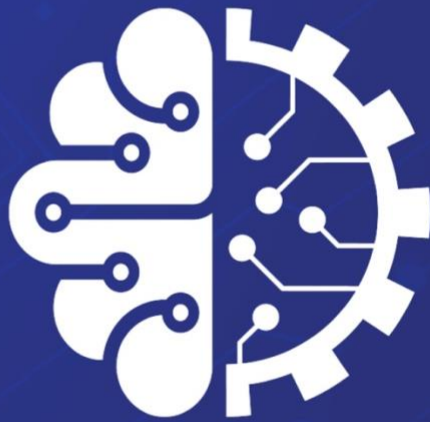




UNIVERSITY OF  
**KELANIYA**

Faculty of  
Computing and Technology



**ICATC**  
**2024**

**9<sup>TH</sup> INTERNATIONAL CONFERENCE ON  
ADVANCES IN TECHNOLOGY AND COMPUTING  
(ICATC) 2024**

# **BOOK OF ABSTRACTS**

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# Abstracts

9<sup>th</sup> International Conference on Advancement of Technology and Computing  
ICATC 2024

19<sup>th</sup> December 2024  
Faculty of Computing and Technology  
University of Kelaniya  
Sri Lanka  
2024

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International Conference on Advances in Technology and Computing

Abstracts

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## Message from the Vice Chancellor of University of Kelaniya



It is with great pleasure that I write this message for ICACT 2024, the 9th International Conference on Advances in Computing and Technology, organized by the Faculty of Computing and Technology at the University of Kelaniya.

This year's conference holds particular significance as we proudly announce that ICACT has received IEEE Technical Co-Sponsorship for the very first time. This recognition reflects the growing

impact of our conference as a platform for fostering innovative research and meaningful collaboration in the field of computing and technology.

The theme of ICACT 2024, "Leveraging Advancement in Computing and Technology Towards a Circular Economy," underscores the vital role of technology in shaping a sustainable future. The discussions and insights shared during this conference will contribute to addressing pressing global challenges, such as resource efficiency, waste reduction, and the transition to sustainable economic models. Your contributions to this dialogue are essential in advancing the knowledge and practices needed to achieve these goals.

I extend my heartfelt appreciation to the Organizing Committee for their unwavering dedication in putting together a conference program that brings together a diverse community of academics, researchers, and industry professionals. This event serves as a valuable platform for sharing ideas, presenting findings, and exploring opportunities for collaboration. My sincere thanks go to everyone who has worked behind the scenes to ensure the success of ICACT 2024.

May the proceedings of this year's conference inspire transformative ideas and pave the way for new innovations that align technology with sustainability. I wish all participants engaging deliberations and a rewarding experience throughout the conference.

Thank you for your commitment to advancing knowledge and innovation.

### **Senior Professor Nilanthi de Silva**

MBBS (Colombo), MSc (London), MD (Colombo)

Senior Professor of Parasitology and Vice Chancellor

## Message from Chairman Research Council University of Kelaniya



Research is the cornerstone of societal progress, offering solutions to the challenges faced by our rapidly evolving communities. The knowledge gained through research flows through many channels, ultimately finding its way into the classroom, shaping and inspiring future generations. Academics are central to this process, serving as drivers of new ideas and creating knowledge that is both relevant and beneficial to society.

Universities, as centres of learning and discovery, play a crucial role in fostering this cycle of knowledge creation and dissemination. However, the journey of research does not necessarily end with publication. Its true value lies in how other academics embrace and apply it, influencing the broader community and ultimately benefiting learners. The culmination of this process is seen in publications that deepen understanding and spark further inquiry.

This year's conference is particularly special as ICATC celebrate obtaining IEEE Technical Co-Sponsorship for the first time. This recognition marks an important milestone, reflecting the growing impact of our event in bringing together researchers and practitioners to share and advance knowledge.

The theme of ICACT 2024, "Leveraging Advancement in Computing and Technology Towards a Circular Economy," emphasizes the critical need to align technological innovation with sustainability. It challenges us to create research that advances the frontiers of computing and technology and contributes meaningfully to building a resilient and sustainable future.

I wish you all a day filled with insightful discussions, valuable connections, and ideas that will inspire continued progress in your work.

### **Professor Sachith Mettananda**

MBBS(Col) MD(Col) DPhil(Oxon) FRCPCH(UK) FRCP(Lond) FRCP(Edin) FNASSL  
Chairman – Research Council  
University of Kelaniya

## Message from the Dean of the Faculty of Computing and Technology



It is my privilege to extend a warm welcome to all participants of the International Conference on Advances in Computing and Technology 2024 (ICACT 2024). This year, we celebrate a significant milestone as the conference receives IEEE Technical Co-Sponsorship for the very first time—a testament to the growing recognition and impact of this event.

As we gather in person, I am truly inspired by the presence of so many distinguished academics, researchers, and professionals from across the country. Together, we will explore this year's theme, *"Leveraging Advancement in Computing and Technology Towards a Circular Economy,"* and examine how cutting-edge innovation can drive sustainable economic recovery.

I am especially delighted to announce that our keynote address will be delivered by the renowned researcher Prof. Clarence De Silva, whose expertise will undoubtedly set the tone for insightful discussions and meaningful engagements throughout the conference.

To our presenters and researchers, I wish you productive sessions and thought-provoking exchanges. Your work is at the heart of what this conference represents—pioneering advancements that have the potential to shape a more sustainable and equitable future.

Thank you for your participation and commitment to advancing the fields of computing and technology. Your presence and contributions make ICACT 2024 a truly remarkable gathering of minds.

### **Dr. Chamli Pushpakumara**

PhD (Sheffield Hallam, UK), BSc (Kelaniya)

Dean - Faculty of Computing and Technology

# Message from the General Chair of ICATC 2024



It is my honor to welcome you to ICACT 2024, the 9<sup>th</sup> International Conference on Advances in Computing and Technology, organized by the Faculty of Computing and Technology at the University of Kelaniya. This year, we are proud to announce a significant milestone: ICACT has received IEEE Technical Co-Sponsorship for the first time. This achievement reflects the conference's growing reputation as a platform for advancing research and fostering collaboration in the fields of computing and technology.

The theme of ICACT 2024, *"Leveraging Advancement in Computing and Technology Towards a Circular Economy,"* addresses one of the most pressing challenges of our time: how to align technological innovation with sustainable development. As global economies strive to reduce waste, improve resource efficiency, and transition to sustainable practices, the role of computing and technology has never been more critical. This conference provides a space for researchers, practitioners, and academics to share their findings, exchange ideas, and contribute to the ongoing dialogue on how to achieve these goals.

I would like to extend my deepest gratitude to the Organizing Committee for their dedication and meticulous planning, which have been instrumental in making this event possible. I would also like to express my heartfelt appreciation to the IEEE Sri Lanka Section for their invaluable support throughout the process of organizing this conference, particularly in facilitating collaboration and sharing their expertise. My thanks also go to the authors, reviewers, and session chairs whose efforts have ensured the quality and relevance of the research presented here.

It is my sincere hope that the work showcased in these proceedings will inspire new ideas and collaborations, driving further advancements in the field while contributing to a sustainable and equitable future. Thank you for your participation in ICACT 2024, and I wish you all an engaging and productive conference.

**Dr. Chanaka Udayanga**

BSc Eng. (Moratuwa), PhD (NTU, Singapore), AMIESL  
Senior Lecturer (Grade II)

## Keynote of Speaker of ICATC 2024



Professor Clarence De Silva  
The University of British Columbia  
Vancouver, Canada

### **“Myths and Realities of AI Technologies for the Developing World”**

This talk will start by indicating the importance of “Intelligence” in autonomous practical systems. Next, it will outline some important practical applications of Intelligent Systems, including those developed by groups worldwide and in the Industrial Automation Laboratory at the University of British Columbia, headed by the author. Some myths, misconceptions and shortcomings related to Intelligent Systems will be pointed out. The main shortcomings concern mechanical requirements, the nature of intelligence, and the achievable level of precision.

Artificial Intelligence (AI) is a broad term. The meaning of intelligence, in that context, is various. Its application methodology is various as well. The older concepts of AI primarily involved rule-based and soft computing methodologies. The new methodologies of AI and machine learning primarily involve data-based concepts, which are used in deep learning, deep neural networks, compositional neural networks, and so on. In short, in the context of “artificial learning,” what is commonplace today is the use of data. However, a more appropriate mindset is evolving, where the primary focus is to use the “Physics” of the system, in the process of learning. Still, AI is not a panacea, and is presently more appropriate in applications that do not require high precision (e.g., music, medical diagnosis, advisory systems). Nevertheless, future variations should become conducive to high-precision applications. Then, one has to be aware of myths, false expectations, and present realities of AI.

The talk will conclude by mentioning future trends and key opportunities of Artificial Intelligence, particularly for developing countries.



