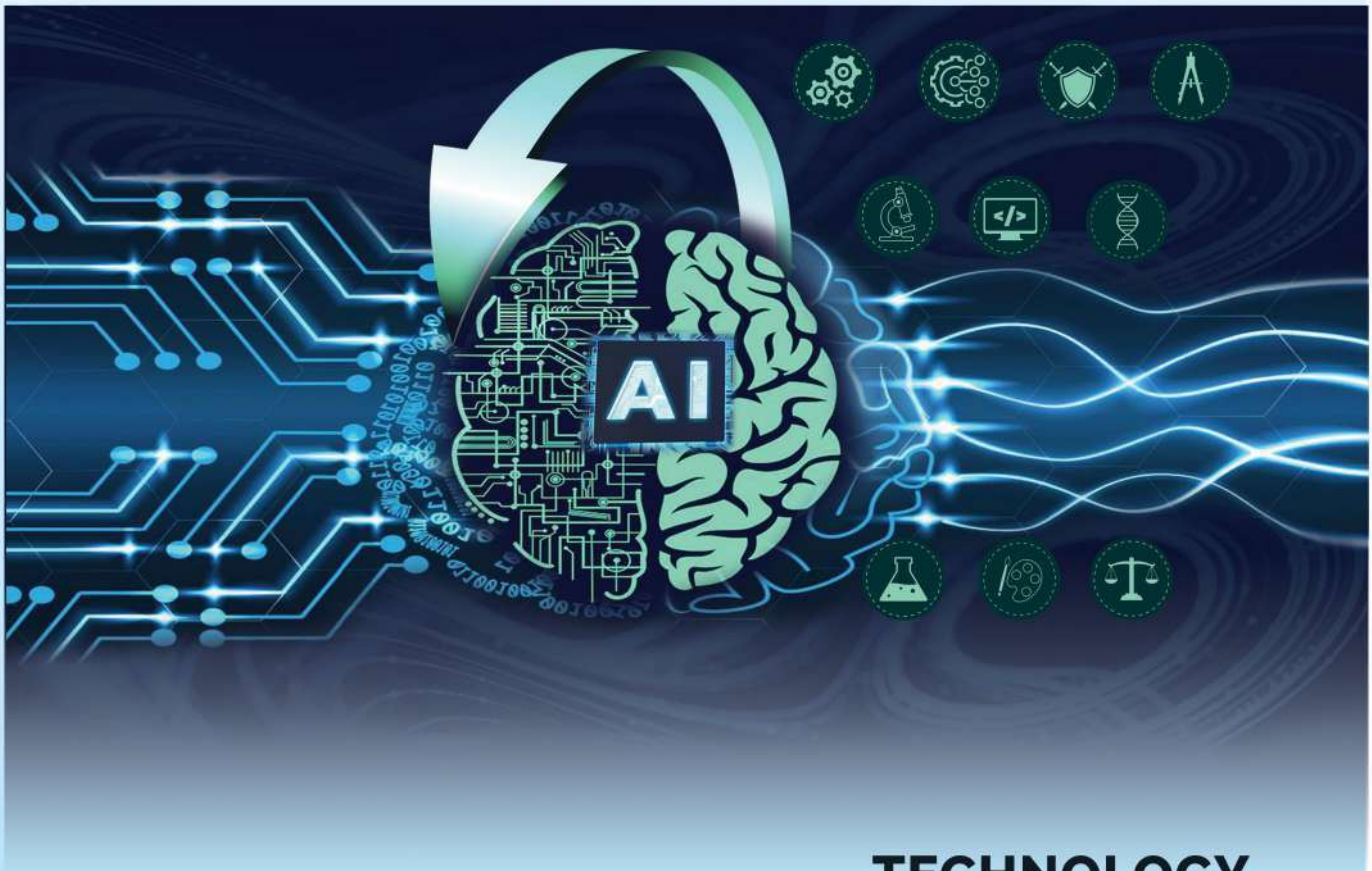**KDUiRC**
INTERNATIONAL RESEARCH CONFERENCE

17th INTERNATIONAL RESEARCH CONFERENCE

Unravelling the Paradigm Shift:
Revolutions in the Era of AI

26TH - 27TH SEPTEMBER 2024

TECHNOLOGY

ABSTRACTS

General Sir John Kotelawala Defence University

17th INTERNATIONAL RESEARCH CONFERENCE

UNRAVELLING THE PARADIGM SHIFT: REVOLUTIONS IN THE ERA OF AI

TECHNOLOGY

ABSTRACTS

General Sir John Kotelawala Defence University
Ratmalana, Sri Lanka.

