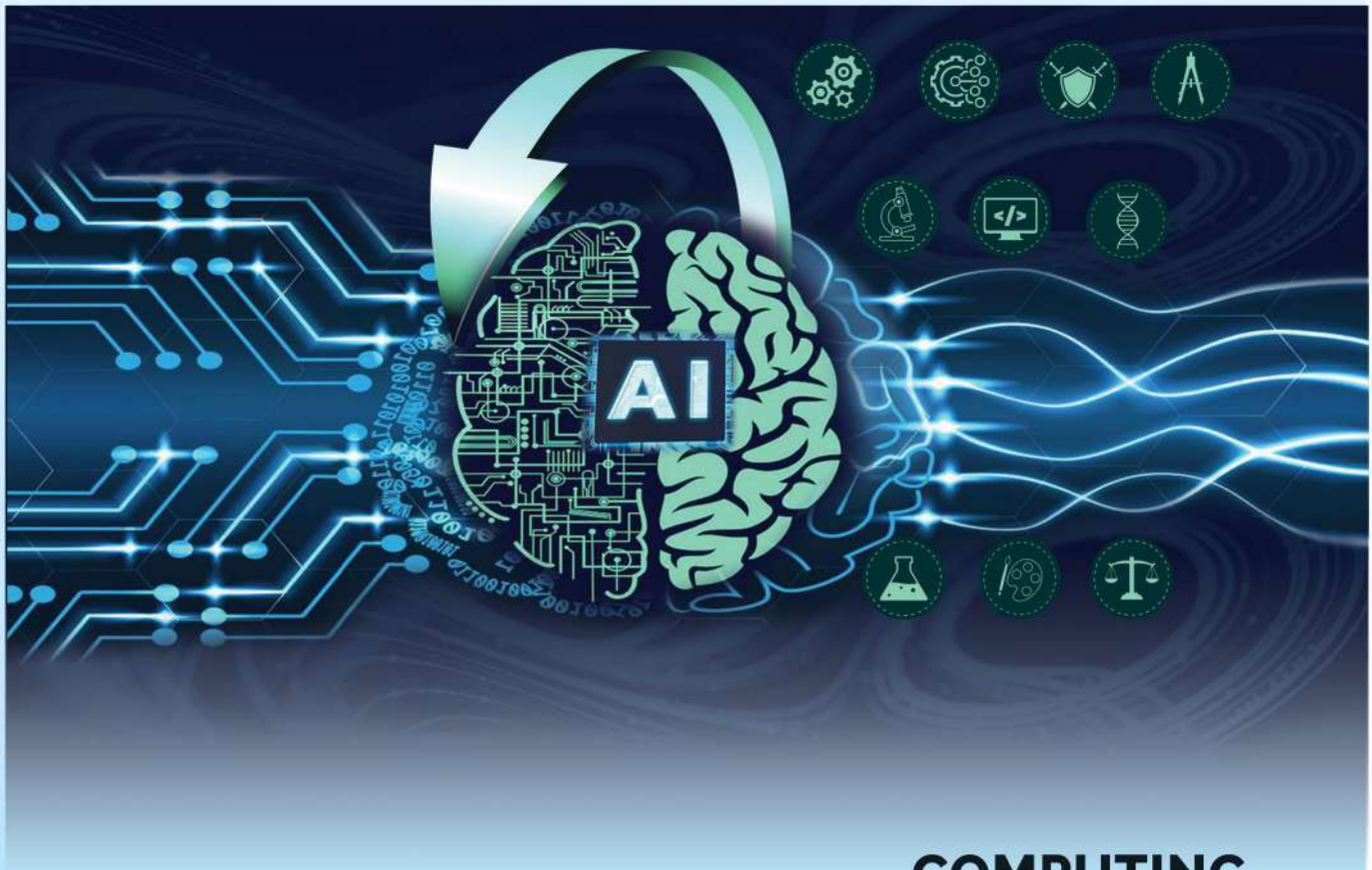# KDU IRC
INTERNATIONAL RESEARCH CONFERENCE

17th INTERNATIONAL RESEARCH CONFERENCE

Unravelling the Paradigm Shift: Revolutions in the Era of AI

26TH - 27TH SEPTEMBER 2024

COMPUTING
ABSTRACTS

General Sir John Kotelawala Defence University

17ᵗʰ INTERNATIONAL RESEARCH CONFERENCE

UNRAVELLING THE PARADIGM SHIFT: REVOLUTIONS IN THE ERA OF AI

COMPUTING

ABSTRACTS

General Sir John Kotelawala Defence University
Ratmalana, Sri Lanka.

KDU PRESS

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Message from the Chief Guest

I am truly honoured to welcome all the distinguished participants to the 17th International Research Conference (IRC) at General Sir John Kotelawala Defence University (KDU). This annually organized conference serves as a unique milestone showcasing the rich research culture deeply embedded within KDU. As a prestigious seat of learning, novelty and innovation remain at the heart of KDU's mission. Therefore, 'Unravelling the Paradigm Shift: Revolutions in the Era of AI' has been chosen as the key theme of IRC 2024.

Moving ahead with the momentum of modern-day research, we are set to uncover the extensive impacts of artificial intelligence, not just in defence but across every facet of national interest. Currently, AI has become a driving force, reforming our defence strategies, transforming healthcare, and restructuring our educational frameworks and infrastructure.

Investing in research is essential for national advancement, promoting innovation, formulating policies, and offering solutions that address our most pressing challenges. Hence, the IRC serves as a vital platform that fosters such great endeavours, contributing significantly to national development. Our responsibility as defenders of national security is profound, extending beyond traditional roles to include the ethical integration of advanced technologies that ensure our nation's safety and prosperity.

KDU stands as a symbol of a rich and diverse research culture across many disciplines. It is also a hub for high-quality research, upholding international standards of academic excellence. This conference represents a critical meeting of minds where leading experts converge to define strategies for our future. Each discussion and presentation at this event is a step toward securing a thriving, prosperous future for our region.

I extend my best wishes to all for a successful and productive conference, eagerly anticipating the innovative ideas and transformative insights that will undoubtedly arise.

GENERAL SHS KOTTEGODA (Retd) WWV RWP RSP VSV USP ndc
Chancellor General Sir John Kotelawala Defence University

Message from the Keynote Speaker

Brain health is a holistic concept encompassing cognitive, sensory, social-emotional, behavioural, and motor functions, enabling individuals to achieve their full potential. With one in three people globally affected by a brain disorder, the urgency for preventive brain health initiatives is evident. Since the inception of World Brain Day in 2014, there has been a renewed global focus on this critical area. The World Federation of Neurology (WFN), in collaboration with key organizations such as the American Academy of Neurology (AAN), the European Academy of Neurology (EAN), and the Asian Regional Consortium of Headaches (ARCH), has led the charge to raise awareness and promote brain health worldwide.

This keynote address will outline the journey of World Brain Day and its impact on the global brain health movement, with a specific focus on prevention. It will explore the evolution of brain health concepts and the alarming prevalence of brain disorders, emphasizing the need for urgent, coordinated action. Central to this effort is the role of artificial intelligence (AI) in enhancing preventive brain health strategies. AI-driven technologies are increasingly being used to predict, diagnose, and monitor brain health conditions, enabling earlier interventions and more personalized approaches to prevention.

The address will highlight the author's pioneering work in community-based programs, public health campaigns, and international collaborations. It will underscore the critical role of prevention, early intervention, and AI-powered tools in improving quality of life and reducing the global burden of brain disorders. The ultimate goal is to advance comprehensive brain health initiatives that leverage cutting-edge technologies to ensure a healthier future for all.

Professor Tissa Wijeratne
DR OAM MD PhD FRACP FRCP(London) FRCP (Edin) FAAN (USA) FEAN (EAN) Professor and Chair, Director, Senior Neurologist, Department of Neurology, Western Health, Victoria, Australia Co-Founder and Co-Chair, World Brain Day, World Federation of Neurology

Message from the Vice-Chancellor

Greetings to all participants, speakers, and guests of the 17th International Research Conference (IRC) at KDU. This year's IRC is centered around a timely theme that has sparked diverse dialogues in the realms of research and innovation. The theme, 'Unravelling the Paradigm Shift: Revolutions in the Era of AI', serves as an eye-opener for both eminent and novice researchers across the globe. It also highlights the critical role that advanced technologies play in shaping our world.

At KDU, we take pride in being at the forefront of defence education in Asia, a distinction affirmed by our high rankings and our pivotal role in shaping global security dialogues. KDU claims to have a unique history of providing high-quality education for both military and civilian students. It also proudly stands as a thriving hub for cutting-edge research that addresses pressing global and national issues. We strongly believe in fostering a rich and diverse research culture among KDU's students and staff, aligned with international standards. Therefore, IRC is recognszed as a key event in KDU's annual calendar, emphasizing its significance in the institution's academic and research endeavours.

This year, we aim to explore the revolutionary impacts of AI across diverse disciplines, reaffirming our commitment to leading these discussions on a global scale. The insights shared here will undoubtedly spark new research initiatives and strategic collaborations, enhancing Sri Lanka's stature as a leader in both academic and strategic domains.

I extend my sincere gratitude to all those whose collective efforts have brought this conference to a reality. Your contributions ensure that KDU plays a prominent role in the international arena, driving discussions that will shape the future of technology and strategy. I look forward to a successful event, characterized by insightful discussions and pioneering ideas.

REAR ADMIRAL HGU DAMMIKA KUMARA, **VSV**, **USP, psc, MMaritimePol, BSc (DS)**
Vice Chancellor General Sir John Kotelawala Defence University

Message from the Chairperson

It is my honour, as the Chairperson, to welcome you all to the 17th International Research Conference at KDU. This year, we explore how artificial intelligence has evolved from a technological innovation into a catalyst for transformative change across numerous sectors. With an impressive selection of 441 research papers, drawn from nearly 1000 submissions, our conference spans across 11 distinct tracks covering a wide range of disciplines. Our theme, "Unravelling the Paradigm Shift: Revolutions in the Era of AI," highlights the profound and far-reaching transformations that AI is driving—from reshaping urban infrastructure to revolutionizing healthcare. The conference is designed to promote interdisciplinary dialogue, addressing not only technological advancements but also the ethical, social, and economic implications of these developments. One of our key objectives is to create a platform where researchers, professionals, and thought leaders can come together, exchange ideas, and foster collaborative initiatives that will push the boundaries of innovation. I am deeply grateful to all our keynote speaker and the plenary speakers, other presenters, , participants, and the entire organizing team for their tireless efforts and contributions. Your dedication to advancing knowledge is what brings this conference to life, positioning it as a critical forum in global research. Together, we are charting a path toward a future where technology and society grow hand in hand, reshaping the landscape of not just research but our daily lives. Let's engage in meaningful discussions that will inspire new perspectives and drive impactful solutions. Here's to a successful conference, rich in insight and collaboration. Finally, I would like to extend my best wishes to all the presenters, authors, and participants joining the KDU IRC 2024, whether on-site or online. I hope each of you finds this conference not only informative and enjoyable but also an encouraging opportunity to experience the warm hospitality of KDU throughout these two fruitful days.

