keywords: *Deepfake detection, AI-generated images, Diffusion models, Convolutional neural networks, Hybrid models*

Impact of Artificial Intelligence in Modern Educational Environments: A Retrospective Analysis

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Abstract

Artificial intelligence is dynamically, and in many ways, irretrievably changing modern education due to personalized learning support, the automation of administrative duties, and improvements in the classroom. However, not all challenges are met squarely: teacher preparedness and ethical concerns are only the beginning, not to mention infrastructural constraints. This is a review of certain applications of AI in facilitating adaptive learning, intelligent tutoring systems, and inclusive education for learners. A literature review on artificial intelligence in education from the years 2015 to 2024 reveals that it produces better learning outcomes for students and increased efficiency for teachers through immediate feedback, thus helping both in the process of education. Some of the most prominent applications include Adaptive Learning Systems and Intelligent Tutoring Systems. However, the following issues of Algorithmic Bias, Data Privacy, and Teacher Digital Literacy are all important concerns that each deserves much more emphasis than they have received so far. This paper presents a critical review of the literature on AI integration, tracing the gaps in the same. Therefore, it calls for the continuous training of teachers, robust policy reforms, and heavy infrastructure investments that will ensure effective and equitable AI adoption. The finding underlines that only with responsible implementation will the full potential of AI be reaped to foster an inclusive and efficient educational environment.

Keywords: *Artificial Intelligence, Education, Learning analytics, Tutoring systems, Assessment system*

A Review of AI-Driven Intelligent Tutoring System for Enhancing Problem-Solving Skills through Personalized Programming Instruction

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Abstract

Traditional programming education often employs uniform instructional methods, neglecting diverse learner needs in terms of prior knowledge, learning styles, and pacing. These limitations lead to disengagement and inconsistent outcomes. To address this, the study introduces an AI-enabled Intelligent Tutoring System (ITS) designed to deliver personalized programming instruction. This ITS employs machine learning, collaborative filtering, and deep learning to dynamically adapt content, including tailored exercises and real-time feedback based on learners' progress and performance. A distinctive feature of the proposed ITS is its immediate feedback mechanism, enabling students to identify and correct mistakes, fostering deeper understanding and mastery of concepts. Personalized exercises are generated to address specific learning gaps, strengthening problem-solving skills while keeping learners engaged. Additionally, the system supports peer collaboration, connecting students with similar proficiency levels to enhance learning through teamwork. The dataset comprises diverse programming students across academic institutions and online platforms. Collaborative filtering techniques recommend relevant exercises, while deep learning models extract patterns from learner interactions to refine personalization further. Experimental results demonstrate that students using the ITS perform 25% better in problem-solving and retain 40% more knowledge compared to traditional methods. This ITS bridges gaps in traditional systems by offering scalability across varied programming environments and providing adaptive learning paths supported by real-time analytics. Its innovative approach ensures greater learner independence, engagement, and skill acquisition, positioning it as a transformative tool in programming education. Future research should focus on optimizing computational efficiency for real-time scalability and exploring cross-domain applications. This study underscores the potential of AI-driven ITS to revolutionize programming education, paving the way for personalized learning and enhanced educational outcomes in a technology-driven world.

Keywords: *Personalized Learning, Intelligent Tutoring Systems, Programming Instruction, Collaborative Filtering, and Deep Learning*

The Role of Artificial Intelligence in Predicting Academic Procrastination: A Review

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Abstract

Academic procrastination is a common problem in education, affecting student performance and success. While traditional methods of studying procrastination frequently rely on self-reports and surveys, recent advancements in Artificial Intelligence (AI) provide novel possibilities for predicting and addressing procrastination behaviors. However, the literature lacks a comprehensive understanding of AI's role in predicting academic procrastination. This review paper fills this gap by investigating the use of AI techniques such as machine learning and deep learning algorithms to predict academic procrastination. Using the PRISMA framework, the review summarizes findings from various studies that use AI to analyze factors such as student demographics, online learning behaviors, and academic performance metrics. The methodology entailed screening and selecting studies based on criteria such as the use of AI in educational settings and the emphasis on predicting procrastination. Procrastination is influenced by age, gender, entry grades, and submission patterns, as well as challenges such as data privacy, algorithmic bias, and variability across educational settings. For example, biases in training data can result in unrelated predictions for specific demographics, and ethical considerations are essential for responsible AI integration. The review discovered that AI techniques can accurately identify at-risk students, allowing for preventive measures that improve academic outcomes. It also highlights the importance of ethical considerations and tailored AI models that account for contextual differences. The findings show AI's transformative potential in education, providing actionable insights for reducing procrastination and fostering student success.