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Message from the Chief Guest

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

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

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

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

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

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

Message from the Keynote Speaker

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

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

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

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

Message from the Vice-Chancellor

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

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

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

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

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

Message from the Chairperson

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

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

Message from the Secretary

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

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

Message from the Dean

It is with great pride and enthusiasm that I welcome you to the Technology Research Session of the 17th Annual International Research Conference (IRC) of General Sir John Kotelawala Defence University. As the founding dean of the Faculty of Technology, it is a privilege to lead my team in this endeavour for the third consecutive year. Despite the relatively young age, the Faculty of Technology has consistently delivered successful research sessions at the IRC. This platform serves as a valuable avenue for researchers worldwide to share their novel findings and fosters a vibrant research culture in the faculty. I am confident that this year's session will be even more impactful, as we continue to build upon the successes of the past. We have reviewed diverse manuscripts featuring a wide range of topics, from cutting-edge technologies to emerging trends in the field. Esteemed speakers and, renowned experts in their respective domains, will offer invaluable insights and perspectives. I extend my sincere gratitude to all participants, presenters, and attendees for their contributions to this enriching academic event. Your involvement is crucial in making this event a success. Let us embark on this intellectual journey together, exploring the frontiers of technology and innovation. I am confident that this conference will inspire new ideas, foster collaboration, and contribute to the advancement of knowledge.

Prof Prasanna Premadasa
Dean, Faulty of Technology, General Sir John Kotelawala Defence University

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ORAL PRESENTATIONS

Eco-Friendly Innovation: Photocatalytic Degradation of IC-50 Orange Dye with Banana Flower ZnO Nano Particles

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Integrating green nanotechnology contributes to a circular economy by converting waste into functional materials, thereby reducing pollution and promoting the sustainable use of resources. This study focused on synthesising zinc oxide nanoparticles (ZnO NPs) derived from Banana Flower (*Musa acuminate*) (BF), emphasizing their photocatalytic efficiency against IC 50 orange pigment dye (PD), a widely used industrial dye. The optimal conditions for synthesizing ZnO NPs with improved yields were determined by varying parameters such as pH, ion precursor concentration, plant extract-to-ion solution ratio, irradiation methods, and incubation time. The NPs were characterized using UV-Vis spectroscopy, FTIR, SEM, TEM, EDS, and XRD analysis. Surface plasmon resonance peaks between 350 and 370 nm preliminarily confirmed the formation of ZnO NPs. FTIR analysis indicated the stretching mode of the Zn-O bond around 625 cm-1. SEM analysis revealed the spherical morphology of the NPs, while TEM analysis showed an average particle size of 84.3 nm. XRD analysis confirmed the presence of the hexagonal crystalline structure typical of ZnO NPs, and EDS analysis validated the elemental composition, with Zn and O being the predominant constituents. Under optimized conditions, including catalytic load, pH, and dye concentration, the ZnO NPs synthesized from BF demonstrated exceptional photodegradation efficiency, achieving a 93.80% dye degradation within 7 hours. These findings highlight the potential of ZnO NPs synthesized with BF as a sustainable solution for textile and wastewater treatment applications due to their high photodegradation efficiency, environmentally friendly synthesis process, and effective removal of industrial dyes.