Dr. Nirosha Wedasinghe
Ph.D(KDU-SL), MIT(CStud-Aus),B.Sc in Comp IS (London Met -UK), SMIEEE(US), MBSC(UK), MCS(SL), FISDS(Japan) Senior Lecturer cum Director -Centre for Gender Equity and Equality General Sir John Kotelawala Defence University Conference Chair-IRC 2024

Message from the Secretary

As we gather for the 17th International Research Conference at KDU, I extend a warm and heartfelt welcome to all participants, researchers, and thought leaders. This year, we proudly present 441 research papers selected from nearly 1,000 submissions, spanning across 11 tracks in diverse fields such as Defence and Strategic Studies, Medicine, Health Sciences, Engineering, Technology and Computing, Basic sciences, Law, Social Sciences and Humanities, and the Built Environment and Spatial Sciences. Our theme, "Unravelling the Paradigm Shift: Revolutions in the Era of AI," reflects the profound ways that AI is transforming our world, becoming integral to our lives and work. The discussions here aim to explore how AI can address global challenges, drive innovation, and foster interdisciplinary collaborations that will shape the future. Looking ahead, the future of IRC lies in broadening its horizons. We aim to increase international participation, diversify the scope of research, and establish global research consortia to tackle real-world problems that extend beyond the borders of Sri Lanka. The insights gained here must lead to actionable outcomes, particularly in formulating policy recommendations in areas such as AI in defence, public health, and education. This conference is more than just a forum for discussion; it is a platform where the brightest minds collaborate to drive change. I extend my heartfelt thanks to all our speakers and participants for their dedication and contributions. Together, we are not only shaping the future of research but also crafting solutions that will impact society on a global scale. Here's to a successful and inspiring conference that drives innovation, shapes policy, and sparks meaningful collaboration.

Dr. HM Prasanna Herath
Ph.D. (USJ), RN(SLNC), B.Sc(Nursing) Hons (UPSL), CTHE Senior Lecturer Faculty of Allied Health Sciences Erasmus coordinator General Sir John Kotelawala Defence University Conference Secretary- IRC 2024

Message from the Dean

It is with immense pride and a sense of great responsibility that I welcome you to the 17th International Research Conference of General Sir John Kotelawala Defence University. This year's theme, "Unravelling the Paradigm Shift: Revolutions in the Era of AI," perfectly captures the transformative period we find ourselves in today, where artificial intelligence (AI) stands as a beacon of innovation and change across all sectors of society. The Faculty of Computing has long recognized the significant role that AI and related technologies play in shaping the future of education, industry, and daily human interactions. This conference serves as a vital platform for the exchange of knowledge, encouraging academic collaboration and the generation of new ideas that will drive progress in this rapidly evolving field. We are proud to contribute to this global dialogue and are excited to see the innovations and research presented at this year's event. I would like to extend my heartfelt congratulations to the Conference Chair, Dr. Nirosha Wedasinghe, along with the entire organizing team, for their tireless efforts in ensuring the success of this event. Their dedication and hard work have culminated in a remarkable program that promises to inspire and challenge us all. I also want to express my sincere appreciation to the authors who have contributed their invaluable research work to this conference. Their publications reflect the innovative spirit and academic rigor that drive progress in AI and related fields, making this event a rich repository of knowledge. As we gather to explore the revolutionary impact of AI, let us seize this opportunity to not only share knowledge but also to form collaborations that will shape the future of research and technological advancement. I wish all participants a fruitful and engaging experience at KDU IRC 2024.

Dr. Pradeep Kalansooriya
BSc (Peradeniya), MIT- Specialized in Management (Colombo), PhD in Information Science and Control Engineering (Japan)

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ORAL PRESENTATIONS

Autoencoder Empowered EEG Data Classification: A Self-Supervised Learning Approach

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Electroencephalogram (EEG) analysis plays a crucial role in understanding brain activity and diagnosing neurological conditions. Traditional methods often struggle with the complexity and high dimensionality of EEG data. This study analysed these challenges by developing a novel framework that leverages generative self-supervised learning and autoencoder architecture to enhance EEG data analysis. The primary problem lies in the accurate and efficient extraction of meaningful features from EEG signals, which are inherently noisy and complex. The objectives of this research study were to improve feature extraction from EEG data using an autoencoder and accurately predict sleep stages using advanced machine learning techniques. The methodology involveds pre-processing the EEG data, segmenting it into 30-second epochs, and annotating it according to standard scoring guidelines. An autoencoder was used for feature extraction, followed by the application of Synthetic Minority Over-sampling Technique to address the class imbalance. The encoded features were then classified using a robust machine learning model within a TensorFlow environment. Results demonstrate a high average F1-score of 0.97, indicating the effectiveness of the proposed framework. High evaluation metrics, such as Area Under the Curve, Cohen's Kappa Coefficient, and Matthews Correlation Coefficient, further validate the model's performance. This study presents an effective framework for EEG data analysis, combining generative self-supervised learning and autoencoder techniques. Future work will focus on enhancing the autoencoder architecture and applying transfer learning to diverse datasets.

Keywords: *machine learning, TensorFlow, EEG classification, neural networks, generative self-supervised learning.*

Prediction of Coronary Artery Disease Using Artificial Neural Network

GK Dhananjaya[1#], JACA Perera[1], GRA Senarathne[1], JADI Priyashan[1], and B Hettige[2]

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Machine learning techniques offer powerful tools for early prediction and diagnosis of Coronary Artery Disease , a major cause of global mortality, by analyzing complex medical data to recognize patterns that conventional methods might miss, potentially leading to timely interventions and reduced death rates. The objective of this study was to model an Artificial Neural Network for Coronary Artery Disease diagnosis, achieving an accuracy of roughly 90 Synthetic Minority Over-sampling Technique (SMOTE) was employed to address the problem of data imbalance. Leveraging the expertise of a cardiologist, we tuned the feature search to include key clinical characteristics only, such as basic demographics, clinical history, and diagnostic test results. This approach made the interpretations more feasible, and at the same time, improved the predictive efficiency of the model. Optimized tuning of the hyperparameters was done while designing the Artificial Neural Network and the use of dropout layers as an anti-over-fitting technique and batch normalization technique for stabilising the training phase. To support the created model cross-validation at a lower level named stratified k-fold cross-validation was done. The model was accurate and reliable compared to conventional machine learning methods. Moreover, it was beneficial to combine clinical knowledge in qualitative feature reduction with the presented technical approach because it led to a more clinically pertinent and accurate model.

Keywords: *coronary artery disease , artificial neural network, machine learning, SMOTE, EDA*

Harmonizing Business Process Re-Engineering, Industry 4.0 and Artificial Intelligence: Towards Sophisticated and Dynamic Business Processes

HT Gunasekara[1#], SA Nanayakkara[1], and DHS Santhushni[1]

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In an era where technology has profoundly infiltrated the dynamics of the business sphere, this study attempted to determine the possibility of effective integration of Business Process Reengineering (BPR), Industry 4.0, and Artificial Intelligence (AI), as a critical driver to attain organizational transformation.It aimed to explore the synchronization between these domains and provide a comprehensive understanding of the current state of research and practice, through an extensive review of literature. The study examineds the key drivers, enablers, and barriers to the successful convergence of BPR, Industry 4.0 and AI. Drawing on the findings, the paper discusses a set of strategic recommendations, including the establishment of a clear roadmap, increased investment in digital infrastructure, and the fostering of a culture of innovation and risk-taking. The conclusion emphasizes the importance of a holistic and collaborative approach to digital transformation, as well as the need for continued research and knowledge sharing in this rapidly evolving field. This study is expected to render many insights for individuals seeking to leverage the potential of BPR, Industry 4.0 and AI, to achieve the ultimate goal of growing businesses in a sustainable manner.

Keywords: *artificial intelligence, business process reengineering, Industry 4.0.*

An Ensemble Machine Learning Approach for Categorizing English Sentences Based on their Emotional Tone

DBY Perera[1] and RAHM Rupasingha[1#]

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Communicating in English is a common thing in day-to-day life, since it is influential to understand the tone or the idea of English sentences. There will be misunderstandings regarding the attitude, sentiments, and point of view of the speaker or writer if we are unable to identify the appropriate sentence tone. Therefore, the objective of this study was to propose a machine learning based ensemble approach for identifying the tone of the English sentences automatically. Here we collected around 1000 English sentences as the input data. This approach used lowercasing, stopping words removal, lemmatization and tokenization as preprocessing techniques. Then Term Frequency-Inverse Document Frequency (TF-IDF) feature vector extraction method was used to extract features from the sentences. For classification five different individual ML algorithms namely Nave Bayes, Support Vector Machine (SVM), Logistic Regression, Random Forest, and Decision tree were applied. Then, an ensemble learning algorithm was applied by combining those five algorithms through the average probability method. The experimental results show that the ensemble learning algorithm outperforms the individual algorithms in terms of accuracy (96.9%), precision (97.2%), f-measure (96.9%), recall (96.9%) as well as Mean Absolute Error (MAE)(0.0113) and Root Mean Square Error (RMSE) (0.0163) for measuring error. The study introduced an ML based ensemble method, incorporating preprocessing techniques and TF-IDF feature extraction, which outperforms individual algorithms in classifying English sentences based on their tone.