Keywords: *Academic Procrastination, Artificial Intelligence in Education, Predictive Analytics*

Optimizing Schema and Indexing Strategies for Large Databases: A Comparative Study of SQL, NoSQL, and HTAP Systems

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Abstract

Most large-scale modern applications are increasingly in need of database management systems that are effective and scalable, meeting increased data complexity and volume continuously. This study explores the programming and indexing methodologies of SQL, NoSQL, and Hybrid Transactional/Analytical Processing (HTAP) systems, assessing their suitability for large-scale databases. The objective is to compare the structured, transactional strengths of SQL with the scalability and flexibility of NoSQL for unstructured data, and to evaluate HTAP systems for handling both transactional and analytical queries. Relevant studies published after 2015 were sourced from IEEE Xplore, ACM Digital Library, and ScienceDirect, focusing on empirical performance metrics. The findings highlight SQL's strength in structured data processing, achieving query speeds of up to 10ms for transactional workloads, while NoSQL excels in unstructured environments with 20–30% faster query speeds. HTAP systems combine features of SQL and NoSQL but face challenges in indexing strategies to optimize diverse workload types. The review concludes that database selection should be context-driven, optimizing for performance and scalability. The direction for future research will be the empirical testing of HTAP systems in real large-scale environments for the optimization of indexing strategies catering to both transactional and analytical demands.

Keywords: *schema optimization, indexing in large databases, SQL vs NoSQL, HTAP database performance*

A Systematic Review on Emotion-Based Music Recommendation System for Blind Individuals

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Abstract

Music recommendation systems based on emotions have gained traction for their ability to personalize user experiences. However, such systems often overlook the unique needs of blind individuals by depending heavily on visual user interfaces and data inputs such as facial expressions. This research systematically reviews existing emotion-based music recommendation systems, employing the PRISMA methodology to analyze their suitability for blind users. It explores various emotion detection methods, including electroencephalogram (EEG) signals, voice commands, and physiological signals, emphasizing non-visual alternatives. This study focuses on evaluating current technologies and methods, identifying their strengths and limitations, and proposing hybrid solutions combining EEG and voice recognition. This review results in the identification of significant gaps in accessibility and precision in existing systems for blind users. The proposed technique integrates EEG-based emotion detection and voice-command systems to create a non-visual, user-centered music recommendation platform. This hybrid approach leverages real-time adaptability and artificial intelligence-driven personalization to address these challenges. It will enhance the inclusivity and emotional engagement of blind users, providing accurate emotion detection and seamless interaction. The implications of the study highlighted the advancements in hybrid technologies and artificial intelligence are vital for future development to bridge the accessibility gap and ensure equitable user experiences.

Keywords: *Music recommendation system, Emotion, electroencephalogram emotion detection, Blind people, Voice command*

Enhance Maternal Health Outcomes with Personalized Pregnancy Management Systems: A Technology-Driven Approach

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Abstract

Personalized Pregnancy Management Systems (PPMS) enhance maternal healthcare by leveraging wearable devices and Artificial Intelligence. However, a critical research gap exists due to the limited data availability from pregnant women using wearable devices, impacting system reliability. The study aims to evaluate the effectiveness of Personalized Pregnancy Management Systems (PPMS) in improving maternal health and explores enhancements through advanced technologies. Clinical Decision Support System (CDSS), which assist healthcare providers in decision-making, while Long Short-Term Memory (LSTM) networks, designed to analyse time-sequenced health data, form the core of the proposed approach. The project adopts a structured approach that integrates LSTM networks for time-series data prediction with CDSS for providing actionable insights. This hybrid approach enables PPMS on timely warnings for midwives based on wearable device data. The findings demonstrate that, while PPMS has significant potential for early danger detection and individualized care, the system's performance could be further enhanced by addressing the current limitations with more extensive wearable device datasets. In summary, the study underscores the need for more robust data techniques and flexible algorithms to optimize PPMS and ensuring reliable, individualized treatment to pregnant women across diverse settings.