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## Management of Technology

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# Cyber Security

# Hybrid Supervised Machine Learning Driven Novel IP Reputation Validating Techniques for Cloud Firewalls

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**Abstract**— Cloud firewall systems have exponentially improved with artificial intelligence (AI) to achieve more accurate IP reputation (IPR) validation and robust threat detection. In this paper, we present a novel hybrid machine learning (ML) approach to infer IP address reputation to protect hosted applications in Amazon Web Services (AWS) cloud infrastructure. A multi-source data pipeline, including SOC logs, WAF and Guard Duty Logs, is leveraged to have higher precision and better utility in the IP reputation assessment. This solution takes pre-processed IP threat metadata as input and passes it through an ensemble ML model of Random Forest (RF), Linear Regression (LR), and Support Vector Machine (SVM) classifiers. Different aspects of IP threat detection are addressed by each algorithm. This hybrid model tracks suspicious IP patterns, aggregates findings for supervisory analysis, and dynamically creates AWS firewall rules to block identified threats in real time. The system learns to synchronously adapt to changing ensemble models' output through the 'IP-List' and Instant Blacklists, significantly improving their overall defence capability. It achieves substantial reduction of false positives and fasten the response to combat against malicious IP behaviour in cloud hosted applications and is quite secure and robust.

**Keywords**— Hybrid machine learning IP reputation validation, Web application firewall Auto-defence, Extended validation with machine learning, Accurate data processing, Dynamic and effective forensics.

# An Enhanced Approach to DDoS Detection using Machine Learning models with Explainability

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**Abstract—** The widespread use of the Internet for various purposes has increased the vulnerability to cyberattacks, particularly Distributed Denial of Service attacks, which severely disrupt system functionality by interrupting communication. These attacks have led to significant losses, prompting numerous studies aimed at mitigating their impact and protecting network systems. This study presents a comparative analysis of several machine learning models using a dataset specifically developed for DDoS detection. Among the evaluated algorithms, the CatBoost classifier with optimized parameters demonstrated superior performance, achieving an accuracy of 99.99%. This research further examines the CatBoost model in comparison with other algorithms and discusses its interpretability using explainable AI (XAI) technique.

**Keywords—** CatBoost, DDoS attack, Machine Learning, XAI

# Explainable AI for Transparent Phishing Email Detection

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**Abstract—** Phishing attacks continue to pose significant threats by impersonating legitimate entities to extract sensitive information, often evading traditional security measures. This research addresses the need for advanced phishing detection systems capable of adapting to sophisticated tactics, focusing on leveraging machine learning models. The study evaluates various machine learning algorithms, including Support Vector Machines (SVM), Random Forest, and Logistic Regression, to identify the most effective model for phishing email detection. Explainable AI (XAI) techniques, such as Local Interpretable Model-Agnostic Explanations (LIME), are integrated to provide transparent, user-friendly explanations for model decisions. In testing, the SVM model achieved the highest accuracy (96%) and precision. User-friendly visualizations of the model's decision-making process significantly improved user trust. This paper highlights the potential of combining machine learning with XAI to enhance phishing detection, creating a robust, transparent system that empowers users to make informed decisions about email security.

**Keywords—** Cybersecurity, Email security, Explainable AI (XAI), LIME, Machine learning, Phishing detection, Support Vector Machines (SVM).

# Assessing Security Risks in Low-Code Development Platforms: A Systematic Literature Review

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**Abstract**— Low Code Development Platforms (LCDPs) have transformed software development by enabling rapid application creation with minimal coding, democratizing the process beyond professional developers. This type of democratization comes with considerable security risks. The paper aims to classify security risks associated with seven leading LCDPs: Mendix, OutSystems, Microsoft Power Apps, ServiceNow, Salesforce, Oracle, and Pegasystems. It evaluates respective mitigation strategies to improve security. 27 studies reviewed using the PRISMA methodology showed critical vulnerabilities in application, information, platform-specific, and user-related risks. The most frequent application-level vulnerabilities are code injection, XSS, and insecure APIs, which amateur developers unaware of secure coding practices further worsen. Common information security risks across various platforms include weak encryption, data breaches, and misconfigurations. User-related risks include weak credentials and insider threats that expose applications to breaches in Salesforce and Oracle. With automated patch management and secure coding practices, Mendix and OutSystems have better security postures. In contrast, others like ServiceNow and Pegasystems remain vulnerable because of delayed patching and other manual security processes, which introduces a higher probability of human error. Based on this, the study concluded that an extended multi-dimensional security strategy is required, comprising technological solutions such as automation, human-centered interventions, training, and user management in managing the risks within LCDPs.

**Keywords**—Citizen Developers, Low-Code Development Platforms, Low-Code Software Development, Mitigative Measures, Security Risks

# A Systematic Literature Review of Deepfake Literacy, Societal Impacts, and AI-Driven Prevention Strategies for Platform-Specific Vulnerabilities

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**Abstract**—Deepfake technology has rapidly evolved from a niche novelty into a significant threat to digital security, media integrity, and societal trust. This systematic review aims to analyze the progression of deepfake technology, its increasing societal impact, and how generative AI models can be leveraged for developing personalized, platform-specific prevention strategies. The review begins by exploring the foundational work on deepfakes, focusing on the technological advancements of Generative Adversarial Networks (GANs) that make the creation of hyper-realistic manipulated content possible. It then examines the societal implications of deepfakes, including their role in misinformation campaigns, political manipulation, and privacy violations. As deepfakes become more prevalent across social media platforms like Facebook, Instagram, and YouTube, the challenges in detecting and mitigating their impact are increasing. The review highlights the limitations of current detection tools and the urgent need for user education and technological interventions. Generative AI models such as ChatGPT, Google Bard, and Meta’s LLaMA are analyzed for their potential to provide tailored deepfake prevention strategies that enhance user awareness and digital literacy. The study compares these models’ ability to offer personalized recommendations, focusing on ChatGPT’s superior adaptability and user-friendliness. By addressing the gaps in deepfake literacy and platform-specific vulnerabilities, this review aims to present a comprehensive framework for mitigating the risks associated with deepfakes and empowering users with AI-driven solutions.

**Keywords**—Deepfake prevention, Generative AI, digital security, media literacy, social media platforms, personalized recommendations





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# Data Science

# A Comparative Study in Usage of Convolutional Neural Network Models in Waste Classification

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**Abstract**— Waste accumulation has become a concerning problem over many years for the human race. Unmanaged waste poses risks to life, including hazardous effects, improper disposal, worker fatigue, and costly costs due to manual labor usage. Currently, in many countries, waste picking and classification are done manually. However, manual waste classification can lead to physical strain and health issues for human laborers. Considering these pressing issues it is necessary to introduce procedures that can automate manual waste classification. This research work proposes a waste classification solution using pre-trained convolutional neural network models. The Waste Recycling Plant Dataset-Classification (WARP-C) was used as the dataset, which contained pictures of bottles, cardboard, cans, canisters, and detergent materials. Before the model training phase, image interpolation methods such as inter-linear, inter-area, inter-cubic, inter-nearest, and lanczso4 filters were also used to upscale the images. Pre-trained models, MobileNet, MobileNetV2, Xception, InceptionV3, EfficientNetB0, EfficientNetB1, EfficientNetB2, EfficientNetB3, DenseNet121, DenseNet169, and DenseNet201 were used for classification. The DenseNet169 model outperformed the rest of the classifiers when applied with inter-linear interpolation with a model accuracy of 87.68% along with best scores for precision, recall, and f1-score.

**Keywords**— Waste Classification, Convolutional Neural Networks, Pretrained Models, Transfer Learning

# Diagnosis of Alzheimer's Disease Onset and Progression using Deep Learning Techniques

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**Abstract**—Alzheimer's disease is a progressive neurological brain disorder that causes memory impairment, loss of thinking ability and the ability to conduct simplest day to day tasks. Alzheimer's disease is a common form of dementia that causes continuous cognitive and behavioral impairments. The cognitive decline is characterized by abnormal accumulation of amyloid, protein fragments, plaques between nerve cells and degeneration of nerve cells in the cerebral cortex. Alzheimer's disease progresses at different rates yet has an irreversible progression and for most individuals, decline in non-memory aspects, spatial issues and reduced reasoning can be identified as the early stages of Alzheimer's disease. The disease onset usually occurs when a person is over 65 years of age. There are four different stages identified in the disease: Non-Demented, Very Mild Demented, Mild Demented and Moderate Demented.

The purpose of this study is to develop a deep learning model to detect early stages of Alzheimer's disease. This research study presents three deep learning based approaches for Alzheimer's disease prediction; a custom CNN, transfer learning based CNNs using InceptionV3 and RestNet50. Each approach is evaluated so that insights can be gained on the classification approach. Each approach had an average accuracy of 94.18%, 88.95%, and 77.7%. respectively.