Keywords: *machine learning, ensemble learning, sentence tone analysis, classification*

Tense Identification in English Sentences Using an Ensemble Machine Learning Approach

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For efficient communication, comprehension, and writing in a variety of contexts including academic papers, legal documents, and media documents proper use of tense is essential. Notwithstanding its significance, tense usage is a common error for both experts and students. By having access to a built-in tense detection tool, students can easily enhance their sentence construction skills through consistent self-study in early life education. The study objective was to propose an automatic classification of English sentences using machine learning algorithms according to their tense: past, present, or future. We used a dataset with 1500 sentences that were split equally across the three tense groups. Tokenization and lowercasing were used in the preprocessing phase, and the Term Frequency-Inverse Document Frequency (TF-IDF) technique was then used to extract features. Then, six classification algorithms Naive Bayes, Random Forest, Decision Tree (J48), Support Vector Machine (SVM), Logistic Regression and ensemble learning by combining the above five algorithms were tested. Metrics including accuracy, precision, recall, F-measure, and error values were used in the evaluation. In terms of evaluation, the ensemble learning strategy outperformed individual models in all evaluations by achieving the best accuracy of 95.56%. In ensemble learning, the majority voting combination rule worked best in 70% training data. This work shows how machine learning may improve tense classification, providing a useful tool for both academic and professional contexts.

Keywords: *tense identification, machine learning, ensemble learning, classification, English sentence*

Ethical Landscape of Artificial Intelligence: A Review

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The rapid growth of artificial intelligence technologies raises critical ethical concerns, particularly regarding fairness, transparency, privacy, and accountability. This review synthesizeds current research findings to identify key ethical challenges and proposes strategies for responsible artificial intelligence development. A systematic literature review was conducted, examining peer-reviewed articles, reports, and policy documents. The review focused on recurring themes such as data bias, privacy concerns, accountability, and transparency, using thematic synthesis to integrate findings. The review identified several critical ethical challenges in artificial intelligence including inherent biases in training data, difficulties in ensuring accountability, and the tension between maximizing innovation and safeguarding human rights. It was found that existing guidelines vary significantly in scope and effectiveness, often lacking in operationalization and real-world impact assessment. Additionally, the study highlights the importance of inclusive governance and stakeholder participation in addressing these challenges. The findings emphasize that technical solutions alone are not sufficient to address artificial intelligence ethics; social and governance responses are also necessary. Further, the review advocates for a comprehensive approach to artificial intelligence ethics, focusing on transparency, responsibility, and human-centred design. Additionally, it calls for the development of adaptable frameworks that align artificial intelligence technologies with societal values and ensure their ethical deployment.

Keywords: *artificial intelligence, artificial intelligence ethics, data bias in artificial intelligence, data privacy in artificial intelligence, responsible artificial intelligence development*

Classification of Research Papers Based on their Subject Field Using an Ensemble Machine Learning Approach

GKE Dilushika[1#] and RAHM Rupasingha[1]

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Research papers are the most important documents for researchers and scholars. Scholars face the challenge of sifting through relevant research data to find papers that align with their educational interests. This abundance of information can complicate the process of identifying valuable insights across various research types. Therefore, finding related research papers becomes a time-consuming process. Here an automatic classification of research papers helps researchers to do their research easily and effectively. This paper introduces a novel method to classify research papers based on subject fields using machine learning. Unlike previous approaches, which rely on abstracts, limited subjects, or individual algorithms, this study analyzed full paper content and expand classification to five disciplines using an ensemble learning approach by combining four individual algorithms. With a dataset of 2000 papers, preprocessed and extracted feature vectors using Term Frequency-Inverse Document Frequency (TF-IDF). The study used five machine learning algorithms namely NavieBayes, Random Forest, Decision Tree (J48), SVM, and ensemble learning. Employing Naive Bayes and ensemble learning, our results demonstrate high accuracy, with ensemble learning surpassing individual algorithms in 5-fold cross-validation. The performance of the classification system was evaluated using metrics such as accuracy, precision, recall, and F-measure, as well as error rates. Results indicate that Naive Bayes exhibited the highest accuracy among individual algorithms, while ensemble learning, particularly through the Majority Voting combination rule outperformed individual algorithms with an accuracy of 94.20%. This study underscores ensemble learning-based machine learning's efficacy in enhancing research paper classification processes and accessing relevant research.

Keywords: *machine learning, ensemble learning, classification, subject field, academic paper analysis*

Detecting AI-generated and Human-Written Documents Using an Ensemble Learning Approach

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Artificial Intelligence (AI) has revolutionized many parts of modern life including written content. Because of this reason, it is challenging to identify separate AI-generated documents and human-written documents. There are different positive and negative effects of AI-generated documents in different fields including Education. This study aimed to develop a detective mechanism to identify. AI-generated documents and human-written documents automatically using machine learning (ML) algorithms. The acquired AI-generated and human-written documents were pre-processed by cleaning the data set and Term Frequency-Inverse Document Frequency (TF-IDF) was used for feature extraction. Then the study continued utilizing five classification methods such as Naïve Bayes, Random Forest, Decision Tree, Support Vector Machine (SVM), and ensemble learning algorithm that combined the four individual algorithms listed above. The Random Forest individual algorithm shows the best testing accuracy with 65% training and 35% testing dataset for the classification. Ensemble learning outperformed the outcomes in the precision, accuracy, recall, f-measure, and error values. Results demonstrate that this mechanism can successfully detect AI-generated documents and human-written documents separately using an ensemble learning approach.

Keywords: *Artificial intelligence, AI-generated, human-written, machine learning, classification, natural language processing.*

Comprehensive Review of Mobile Personal Assistant (Chatbot) for Depression Patients Using Emotion Recognition :A Large Language Model

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Depression is a common mental health issue that affects many people, often making them feel persistently sad or lose interest in activities. Despite its global impact, with 246 million people affected worldwide, access to professional help remains limited due to cost, stigma, and accessibility issues. Existing mobile personal chatbots primarily offer generic responses without personalized context, lacking deep personalization that adapts to user history, preferences, and specific mental health needs, thereby reducing their effectiveness. Additionally, they have limited integration with established mental health tools, inadequate emotion recognition through multimodal inputs, insufficient mechanisms for long-term engagement, and often lack robust privacy and security measures, compromising user trust and reliability in tracking and assessing mental health conditions. This review explored how AI-powered chatbots, especially those integrated with emotion recognition, might offer personalized and empathetic support to people dealing with depression. The study explored the effectiveness, feasibility, and ethical considerations of implementing AI in mental health applications, aiming to identifying gaps in current care methods and enhance patient support and engagement. Future work will focus on refining the system, expanding its capabilities, and ensuring it meets diverse user needs while adhering to ethical considerations and data privacy.

Keywords: *chatbot, large language models , artificial intelligence, depression patients*

TanzaNote: First Step Towards Classification and Notation Generation for Sri Lankan Traditional Instruments, Gataberaya and Flute

RDP Gamage[1#] and B Hettige[2]

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Sri Lanka has a rich history of music, with a wide variety of traditional instruments. However, a significant challenge in Sri Lankan music is the lack of software capable of identifying which traditional instruments are played in a song. This is an issue for both students and musicians learning music when they struggle to recognize individual instruments when multiple instruments are played together. This paper presents a novel approach to address the gap in instrument classification by a standard traditional deep learning approach, using a flute, a pitched instrument, and gataberaya, an unpitched indigenous drum, using 249 manually recorded audio samples. These instruments play a crucial role in folk and ceremonial music. The classification model was trained on 168 flute and 81 gataberaya raw audio files which were in varying lengths and were single noted. These audio files were turned into Mel-spectrograms to train the Convolutional Neural Network model featuring two convolutional layers.This work includes class imbalance handling and data augmentation methods for both raw audio and Mel-spectrograms, which increased the dataset size to 5,632 before the model training process. The raw audio data augmentation techniques used were noise addition and time stretch, frequency masking and time masking were added for Mel-spectrograms. The model achieved a training accuracy of 99.67%, a validation accuracy of 99.82%, and a testing accuracy of 99.23%, showing reliability and consistency. This approach provides a valuable tool for improving music education and potentially preserves cultural heritage through advanced technology.

Keywords: *deep learning, convolutional neural network, Mel-spectrogram, music instrument classification.*

Rail Track Surface Defects Detection Using CNN

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Railway transportation plays an important role in global transportation systems, providing efficient and rapid movement of passengers and goods. The safety and reliability of train travel heavily depend on the railway tracks' quality. Rail surface defects present a substantial risk, which can result in accidents and service interruptions. Identifying rail surface defects presents several challenges, particularly in extracting discriminant features for effective defect detection. This task is complex and non-trivial due to the diverse nature of defects and their appearances. Timely identification is crucial to ensure railway operations' safety and continuous functioning. This paper proposes a method using convolutional neural networks (CNNs) to detect defects on rail surfaces. A publicly available dataset containing 1838 images, with 70% allocated for training, 20% for testing, and the remaining for validation, was employed to evaluate the proposed methodology's performance. Rail surface images were improved through various preprocessing methods. This includes resizing the images to compatibility with the CNN model, noise reduction, and pixel value normalization. Data augmentation techniques like rotation, zooming, brightness adjustment, channel shifting, and horizontal flipping wereare used to diversify the dataset by generating additional samples with different perspectives and appearances. Convolutional Neural Networks were employed, utilizing transfer learning techniques such as Mobilenet-V2, VGG-16, SqueezeNet, and Inception-V3 to train the classification model with the addition of channel attention. Several pre-trained models were are evaluated, and the fine-tuned Inception-V3 model demonstrates a classification accuracy of 95.76%. This study contributes to the development of the railway industry, offering cost-effective solutions for detecting defects in railway tracks in earlier stages.

Keywords: *rail defect detection, transfer learning, CNN, channel attention*

Deep Learning for Early Skin Cancer Detection: A Convolutional Neural Network Approach

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Skin cancer diagnosis often involves a lengthy waiting period for biopsy results, leaving patients in uncertainty and at risk. A patient with a suspicious lesion may wait one to three weeks for biopsy results, impacting their health and peace of mind. This study introduces a deep learning system using Convolutional Neural Networks (CNNs) to classify skin lesions as melanoma or non-melanoma. Trained on a dataset of approximately 44,000 images, the system achieves 86% accuracy, 76% precision, and 92% recall, aiming to automate preliminary diagnoses and reduce waiting times. The methodology included extensive data collection, preprocessing, model development, and training. Future work will focus on creating a user-friendly web application to improve accessibility for healthcare professionals and patients. Further research is needed to understand the model's performance across different data subgroups and to identify strategies for improvement. The proposed system supports dermatologists in early skin cancer detection and treatment, potentially transforming patient care. Its significant impact suggests it could become a valuable tool for both healthcare providers and patients.