Keywords: *Maternal health, Artificial Intelligence, Machine learning, Pregnancy Management System, mHealth application and wearable sensors*

A Systematic Review on Elderly Behavior Analysis Technologies: Bridging the Gaps in Safety and Personalization

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Abstract

The increasing elderly population, particularly those living alone, faces significant challenges related to health monitoring and emergency response. Existing technologies often lack personalization and generate false alerts, hindering their effectiveness in ensuring the safety and well-being of elderly individuals. This review explores and analyzes various technologies employed for monitoring behavioral patterns in elderly individuals, focusing on smartwatch-based systems, machine learning integration, and indoor localization techniques. A systematic examination of the literature was conducted, highlighting the strengths and limitations of existing solutions. It was found that while smartwatch-based systems demonstrate promising capabilities in detecting falls and tracking health metrics, they frequently struggle with false alerts and limited contextual integration. Machine learning algorithms, although highly accurate in identifying behavioral anomalies, often rely on manually labeled data, restricting their adaptability. Furthermore, indoor localization technologies present privacy challenges that impact user acceptance. To bridge personalization and safety, this review clusters its analysis into technology-wise, software-wise, and instrumental-wise categories. The review emphasizes the need for more accurate and reliable solutions, calling for advancements in personalization, real-time contextual awareness, and enhanced privacy measures. Key findings suggest that integrating advanced AI techniques and secure data handling processes will be crucial for the future development of elderly monitoring systems.

Keywords: *AI in elderly care, Wearable technology, Neural networks, Behavioral analysis, Context-aware monitoring*

A Systematic Review on Real-Time Posture Correction and Exercise Guidance for Elderly People Using Expert Systems and Computer Vision

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Abstract

Elderly individuals often face challenges staying physically active due to age-related issues such as mobility problems, balance difficulties, and stiff joints, which increase the risk of injuries and reduce the effectiveness of workouts. This research focuses on identifying the most effective technologies and methodologies to address these challenges by providing safe and personalized exercise guidance, particularly for home-based routines. The proposed solution integrates an expert system for personalized recommendations and health warnings, along with a computer vision framework to monitor posture and provide real-time corrective feedback. Using the PRISMA framework, a systematic literature review was conducted to explore existing technologies and methodologies. This process identified over 100 relevant studies, of which 30 were selected for detailed review. The analysis revealed that 40% of the studies highlighted the high accuracy of motion detection devices, such as Kinect cameras, while 30% emphasized the importance of expert systems for tailored exercise guidance. The findings suggest that combining expert systems with computer vision technologies is the optimal approach for enhancing safety, posture accuracy, and the effectiveness of exercises for elderly users. This research contributes to addressing the current gaps in fitness technology by providing a practical framework for supporting elderly individuals through guided, interactive home workouts.

Keywords: *Elderly Fitness, Expert System, Computer Vision, Posture Correction, Personalized Exercise*

Identifying the Most Optimum Technology to Detect Pimples and Facial Skin Diseases

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Abstract

The rising prevalence of facial dermatoses, including acne and their variants, necessitates the development of effective diagnosis and classification techniques. This systematic review evaluates optimal technologies for detecting pimples and classifying facial skin diseases by analysing diverse image processing and machine learning methodologies. The review examines research employing approaches such as Convolutional Neural Networks (CNNs), texture feature extraction, and hybrid strategies that integrate multiple algorithms for detection with high precision. It critically assesses the strengths and limitations of existing technologies in terms of their performance and clinical applicability. Findings highlight significant advancement in automated skin assessment, yet underscore persistent challenges related to dataset diversity, model generalizability, and integration into practical clinical applications. The review emphasizes the necessity of larger, more diverse datasets and the adoption of advanced machine learning techniques to enhance detection performance. Future research directions are proposed to address these gaps, aiming to develop superior tools for dermatologists and patients. These advancements are envisioned to facilitate early diagnosis and treatment of facial skin disorders, ultimately improving patient outcomes.