Keywords: *banana flower, photocatalytic activity, photodegradation, Pigment dye, ZnO NPs*

Development of a Machine Learning-Based Methodology for Accurate Staging of Lumbar Intervertebral Disc Degeneration using T2-Weighted Magnetic Resonance Imaging (MRI) and Radiomics Features

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Determining the stages of Lumbar Inter-vertebral Disc Degeneration (LIVDD) correctly is important for accurate diagnosis. This study sought to develop a robust methodology combining advanced image analysis techniques and machine learning to assess disc degeneration stages using T2-weighted Magnetic Resonance Imaging (MRI) data. A fine-tuned dataset of 100 Digital Imaging and Communications in Medicine (DICOM) images representing different stages of degeneration was subjected to radiomics feature extraction by 500 regions of interest (ROIs) using manual segmentation. Stage evaluations were obtained for each ROI by a radiologist. Machine learning models (Support Vector Machine (SVM), Decision Tree, Random Forest) were trained on the training set (80% for training and 20% for testing from the raw data). A comparative analysis of the model predictions and expert judgments were performed for performance evaluation, by the accuracy of the test set. The models were repeatedly trained by selecting the features that give the highest accuracy through several different feature selection methods (Odds ratio and PCA). Principal Component Analysis (PCA) showed that feature selection method was more accurate . It was able to achieve 63% accuracy for SVM model, 57% accuracy for Decision tree model and 67% accuracy for Random Forest model. Findings underscore the potential of machine learning in accurate and efficient staging. Strengths and limitations of the methodology provides a basis for future refinement. This study marks an important step towards the integration of innovative techniques in spine health assessment, towards precise and personalized patient care.

Keywords: *Lumbar Inter-Vertebral Disc Degeneration (LIVDD), T2-Weighted MRI, radiomics, machine learning, feature selection, diagnostic accuracy*

Development and Characterization of a Cinnamon-based Cereal Using Low-Pressure Cold Extrusion for Hyperglycemia Management

PGU Chathuranga[1], PHUW De Silva[1], and BM Jayawardena[1#]

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Diabetes mellitus is a chronic disorder with increasing prevalence worldwide. The use of bioactive compounds from medicinal plants with antidiabetic activity is becoming more popular because of the adverse effects of synthetic medications for diabetes. Therefore, dietary supplements containing biologically active ingredients are being explored for their potential to control hyperglycemia in diabetic patients. Sri Wijaya accession of *Cinnamomum zeylanicum* has demonstrated significant anti-diabetic effects. Previous studies have shown that pressurized water extraction of cinnamon quills yields a higher concentration of bioactive compounds. This study aimed to develop and characterize a cinnamon-based cereal using cold extrusion, incorporating medium pressurized water extract of cinnamon (0.103 MPa, 121°C, 100 mL for 20 minutes), finger millet powder and coconut flour, to manage hyperglycemia. The cereal was prepared using a ratio of 9:5:1 (finger millet powder: cinnamon extract: coconut flour) determined through a trial-and-error method. Proximate chemical analysis was performed on raw materials to assess their nutritional composition. The anti-diabetic properties of the cereal product were evaluated through *in-vitro* alpha-amylase and alpha-glucosidase inhibition assays. The IC_{50} value of the cereal product for the alpha-amylase inhibition assay was 128.70 ± 0.46 µg/mL and the positive control, Acarbose gave an IC_{50} of 44.58 ± 0.01 µg/mL. In the alpha-glucosidase inhibition assay, the IC_{50} value of the cereal product was 118.0 ± 0.06 µg/mL, while Acarbose exhibited an IC_{50} of 87.06 ± 0.01 µg/mL. The results suggest that the developed finger millet-based cereal has potential as a dietary supplement for managing hyperglycemia, leveraging the antidiabetic properties of cinnamon extract.

Keywords: *cereal, cinnamon, coconut flour, cold extrusion, finger millet, hyperglycemia*

Development of Low-Pressure Extraction Technique to Extract Plant Secondary Metabolites