Keywords: *skin cancer, deep learning, Convolutional Neural Networks*

A Comparative Analysis of Dog Emotion Prediction Using Full-Body and Facial Images with Transfer Learning

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Prediction and recognition of animal emotions has become an interesting and challenging problem. This study proposed a transfer learning approach using computer vision techniques to predict dog emotions by comparing the effectiveness of faced images versus full body images to predict emotions in dogs. In order to try this the performance of various pre-trained models utilizing distinct optimizers was assessed. Specifically, VGG16, InceptionV2, MobileNetV3, and ResNet50 were harnessed as feature extractors, while stochastic gradient descent (SGD), RMSProp, and Adam served as optimizers. Our assessment encompassed the evaluation of all four models under these three optimizers, utilizing datasets of facial images. The ultimate model selection was guided by accuracy, where MobileNetV3 with the SGD optimizer exhibited the highest performance, achieving a commendable 76% accuracy, whereas full-body images attained a 65% accuracy rate. By leveraging transfer learning techniques and computer vision algorithms, our results indicate that facial expressions provide the most accurate means of predicting emotion in dogs. This finding underscores the importance of prioritizing the dog's face as the primary input for emotion prediction. By harnessing the power of transfer learning and sophisticated computer vision techniques, we propose a compelling path forward for advancing our understanding of non-human emotional communication, ultimately enriching the interactions between humans and dogs in diverse contexts .

Keywords: *transfer learning, dog emotion prediction, full-body images, facial images, computer Vision*

NutriMom: Image Processing Based Mobile Application for Empowering Pregnant Mothers in Sri Lanka with Health and Convenience

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The rapid progression of internet-based communication technology has brought about a profound transformation in society, with implications for health care, particularly for expectant mothers. The smartphone application "NutriMom," which is based on image processing, is suggested in this study to empower expectant moms in Sri Lanka by improving their convenience and well-being. By letting users track their daily caloric intake and applying picture analysis to detect nutrients in their meals, the application aims to reduce nutritional issues. The app has features including an AI guide, grocery list generation, and a nearby grocery store locator in addition to providing individualized nutritional suggestions depending on the user's BMI. Using a mixed-method approach, the study combines data from interviews, surveys, and content analysis that is both quantitative and qualitative. With 74.7% of surveyed pregnant women not utilizing any such applications, preliminary findings indicate a significant demand for mobile applications in pregnancy care. The study emphasizes how mobile health solutions might enhance the health of expectant mothers and foetuses, especially in settings with limited resources like Sri Lanka. Moreover, the app's design considers localized dietary requirements and cultural customs, guaranteeing its applicability and acceptance by the intended user base. The user interface of the application has been developed to provide ease of use, especially for individuals with less expertise in technology. The NutriMom app makes use of developments in deep learning and computer vision to offer dietary assessments in real-time, guaranteeing pregnant moms receive the assistance and care they need for a safe pregnancy.

Keywords: *image processing, mobile application, pregnancy, nutrition, health monitoring*

AI Powered Course Recommendation System for Private Education

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The growing variety of courses and the broad range of student preferences in Sri Lanka's private education industry makes it difficult to assist students in choosing the right academic pathways. By creating an AI-powered course recommendation system, especially for private educational institutions, this study aimed to address these issues. The system analyses several aspects of student data, such as academic performance, courses presently taken, and individual preferences, using sophisticated machine learning algorithms. Through the integration of collaborative and content-based filtering processes, the system seeks to improve the accuracy of its course recommendations. The basis for training the algorithms was a large dataset that includes rich student records and thorough course descriptions. The system's goal is to find patterns in this data so that it can recommend courses to students that are both relevant and unique to them. Prototype tests and input from teachers and students were used to gauge the system's efficacy. The system effectively provides customised recommendations that are in line with students' academic goals, and the results show a noticeable improvement in student satisfaction and an efficient course selection process. The system's intuitive design also promotes openness and confidence, which helps students make better decisions about their education. Overall, the results point to a substantial improvement in educational quality in Sri Lanka's private higher education sector using AI-driven recommendation systems. Through personalised suggestions that direct students towards successful academic courses, the system can significantly influence academic achievements.

Keywords: *AI-powered systems, course recommendation, machine learning, private education*

Multi-Agent Solution for Autonomous Home Automation

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Home automation involves integrating technology within residential spaces to control and automate various household functions, such as lighting, heating, and security systems, to achieve better and more effective power management. Traditional home automation systems often rely on cloud-based platforms, which, while effective, can experience latency, dependence on internet connectivity, and potential security vulnerabilities. These challenges highlight the need for more robust, efficient, and secure communication frameworks within smart home environments beyond the limitations of cloud-based systems. In this researchstudy, we propose a multi-agent-based solution that emphasizes agent-to-agent communication as a more resilient alternative to cloud-based systems. Agent-based systems operate on the principle of multi-agent communication, where each device, or "agent," communicates directly with others within the network. These communications are were further tested using the multi-agent development framework MASMT, which enables seamless and efficient communication between devices. By adopting this multi-agent approach, the communication within the home automation system becomes more robust, secure, and less dependent on external factors, ensuring a more reliable and autonomous operation of smart homes. In summary, this system comprises a hardware unit and a multi-agent-based backend system. The hardware unit consists of 16 power outlets that can be fully controlled bidirectionally by the multi-agent system. The multi-agent system communicates with all devices, referred to as agents, to effectively manage power requirements within the home automation system. This system has been successfully tested in a laboratory environment, yielding positive results compared to traditional cloud-based approaches. Notably, this system proves to be more effective in complex and dynamic environments.

Keywords: *AI-powered systems, course recommendation, machine learning, private education*

Artificial Intelligence based Mobile Application for Interior Design in Sri Lanka

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AI has revolutionized interior design, offering innovative tools for creating visually appealing and healthier spaces through applications. Even with this progress, many existing applications are not well-suited to specific local needs, particularly in developing markets. In Sri Lanka, interior designers frequently use 3D modelling software and AI-based mobile applications. However, these applications often suggest international and expensive designs that lack local relevance. This study investigated the challenges users experience with these applications in the Sri Lankan context and it aimed to develop an AI-based mobile application tailored specifically for local interior design needs. Primary data were gathered through a survey conducted on social media platforms, targeting interior designers and clients in Sri Lanka. The collected survey responses were analyzed using quantitative statistical methods to gain insights into Sri Lankan interior design preferences and needs. Additionally, qualitative secondary data from published research articles were used to provide context and support the findings. The survey highlighted significant challenges, including the high costs of recommended designs and a lack of locally relevant design options. Furthermore, respondents expressed a need for features such as local furniture recommendations and budget planning tools. In response to these challenges, this paper proposes an AI-based mobile application that includes these essential features. This proposed application aims to provide more efficient and locally relevant interior design options tailored to Sri Lankan interior design industry. Future improvements could enhance advanced customization and predictive features through machine learning and user data analysis, further improving the application's effectiveness and user satisfaction.

Keywords: *mobile application, artificial intelligence, interior design*

Navigating Future Careers: Design, Implementation, and Evaluation of an AI-driven Career Guidance System for IT Professionals in Sri Lanka

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In Sri Lanka's burgeoning information technology (IT) landscape, the Future Entrepreneurship Management and Career Guidance System (FEMCGS), called NavigateFuture, is strategically crafted to address a pivotal challenge—streamlining and enhancing career trajectories for individuals aspiring to join the IT industry. The primary objective is to facilitate a seamless and efficient transition for IT job seekers into a rapidly evolving professional domain. The key problem that NavigateFuture aims to solve is the complexity of aligning personal skills and aspirations with the demands of the IT job market. The IT sector in Sri Lanka witnesses a surge in interest from individuals eager to establish their careers in this dynamic industry. However, navigating the intricacies of IT job searches, predicting suitable qualifications, and presenting oneself effectively to potential employers poses a significant challenge. NavigateFuture serves as an innovative solution by introducing a specialized FEMCGS, powered by advanced Artificial Intelligence (AI). Through tailored dashboards and AI-driven algorithms, the system focuses on providing personalized job matches, automating CV generation, and offering a structured career path for IT professionals. Surveys and interviews with 150 IT professionals in Sri Lanka were conducted to validate the system's alignment with user needs. By conducting thorough research involving individuals from the IT sector, the system ensures that it aligns with the unique needs and preferences of Sri Lanka's IT workforce. Navigate Future emerges as a strategic guide for individuals navigating the complexities of the IT job market in Sri Lanka, offering a comprehensive solution to career development challenges

Keywords: *future entrepreneurship management, career guidance system, artificial intelligence*

Optimizing task assignment for Teams of Robots Using Ant Colony Optimization

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The rapid advancements in robotics and artificial intelligence have driven the growth of Multi-Robot Systems (MRS) and Teams of Robots (TOR), where collaboration is critical in domains like manufacturing, search and rescue, and military operations. Effective task allocation remains a significant challenge, often addressed via optimization techniques like Ant Colony Optimization (ACO). However, current approaches primarily focus on real-time availability and computational efficiency, overlooking the historical performance of individual robots. This paper proposes an enhanced ACO-based method that integrates both the real-time factors and the past experiences of each robot, to optimize task assignment. The approach focuses on optimizing problem-solving using the ACO by selecting the most suitable candidate for a specific task from a given TOR while considering the agent's prior experience with similar tasks. The approach also addresses the possibility of using the ACO when transferring an assigned task to another robot in the TOR. The results validate the effectiveness of the approach in dynamically selecting the most suitable and available robot, offering a significant advancement in task allocation strategies for TOR.

Keywords: *ant colony optimization, task allocation, multi-robot systems, teams of robots, swarm intelligence, robot experience*

Shifting Paradigms in Stakeholder Identification: Integrating Enhanced Use Case Tool with Automated Analysis

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In the domain of complex process automation, accurate stakeholder identification is critical. Nevertheless, the methods employed by requirement-gathering professionals primarily focus on direct software users. This oversight can lead to incomplete stakeholder profiles, which endanger the sustainability of software projects. Specifically, these overlooked stakeholders are often well-known to Organizational Professionals, while the users are identified by Software Professionals. Currently, this task is done separately and is never amalgamated. Hence, the aim of this study was to develop a mechanism to engage both Organizational Professionals and Software Professionals in the process of stakeholder identification without significantly disrupting their roles and tasks. This aim was achieved through several key steps: first, selecting a requirement-gathering tool that effectively identifies users and a project management tool that prioritizes stakeholders. Next, the study identified the roles of both Software Engineers and Organizational Professionals in the stakeholder identification process and developed an integrated process for collaboration. This process culminated in the development of an automated tool, UC2IM, which allows both user identification and stakeholder prioritization. The proposed process was confirmed by both Software Professionals and Organizational Professionals. The UC2IM tool was then applied in a case study on urban flood management. Once the tool generated a list of stakeholders, they were verified through an expert discussion, which confirmed the tool's capability to identify all required stakeholders. The results showed that the tool successfully identified 100% of the stakeholders. This study concludes that the UC2IM tool significantly enhances stakeholder identification processes, leading to more comprehensive profiling and supporting the sustainability of automated systems. However, the tool was developed to propose a methodology, and thus, it should be further developed to improve its usability and achieve other quality attributes.