**Keywords**—Alzheimer's disease, multi-stage classification, transfer learning, deep learning

# Leveraging Ensemble Model for Robust Time Series Forecasting and Anomaly Detection

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**Abstract** - Accurate time series forecasting and anomaly detection are essential for ensuring the reliability of critical systems, such as industrial sensor networks and financial markets. We propose a hybrid approach that combines Convolutional Neural Networks with Bi-Directional Long Short-Term Memory (CNN-BiLSTM) and Autoregressive Integrated Moving Average (ARIMA) models to capture both nonlinear patterns through deep learning and linear trends with statistical methods. Hyperparameter optimization techniques like Optuna and Hyperband enhance performance, while a linear regression meta-learner integrates forecasts for improved accuracy. By blending deep learning with statistical methods, our approach achieves robust forecasting and anomaly detection through residual analysis and advanced machine learning techniques. Experiments on real-world datasets demonstrate superior accuracy and reliability compared to conventional methods, making it highly effective for industrial applications.

**Keywords** - Anomaly detection, sensor data, time series, bidirectional Long Short-Term Memory (Bi-LSTM), convolutional neural network (CNN), Deep Learning, Auto Regressive Integrated Moving Average (ARIMA)

# Demand Forecasting for Perishable Products Using Data Mining Techniques: Systematic Review

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**Abstract**—Demand forecasting for perishable goods has become increasingly critical due to the growing complexity of supply chains and the need to minimize waste. This systematic review focuses on cold chain logistics products, excluding agricultural items, to identify key challenges and significant demand factors and to evaluate the effectiveness of traditional and advanced forecasting methods. To achieve these objectives, the PRISMA framework guided the selection and analysis of 54 studies based on specific inclusion and exclusion criteria. Key findings highlight consumer preferences, income, and product pricing as major factors affecting forecasting accuracy. Traditional models like ARIMA and Holt-Winters are widely used for their effectiveness in capturing trends and seasonality but struggle with outliers and sudden demand shifts. Advanced techniques, such as LSTM, are effective at identifying detailed and complicated patterns but demand significant computing resources and large datasets. The findings underscore the need for hybrid approaches combining traditional and advanced methods to improve forecasting, enhance supply chain efficiency, and reduce waste. This research offers actionable insights for optimizing cold chain logistics and strengthening the perishable goods industry's competitiveness.

**Keywords**—Demand Forecasting, Perishable Goods, Cold Chain Logistics Products, Data Mining Techniques

# A Hybrid Approach for Predicting Tourist Arrivals in Sri Lanka: Integrating Machine Learning with Time Series Modelling

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**Abstract**—This study aims to refine forecasting models for tourist arrivals in Sri Lanka, a sector pivotal to the nation's economic and social vitality. Utilizing advanced hybrid modelling techniques, the study integrates traditional statistical models (SARIMA, VAR) with machine learning approaches (SVR, ANN, LSTM) to enhance predictive accuracy and robustness. A dataset spanning from January 2012 to December 2021 is utilized for this purpose. The methodology involves a comparative analysis of single models against hybrid configurations that capitalize on the strengths of both linear and nonlinear modelling techniques. The models were rigorously evaluated using the root mean squared error (RMSE) and the mean absolute error (MAE) across different forecasting horizons (short-term, mid-term, and long-term). This evaluation was conducted using a diverse array of features, including climate data, TripAdvisor reviews, and Google Trends data, offering a comprehensive view of the factors influencing tourist arrivals. Results indicate that hybrid models, particularly those combining linear and nonlinear methodologies, substantially outperform single model approaches. These models demonstrated a superior capacity to capture the complex interdependencies and nonlinear patterns affecting tourist behavior, thus providing more accurate and actionable forecasts. The relevance of this research extends beyond academic circles to practical applications, aiding policymakers, tourism operators, and economic planners in strategic decision-making. By enhancing forecasting accuracy, this study contributes significantly to the sustainable growth and resilience of Sri Lanka's tourism industry.

**Keywords**—time-series modelling, Sri Lankan tourism forecasting, machine learning, hybrid modelling

# A Hybrid Automated Framework for Outlier Detection in Data Warehousing

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**Abstract**—This paper introduces the hybrid automated framework to enhance the performance of outlier detection (OD) in data warehousing. The framework uses four unsupervised machine learning (ML) models which are LOF, Isolation Forest (iForest), One-Class SVM (OCSVM), and Autoencoder to detect outliers across various fact tables. In this approach, OD is automated to improve data quality within data warehouses for more accurate and efficient data analysis. Another key benefit of the framework is that, with minimal effort, it can easily be ported to other data warehouse environments, making the framework versatile in many fields. This framework was tested using the sample Microsoft database AdventureWorksDW2019, considering various categorical dimensions related to product attributes and geographic locations. Therefore, this research aims to investigate the most effective methods of OD, develop a robust framework, and quantify the framework's performance concerning OD and their analysis. The results prove that the proposed system can enhance OD to inform data-driven decision-making in complex data environments. This forms a much better paradigm for maintaining the integrity of business data in large scale, dynamic data warehouses.

**Keywords**—Data warehouse, Dimension modeling, Hybrid model, Machine Learning models, Outlier Detection

# Predictive Modeling for Tourist Arrivals: Assessing the Impact of Weather Data Using Machine Learning Models

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**Abstract**—This pioneering study explores the impact of incorporating weather data into the prediction of tourism demand in Sri Lanka, marking one of the first assessments of its kind in this context. We assessed the ability to forecast using three machine learning models—Long Short-Term Memory, Random Forest, and Support Vector Regression—using monthly data spanning January 2017 to October 2023. Two different sets of features were used to fit the models: one included only historical tourist arrival data, while the other included current and historical air quality data, which was the weather variable that had the greatest correlation with tourists arrival. Support Vector Regression demonstrated the best performance among all the models, with mean squared errors (MSE) of 0.01 and 0.16 for the models containing historical tourist arrivals and air quality as features, respectively. Interestingly, models using only historical tourist arrival data outperformed those incorporating weather data, suggesting that the inclusion of these external factors did not enhance forecasting accuracy as expected. These findings provide valuable insights for data-driven decision-making in the tourism sector, highlighting the need for careful feature selection and consideration of relevant external influences.

**Keywords**—Tourists arrival, Weather data, AQI, LSTM, RF, SVR



# Airline Delay Prediction: A Comparative Study using Machine Learning and Deep Learning Models

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**Abstract** - The goal of this research is to use past flight data to create predictive models that will forecast airline delays, thereby alleviating operational inefficiencies and displeasure among passengers in the aviation industry. A large dataset containing parameters such as flight timings, travel time, transit airport and so on was employed. Preprocessing involved feature engineering and dealing with missing values. Different machine learning methods were tested with hyperparameter tuning done to improve their performance. These included Random Forest, Logistic Regression, Gradient Boosted Trees, Support Vector Machines, and Multilayer Perceptron (MLP). Among these classifiers, it was observed that the MLP model had a prediction accuracy of 98.83%. The importance of hyperparameter tuning for better model performance has been highlighted by the study. Airlines can now make good predictions of when delays are likely to happen, enabling them to counter inefficiencies, hence improving scheduling as well as operational effectiveness.

**Keywords**—Airline delays, Feature engineering, Hyperparameter tuning, Random Forest, Logistic Regression, Gradient Boosted Trees, Support Vector Machines (SVM), Multilayer Perceptron (MLP)

## UX Researchers in the Information Technology Field in Sri Lanka: Why So Few?

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**Abstract**—User experience research (UXR) is a new career that is emerging in the world. People who engage in this career, known as UX (User Experience) researchers, provide immense support for Information Technology (IT) from the aspect of Human-Computer Interaction (HCI) and UX. Yet professional employee in this career is very few to find in the IT industry in Sri Lanka. The goal of this research was to find issues and restrictions experienced in the academia and IT industry that affect the growth of the UX researcher profession in Sri Lanka. This research utilized a mixed methodology where the qualitative study was conducted to gain in-depth insights from industry experts, allowing for a deeper exploration of the underlying causes of the shortage of UX researchers in Sri Lanka, and a survey-based quantitative and qualitative analysis was conducted among undergraduate students enrolled in IT-related degree programs to examine their perspectives on the shortage of UX researchers in Sri Lanka. The study determined that the main reason for the limited pool of UX researchers in Sri Lanka is a deficiency in interest in the UXR role, particularly regarding career opportunities and UX research practices. The research uncovered more facts associated with the scarcity of UXR roles which should be examined in future studies.

**Keywords**—User experience research, Information Technology career, Career awareness

# AI-Driven Modeling of Graduate Unemployment Duration: A Case study of Sri Lankan Graduates

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**Abstract**—Unemployment among university graduates is a significant issue in many developing countries, including Sri Lanka. Despite the increasing number of graduates entering the job market, many face challenges in securing employment, leading to prolonged periods of unemployment. This research aims to model the duration of unemployment among graduates in Sri Lanka using Artificial Intelligence (AI) techniques. By leveraging a dataset containing demographic and educational variables such as age, gender, district, degree type, subject area, and preferred job category. This study seeks to identify key factors influencing the length of unemployment and predict the likelihood of unemployment over time. The AI models employed include machine learning algorithms capable of analyzing complex relationships between these variables and unemployment duration. Furthermore, this research has significant implications for various stakeholders, including policymakers, educational institutions, and job seekers. Universities can use the insights to adapt curricula to align better with labor market demands, while government agencies can formulate policies aimed at addressing regional and gender disparities in employment opportunities. For graduates, the model offers valuable guidance on career planning and job search strategies based on the likelihood of unemployment associated with specific degree types or regions. Overall, this research contributes to a deeper understanding of the unemployment dynamics in Sri Lanka's graduate job market, offering a robust, AI-powered tool for improving employment outcomes.