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A variety of extraction methods ranging from conventional methods to modern techniques have been used to improve the yield of cinnamon extract of "Sri Wijaya" (SW) accession in terms of quality and quantity since it has proven to exhibit antioxidant and anti-hypoglycemic properties. However, those extraction methods which provide higher yield are not considerably cost effective. Therefore, the objectives of this study were to develop an extraction technique to extract plant metabolites under low pressure and determine its efficiency by comparing it with other extraction methods. For that the conventional Soxhlet apparatus was modified into a technique that can be used to extract plant metabolites of *Cinnamon zeylanicum* under reduced pressure. Alpha amylase inhibitory activity of the Cinnamon extract obtained under low pressure was determined by using alpha-amylase inhibitory assay. It obtained an IC_{50} value of 155.2 (± 9.38) µg/mL. The antioxidant activity of the low pressurized cinnamon extract was determined by using DPPH radical scavenging assay and the IC_{50} value obtained was 138.7 (± 5.81) µg/mL. Total Phenolic Content (TPC) and Proanthocyanidin Content (PC) of low pressurized Cinnamon extract were evaluated by using Folin-Ciocalteu method and Vanillin assay respectively. The TPC and PC values obtained were 21.2 (± 0.173) mg GAE/g and 38.2 (± 0.603) mg of catechin equivalent/g accordingly. This is the first study to investigate the extraction of anti-diabetic and antioxidant phytochemicals from cinnamon (SW accession) using low pressure extraction technique and it has proven to exhibit considerably high anti-diabetic activity and strong antioxidant activity altogether.

Keywords: *low pressure, Soxhlet, cinnamon, alpha-amylase, antioxidant*

Integrating Sentiment Analysis and Predictive Modelling for Stock Forecasting: A Case Study on Sentiment-Sensitive Industries in the Colombo Stock Exchange

MASH Perera[1#], GWGIU Munirathna [1], WUD Perera[1], MT Dewmika[1], HWRS De Silva[1], and DU Vidanagama[1]

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Stock price forecasting is challenging as factors like economic shifts, political changes, and investor behavior influence it. Although numerous studies have explored sentiment analysis and predictive modelling, a critical gap remains in understanding how different sectors react uniquely to financial news. This study takes an innovative approach by focusing on the Colombo Stock Exchange (CSE), characterized by unpredictable market movements. We intend to identify the five most sentiment-sensitive industries within the CSE from a broader set of 20 sectors. We will use this knowledge to develop a forecasting model that captures industry-specific responses to sentiment by analyzing daily stock prices alongside sentiment data extracted from approximately 100,000 financial news articles from 2016 to 2023. We aim to develop an adaptable forecasting model that enhances prediction accuracy, offering actionable insights for investors, particularly in the volatile CSE market. Our approach addresses industries' unique sensitivity to sentiment and provides a more nuanced understanding of market dynamics. The result will be a robust, industry-focused forecasting tool that better equips investors to navigate the complexities of the CSE, ultimately leading to more informed decision-making in volatile market conditions.

Keywords: *stock market forecasting, sentiment analysis, predictive modelling, colombo stock exchange, industry sensitivity, financial news.*

ID 559

Improving Cyber Security Education through Gamification in Sri Lanka

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Many existing cyber security education platforms are focused on providing a comprehensive set of training materials, but they often lack the engagement and motivation needed to effectively learn. The major issue is the lack of engagement and motivation in traditional cyber security education and available platforms lack interactive and immersive learning experiences and they fail to build the necessary mindset and skills for the industry. The design-based research approach involved a literature review, followed by prototyping, usability testing and refinement of the application. The application was designed to be engaging and effective, using gamified elements and methods, such as capture-the-flag (CTF) competitions. This used HTML, CSS, Javascript and REACT.Js framework with Firebase for the application development and the web application is designed to grant entry only to registered users and contains tasks related to four different topics on web security: Cross Site Scripting, Cryptography, Open-Source Intelligence, and SQL injection. Further, this application includes three sub-sections: learning resources, guidelines, and leaderboard. The REACT.Js component makes an API call to the Firestore database to retrieve the scores and time taken to solve the tasks by each player. Further, in the usability testing phase, the enthusiastic behaviour of participants/players was evaluated under four independent variables with 97 in the sample. The application uses gamification to make cybersecurity training engaging, interactive and effective. It demonstrates the importance of building a strong cybersecurity mindset alongside technical knowledge, improving user retention and understanding. By offering a comprehensive and enjoyable learning experience, the application aims to raise awareness and encourage active participation in the field of cyber security.