Keywords: *system users, Use Case tool, stakeholder identification tool, Influence-Interest matrix, software sustainability*

Real-Time Monitoring of Gas Station underground Fuel Tanks Using IoT Technology

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The management of underground fuel storage in gas stations presents significant challenges, including imprecise level measurements, the absence of real-time monitoring capabilities, and potential safety hazards. Contemporary solutions predominantly rely on manual or rudimentary automated systems, lacking comprehensive data integration. This paper introduces an innovative Internet of Things (IoT) based Real-Time Monitoring of Gas Station Underground Fuel tanks designed to address these critical issues. The proposed system integrates advanced sensing technologies: the HRXL MaxSonar WRIST ultrasonic sensor for fuel level detection, BMP280 for pressure monitoring, and DS18B20 for temperature measurement orchestrated by an ESP32 Devkit V1 microcontroller. This configuration enables high-precision, real-time monitoring of tank conditions. The primary innovation lies in the seamless integration of these components with a cloud-based data management system, utilising Wi-Fi technology for real-time data transmission to a Firebase database. To mitigate connectivity challenges in diverse operational environments, a dual-storage approach has been implemented: cloud-based storage for immediate data access and local SD card storage as a failsafe mechanism. This design ensures continuous data collection and integrity in areas characterised by unreliable network coverage. The methodologies involved gathering insights through interviews with professionals and management in the fuel station industry to ensure practical relevance and system efficacy. The system encompasses custom firmware development, the creation of an intuitive web-based interface, and rigorous testing in simulated environments. This study contributes significantly to the digitization and modernization of fuel station operations, enhancing safety protocols, mitigating environmental risks, and optimising inventory management processes.

Keywords: *Internet of Things, gas station, monitoring system, underground fuel tank*

Intelligent Gaming Robot: Robotic Solution for the Traditional Sri Lankan Board Game 'Nerenchi'

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Nerenchi, a board game, deeply rooted in Sri Lankan culture, involves strategy and skill, making it a challenging and engaging pastime. Traditionally played with two players, the game is known for its intricate rules and strategic depth. Nerenchi is under the threat of extinction and there is a need for innovative solutions to modernize and preserve these games, making them appealing to contemporary audiences and protecting these cultural games. This paper presents the design and implementation of an Intelligent Gaming Robot, capable of playing the traditional Sri Lankan board game, 'Nerenchi', with a human opponent. A monitoring system, knowledge-based decision-making system, and a robotic system are the 3 main units of this proposed system that can easily identify, make decisions, and act according to the game stage and the opponent's movements. The monitoring system is used to identify the positions of the board and the Nerenchi pieces by image processing techniques and according to that data, the knowledge-based decision-making system with a prolog rule-based engine specially designed to Nerenchi sends instructions to the robotics system, that used to place, remove and replace the Nerenchi pieces using a robotic arm with 4 servo motors. This innovative approach combines advanced robotics and human-computer gaming to preserve and modernize traditional board games, offering a unique blend of heritage and technology. The paper mainly details the hardware architecture and techniques, the computer vision algorithms employed, and rule-based decision-making process, demonstrating the feasibility and effectiveness of the proposed system.

Keywords: *human-computer gaming, rule-based gaming systems, Sri Lankan traditional games*

ID 243

Enhancing Physical Rehabilitation through Gaming and Gaming NPCs: A novel approach

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Rehabilitation is a well-established process that takes place under the supervision of doctors and involves substantial amounts of time, effort, and money. This review focuses on the incorporation of video games and gaming NPCs as an additional therapy approach alongside conventional approaches to rehabilitation. Algorithms based on physical exercises included in the game will allow patients to perform rehabilitation independently at home. The strategy is to conceive and incorporate such games into a live environment for a meaningful rehabilitation process. The idea underpinning this system is to help patients to recover faster and gamify the rehabilitation process, thus making the experience enjoyable and more productive.

Keywords: *rehabilitation, gaming, healthcare gaming, gaming NPC, gesture recognition*

POSTER PRESENTATIONS

Cinnamon Care: Digitizing Disease Detection and Treatment Recommendations for Cinnamon Plants Using Image Processing and Machine Learning

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Cinnamon is one of the most essential spice crops with significant global economic importance, and Sri Lanka is renowned for producing the highest quality cinnamon, known as Ceylon Cinnamon. Contributing to over 90% of the global spice market, cinnamon is the most exported spice from Sri Lanka, particularly to countries such as Mexico, the USA, and Peru. Between 2017 and 2022, cinnamon exports increased by 1,618 metric tons, and its export value grew by Rs. 40,843 million. However, diseases such as leaf spot, rough bark disease, and stripe canker present significant threats to cinnamon cultivation, impacting both yield quality and quantity. This study aimed to address these challenges by developing a machine learning and image processing-based system for the early detection of these three prevalent cinnamon diseases. The system not only identifies the diseases but also provides detailed information on symptoms and treatments, improving disease management for farmers. A dataset of diseased cinnamon plant images, provided by the National Cinnamon Research Center in Matara, was used for training, consisting of leaf spot, rough bark, stripe canker, and healthy image samples. The DenseNet-121 model was employed to train the system, which achieved a high accuracy rate of 94%. This system has the potential to significantly mitigate the adverse effects of these diseases, enhancing both productivity and the quality of cinnamon quills. Additionally, it offers guidance to cinnamon peelers by providing a peeling guide to support the peeling process. Ultimately, this study aimed to enhance cinnamon production through timely disease detection and effective treatment strategies.

Keywords: *cinnamon production, diseases, early detection, treatment, machine learning*

Adaptive Security Protocols for Wireless Mobile Ad-hoc networks: A Review of Challenges and Innovations

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Mobile Ad hoc Networks (MANETs) are considered an innovative wireless technology that allows mobile nodes to network with each other without bounds of fixed infrastructure or centralized administration. MANETS are used in numerous industries, such as emergency services, the army, and increasingly, healthcare, and intelligent cities. On the other hand, these traits of open medium, diverse topology, and distributed nature are what make them susceptible to novel security threats. This paper gives a detailed description of MANET's security issues with conventional attacks such as blackholes, wormholes, and denial-of-service, as well as advanced ones arising from AI and IoT integration and the emergence of 5G networks. The questionnaire involves the weaknesses at different layers of the MANET protocol model and the latest methods in security, such as blockchain technology, intrusion detection systems using machine learning, and software-defined networking. Through studying these changing threats and measures developed to counter them, this study intended to enhance MANET security awareness and the design of more robust and reliable networking components for the time to come.

Keywords: *MANET security, emerging threats , AI-powered attacks, IoT security, 5G networks*

ID 121

Comparative Analysis of Food Recommendation Systems: Tailoring to Sri Lankan Cultural Events and Traditions

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This study investigated the development of an event-based food recommendation system tailored to Sri Lankan culinary traditions, comparing it with existing systems. The goal of the project was to analyse a way to fill the demand that present systems mainly fail to meet: the need for meal suggestions that are is both culturally appropriate and event-specific. In the culinary domain, food recommendation systems have gained popularity for their ability to provide personalized dietary advice based on user behavior and preferences. While some current systems deal with diabetes self-management, health-conscious nutrition, and allergen-free infant food, show strong personalization, and they frequently lack cultural sensitivity and event-specific adaptation. This study examined a variety of approaches, such as content-based algorithms, collaborative filtering, and machine-learning techniques similar to those employed in RecipeMate, emphasizing the benefits and drawbacks of each in terms of contextual and cultural flexibility. Primary data through surveys and interviews with users familiar with Sri Lankan cuisine, along with a thorough literature review, formed the basis of our comparative analysis. Our findings underscore the need for a culturally aware recommendation system that caters to the unique requirements of traditional Sri Lankan events. The study proposes the development of a novel system incorporating user feedback, dynamic profiles, and culturally significant recipes to enhance user satisfaction and engagement. Future work will focus on testing the system's effectiveness across diverse user groups and integrating it with food delivery and e-commerce platforms, aiming to set a precedent for similar applications in other cultural contexts. This approach seeks to merge modern technological capabilities with rich cultural traditions, enhancing the culinary experience for users.

Keywords: *food recommendation systems, Sri Lankan traditions, event-based recommendations, comparative Analysis, cultural adaption*

Optimizing Sri Lankan Ayurvedic Healthcare Industry: A Technological Approach to Enhance Patient Care and Management with Special References to the Central Province in Sri Lanka

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Ayurvedic medicine, which originated in ancient Indian traditions, has acquired international recognition as a holistic and natural healing approach that emphasizes the balance of mind, body, and spirit via tailored treatments, herbal cures, and lifestyle practices. This study focused on the integration of modern technologies into Sri Lanka's traditional Ayurvedic healthcare system, to optimize patient care and management. The purpose of this study was to direct the thoughtful integration of contemporary instruments, promoting a medical environment that skillfully combines traditional healing methods with state-of-the-art discoveries for the benefit of patients in Sri Lanka and elsewhere. Ayurveda, which is based on ancient practices, plays an important part in the nation's healthcare, but the changing landscape needs a collaborative approach to provide consideration at of how modern technology like wearables, telemedicine, digital health records, and artificial intelligence interact with traditional Ayurveda. The goal of this study was to create a web-based platform that will improve the standard of Ayurvedic care in the Central Province of Sri Lanka. The study covers current issues in the Ayurvedic healthcare system by concentrating on the Central province main 9 ayurvedic hospitals: Palakele, Doluwa, Gelioya, Nildandahena, Panvila, Thanna, North Matale, and Hadaganawa. Additionally, it includes 37 community medical offices and 21 central dispensaries. By using contemporary technologies, the platform aims to enhance medication supply management, expedite patient care, and promote better communication between healthcare providers all of which contribute to the development of an Ayurvedic treatment system that is more responsive and successful.