Keywords: *Facial Dermatoses, Acne Detection, Image Processing, Machine Learning, Skin Disease Classification*

Enhancing Personalization of Fitness Tracking Systems with The Help of Data Analytics

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Abstract

This review explores the application of data analytics to enhance personalization in fitness tracking systems, a growing need within the expanding domain of wearable and mobile health technology. Although fitness trackers have made significant strides in capturing data on daily activity and health metrics, most remain limited to basic descriptive insights, which restrict their potential for adaptive user engagement. By categorizing existing research through the PRISMA approach, this paper investigates how advanced analytics—descriptive, predictive, and prescriptive can contribute to personalized fitness guidance. While descriptive analytics offers foundational insights into daily metrics, predictive analytics enables anticipatory adjustments in fitness regimens, and prescriptive analytics provides actionable recommendations. The study identifies several promising opportunities and highlights challenges, such as privacy, algorithmic biases, and the need for robust real-time data processing. The findings of the study suggest that integrating predictive and prescriptive models could advance the field by delivering a deeper, more tailored user experience in fitness tracking, ultimately supporting sustained fitness improvement and adherence.

Keywords: *Fitness tracking systems, Personalization, Descriptive analytics, Predictive analytics, Prescriptive analytics*

Comprehensive Review on Design of Low-Cost Portable Ventilator for Emergency Use in Resource-Limited Settings

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Abstract

Mechanical ventilation serves as a lifesaver in the rapidly evolving field of respiratory disease treatment. However, limitations of existing ventilators, such as high cost and limited portability, affect the accessibility and affordability of respiratory support in resource-limited emergency settings. The aim of this paper is to design a low-cost and portable ventilator machine that overcomes the limitations of ICU ventilators and other portable ventilators. This proposed solution focuses on affordability, portability, and versatility, making it suitable to provide lifesaving respiratory support in various settings. Prior to the design phase, a background study was conducted using the shadow approach, alongside a literature review to collect relevant data and insights. The proposed design consists of an ATmega2560 Arduino microcontroller as the main control board, along with a Honeywell AWM720P1 flow meter, Bosch BMP280 pressure sensor, SST OXY-LC oxygen sensor, and Max30100 pulse oximetry sensor. This system offers Assist Control (AC), Synchronized Intermittent Mandatory Ventilation (SIMV), and Cardiopulmonary Resuscitation (CPR) ventilator modes, as well as adjustable tidal volume, respiratory rate, positive end-expiratory pressure value, and a pressure control system with a user-friendly interface. This design includes a standalone feature, allowing the ventilator to operate in the absence of an external oxygen supply. It also has an alarm system to alert operators or caretakers about potential issues such as high pressure, insufficient oxygen levels, low pulse oximetry, power shortages, or abnormal heart rates.

Keywords: *Respiratory Disease treatment, Low-cost Respiratory support, Portable ventilator, Resource-limited emergency settings*

Structural Health Monitoring System for Large Structures Using Wireless Sensor Networks: A Machine-Learning Enabled Edge Computing Approach

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Abstract

Structural Health Monitoring (SHM) is critical for the safety, durability, and longevity of critical infrastructures ranging from buildings to very big structures such as wind turbines, and bridges. In traditional cloud-based SHM systems, high latency, energy consumption, and low scalability are the challenges. By integrating Machine Learning (ML) with edge computing via Wireless Sensor Networks (WSNs) leveraging device learning, we propose a new approach to address these issues. Deep Neural Networks (DNNs) are directly deployed on edge devices for real-time data analysis and anomaly detection at sensor nodes using the framework. Thus, it reduces the need for continuous data transmission to the centralized servers, reduces energy consumption, and improves system efficiency. Real-time data are collected from key sensors, such as accelerometers and strain gauges, and processed locally by DNNs. Adaptive retraining is enabled by drift detection algorithms, which allow response to changing structural conditions. The findings show that DNNs on the device provide both latency and scalability benefits and are unable to accurately classify clean as well as noisy sensor data. On-device learning in combination with adaptive retraining to keep the system accurate and reactive to changing structural conditions. This proposed system also finds a quantized model using TensorflowLite, for optimizing DNN deployment on resource-constrained devices, to reduce computational overhead and memory footprint, while maintaining acceptable inference accuracy for real-time processing and data transmission. This research also provides a scalable, adaptive solution for real-time infrastructure monitoring, as well as new avenues for adaptive re-training, predictive maintenance, and energy harvesting for Structural Health Monitoring.

Keywords: *Structural Health Monitoring, Wireless Sensor Network, Edge Computing, On-Device Learning, Adaptive Retraining*

Real-Time V2V Communication for Traffic Optimization and Collision Prevention Using Machine Learning.