Keywords: *cyber security, capture the flag, self-training, education*

Innovating Sri Lankan School Management: A Design Science Research Approach to Developing an Automated Web-Based School Management System

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Education is the cornerstone of societal development, fostering open-minded and innovative generations. Despite its significance, the majority of Sri Lankan schools still rely on outdated, paper-based management systems, with only a few integrating automated solutions that often have functional issues. This study addressed the limitations of these systems by developing an advanced web-based school management system specifically tailored for Sri Lankan schools, using the Design Science Research (DSR) methodology. The study began with a thorough analysis of existing systems, identifying critical issues and gaps. Objectives were set following an extensive literature review, which informed the design and development of the new system. The system's performance was evaluated using the ISO 25010 quality model, with a focus on functionality, usability, and reliability. The results indicate a high performance level, with an average score of 4.04 across the evaluated categories. The Agile Web Engineering (AWE) model guided the development process, ensuring flexibility and responsiveness to user needs. Key features of the system include automated attendance tracking using barcode readers, streamlined report card generation, and efficient character certificate issuance. These features significantly reduce manual workloads and error rates. The system was successfully implemented in a school transitioning from manual processes. This has the potentials to contribute to inclusive and equitable quality education aligning with the UN Sustainable Development Goal 4. Feedback from end-users—teachers, students, and parents—played a crucial role in refining the system, leading to marked improvements in school administration efficiency.

Keywords: *automated school management system, Design Science Research (DSR), Sri Lankan education, Agile Web Engineering (AWE), ISO 25010 quality model, UN Sustainable Development Goal 4*

Revolutionizing Mobility: Exploring the Integration of Ridesharing and Parcel Delivery Applications

BKT Pabasara[1#], MAST Goonathilake[1], and N Wedasighe[1]

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This study explored the use of mobile applications to address traffic congestion and environmental degradation caused by the increasing number of vehicles. The study focuses on ridesharing and parcel delivery services as potential solutions. By optimizing seat occupancy in private vehicles through ridesharing apps, the number of vehicles on the road can be reduced. These applications connect drivers and riders with similar routes, enabling shared rides and more efficient use of available space. Additionally, integrating parcel delivery services into these applications can further decrease vehicle usage and reduce delivery times. This study evaluated the critical factors for the success of such applications, including the number of seats utilized and key features that benefit both drivers and passengers. The goal was to provide insights into how mobile apps can contribute to a more sustainable and efficient transportation system.

Keywords: *mobile application, ridesharing, parcel delivery*

Differences in Learning Environment: The Effectiveness of Online Learning platforms in Higher Education

DN Gamanayake[1#] and R Laveena[1]

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The aim of this study was to assess the efficiency of online education platforms for learning in higher learning institutions through a systematic quantitative analysis. It analysed various areas such as student interaction, involvement, performance, access, and technological barriers and opportunities within online learning environments. For the purpose of including participants from various fields and to achieve diversity of population, the study used a stratified random sampling technique utilizing online structured questionnaires. It also reviewed records of institutional data, and conducted interviews. In order to attend to accessibility and inclusiveness concerns, particular attention was paid to the students with learning disabilities. The participative investigation involved a case- based application of the proposed instrument to measure the usability and accessibility of Learning Management Systems (LMS) to investigate technological issues and possible solutions. The study demonstrated the positive effects of the use of materials which can be used interactively, and the results of the continuous assessment, quizzes and discussion forums. The current study focused on an analytical component of promoting Universal Design for Learning (UDL) to enhance teacher student accessibility. It also discussed the potential of emerging technologies like Artificial Intelligence (AI) and Virtual Reality (VR) to improve interactive learning experiences. It is essential to understand that, although there are apparent benefits when it comes to flexibility and accessibility of online learning platforms, some technological and inclusiveness problems must be solved in order to enhance effectiveness. The research calls for plans for constant trainer use information communications technology, and formative approaches in line with new learner and trainer needs.