Keywords: *ayurvedic healthcare industry, patient care, modern technologies*

Advanced Strategies for Dietary Recommendations in Liver Disease: A Comprehensive Literature Review

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The global prevalence of non-alcoholic fatty liver disease (NAFLD), driven by unhealthy dietary habits and uncontrollable genetic factors is closely associated with obesity, diabetes, and high cholesterol, and can progress to life-threatening cirrhosis. This creates a significant health challenge, especially because currently there is no approved medications or targeted pharmaceutical treatments for NAFLD, underscoring the critical importance of diet and exercise in managing the disease. This paper presents a comprehensive literature review to which explored advanced methods for developing a food recommendation system tailored to liver disease patients. The review evaluated various methodologies, including Machine Learning (ML), Deep Learning (DL), and ontology-based AI. Through a structured approach involving literature review, expert consultation, and the application of inclusion and exclusion criteria, the results highlight the superiority of the ontology-based approach. This approach integrates key parameters such as BMI, blood sugar levels, disease stage, and food preferences to offer personalized dietary recommendations for liver disease patients. The study's novelty lies in bridging the gap in expert knowledge integration and developing a Smart Nutrition System for fatty liver disease that accommodates both vegetarian and non-vegetarian options. The review also identifies limitations in existing systems, such as insufficient expert knowledge integration and inadequate consideration of individual dietary needs. Future work aims to build a comprehensive ontology-based food recommendation system to enhance patient outcomes and improve quality of life.

Keywords: *non-alcoholic fatty liver disease, food recommendation system, deap learning, machine learning, ontology-based artificial intelligence*

Exploration of Technological Interventions for Borderline Personality Disorder

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Borderline Personality Disorder (BPD) is a complex, challenging, and prevalent mental health condition causing significant distress to those who are suffering. Due to the subtle complexities and overlapping symptoms associated with BPD, early diagnosis can be challenging, often leading to a less favorable prognosis. To explore the technological-based interventions for BPD treatments, a systematic literature review was conducted with two primary aims: to assess the potential of technological tools to enhance treatment outcomes for individuals with BPD and to examine the associated limitations of these interventions. The review utilized a total of twelve papers sourced from electronic databases and journals including IEEE Xplore, PubMed, JMIR Mental Health Journal, Springer Nature, Research Gate, and Journal of Psychiatric Practice. Authors in these papers explore a variety of technological interventions from the integration of virtual reality technology in enhancing treatments, DBT coach apps for addressing BPD and substance usage issues, the use of image processing techniques in predicting treatment responses, artificial intelligence-based tools, expert systems, and chatbots, in identifying the potential and limitations of these interventions. The findings reveal that novel technologies such as virtual reality show potential in therapy skill training. However, despite advancements in artificial intelligence and machine learning, Program-O-based chatbots lack personalization in addressing treatment plans effectively for individuals. Future researchers can be focused on integrating Natural Language Processing into existing interventions for real-time monitoring.

Keywords: *borderline personality disorder, mental health interventions, digital health, technological interventions, artificial intelligence*

Identification and Assessment of Key Performance Indicators in Sri Lankan Volleyball

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Player performance analysis and game strategy classification have seen significant advancements in global volleyball. However, these developments have been largely absent in Sri Lanka's volleyball landscape, where minimal research has been conducted. This study addresses the need to identify and evaluate key performance indicators (KPIs) specific to Sri Lankan volleyball. As an initial step, 25 research papers were reviewed, resulting in a preliminary list of 13 KPIs. To calibrate these KPIs, 10 interviews were conducted with coaches and volleyball experts, leading to the addition of 5 more KPIs. In the final phase, a questionnaire survey was administered to volleyball coaches and experts to evaluate and prioritize the KPIs. All 10 responses from the questionnaire were evaluated through a weighted scoring system, considering factors such as experience level, type of players trained, and coaching level. This process culminated in a final list of 12 KPIs: Flexibility, Aerobic Endurance, Hand Strength to Body Weight, Agility, Explosive Power (Lower Body), Explosive Power (Upper Body), Speed, Height, Weight, Age, Body Composition, and Skills and Game Conditions. This comprehensive approach ensures that the identified KPIs are both relevant and tailored to the local context, providing a solid foundation for future performance evaluation models in Sri Lankan volleyball.

Keywords: *volleyball, key performance indicators, Sri Lanka, anthropometric-variables*

Enhance Tea Quality and Market Stability with Advanced Technology: A Strategic Management Approach

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The tea sector has a substantial impact on the world economy; however, it faces difficulties such as unstable markets, uneven tea leaf quality, and ineffective inventory management. Therefore, to improve tea quality and market stability, this study suggests a web-based application that combines cutting-edge technology, such as image processing, vehicle monitoring, and predictive analytics. The main goal was to create a complete solution that enhances the ability of tea producers and processors to make decisions and operate more efficiently. The methodology of the study involves designing a system with five key components: predictive analytics for market forecasting, vehicle monitoring for logistics optimization, message control for stakeholder communication, tea leaf quality assessment through advanced image processing, and tea type management for inventory control. This integrated approach streamlines the operations in tea manufacturing, and it provides valuable insights into market trends and consumer preferences. The findings of the study indicate that the implementation of this system leads to improved tea quality, enhanced transportation efficiency, and better market responsiveness. However, challenges such as technology adoption and data integration remain. Future research will focus on refining these technologies and exploring their scalability across the industry. Furthermore, it improves the competitiveness and sustainability of the tea sector by presenting a strategic framework that makes use of state-of-the-art technologies to address critical issues.

Keywords: *tea quality enhancement, market stability, predictive analytics, image processing, strategic management approach*

Artificial Intelligence-based Geospatial Framework to Simulate Landslide Susceptibility

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In the context of natural disasters, landslides are more significant because of the threat to life and property that they cause. The uncertainty of the occurrence of landslides, and the scarcity of accurate models for precise predictions have led to huge losses. Studies have been conducted in this paradigm worldwide to provide both quantitative and qualitative analysis. Moreover, many approaches have been taken to develop machine learning-based quantitative models. Yet, there is a timely need to develop an explainable artificial intelligence model to predict and interpret landslides with logical arguments comprehensively. This study focused on developing an artificial intelligence model incorporating both training and logic to predict landslides which can be used to map landslide susceptibility. Landslide data, including topographical, climatic, and geological factors affecting landslides, related to Sri Lanka, retrieved from the National Building Research Organization of Sri Lanka, were incorporated in modelling an artificial neural network which learns on its own through training to give predictions. Comparatively higher accuracy was obtained from the artificial neural network model over those in the literature. In addition, a logical/rule-based model based on Expert Systems and Fuzzy Reasoning is planned to be incorporated into the artificial neural network model to predict the landslide occurrence giving probabilities and reasoning. Finally, a Geospatial framework will be developed to simulate landslide susceptibility. The approach will lead to mitigating the drawbacks of existing early warning systems and present the general public with a logical and more accurate mapping of landslide susceptibility and minimize losses to life and property.

Keywords: *landslide susceptibility mapping, artificial neural networks, expert systems, fuzzy reasoning, explainable artificial intelligence*

Sustainable Waste Management in Urban Areas: A Case Study in Ratmalana, Sri Lanka

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In Ratmalana, Sri Lanka, urbanization has resulted in a significant rise in trash production, overwhelming the infrastructure currently in place for waste disposal and posing threats to public health and the environment. The goal of the study was to create a mobile application that will improve community involvement, recycling procedures, and trash management efficiency. Using a mixed-methods approach, the study combined quantitative data on garbage creation and recycling rates with qualitative information from stakeholder interviews and literature reviews. Features like scheduling waste collection, real-time mapping of waste bins, instructional materials to promote recycling and appropriate waste disposal wereare included in the prototype of the mobile application. The findings show that Ratmalana's waste management outcomes were considerably enhanced by the usage of the mobile application. Recycling activities in the community increased, and recycling streams became less contaminated. The study also emphasized how mobile technologies may promote improved environmental practices and raise public awareness. Plans for the future include expanding the mobile application to additional cities, improving its features in response to user input, and carrying out additional studies to investigate long-term sustainability. The study highlights the significance of technology in developing sustainable urban environments, offering insightful information to interested organizations, the general public, and urban planners.

Keywords: *waste management, recycling initiatives, mobile application, sustainable cities, community engagement, urban Waste, environmental sustainability, stakeholder collaboration*

Using a Study Planner with Predictive Analytics: A Systematic Review on Exploring the Effects on Academic Performance and Time Management

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This study examines the impact of a data-driven study planner with predictive analytics on students' academic performance and time management to find out the effect of the innovation. The study aimed to determine the effectiveness of task tracking and time management tools in improving the time management skills of students which can improves academic success. The analysis of students' performance by using predictive analytics includes examining students' academic behaviour, interaction patterns and the advantages they get from the study planner. The study also identifies the advantages and the limitations of the planner and focused on what can prevent the students from falling behind in their work by offering personalized insights and visualizations that align with the study patterns of each individual provided the required motivational support. Additionally, the study explored the role of innovative testing methods to improve academic outcomes. It provides suitable suggestions to enhance and develop study planners with new critical features.

Keywords: *study planner, predictive analytics, academic performance, time management*

A Comprehensive Review of Dynamic Pricing Strategies: Optimizing Market Competitiveness and Consumer Satisfaction for Sri Lankan Consumer Brands

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Dynamic pricing has been widely successful in enhancing customer satisfaction and maximizing revenue across global markets. This study aimed to delve into creating dynamic pricing models specifically designed for Sri Lankan consumer brands, paying close attention to the distinctive features of the local market and consumer buying habits. The paper examines how dynamic pricing has been used worldwide in retail and electric vehicle charging sectors to develop a model that suits the Sri Lankan context. The approach involves statistical analysis to select key features, gathering data from external market sources and internal brand records, and evaluating the model using machine learning techniques like ensemble methods and deep learning. The effectiveness of these models was gauged using metrics such as Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE), comparing dynamic pricing strategies with traditional static models. The findings indicate that dynamic pricing can enhance sales, customer satisfaction, and operational efficiency for Sri Lankan brands, although legal and ethical considerations must be addressed in the implementation process. Future research should focus on validating the findings empirically, refining the model through practical experiments, and integrating additional variables. This paper provides valuable insights into the utilization of dynamic pricing in emerging markets and contributes to the broader academic discussion.