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# Image processing

# Multi-Scale Efficient Attention Net for Person Re-Identification

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**Abstract**—In the realm of person re-identification (re-id), attention mechanisms have attracted significant interest because of their ability to enhance discriminative features while suppressing irrelevant ones. Among these, multi-scale attention models stand out, as they emulate the human visual perception process, focusing on foreground individuals amidst cluttered backgrounds and zooming in on specific details for closer inspection. This paper introduces a model designed to reduce complexity compared to existing multi-scale attention models while maintaining competitive accuracy. By leveraging the Efficient Channel Attention (ECA) module, which employs a minimal number of parameters, MSEA Net achieves efficient channel attention generation. We validate the effectiveness of our model through extensive performance evaluations on an established person re-identification dataset, demonstrating its superior balance between efficiency and performance.

**Keywords**—person re-identification, multi-scale attention, efficient attention, convolutional neural networks

# Deep Learning Multimodal Approach for Dog Emotion Detection in Images, Audios and Videos

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**Abstract**—This paper proposes a new multimodal approach for dog emotion detection using both audio and video streams to enhance the understanding of a dog's emotional states. Most existing approaches focus on single-modality methods, analyzing either barking and other non-verbal vocal signals in isolation or facial and body gestures separately. In contrast, this system combines advanced deep learning techniques: the CNN-LSTM for audio signal analysis, and ResNet for image analysis, to reach a better comprehension. As shown in this system, the late fusion method that employs the advantages of both modalities significantly enhanced the emotion recognition rate. This research addresses this challenge by proposing a new multimodal dataset for model training and evaluation. The proposed system will be employed in real-time IoT-based dog monitoring applications that help improve the health of pets and reinforce human-animal bonds.

**Index Terms**—Dog emotion detection, multimodal deep learning, audio-visual fusion, CNN-LSTM, ResNet

# Plasmodium Detection from Blood-cell Images using MobileNet and Firefly Algorithm

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**Abstract**—Malaria is a most prevalent mosquito-borne disease that can result in mild to severe health issues. The main cause of malaria is blood infection due to the plasmodium parasite, which enters the bloodstream by the bite of an infected Anopheles mosquito. Blood samples taken from infected individuals are often examined under a microscope to facilitate clinical level diagnosis of malaria. To plan and execute the treatment, an accurate diagnosis of the red-blood cell (RBC) infection is required. To automate the RBC examination task, this research proposes a Deep-Learning (DL) technique employing the MobileNet (MN). Proposed DL-tool consist following phases; collecting and resizing the microscopic images, deep-feature extraction with a chosen MN-variant, reducing features using Firefly-Algorithm (FA), creating fused-deep-features (FDF), and classifying data using 3-fold cross validation. In this work, the suggested MN-tool uses the individual and FDF with SoftMax to classify the selected microscopic images into healthy RBC/Plasmodium. The performance of proposed DL-tool is verified using two forms of FDFs: (a) FDF1 generated with deep features after 50% dropout, and (b) FDF2 generated with deep features optimized using FA. The results of this study validate that the suggested DL-tool contributes to >99% accuracy when FDF2 based classification is used.

**Keywords**—Healthcare; Malaria; Deep-learning; Firefly algorithm; RBC analysis.

# Real-Time Tire Wear Prediction

## Using Deep Learning and Explainable AI

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**Abstract**—This research introduces a novel deep-learning model for tire wear detection that significantly enhances detection accuracy and system explainability. By integrating the Exception architecture with a custom Dual Attention layer, the model offers precise insights into tire wear patterns, focusing on critical features for improved predictive accuracy. The addition of Integrated Gradients for explainability not only elucidates the model's decision-making process but also fosters user trust by making the results understandable and transparent. The implementation includes a user-friendly interface that allows for real-time feedback and actionable insights, making it a practical tool for proactive vehicle maintenance and safety enhancements.

**Keywords**—Tire Wear Detection, Deep Learning, Model Explainability, Predictive Maintenance.



## Deep Learning for Soil Moisture Content Estimation via Reflectance Multispectral Imaging

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**Abstract**—Soil moisture content estimation is essential for soil quality assurance before undertaking construction operations. Existing methodologies for estimating soil moisture content are often associated with significant costs and considerable time requirements. This study introduces a pragmatic, cost-effective, accurate, and prompt indirect method for estimating soil moisture content using a multispectral imaging based regression neural network. An in-house built, site-testing capable multispectral imaging system operating in the range from 365 nm to 940 nm is used to obtain multispectral images of soil samples. Image preprocessing techniques such as dark current subtraction and histogram equalization are used to mitigate the random noise and surface imperfections in the images. A regression neural network is utilized to estimate the soil moisture content with R<sup>2</sup> value of 0.9987. Further testing with validation data gives R<sup>2</sup> value of 0.9922 ensuring the suitability of this method for real-world applications.

**Keywords**—Regression Neural Network, Multispectral Imaging, Soil Moisture Content, Building Construction

# Adapting Prompt-Driven Approach for Diabetic Foot Ulcer Segmentation: A Sri Lankan Patient Study

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**Abstract**—Diabetes is a common metabolic disorder affecting millions worldwide, including a significant population in Sri Lanka, and often leads to diabetic foot ulcers (DFUs). Accurate wound measurement is essential for diagnosing and monitoring DFUs, as it provides crucial metrics for tracking healing and guiding treatment decisions. However, manual measurement is time-consuming and prone to errors, potentially resulting in misdiagnoses and flawed records. Automating wound segmentation from medical images offers a promising solution, improving efficiency and patient outcomes. This study presents a prompt driven segmentation approach to address the challenges of DFU segmentation, particularly in scenarios with limited data from Sri Lankan patients. By using user-provided bounding boxes, the model focuses on complex wound areas, improving accuracy in cases with unclear boundaries or sparse data. The research involves creating a diverse dataset of 300 samples from 180 patients at Dambulla Base Hospital, capturing variations in skin tone, ulcer size, shape, and surrounding tissue conditions. The proposed approach fine-tunes the Segment Anything Model (SAM) using prompt-driven techniques to adapt to the unique characteristics of DFUs in Sri Lanka. The model achieved strong performance metrics, including a Dice Coefficient of 83.31%, Specificity of 99.73%, and Precision of 90.42%. This method reduces the need for large annotated datasets, enhances generalization from limited data, and allows user-guided adjustments. By developing population-specific models, this research has the potential to improve clinical decision-making and significantly enhance DFU management in Sri Lanka. Furthermore, this approach demonstrates the broader applicability of prompt driven segmentation techniques to address healthcare challenges in resource-constrained settings.

**Keywords**- Diabetic Foot Ulcer, Segment Anything Model, Sri Lankan Patients, Segmentation

# Integrate Interpretable AI into Chest X-ray Diagnosis: Comparative Analysis of CNN Architectures with Grad- CAM Visualizations

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**Abstract**— Artificial Intelligence, as an aid to medical image interpretation has marked a significant advantage for improving diagnostic accuracy and aiding the clinical workflow. However, an issue that needs to be addressed is the “black box” nature of AI models, which makes them not very trusted or adoptable at a clinical level. This research focuses on the role of interpretable AI models with respect to being implementable within clinical workflows for influencing medical image interpretation. The study has trained and finalized the advanced deep learning architectures that includes VGG19, MobileNet as well InceptionResnetV2 to classify data of chest X-ray modalities using 13 distinct diseases labelled in multilabel classification problem. Several ensemble methods have been used to boost the prediction like Max Vote, HardVote, Simple Average and Weighted Average. The system evaluates accuracy, loss plots, Receiver Operating Characteristic (ROC) curves and Area Under the ROC Curve (AUC) scores. The results depicted the performance of VGG19 and MobileNet with 88.5% validation accuracies and their respective validation losses as 0.29 and 0.29. Attention layers and Grad-CAM will further ensure more explainability, thus instilling confidence in AI-driven decisions. This transparency is very key to the practical application of AI in healthcare and will lead to better patient outcomes, further optimizing clinical processes. This work potentially opens the door for wider AI deployment in clinical diagnostics by opening two major impediments: challenges in interpretability and transparency.