Keywords: *online learning, higher education, student engagement, learning outcomes, technological challenges.*

Harnessing Wave Energy for Sustainable and Resilient Power Generation in Sri Lanka: A Feasibility Study

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Sri Lanka is experiencing an annual growth in electricity demand of approximately 5-6%, necessitating the development of new power plants to accommodate this increase. With the majority of the country's rivers already utilized for hydroelectric power, the focus has shifted towards thermal and diesel power plants, despite their considerable environmental impacts. Although Sri Lanka has optimized conventional renewable energy sources, such as solar and wind, non-conventional sources remain underexplored. Among these, wave energy presents significant, yet largely untapped potential. This paper investigates current wave energy harnessing technologies, evaluates criteria for selecting optimal locations and devices, and assesses the associated environmental impacts. A comprehensive new design and mathematical model is proposed, tailored to Sri Lanka's specific technical, environmental, social, and economic conditions. This model aims to advance sustainable and resilient power generation systems by integrating modern technological advancements and addressing the increasing demand for clean energy. The study contributes to the development of a more sustainable energy sector in Sri Lanka, providing insights into the feasibility of wave energy as a viable alternative. It seeks to align with global trends in clean energy while addressing local energy needs and environmental concerns, offering a path towards a more resilient and eco-friendly power infrastructure.

Keywords: *renewable energy, power generation, non-conventional sources, wave energy, sri lanka*

Toxicological effects of *Flueggea leucopyrus* Extracts on Wistar Rats: Impact of Different Doses on Physiological Parameters and Organs

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The present study assessed the toxicological effects of *Fluggea leucopyrus* leaf extracts on Wistar rats, focusing on physiological parameters and organ function. Despite its traditional use in Sri Lanka for its alleged anti-cancer properties, the safety of F. *leucopyrus* needs to be validated scientifically. The study involved preparing aqueous extracts from air-dried and ground leaves of *F.leucopyrus*. Male Wistar rats were administered varying doses of extract (100, 250 and 500 mg/kg) over 21 days, with a control group for comparison. Throughout the experiment, mortality, clinical indicators of toxicity, and body weight were monitored. Blood samples were collected for haematological and biological analysis and organ tissue sections were labelled with H&E for histopathological examination. Results showed no mortality or overt signs of toxicity in any of the groups. A decline in mean body weight was observed for treated rats, a significant ($p<0.05$) increase in white blood cell counts was observed in the 100 mg/kg and 500 mg/kg treated groups. Biochemical analysis indicated a significant ($p<0.05$) rise in the levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP) which may indicate possible liver damage. Histopathology examination revealed liver and kidney alterations in treated groups accompanied by vascular congestion and haemorrhage which indicated mild hepatic and renal damage. This study highlights that *F.leucopyrus* extract induces notable biochemical and histopathological changes with the liver and kidneys appearing to be the most exposed organs to toxicities; hence the results shows that *F.leucopyrus* needs to be used cautiously, despite its possible anti-cancer properties.

Keywords: *Flueggea leucopyrus, hepatotoxicity, nephrotoxicity*

POSTER PRESENTATIONS

A Review on Developing High-Capacity Battery Systems for Warships in the Era of Artificial Intelligence

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Battery technologies have ever been developing rapidly in the era of Artificial Intelligence for the marine transportation industry aiming for more greener energy for propulsion. Meanwhile, the warships are also transforming from traditional propulsion to modern hybrid or pure electric propulsion. The potential for battery-electric propulsion and batteries in combination with a diesel-powered and steam-powered main engine in a hybrid system is considered currently. Therefore, battery technologies are developing rapidly to cater to this future potential maritime propulsion applications /requirements. The propulsion and auxiliary systems onboard ships are designed to run the ship smoothly. Therefore, it is required to cater to the energy demand of ships by either traditional energy sources such as fossil fuel or by hybrid energy sources such as diesel /electrical, pure electrical energy sources, or renewable energy sources.The weight, volume, and cost of a maritime battery system are major factors when designing a battery system to run ships. The energy consumption for various operations and routes of a large military vessel is considered in identifying energy demands through pure battery, battery-electric, or hybrid propulsion, along with the potential for catering to the ship's electric load while the vessel is in harbour. The amount of load required to move in different environmental conditions is also considered while selecting the best energy storage systems onboard. This paper gives an overview of the state-of-the-art battery technologies available and important future developments that may potentially exploit the usage of batteries in future ship's power and propulsion requirements in the era of Artificial intelligence.