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Abstract

Vehicle-to-vehicle(V2V) communication represent a critical of next generation transportation systems. This paper explores how to improve V2V systems through the integration of V2X, using machine learning models, and blockchain-based security techniques, bringing greater road safety and traffic management optimization. Leveraging cellular Vehicle-to-Everything (C-V2X) technology, the proposed system offers enhanced capability in range, scalability, and low-latency communication, making it highly suitable for high-speed mobility scenarios. Furthermore, the study provides insights into the works of power transfer, providing discussions on how electric vehicles would be able to share power and data in real time. The paper also examines the role of machine learning algorithms, particularly Deep Reinforcement Learning (DRL) and transformer-based models, in enhancing the efficiency, safety, and data security of V2V systems. Special emphasis is placed on the implications of these technologies for autonomous vehicle systems. By addressing key challenges and proposing innovative solutions, this research contributes to the advancement of intelligent and secure transportation networks.

Keywords: *Vehicle-to-Vehicle Communication (V2V), Vehicle-to-Everything (V2X), Cellular Vehicle-to-Everything(C-V2X), Deep Reinforcement Learning (DRL).*

A Comprehensive Review of Advanced Driver Assistance Systems (ADAS) and Their Role in Enhancing Human and Road Safety

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Abstract

Advanced Driver Assistance Systems (ADAS) play a crucial role in enhancing road safety by leveraging technological advancements to minimize the risk of accidents. This review highlights the importance of ADAS in mitigating risks, even when human reflexes fall short, by enabling drivers to adapt quickly to changing situations. Key technologies such as Adaptive Cruise Control, Emergency Brake Assistance, and Lane Departure Warning rely on sensor fusion involving radar, LiDAR, and camera imaging, which enhance vehicle responsiveness and provide timely warnings to drivers. The findings emphasize the significance of Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication in facilitating real-time data exchange. This not only improves traffic safety but also accelerates the transition toward fully autonomous driving systems. However, challenges remain, such as ensuring sensor accuracy in adverse weather conditions and addressing security concerns related to data sharing. Further research is necessary to resolve these issues and fully realize the potential of ADAS technologies. The literature review was conducted using highly cited research papers from sources such as ResearchGate, Elsevier, ScienceDirect, and Google Scholar, following the PRISMA workflow to ensure quality and relevance. Results indicate that ADAS contributes significantly to road safety while laying a foundation for adaptive automated driving systems. For instance, emergency braking systems automatically respond to detected faults, and computer vision technology helps identify environmental hazards and driver blind spots, reducing the likelihood of accidents. In conclusion, ADAS not only enhances safety for all road users but also contributes to the development of flexible and safe automated driving systems. By addressing existing challenges, ADAS can further revolutionize road safety, offering society a reliable means of travel with minimal risk, ultimately shaping the future of transportation.

Keywords: *Advanced Driver Assistance Systems, Human safety, Sensor fusion, Accident prevention*

The Virtual Mouse - A Revolutionary Replacement for the Physical Mouse

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Abstract

The rapid progress in Human-Computer Interaction (HCI) has facilitated the emergence of virtual mouse systems that leverage gesture recognition and voice commands as innovative, touch-free alternatives to conventional physical mice. These technologies offer significant potential to enhance user experiences in domains such as healthcare, manufacturing, and environments where hygiene, accessibility, and hands-free operation are paramount. This review presents a comprehensive analysis of gesture-based systems, driven by tools like OpenCV and MediaPipe, which enable real-time hand tracking and intuitive gesture control. Additionally, voice command systems powered by Natural Language Processing (NLP) expand accessibility for users with limited mobility by enabling voice-driven interactions. Using a systematic literature review methodology, this study synthesizes secondary data from peer-reviewed articles and technical reports to assess system performance, usability, and associated challenges. The analysis highlights emerging trends in hybrid systems that integrate gesture and voice controls, aiming to create more adaptable, ergonomic, and user-friendly interfaces. However, several challenges impede widespread adoption. Gesture recognition systems are sensitive to environmental factors such as lighting and background interference, while voice systems face obstacles related to noise interference, privacy concerns, and linguistic variability. Moreover, issues like user fatigue in gesture-based interactions and latency in real-time processing remain critical barriers. The findings underscore the importance of addressing these limitations through advancements in customization, enhanced real-time processing capabilities, and robust security measures. With these improvements, virtual mouse technology holds the potential to become a viable alternative to physical mice in both personal and professional applications.

Keywords: *Virtual Mouse, Gesture Recognition, Voice Commands, Human-Computer Interaction, Touchless Interaction*