Keywords: *dynamic pricing, market competitiveness, consumer satisfaction, Sri Lankan consumer brands, pricing strategies*

Piloting Data-Driven Real Estate Decisions in Colombo: A Prototype Dashboard for Informed Stakeholder Engagement

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The real estate sector in Colombo is challenged by fragmented data repositories and a lack of integrated analytical tools, resulting in inefficiencies and suboptimal decision-making by stakeholders. To address these challenges, this paper discusses the development of a prototype dashboard that harnesses the power of data analytics to offer actionable insights tailored to stakeholder needs. The primary objective of this study was to design and implement a dashboard that enhances decision-making processes by providing a unified data visualization and analysis platform. This includes conducting a comprehensive requirement analysis to ensure that the dashboard aligns with stakeholder expectations, exploring map-based visualization tools for effective data integration, and applying advanced analytical techniques, such as predictive analytics, to forecast real estate trends. Preliminary findings demonstrate the dashboard's effectiveness in visualizing key metrics, enabling dynamic data exploration, and offering stakeholders clear, actionable insights. Initial user feedback indicated the dashboard significantly improves the understanding of market dynamics, facilitating more informed decision-making. However, challenges remain, particularly in data completeness and integration, which are critical for the dashboard's functionality and user experience. These efforts will ensure that the dashboard continues to evolve in line with the dynamic needs of Colombo's real estate sector, ultimately leading to more informed and effective decision-making.

Keywords: *real estate analytics, Colombo real estate, data-driven decision-making, dashboard development*

A Review of Machine Learning Algorithms and Weather Forecasting Integration for Enhancing Flood Prediction in the Nilwala River Basin

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In Sri Lanka, the Nilwala River Basin is very vulnerable to severe flooding that often places local lives, property, and livelihoods at risk. The current review evaluates the integration of complex machine learning models with weather forecasting methodologies, in particular rainfall data, aiming for substantial improvements in timely and accurate predictions of floods within this very fragile region. Timing and intensity of rainfall are crucial information for flood prediction, in which traditional forecasting often fails due to incorrect predictions. This study conducted a detailed analysis of ten years of daily rainfall records and utiliseds multiple machine learning models such as Artificial Neural Networks (ANN), Support Vector Machines (SVM), Convolutional Neural Networks (CNN), and Long Short-Term Memory networks (LSTM) to learn which predictive algorithms ultimately outperform others. The superiority of the LSTM network for predicting flood events in comparison to other models reveals the ability of LSTM networks, detecting patterns over time and sequence data. These high-resolution weather data integrate with remote sensing technology, underpinning not only the levels of precision in rainfall forecasts but also those needed for flood dynamics. The approach promotes both prevention and response strategies of early warning and disaster preparedness to reduce the vulnerability of groups at different stages during natural disasters, particularly flooding in river basin basins as a case study. This paper highlights the enabling role of machine learning in improving flood prediction and hazard assessment by working alongside conventional constitutive weather forecasting.

Keywords: *machine learning, flood prediction, rainfall data, weather forecasting*

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Enhancing On-Device Learning in IoT Systems Through Meta-Learning Techniques: A Comprehensive Review

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The incorporation of meta-learning approaches to on-device learning for IoT systems has emerged as one of the effective ways of developing intelligent and never-stopping devices capable of learning and adapting on their own. This study examined the existing literature to highlight the progress, prospects, and potential complications prevalent in this dynamic field. The paper revieweds specialized hardware architecture, meta-learning algorithms, and system modularity that support on-device learning in constrained IoT systems. This study investigateds several existing methods to enhance on-device learning, such as Federated Learning (FL), Transfer Learning (TL), and Continual Learning (CL) in relation to IoT systems by using meta-learning. It also covered the predictive modeling perspectives, performance assessment, and emerging issues such as privacy, security, and professional ethics. Thus, it synthesizeds the latest research and current literature to identify gaps in existing knowledge to enhance on-device learning in IoT systems through meta-learning techniques. The findings may enables researchers and practitioners to get insights with a comprehensive understanding of the state-of-the-art, prospects and potential developments of on-device meta-learning in IoT systems, fostering further advancements in this rapidly evolving area of study.

Keywords: *on-device learning, IoT systems, meta-learning, edge computing, resource-constrained devices*

Data-Driven Optimization Strategies for Resource Allocation in Small Businesses

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Small business are critical drivers of economic growth and innovation globally. However, in Sri Lanka, these businesses face significant challenges related to resource management, including inefficient allocation of labor, materials, and equipment. This study addresses these challenges by developing a data-driven approach to optimize resource allocation, focusing specifically on small-scale aqua plant businesses. Capitalizing on Sri Lanka's rich biodiversity and the growing global demand for ornamental plants, this study used an ontology-based framework with machine learning techniques to enhance operational efficiency and sustainability. The methodology employed a mixed-methods approach, combining qualitative insights from interviews with business owners, managers, and workers, alongside quantitative analysis of historical business data. An ontology was created using Protégé to categorize essential resources such as labor, materials, and equipment, and to map their interdependencies. Building on this, a machine learning model was developed in Python to dynamically adjust resource allocation based on real-time inputs, minimizing waste and reducing costs. The findings demonstrate that this integrated model significantly improves resource management practices, leading to increased efficiency and sustainability in operations. By tailoring solutions to the specific context of small-scale aqua plant businesses in Sri Lanka, this research provides actionable insights that can help SMEs overcome resource-related obstacles and thrive in competitive markets. This study highlights the practical implications of adopting data-driven optimization strategies and offers a framework that can be replicated across similar industries facing resource management challenges.

Keywords: *data-driven optimization, resource allocation, small businesses , ontology-based approach, machine learning*

Attribute Selection and Verification for Effective Hockey Player Ranking in Sri Lankan Context

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Sri Lanka's hockey domain has been hindered by the lack of a standardized dataset and the absence of a well-defined set of attributes for player performance assessment, limiting the application of advanced AI technologies. This study aims to identify and verify a key set of attributes specific to Sri Lankan hockey players. The methodology involved three phases: First, an extensive literature review of 30 research papers was conducted to identify a preliminary list of 10 attributes. Second, these attributes were calibrated through face-to-face interviews with coaching experts, involving 25 national-level hockey players, resulting in the refinement to 8 attributes. Finally, these attributes were verified through a structured questionnaire survey conducted with hockey coaching experts, leading to the finalization of 9 key attributes: Front Goals, Penalty Strokes, Penalty Corners, Green Cards, Yellow Cards, Red Cards, Card Issue Time, Goal Time, and Skill Accuracy. The next phase of this study will focus on developing a mathematical rating equation with weighted attributes to calculate performance scores for each player.

Keywords: *hockey analytics, attribute selection, player evaluation*

A Comprehensive Review of Automated ICD -10 Categorization Model: Methodologies, Challenges, and Future Directions

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In healthcare systems worldwide, the manual assignment of ICD-10 (International Classification of Diseases, 10th Revision) codes presents significant challenges, including resource constraints, lengthy processing times, and potential inaccuracies. This comprehensive review of the literature analyzed existing research papers on automated ICD-10 coding systems, focusing on machine learning methodologies such as decision trees, natural language processing (NLP), and deep learning models. The review comprehensively evaluates the performance, accuracy, and implementation challenges of these techniques across diverse healthcare settings. By examining studies from multiple healthcare settings, this paper highlights the potential of automated systems to improve diagnostic precision, reduce manual workloads, and enhance overall healthcare efficiency. The evaluation highlights major obstacles, including data availability, integration with existing systems, and the need for ongoing training of healthcare professionals, with brief implications for developing countries like Sri Lanka. Finally, this comprehensive analysis recommends future research areas to help automated ICD-10 coding systems become more widely used, which would ultimately lead to better healthcare outcomes worldwide.

Keywords: *ICD – 10 codes, classification method, ICD – 10 code assignment, machine learning*

OptiLens AI: Empowering Patients with Advanced Cataract Diagnosis and Personalized Eye Care

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Globally, cataract is among the major causes of blindness. Previously, ophthalmologists used objective lens examination and visual acuity tests, to diagnose cataracts. In general, this method of manual diagnosis has drawbacks in terms of accuracy, inter and intra-observer consistency, and most importantly, consistency across cases.Currently AI and ML are used to evaluate digital eye images for cataract classification and staging with greater objectivity. This study examineds 18 prior studies on how the use of AI in diagnosing cataract outperforms physicians even without the assistance of the former, which could contribute to the improvement of decision-making services and global patients' accessibility to quality eye care. The prominent obstacles to the establishment of the technology include data privacy, monitoring, and acceptability among physicians. However, AI has great potential to help improve precision in medicine and individualized treatment of patients with cataracts.

Keywords: *cataract diagnosis, artificial intelligence, machine learning, computer-aided detection, digital imaging, ophthalmology, precision medicine*

Early Detection and Identification of Blister Blight Disease in Tea Plantations Using Deep Learning and Real-Time Environmental Data

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Tea, one of the world's most widely consumed beverages, faces significant threats from Blister Blight disease, particularly in hot and humid regions. This disease, caused by the fungus Exobasidium vexans, leads to substantial crop losses, negatively impacting both the quality and quantity of tea production. This paper proposes an integrated approach to tackling Blister Blight disease by which combine Machine Learning techniques, and real-time environmental data analysis. This approach aims to accurately detect and classify Blister Blight infected leaves via deep learning models trained by image data from various sources. Additionally, real-time environmental data analysis will be used to predict Blister Blight onset by identifying critical weather thresholds and correlating them with disease occurrence. The implementation of an automated alert system delivers timely warnings based on environmental conditions, enabling proactive interventions to mitigate Blister Blights's impact on tea production. This approach not only improves the accuracy and efficiency of disease detection but also aligns with the broader trend of incorporating technology into agriculture for sustainable and efficient practices. The proposed framework represents a significant advancement in agricultural disease management, offering a scalable and adaptable solution that can be applied to various plant diseases. Through this work, we aim to contribute to the long-term sustainability of the tea industry, ensuring economic stability for regions dependent on tea cultivation and promoting the broader adoption of precision agriculture technologies.