Keywords: *specific density, specific power, energy density, charge-discharge efficiency, self-discharge rate, cycle efficiency , war ships , high capacity battery systems, propulsion & auxiliary systems, maritime battery systems.*

A Critical Review on Compatibility of Energy Storage Technologies with Renewable Energy Integration

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The global shift towards sustainable energy necessitates the integration of renewable sources like solar and wind into power systems. However, the intermittent nature of these sources presents significant challenges to grid stability and reliability. This study critically reviewed the compatibility of various energy storage technologies—Pumped Hydroelectric Energy Storage (PHES), Flywheel Energy Storage (FES), and Li-Ion Battery Storage (LIBS)—with renewable energy integration. Each technology's unique characteristics, including energy and power density, efficiency, cost, lifetime, and response time, were analyzed in detail. PHES, with its large-scale storage capacity, offers a cost-effective solution but is geographically constrained. FES provides rapid response capabilities suitable for frequency regulation, while LIBS, despite higher costs, promises flexibility and scalability. The study highlights the crucial role of energy storage in mitigating the intermittency of renewable sources, enhancing grid stability, and promoting sustainable energy. Through a comprehensive analysis, this critical review aims to assist decision-making by providing insights on the effective integration of energy storage technologies in renewable energy systems.

Keywords: *pumped hydroelectric energy storage (PHES), flywheel energy storage (FES), Li-Ion battery storage (LIBS)*

Investigating Material Degradation and Durability in Hypersonic Environments

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Hypersonic flights present formidable challenges in material science, particularly concerning wing tip materials. This review paper delves into material degradation mechanisms and factors influencing durability in hypersonic environments. We explored high-temperature properties, oxidation, corrosion resistance, mechanical fatigue, creep, ablation, and erosion, assessing their impact on material performance. Additionally, we evaluated innovative materials, including nanomaterials and composites, for enhanced durability. Experimental testing under simulated hypersonic conditions were computational modelling inform long-term performance predictions. Our study aimed to identify materials that withstand extreme thermal, mechanical, and environmental stresses during hypersonic flight, bridging traditional paradigms with AI-driven advancements.

Keywords: *hypersonic flight, material degradation, durability, wing tip materials, high temperature properties*

How Ultrasound Imaging Could Revolutionize Brain Imaging: A Review of its Potential as an Alternative to MRI and CT

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Medical imaging is constantly evolving, with ultrasound remaining a versatile and reliable method for visualizing the human body. While ultrasound is well-known for its applications in cardiac, abdominal, and pelvic imaging, its use in brain imaging has been limited due to the skull's attenuation of ultrasound waves. Nonetheless, recent technological advancements have renewed interest in ultrasound's potential to transform brain imaging. These advancements, along with ultrasound's inherent advantages such as real-time imaging, non-invasiveness, and cost-effectiveness, suggest that it could be a strong alternative to traditional brain imaging techniques like Magnetic Resonance Imaging (MRI) and Computed Tomography (CT). This review examined the significant potential of ultrasound in brain imaging, offering a comparative analysis with MRI and CT, and discussing its strengths and limitations. It thoroughly reviewed recent technological improvements, current clinical applications, and future research possibilities. By addressing the drawbacks of MRI and CT, such as high costs and limited accessibility, this review highlights how ultrasound can become a viable and innovative option in brain imaging, promoting safer, more affordable, and widely accessible diagnostic methods.