**Keywords**— Interpretable AI, Healthcare Workflow, Medical Imaging, Grad-CAM, CNN, Ensemble Methods



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# Natural Language Processing

# Comprehension and Verification of Ontology Increments via AIML and Alice Bot

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**Abstract**—Ontology construction is a repetitious and gradual operation. Involvement of both domain experts and ontologists are very important to ensure successful ontology construction. Once developed, the advantages of ontologies are numerous. However, ontology increment verification is a challenging hurdle for non-related computing domain professionals like bankers, lawyers, medical related doctors etc. Because they are not experts in Resource Description Language (RDL) or Web Ontology Language (OWL) specifications, semantic concepts and SPARQL querying. But the input of the domain specialists is very crucial in determining the adequacy and accuracy of the interpretation, presented in the specific ontology increment. Though there are existing verbalizers, almost all of them are schema and domain dependent. Therefore, tedious customizations are mandatory for using them for a new task. This is the main problem addressed in this research. As a remedy to this issue, this research attempts to resolve this technical bottleneck via a new algorithm capable of verbalizing the contents of the ontology increment in natural language, despite the domain and schema of the ontology increment. Upon testing the efficiency of the proposed algorithm for three different domain-based case experiments (i.e. Law, Psychology and Marine Biology), it yielded an overall accuracy of 82 percent.

**Keywords**—AIML, Alice Bot, Ontology, Verbalization

# A Review of Hybrid Sampling Techniques for Classifier Performance in Imbalanced Multiclass Sentiment Analysis

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**Abstract**—Class imbalance remains a significant challenge in multiclass sentiment analysis, where the uneven distribution of class samples can lead to biased predictive models and inaccurate results. This study provides a comprehensive analysis of various approaches to address this issue, focusing on data-level techniques such as K-Means-SMOTE, RFMSE, and ROS-NCL, as well as algorithm-level strategies like SE-gcForest, VAE, and ELM-AE. The study critically examines the strengths and limitations of these methods when applied to imbalanced sentiment datasets. Findings suggest that no single technique universally outperforms others; instead, the effectiveness of each method varies depending on the specific characteristics of the dataset and the nature of class imbalance. The review highlights the importance of selecting context-appropriate techniques and highlights the ongoing need for developing scalable, integrated solutions that can adapt to different levels of imbalance and dataset complexities.

**Keywords**—Class Imbalance, Multiclass Sentiment Analysis, Sampling Techniques, Imbalanced Datasets

# Machine Learning Approach for Detection of Harassment and Hate Speech in Sinhala Text Messages on Telegram

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**Abstract**—Nowadays, social media platforms have become an important communication method to connect and express messages without geographical limitations. Nevertheless, harassment and hate speech are some of the main negative outcomes of these platforms, poisoning digital spaces online and leading to depression and even suicide. Hate speech and harassment target individuals or groups based on attributes such as gender, religion, race, or sexuality. According to Sri Lanka CERT (National Centre for Cyber Security), hate crime incidents rose 38% in 2021, with 182 reported cases against 70 in 2020. Although, to overcome that concern, specifically in Sinhala text messages on Telegram, there is a lack of relevant studies. Consequently, this study aims to develop a machine learning model to efficiently identify and mitigate a spectrum of harassment and hate speech, within Sinhala Telegram text messages. The initial step involved developing a Telegram API and a Python application using the Telethon library to collect Telegram text messages automatically. Telegram messages were manually annotated into two categories based on different factors. Sinhala language-specific data preprocessing NLP techniques such as stemming, and tokenization were utilized for normalization and feature extraction. A vectorizer was utilized to convert textual data into a format that can be understood by a classifier. The study found the Support Vector Machine classifier to be effective since, when compared to other developed machine learning classifiers such as Random Forest, Logistic Regression, Decision Tree, and Linear SVC, it has an F1-Score of 0.87. All these models exhibited success to varying degrees and were tested on a balanced dataset.

**Keywords**— Hate speech detection; NLP; SVM; Sinhala text classification; Telegram

# Forex Market Prediction Through Text Mining of Financial News

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**Abstract**—The forex market is the largest and most liquid financial market in the world. Due to its high volatility, speculators trade with a high potential risk of losing money, and this leads them to seek reliable forex market prediction methods. Most traditional approaches have only relied on historical forex data to predict future movements. Since the forex market is highly sensitive to factors like macroeconomics, capital markets, international trade, political news, and economic statistics, it is not quite effective to predict the market only using historical data. Financial news articles are rich with the above factors, but extracting features is difficult due to the special language used in the financial domain. Therefore, the FinBERT language model, which primarily focuses on the financial domain is used for this project. Experiments are done based on three major categories, which are one-hour input time with 5-minute range prediction delays, one-hour input time with hourly range prediction delays, and one-day input time with daily range prediction delays. Support vector machine, random forest, and multilayer perceptron are used as predictive models to predict forex movements as a binary classification problem (up or down). Based on the results, analysis is done to investigate the contribution of individual features in each category and compare the performance of each model in each category. Results conclude that the financial texts can improve the predictability of forex predictions, and hence the proposed method can be used to support speculators' trading decisions, and the findings can be used to guide other researchers who are working in the same domain.

**Keywords**—Forex market, Financial news, FinBERT, Forex movements



# A personalized learning system for mathematics: Harnessing artificial intelligence and machine learning for ordinary-level students in Sri Lanka

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**Abstract**— In the context of Sri Lanka, the use of technology in education has a radical change in the method of learning and has made it possible for even concepts in mathematics to be taught in a manner that is interesting and easy to understand. Mathematics is one of the main subjects that Sri Lankan ordinary-level (O/L) students find difficult to learn due to traditional teaching methods, limited resources, and language barriers. This study introduces an artificial intelligence (AI) and machine learning (ML)-powered personalized learning system to enhance existing education delivery to the intension level in mathematics for grade 10 and 11 students. Individual learning requirements are met by creating learning paths, implementing a chatbot to teach as the learner interacts with the material, and implementing a feedback mechanism to track progress. The agile methodology was adopted for this study. The MERN-Stack-based system and the integration of a linear regression model for individualized feedback are described. Student data, collected through surveys in both English and Sinhala languages, helped train the chatbot using the RASA framework. The system's effectiveness in enhancing math comprehension has been demonstrated, with a higher rate of students improving mathematical performance. The iterative development approach, guided by Agile methodology, allowed for continuous improvements based on user feedback. Even though the system presents effective results, limitations such as scalability and broader testing are noted, with future efforts focused on refining the AI model and enhancing the feedback system. AI and ML-based personalized learning systems are recommended for schools to improve educational outcomes.

**Keywords**—Artificial Intelligence, Machine Learning, Personalized Learning, Mathematics Learning, Sri Lankan Education

# Deep Ensemble Approach for Classifying Documents Based on Writing Styles

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**Abstract**—As digital content grows exponentially, efficient methods for automatically classifying texts are becoming increasingly important. Since most scholars and professionals use the web to collect some documents, it is most important to identify the document with a suitable writing style such as formal or informal. As a solution, research suggests a deep learning-based method for classifying texts according to linguistic markers. A dataset was collected from multiple web sources, containing both formal documents (news stories, formal documents) and informal documents (personal letters, personal blogs). After pre-processing, to create the feature vector, we took into account 13 linguistic markers like voice, language type, modal verbs, slang, acronyms, pronouns, phrasal verbs, colloquialisms, contractions, abbreviations, initialism and grammar, and vocabulary. These linguistic features are very important to identify the difference between formal and informal styles. Then, Long Short-Term Memory Networks (LSTM), Convolutional Neural Networks (CNN), and Artificial Neural Networks (ANN) were taken into consideration. Also, the ensemble approach by majority prediction is applied combining the above three algorithm results. The 80%, 90%, 70%, and 60% were used to train and evaluate the classification models through a variety of testing splitting methods. Using performance indicators, f1-score, accuracy, precision, and recall, the models' efficacy was assessed. The ensemble approach did better than the other individual algorithms, with a maximum accuracy of 87.2% and resilience in identifying between formal and informal texts. Subsequent investigations will explore larger datasets, more language features, advanced deep learning models, as well as multilingual and real-time classification systems.

**Keywords**—Classification, Formal documents, informal documents, Deep learning, Ensemble

# A Comparative Analysis of Machine Translation Approaches for Low-Resource Languages and Future Enhancements

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**Abstract**—This paper provides a comparative analysis of machine translation and its evolution, with a specific focus on the challenges and advancements in translating three low-resource languages. It begins by exploring the emergence of machine translation and compares it with human translation, highlighting their respective strengths and weaknesses. The paper further discusses the evolution of various machine translation approaches, including rule-based, statistical, neural, and hybrid methods, offering a detailed contrast of these models. A comparative analysis of existing research is conducted, followed by a review of findings and an evaluation of translation quality through quantitative and qualitative metrics. The paper concludes by proposing future directions for machine translation, specifically addressing the translation of low-resource languages. Suggested solutions include the integration of data augmentation techniques, transfer learning, and hybrid approaches to enhance translation quality, mitigate resource limitations, and improve the overall effectiveness of machine translation systems for low-resource language pairs.