Keywords: *tea, blister blight, machine learning, real-time environmental data, disease management*

AQUAFINA: Streamlining Collaboration, Meet Management, and Performance Prediction in Swimming

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Swimming is a prominent sport in Sri Lanka with a significant number of school, university, and open-level swimmers participating in competitions. However, the management of these events faces critical challenges, due to outdated manual processes. Current systems rely on physical form submissions, in-person payments, and delayed access to meet schedules and heat assignments, with limited integration of performance data. This study introduces AQUAFINA, a comprehensive digital platform designed to address these inefficiencies and enhance athlete management. AQUAFINA aims to automate meet registrations, facilitate online payments, and provide real-time access to meet schedules and heat assignments. Additionally, the system incorporates a machine learning-based performance prediction tool, utilizing historical performance data, physical metrics, and training records to forecast swimmer results, and facilitates a collaboration platform for swimmers and coaches to interact with each other. This integration addresses gaps identified in existing literature, which highlights the limitations of current systems in performance prediction, swimmer-coach collaboration, and comprehensive meet management. Methodologically, AQUAFINA employs a web-based platform integrating these features, with an emphasis on improving efficiency, transparency, and collaboration. In conclusion, AQUAFINA provides a comprehensive, data-driven solution to improve the efficiency of swimming competition management and swimmer-coach collaboration for swimmers of all levels in Sri Lanka.

Keywords: *swimming, performance prediction, athlete development, meet management, AQUAFINA*

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Optimizing Human-AI Collaboration in Graphic Design: Opportunities, Challenges, and Future Directions

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This study delves into the integration of artificial intelligence (AI) into graphic design workflows. The study aimed to explore the potential opportunities and significant challenges associated with this technological shift. The research objectives included identifying how AI and generative design tools can automate routine tasks, empower non-experts, and enhance creativity in graphic design. It also examineds challenges such as career disruption, loss of tacit design knowledge, and the risk of unintended bias in AI-generated content. Through a comprehensive literature review, the study provides insights into the evolving human-AI collaboration landscape in graphic design. Key findings emphasize the need to balance technological advancement with human-centered creativity to maximize AI's benefits while addressing potential risks and disruptions. The paper concludes by proposing pathways for productive human-AI collaboration and highlights the research gap in understanding the holistic impact of AI on graphic design, focusing on strategies for responsible and effective integration.

Keywords: *graphic design, artificial intelligence, computational creativity, automation, human-computer collaboration*

Leveraging Natural Language Processing to Enhance Patient Feedback Analysis and Improve Shared Antenatal Care at University Hospital KDU, Sri Lanka

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In Sri Lanka, approximately 94% of expectant mothers rely on public-sector health facilities for antenatal care. However, in the manual collection of data using pen and paper poses significant challenges, leading to a time-consuming and cumbersome process. This study addresses the need for an efficient solution to manage antenatal care records, aiming to reduce the Maternal Mortality Ratio (29 per 100,000 live births) and enhance overall maternal care. A comprehensive web-based application is proposed. The system involves five key actors: Primary care staff (MOH/Midwife), Obstetrician, Hospital staff, Patient, System admin. Utilizing HTML, Bootstrap, PHP, and MySQL, the application aims to streamline the information management process. The primary objectives include the development of a patient database system specific to the Medical Officer of Health (MOH) area and an electronic referral system to identify and address potential risk factors in real-time. The integration of NLP allows for the automated analysis of patient feedback and consultation records, enabling the identification of common concerns and areas for improvement in antenatal care. By applying sentiment analysis, topic modelling, and named entity recognition, the system can extract valuable insights from textual data, facilitating data-driven decision-making and personalized care plans. The system will undergo a pilot implementation in three selected MOH areas for a month, followed by validation and full-scale implementation. The focus of the system design was to expedite and simplify information management in the antenatal department, providing a faster, more convenient, and efficient solution. By leveraging technology, this study processes a system to significantly improve the overall quality of antenatal care, contributing to the reduction of maternal mortality and facilitating informed decision-making during emergencies.

Keywords: *antenatal care, database, patient records management, natural language processing*

Data Science Driven Solution to Predict Employee Attrition: A Systematic Review

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Employee attrition refers to leaving employees from the organization due to various reasons. Understanding and predicting employee attrition is crucial for organizations seeking to enhance employee retention and reduce turnover costs. This systematic literature review aims to analyze and compare existing research focused on predicting employee attrition using Machine Learning and Deep Learning techniques. The primary purpose was to identify the most effective models, feature selection methods, and performance evaluation measures employed in the literature from 2016 to 2024 for predicting employee attrition. The review examined 33 selected papers, each evaluated using 5 research questions designed to assess the methodologies and outcomes of different studies. It was found that a wide range of models, including Decision Trees, Random Forests, Deep Neural Networks, Long Short-Term Memory Networks, and Convolutional Neural Networks, were utilized to predict employee attrition. Many studies conducted comparative experiments, testing multiple models to determine the most effective ones. Notably, datasets from IBM and Kaggle were frequently used by researchers, providing a common basis for comparison. The findings emphasized the critical role of feature selection techniques in improving the accuracy of attrition predictions. Engaging in systematic literature reviews not only refines research focus but also helps identify gaps in existing studies, offering valuable insights for developing effective employee retention strategies and guiding future research.

Keywords: *employee attrition, Machine Learning, Predictive Models, classification*

Role of Visual Elements (Color, Typography, and Layout) on User Trust in Online Payment Processes

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Trust is a significant factor when it comes to online business, especially in the e-commerce sector. This study aimed to explore the effects of colour, layout, and typography as visual factors of website user's trust in the payment process. The study aimed to determine the key visual elements that affect users' perception and trust while using the digital platform. The current study employed both quantitative survey method and qualitative interview to obtain adequate data from a range of online shopper. The findings suggest that colour schemes influence emotions of users instantly and the presence of blue increases perceptions of security. The concept of easily uncluttered layouts, enabled enhanced navigation and reduced anxiety amongst the users. Typography, more specifically font size and font style influence the readability and the perceived credibility of the content. Concern on these visual elements are crucial for e-commerce platforms to promote trust and provide the best experience to clients. Finally, it is pointed out that the strategic use of visual language objectives is critical in enhancing and sustaining trust in payments made on the Internet, which can lead to higher customer satisfaction and transaction success rates.

Keywords: *visual elements, user trust, online payment processes, user experience, trustworthiness in e-commerce*

A Data-Driven Approach to Heart Stroke Prediction Using Machine Learning and Fuzzy Logic

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Early detection of heart strokes is crucial for timely medical intervention and improved patient outcomes. This research aims to develop a reliable and accurate heart attack prediction model using machine learning techniques on patient medical data. This study has conducted exploratory data analysis (EDA) on a Kaggle dataset, including variables such as age, sex, blood pressure, BMI, cholesterol, and smoking status. After preprocessing and cleaning the data, it was evaluated several predictive models, including decision trees, logistic regression, and artificial neural networks. Preliminary results indicate that systolic and diastolic blood pressure significantly impact stroke risk. To enhance the model accuracy and robustness, future work may integrate genetic fuzzy logic into the prediction model. This study contributes to the computing and medical domains by providing a framework for effective prediction and insights into key factors influencing heart attack risk, potentially aiding early diagnosis and personalized treatment plans.

Keywords: *heart stroke prediction, machine learning, exploratory data analysis, genetic fuzzy Logic, medical informatics*

Decoding Brain Wave Patterns for Speech Recognition in Individuals with Speaking Disabilities

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Decoding and predicting words from brain wave patterns is an area of growing interest, with numerous methodologies and machine learning techniques being developed to achieve this. However, despite the introduction of various tools and approaches—such as convolutional neural networks (CNNs), support vector machines (SVMs), and advanced noise reduction techniques—the challenges associated with these methods remain underexplored. This study aimed to identify and analyze the key challenges in predicting and decoding words using brain wave patterns. Our methodology involved identifying relevant keywords, selecting standard academic databases like IEEE, Google Scholar, and Elsevier, and critically reviewing the most pertinent research papers. Through a comprehensive analysis. The study highlighted the most common challenges faced by researchers in this domain, such as individual variability in brain wave patterns and the limitations of current machine learning models. Our findings underscore the need for further research and development to overcome these challenges, ultimately enhancing the communication capabilities of individuals with severe speech impairments.

Keywords: *brain-computer interfaces, electroencephalography, speech recognition, machine learning, convolutional neural networks*

IoT-based Assistive Smart Shoe for Disabled Individuals Using Kansei Engineering

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The difficulty accessing the transport for visually impaired people and other people with disabilities shows the need for advanced technology development. To address this problem, this research propose a specialized Smart IoT shoe based on Kansei engineering to improve user mobility, safety, and self-sufficiency. The main goal is to develop an approach that is user-oriented design which identifies obstacles and responses to the emotions and functions of the target user. The study used Kansei Engineering to assess user emotions and needs and create shoes with ultrasonic sensors, tactile feedback and audio signals controlled by microcontrollers incorporated into the shoes. A pilot study was used to evaluate the effectiveness of the system, and the user's orientation was improved using prototypes and the user's ability to navigate independently improved. In addition, the connection of smart shoes with smartphone applications such as Bluetooth allowed users to track, update their locations and notify caregivers, which increases user safety and confidence.The results suggest that smart shoes equipped with IoT can reduce the need for assistance and promote user privacy. This shows that the combination of IoT technology with a human-centered design approach can achieve many positive results for persons with disabilities. We will focus on improving the technology, encouraging its widespread adoption, and assessing the potential impact on other disabilities.

Keywords: *IoT-based assistive technology, Kansei engineering, smart shoe, mobility enhancement*

A Multi-factor Approach of Spot Price Forecasting via Deep Learning

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The potential cost savings and the high scalability behind the spot instances benefit the cloud customers compared to On-demand instances fit for workloads that need uninterrupted compute power. However, the termination of instances by the cloud provider whether exceeds the customer's bid or the unpredictable availability based on supply and demand needs remedies such as appropriate forecasting to optimize bidding strategies.To handle the expansion in instance types and regions as vast datasets, effectiveness in using the history data of different research exhibits a significant range of instability in prediction accuracy. The demand for profit optimization and resource analysis entices to upgrade the traditional methods to improve the accuracy. Resolving these challenges and limitations, this research investigates the Amazon Spot instance forecasting adopting different Deep Neural Networks (DNNs) considering multi-factor approach involving encoding techniques for improvement. Multi-factor strategy ensured compatibility and optimized model selection. Encoding converts those categorical features into unique integers and ensures consistent data representation. The cloud provider's expansion leads to changing datasets and difficult handling of DNN model running mandating a user-friendly application for the customers. To facilitate model interaction and enhance accessibility, a graphical user interface (GUI) is developed where customers select his/her required resources with the date and time they demand, and then the predicted price will be displayed.In both past and future contexts, bidirectional processing shows superior performance in BiLSTM. This assists the user in finding the predicted price in a user-friendly environment with the outperforming DNN.

Keywords: *forecasting, multi-factor, encoding, cloud computing, graphical user interface*

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