**Keywords**—machine translation, low-resource Languages, rule-based translation, statistical machine translation, neural machine translation, hybrid approaches, data augmentation, transfer learning, translation quality evaluation

# Unveiling AI-Enhanced Strategies for Early Detection and Support in Neurodevelopmental Disorders

## Diagnosis: A Systematic Review

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**Abstract**—Neurodevelopmental Disorders (NDDs) pose a significant challenge to the societal and cognitive development of children, toddlers, adolescents, and adults. Common NDDs include Dysarthria, Dyscalculia, Dysgraphia, Dyslexia, Attention Deficit Hyperactivity Disorder, and Autism Spectrum Disorder. Thus, early diagnosis and support on individuals developing NDDs might help them to overcome mental challenges and mitigate the potential development of negative emotions. In this article, a Systematic Literature Review (SLR) of AI-enhanced strategies for Early Detection and Support in Diagnosing NDDs is performed to select and analyze 23 studies published between July 2019 and July 2024, which were critically analyzed to evaluate the performance of AI algorithms, the characteristics of NDD datasets, and trends in global research on NDDs. Additionally, the review highlights the common challenges faced by individuals with NDDs, such as difficulties in reading, writing, speaking, mathematical reasoning, and information processing, which often lead to frustration, low self-esteem, and disengagement from academic and social activities which lead to opening several future research studies. Thus, as future studies can develop deeper into the development of AI-integrated applications for screening and intervention processes for multiple NDDs among multiple age categories in detecting the level of NDDs, application of enhanced feature engineering in identifying and incorporating more informative features in detection of the NDDs along with integrating explainability and interpretability by developing models with enhanced explainable AI techniques. To conclude, this study provides a foundation for advancing AI-driven strategies in the early diagnosis and support of individuals with NDDs, intending to foster better outcomes and improved quality of life.

**Keywords**—Early Detection, Neurodevelopmental Disorders, Machine Learning, Deep Learning, Learning Disabilities

# Interactive Sinhala Alphabet Learning: A Machine Learning-Based Educational Tool for Preschoolers

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**Abstract**—This research presents an innovative digital platform designed to assist preschoolers in learning the Sinhala alphabet through interactive letter recognition and writing. The platform integrates the K-Nearest Neighbors algorithm, a non-parametric and instance-based learning method, to classify handwritten Sinhala characters with high accuracy. By training the model on a dataset of 56,000 images collected from children aged 3 to 7, the platform achieves an 89% accuracy rate in character recognition. The tool's real-time feedback system promotes independent learning. The platform was tested with 30 preschoolers and 10 educators to evaluate its effectiveness. Feedback from both groups emphasized its ease of use and suggested adding more interactive and feedback-oriented features for improvement. This study addresses the complexities of the Sinhala script, providing a practical solution for early childhood education, particularly in areas with limited internet access. Furthermore, the use of image processing techniques enhances recognition accuracy across various handwriting styles, enabling the tool to be reliable in various settings. This research enhances the field of early childhood education and machine learning by providing a robust learning aid that blends traditional education with modern technology. It illustrates the potential of this approach in enhancing literacy education through interactive and adaptive digital tools.

**Keywords**—preschool education, preschoolers, machine learning, handwritten character recognition, image processing

# A Dynamic Framework for Real-Time Student Satisfaction and Teaching Adaptation in Online Education

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**Abstract**—Understanding students' learning styles is widely believed to benefit both students and educators. With the increasing prominence of online education in Sri Lanka, this becomes even more critical. In an online setting, students exhibit various learning styles, while teachers adopt different teaching methods. A student's academic performance is often influenced by the alignment between teaching and learning styles. However, it is not feasible to tailor teaching methods to each student, as students differ in their capacity to grasp information delivered uniformly. This misalignment can lead to decreased academic performance and satisfaction. Despite this challenge, teachers can adjust their teaching styles to better align with students' predominant learning preferences. This study examines the diverse learning styles of students and the teaching styles of lecturers in online education, focusing on data collected from university students, as well as higher national diplomas, national diplomas in technology, and UnivoTech students. Design-based research methodology was employed to improve educational practices. The study aims to identify the most preferred learning styles, introduce suitable teaching methods within a theoretical framework, and analyze student satisfaction with current and modified teaching approaches using the SPSS tool. The effectiveness of this framework is assessed through a web application, which identifies dominant learning styles and suggests appropriate teaching strategies, including teaching aids. The study ultimately seeks to enhance students' academic performance by optimizing teaching aids and adapting them to students' learning styles, thereby improving the overall effectiveness of online education for university students and those in higher education programs across Sri Lanka.

**Keywords**—student satisfaction, web application, learning style, teaching style, online education, design-based research



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# Software systems

# User Experience of One-Stop Administration Services Application Using UEQ and Usability Testing

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**Abstract**—One-stop Administration Services Office is an Indonesian government service for managing motor vehicle documents. In August 2021, this integrated service, involving three institutions in Indonesia—namely the Indonesian National Police, the Regional Revenue Office, and PT Jasa Raharja—enhanced its services by launching the National Digital Samsat Application (SIGNAL) under the Indonesian National Police's program. However, the application has received numerous user complaints, necessitating an analysis of the factors contributing to these issues. This study aims to analyze these factors from the perspectives of user experience and application usability. The analysis was conducted using the User Experience Questionnaire (UEQ) and Usability Testing. The Usability Testing results indicate that the SIGNAL application achieved a success rate of 93% and an error rate of 0.13 in terms of effectiveness. In the efficiency aspect, task completion time was recorded at 0.00006 goals/second, while in satisfaction, a score of 55.8 places the application in the "marginally acceptable" category for users. The UEQ evaluation demonstrates a positive user experience with average scores exceeding 0.8. The SIGNAL application received a "Good" rating on the Stimulation scale and an "Above Average" rating on the Attractiveness, Perspicuity, Efficiency, Dependability, and Novelty scales. Overall, the evaluation indicates that the usability of the SIGNAL application is reasonably good and provides a positive user experience, although improvements are still needed in certain aspects.

**Keywords**—user experience, usability, SIGNAL application, UEQ, usability testing



# An Evaluation of AR-Based Smart Try-On Technology in Online Fashion Retail: A Comprehensive Review

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**Abstract**— The fast growth of e-commerce in various aspects such as customer services, logistics, and small-scale businesses has directly affected the developments in retail. However online fashion shopping has proven to face many challenges, especially due to the customers' need to try on clothes before purchasing. This leads to uncertainty among customers about fitness and appearance, which in turn affects high return rates, customer dissatisfaction, and increasing costs for retailers therefore making integrating e-commerce a challenge for fashion and clothing industries. Though static images and descriptions have been providing a considerable medium for promotion, it does not fully solve the problem of the need for fitting on. Augmented Reality (AR) can be seen as a solution to this problem by allowing virtual try-ons, and by helping customers see how clothes would look on them in real time.

AR can improve customer engagement, and satisfaction, and reduce returns, while also boosting sales by offering a more accurate representation of clothing. This study evaluates the feasibility of an AR-based smart try-on app, focusing on its impact on customer satisfaction, engagement, purchase behavior, and sales. It provides insights for retailers on how AR can enhance the online shopping experience and help grow their market. AR technology can solve key issues in online fashion shopping, improving customer experience and helping retailers increase sales and market reach.

**Keywords**— Augmented Reality, Customer engagement, E-commerce, Online shopping, Virtual try-ons

# Vehicle Identification and Specification Checking Web Application for Japanese-used Vehicles

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**Abstract**— The Vehicle Identification and Specification Checking Application is a web-based system that provides accurate vehicle identification and verification of specifications which are valuable for several parties like vehicle owners, buyers, sellers etc. The application uses modern technologies to provide precise details on vehicles, ensuring reliability and safety. Users can search for used vehicles from Japan and examine their characteristics by entering their registration numbers or uploading their registration certificates. The system uses databases from DMT Sri Lanka and a Japanese vehicle specification directory called "Epc-data" to provide comprehensive information. The application plays a crucial role in identifying legitimate and illegitimate vehicle changes, thereby enhancing the security for insurance companies, dealers, and buyers. The application uses OCR technology (Image Processing technology) to identify vehicle registration numbers from registration certificates, allowing users to cross-reference information with local registration details and manufacturers' specifications. This app enhances user experience through better clarity, protection, and relief as it delivers accurate and authentic information about Japanese-used vehicles.

**Keywords**—OCR Technology, Image Processing

# FireWatch:LoRa based Wildfire Detection and Alert System

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**Abstract**—Wildfires in Sri Lanka pose a significant threat to the country's ecosystems, economy and the communities. To tackle the challenges associated with wildfires and work towards mitigating their impact on the environment, wildlife, and human populations, this research proposes a multidisciplinary approach that leverages technological advancements. However, the lack of an effective wildfire behavior prediction system, limited access to reliable weather data, and communication gaps among firefighting teams impede seamless collaboration, information dissemination, and emergency response efforts. In this regard, this project proposes a novel LoRa-based ad hoc network integrated with blockchain technology to improve communication efficiency, safety, and detection and prediction of scope and direction of wildfires in Sri Lanka's forests. The system facilitates real-time data communication between emergency teams inside the forest and main stations, enabling features like emergency alerts, weather updates, detecting direction and scope of the fire, and object detection. The research aims to develop and implement a system to enhance communication efficiency, improve firefighter's safety through early warning systems, and mitigate harm from wildfires.

**Keywords**—Ad-hoc Network, Blockchain Technology, LoRa, Communication inside the forest, Prediction and Detection of wildfires, Weather



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# Robotics, Control Systems and IoT

## SMART STUDENT RECORD BOOK FOR UNIVERSITY EDUCATION ON THE SRI LANKA EDUCATION SYSTEM

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**Abstract**—The Smart Student Record Book aims to revolutionise student record oversight in Sri Lankan universities with the incorporation of RFID technology, biometric sensors, an ESP32 microcontroller, Flutter for mobile application development, and Firebase for real-time data processing. This technology rectifies the inefficiencies of conventional paper-based approaches, guaranteeing enhanced efficiency, precision, and reliability in the management of student data. The proposed system optimises multiple administrative operations, such as attendance monitoring, library access, and dorm registration, consequently augmenting the entire educational experience. Employing the proposed technology and implemented prototype for the Sri Lankan university system will undoubtedly deliver advanced and high-quality services expeditiously and without suspect.

**Keywords**— Smart Record book, IoT, Mobile App, University System

# Integrated Mobile and IoT Platform for AI-Driven Flower Disease Diagnosis and Care

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**Abstract**—The flower cultivation industry faces critical challenges, such as accurate disease diagnosis, bud counting, and freshness evaluation, all of which affect productivity and quality. This research presents an AI-driven mobile application that integrates machine learning, image processing, and IoT technologies to address these issues. The system achieves a 95% accuracy in disease diagnosis using a convolutional neural network, a correlation coefficient of 0.92 in bud counting via a convolutional neural network regression model, and a 93% accuracy in evaluating flower freshness with the InceptionResnetV2 model. The IoT component ensures real-time environmental monitoring, optimizing growing conditions and improving flower yield. This hybrid AI-IoT framework contributes to the body of knowledge by setting a new standard for precision agriculture, demonstrating technical soundness, and providing practical applications tailored to the flower industry. The significance of this study lies in its ability to integrate AI for real-time decision-making, with broader applications for high-value crops. The framework's potential impact extends beyond immediate agricultural benefits, enabling more sustainable farming practices, reducing waste, and enhancing profitability through innovative smart farming solutions.

**Keywords**—artificial intelligence, machine learning, image processing, Internet of Things, mobile application, flower disease, real-time insights

# Spider Inspired Hexapod Mobile Robot With Ultrasonic SLAM Exploration In Hazards Environment

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**Abstract**— This research starts with issues of human operations in hazardous environments and the need for robots capable of handling such issues, then introduces the main concept: a six-legged robot, inspired by the biological structure and movement of spiders, designed and fabricated using 3D printing technology. This research is focused on the development and evaluation of a bio-inspired hexapod mobile robot for mapping and exploration in hazardous environments. It incorporates SLAM technology, with a view to creating an accurate map in complex and hazardous terrains using the Hector SLAM mapping tool. The results obtained show that the walking speed of the robot on flat surfaces is 4.8 cm/s and on uneven terrains, it walks at a speed of 4.2 cm/s with mapping accuracy of about 83%. Additionally, the robot's stability was confirmed through torque tests, showing that the motors could handle the required load, maintaining balance even under additional weight. This study concludes that the spider-inspired hexapod robot is a viable solution for autonomous exploration in hazardous environments, offering significant potential for applications in search and rescue operations, disaster recovery, and inspection of dangerous sites. The study concludes that the spider-inspired robot is a promising solution for navigating and mapping hazardous environments, with potential applications in disaster management and exploration.

**Keywords**—SLAM, Spider-inspired, Hazards, Ultrasonic

# Design and Analysis of Digital Control System Model For Aerodynamic Ball Levitation System

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**Abstract-** The design and development of an Aerodynamic Ball Levitation Laboratory Plant, offering an engaging platform for studying control systems and real-time system identification. The system employs airflow to suspend a ping-pong ball within a vertical tube, counteracting gravitational forces to maintain the ball at a desired height. This dynamic setup presents a nonlinear, multi-variable control challenge, making it ideal for exploring control theory, system modeling, and stability analysis. A physical model of the Aerodynamic Ball Levitation system was developed alongside a mathematical model, and a classical PID controller was implemented to regulate the ball's position. PID parameters were systematically tuned through theoretical analysis and practical experimentation to achieve optimal control performance. MATLAB system identification tool was employed to model the system's dynamics accurately. The novelty of this work lies in its systematic and quantitative comparison of theoretical and real-time PID controller performance. Discrepancies in transient response metrics such as rise time, settling time, and overshoot were evaluated, identifying the impact of environmental disturbances and hardware limitations. The findings not only bridge the gap between theoretical design and practical application but also provide actionable insights into tuning strategies for real-time systems. These contributions advance the understanding of digital control systems in nonlinear applications and pave the way for further enhancements through adaptive control methods.

**Keywords**—Digital Control Systems, Aerodynamic levitation, Digital PID controller, Ball levitation system, System Identification, Digital system modeling, non-linear systems.



# Development of a User-centred, Smart Phone based, Indoor Route Planning Application for Visually Impaired

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**Abstract**—This study presents the development of a smartphone-based indoor navigation application aimed at enhancing route planning aspect for individuals with visual impairments. The application allows users to find indoor paths based on multiple criteria as per their preference and provides customized navigation experiences. The project utilizes Flutter for mobile app development, Django for the back-end API, PostgreSQL with PostGIS for spatial data management, and OpenStreetMap(OSM) for mapping. The A\* algorithm is employed for optimal route calculation. The design is tested with three criteria distance, light levels and wall presence, using an indoor route data set of a single building. The application's potential impact on improving accessibility for visually impaired individuals is on its affordability, user-centered design and use of standard open-data sources such as OSM. The modular design ensures scalability and extensibility, providing a strong foundation for future enhancements.

**Keywords**—Indoor Navigation, Visual Impairment, Route Planning, Open data, Smartphone



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# Materials and Manufacturing

# Development of an adsorbent filter media using reduced graphene oxide functionalized waste cotton for heavy metal and bacterial removal

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**Abstract** - This research focused on developing an adsorbent filter media using waste cotton treated with reduced graphene oxide (rGO) for heavy metal removal and antibacterial properties. The waste cotton was defibrillate to obtain fibers with an average fiber size of 13.13  $\mu\text{m}$ , as confirmed by Scanning Electron Microscopy (SEM). Next, reduced graphene oxide (rGO) was grafted on these fibers using a wet agitation method to make a rGO-cotton composite. Fourier Transform Infrared (FTIR) spectroscopy confirmed the preservation of the membrane's hydrophilic properties. The Pb (II) ion removal was performed in batch studies using 100 ppm of Pb (II) solutions as inlet. The ion removal was quantified using Atomic Absorption Spectroscopy (AAS) and it showed that the filter media achieved up to 98% lead removal. Further, composite fiber material demonstrated significant antibacterial activity against *Staphylococcus aureus*, with an 18.5 mm inhibition zone. This study provides a novel approach of utilizing hydrophobic rGO, with excellent surface functionalities and antimicrobial properties, in water purification applications, particularly in heavy metal and bacteria removal. Further, this offers using cotton waste to produce biodegradable filter media by surface functionalization. The rGO-cotton composite presents strong potential for water purification, offering an environmentally friendly alternative to non-biodegradable membranes. The future research should focus on improving rGO distribution and long-term performance through durability studies.

**Keywords**- Reduced graphene oxide, Cotton waste, Antibacterial activity, Lead, Cotton fabric, Hydrophobic, Hydrophilic, biodegradable membrane, water purification

# A comprehensive analysis of the effects of abiotic stresses on the phytochemical compositions, antioxidant capacity and investigating the antimicrobial activity of *Coriandrum sativum* L. in Sri Lanka

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**Abstract**— *Coriandrum sativum* L. (coriander) is an annual herb valued for its nutritional and herbal properties. However, abiotic stresses significantly affect its development and productivity. This study examines how drought, salinity, heavy metal, nutrient deficiency and waterlogging stresses affect coriander's phytochemical composition and antioxidant capacity, alongside a healthy control group. This study focused on filling research gaps, particularly in Sri Lanka, and the findings aim to enhance coriander cultivation practices and their nutritional and medicinal properties. Drought stress was induced by using polyethylene glycol (PEG)-6000 weekly and withholding water, salinity stress by adding 150 mM sodium chloride twice daily, heavy metal toxicity by applying 25 mM lead nitrate twice daily, nutrient deficiency by planting in sand and waterlogging by flooding the soil to 2 cm depth. Waterlogged plants exhibited signs of dying earlier within six days, salinity for nine days and nutrient deficiency for twelve days with moderate stress tolerance, while those under heavy metal and drought stress survived up to fourteen days and showed high tolerance. Total moisture content was reduced significantly under drought, salinity and nutrient deficiency conditions. Qualitative tests for alkaloids, tannins, saponins, flavonoids, terpenoids, and coumarins confirmed their presence in healthy and stress-induced plants. Alkaloids and saponins showed elevation under stress conditions compared to healthy coriander plants, particularly under drought. Additionally, quantitative analysis of phytochemical parameters spectrophotometrically indicated significant reductions in total phenolic, flavonoid, and protein contents under heavy metal and waterlogging conditions. However, other stresses did not significantly affect these parameters. All stress-induced plants resulted in a notable elevation in total antioxidant capacity except heavy metals.

**Keywords**— *Coriandrum sativum* L., abiotic stresses, phytochemical composition, total moisture content, total antioxidant capacity

# Microbial Degradation of Anthracene and Pyrene in Urban Roadside Soils for a Sustainable Environment: An Evaluation of Bioremediation Potential

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**Abstract** - Extreme growth in industrialization and urbanization have led to a rise in environmental contamination. While United States Environmental Protection Agency (US EPA) declares that soil is a significant source of contamination. Also, according to previous studies Polycyclic Aromatic Hydrocarbons (PAHs) are considered as one of the common soil contaminants, these toxic organic compounds can lead to serious health issues like cancer and mutagenicity. Both light PAH Anthracene with a molecular weight of 178.22 g/mol and heavy PAH Pyrene with a molecular weight of 202.24 g/mol were considered for this study. Here, these dangerous PAHs were eliminated following microbial bioremediation process resulting in nontoxic benign byproducts. Accordingly, High-performance liquid chromatography (HPLC) was used to analyze PAHs in soil samples taken from urban roadsides. The results reveal that all the samples were contaminated with Anthracene and Pyrene based on their retention time. Ultimately, microbiological methods were used to separate bacterial colonies from the soil samples and three best Anthracene and Pyrene degrading bacteria were identified based on its primary and secondary screening: *Priestia megaterium* SA5 degraded 76.32% Anthracene and 51.67% Pyrene, *Micrococcus luteus* SA7 degraded 57.39% Anthracene and 42.00% Pyrene and *Brevundimonas vancouverensis* SA4 degraded 54.65% Anthracene and 44.42% Pyrene. Molecular methods were subsequently used to identify these bacterial strains. Furthermore, the successful toxicity assays (zoo toxicity and Phytotoxicity) proved that microbial bioremediation can successfully eliminate harmful PAHs (like Anthracene and Pyrene) in highly urbanized areas with PAH contaminations.

**Keywords**- Polycyclic Aromatic Hydrocarbons (PAHs), Anthracene, Pyrene, High pressure liquid chromatography (HPLC), Bioremediation, Toxicity assays.

## Denoising IMU Data Using EKF and UKF for Improved Joint Angle Estimation

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**Abstract**—Gait and posture analysis has become famous among researchers because it is useful in many areas such as health-care, sports, and manufacturing industries. One of the primary methods for analyzing gait and posture involves using Inertial Measurement Units (IMU) sensors, and enhancing the accuracy of this technique is a highly relevant area of research. This work focuses on joint angle estimation incorporating the Extended Kalman Filter (EKF) and Unscented Kalman Filter (UKF) because human motions are highly nonlinear and have rapid changes. Then it compares both approaches with a ground truth to evaluate which one is the best denoising technique for the joint angle estimation.

**Keywords**—Gait and Posture, Joint Angles, Extended Kalman Filter, Unscented Kalman Filter

# Improve the fit precision of stretch knit garments: Developing a novel Pattern Grading Method using Digital fit experiments

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**Abstract**— Inaccurately fitted garments lead to numerous problems within the apparel industry. The apparel industry is one of the most environmentally polluting industries in the world. Most garments are ill-fitted due to incorrect pattern construction and grading methods. Therefore, this research aimed to introduce new pattern grading methods to significantly reduce unnecessary textile waste and facilitate the adoption of circular garment manufacturing. The proposed pattern grading guide can be used to develop automated pattern development tools using computational methods in mass manufacturing or mass customization business. More precisely, this novel pattern grading method was developed for women's upper body contour garments using stretch knit fabrics, addressing the most complex scenario in pattern making and grading. Specifically, this study presents how to derive relevant grading values for different fabric stretch scenarios. Finally, the proposed system was validated by creating graded garments both digitally and physically using ASTM D5585-21 standard dress forms. The findings of the study present a novel grading method that establishes a relationship between fabric stretch and grading values. This proposal data-driven grading methods can apply in developing computational methods in automating the pattern grading process. It is contended that applying digital tools into apparel mass production will help establish a sustainable apparel business.

**Keywords**— Stretch knit fabrics, Pattern grading, Sustainable Apparel Production, Digital prototyping, Multivariate Regression



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# Management of Technology



# The Role of Logistics in Perishable Food Waste Reduction of Small and Medium-Sized Enterprises: A Systematic Review

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**Abstract**— Perishable food waste presents a critical challenge globally; especially as small and medium-sized enterprises (SMEs) play a key role in reducing waste throughout food supply chains. This systematic review examines the role of logistics in reducing perishable food waste in small and medium-sized enterprises, with a particular focus on the highly perishable categories of fish and dairy products. The review identifies significant gaps in existing supply chain frameworks suitable for SMEs, particularly in the context of developing regions. By synthesizing current literature, this study evaluates logistics-related factors and operational practices that contribute to waste reduction. Key findings show that optimizing supply chain areas such as transportation, storage, handling, packaging, and distribution can significantly reduce waste in fish and dairy supply chains. These improvements not only improve the sustainability of supply chains but also enhance food security and economic stability for SMEs. The review concludes by presenting an analysis that integrates these best practices and factors, providing actionable insights for stakeholders aiming to reduce perishable food waste in SMEs.

**Keywords**—Dairy, Fish, Logistics, Perishable food, Small and Medium Sized Enterprises, Wastage

# Risk Assessment of Sustainable Supplier Selection: Systematic Review

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**Abstract**—This systematic literature review focuses on the risk assessment aspect of sustainable supplier selection within supply chains. Spanning peer-reviewed journal articles published between 2008 and 2024, a total of 42 papers were meticulously selected and analyzed in line with PRISMA guidelines. As businesses increasingly prioritize sustainability, the integration of environmental, social, and economic dimensions—commonly referred to as the Triple Bottom Line (TBL)—into supplier selection processes has become imperative. This review examines the evolution of decision-making techniques, highlighting the transition from traditional supplier selection methods to more comprehensive, sustainability-oriented approaches. Multi-Criteria Decision-Making (MCDM) methods, particularly those incorporating fuzzy-based approaches, are identified as essential tools in conducting thorough assessments. The paper also discusses the challenges associated with risk assessment in supply chains, emphasizing the need to address both visible and hidden risks. The findings underscore the importance of adopting advanced decision-making frameworks that integrate sustainability with risk assessment, thereby enhancing supply chain resilience and ensuring long-term corporate competitiveness.

**Keywords**—Sustainable Supplier Selection, Risk Assessment, supply chain management, Triple Bottom Line (TBL), Multi-Criteria Decision-Making (MCDM)

# Moderating effect of Business Ecosystem Volatility between Dynamic Capabilities and Company Performance in Sri Lankan Multinational corporations.

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**Abstract** - The evolution of the theories of Dynamic Capabilities and their importance in paving the path of success for organizations has been studied and researched for decades. Evolving from the resource-based view, theories of Dynamic Capabilities state that organizations should have the ability to adapt to changing environments by integrating, building, and reconfiguring internal and external resources. This study focuses on the above-mentioned external environmental conditions and their effect on the Dynamic Capabilities and their relationship to firm performance within the premise of Sri Lankan Multinational Corporations. The dynamic capabilities a company possesses have paramount importance in sustaining competitiveness. Nonetheless, there are other influential factors in the external environment that dictate the effectiveness of these dynamic capabilities. For instance, the Business Ecosystem Volatility surrounding Organizations can influence the extent to which these dynamic capabilities affect firm performances. Sri Lanka is a unique environment to study this phenomenon due to the emerging market dynamics and multinational activities.

This research employs a quantitative approach using surveys sent to Sri Lankan Multinational corporations to collect data. It also contributes to the existing literature in hopes that it will fill certain research gaps prevalent in this particular area of study. The findings will benefit the management of the Sri Lankan MNCs by providing guidance on how to maneuver Dynamic Capabilities under changing environmental conditions and how they can capitalize on their dynamic capabilities properly.

**Keywords**— Business Ecosystem Volatility, Dynamic Capabilities, Integration, Multinational Corporations, Processes.

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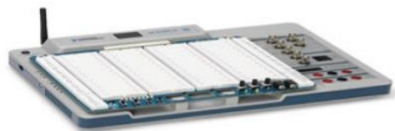


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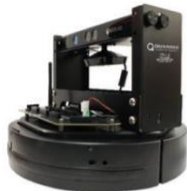
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