Keywords: *brain imaging, transcranial ultrasound, medical imaging advancements*

AI-Assisted Learning: A Study on Undergraduate Web Development Proficiency

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The rapid adoption of Large Language Models (LLMs) in education, particularly AI-powered content generators like ChatGPT, has introduced significant challenges in accurately assessing student learning outcomes. This study investigated the impact of AI-generated content on student performance and the effectiveness of traditional assessment methods in a web development module. The objectives were to evaluate the influence of AI tools on students' knowledge, cognitive abilities, and creative skills, and to identify the challenges in assessing learning outcomes when AI tools are utilized by students. The study involved 450 first-year undergraduates at a private university in Sri Lanka, divided into an experimental group, which utilized ChatGPT, and a control group that did not. Both groups were tasked with creating a webpage within a limited timeframe, using HTML, CSS, JavaScript, and PHP. Performance was assessed across ten attributes, including code quality, problem-solving skills, logical thinking, debugging skills, time management, and innovation. The assessment combined automation tools, such as SonarQube integrated with Jenkins, and manual evaluation methods to ensure comprehensive results. Findings indicate that the experimental group outperformed the control group, suggesting that AI tools can significantly enhance student performance. However, the study also highlights the difficulty in accurately assessing learning outcomes in the presence of AI-generated content, underscoring the need for new evaluation frameworks to differentiate between human and AI contributions.

Keywords: *web development, AI-based responses, undergraduate education*

Development of a Novel RBC Histogram and a RDW-CV Parameter for Improved Diagnosis and Monitoring of Iron Deficiency Anemia using a Computatational Mathematical Tool

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Reduced amounts of body iron stores lead to Iron Deficiency Anaemia (IDA), often because of blood loss or pregnancy. IDA progresses in stages and it continues to be an important global health issue impacting people of all ages and nationalities. RDW-CV carried under complete blood count (CBC) plays a crucial role in the differentiation of iron deficiency anaemia (IDA) from thalassemia minor. It reflects the degree of anisocytosis and the results are interpreted in values along with RBC histograms. Since the RDW-CV is elevated in other diseases that associate with the inflammation, all-cause mortality and post red blood cell (RBC) transfusion cannot be used as a specific indicator for IDA. Therefore, various research groups have attempted to modify the RDW by combining with the other RBC parameters in different iron deficiency (ID) and IDA states. In such grounds, this review describes the possibilities of developing a novel RBC histogram and a RDW-CV related parameter by modifying the existing histogram and a RDW-CV. The pathway of developing the said parameters will be discussed. Once developed, it is expected to use it as a computational mathematical tool to study the response of the iron treatment of IDA to those who are undergoing iron treatment. Furthermore, new avenues are expected to be created to the novel RBC histogram and the RDW-CV to be applied in a wide range of inflammatory diseases that are associated with the elevated RDW-CV.

Keywords: *Iron Deficiency Anaemia (IDA), Red Blood Cell Distribution Width-Coefficient of Variation (RDW-CV), novel RBC histogram, computational & mathematical tools*

Enhancing IoT Security: A Framework for Mitigating Vulnerabilities in Industrial Systems

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IoT-based systems have revolutionized various sectors by improving efficiency and decision-making. However, the increased interconnectivity and complexity have heightened security concerns, including vulnerabilities in communication protocols, inadequate encryption, and insufficient access control mechanisms, risking sensitive data and system integrity. This study proposes a comprehensive security framework tailored for IoT-based systems in industrial environments. By integrating advanced encryption, authentication protocols, and intrusion detection systems this study attempted to develop effective security mechanisms and strategies that can be integrated into IoT-based systems to mitigate potential security threats. The foundation for creating strong security measures that will protect IoT-based systems against various cyberattacks be the outcome of this study. A specific testing environment, utilizing specific tools/technologies, for example, simulated IoT networks and real-time monitoring tools, will be developed to evaluate the effectiveness of the proposed security measures against potential cyberattacks. The suitability and flexibility of the many suggested security improvements in a range of IoT-based systems are further confirmed by case studies. The benefits and drawbacks of the suggested security methods are illustrated by the outcomes of experiments and case studies. In conclusion, this study contributes to the enhancement of security in modern IoT-based systems by providing effective mechanisms to address critical vulnerabilities and enhance system reliability. By implementing these security enhancements, the study provides a framework that ensures the confidentiality, integrity, and availability of data in IoT systems, minimizing risks and enhancing system reliability. These findings have the potential to influence future IoT system designs and contribute to the development of industry-wide security standards.

Keywords: *IoT security, encryption algorithms, vulnerability mitigation, data integrity, Authentication Protocols*

Urban Youth Perspectives on AI-Driven Solutions for Food Waste Management: Evaluating the Smart Food Waste Accelerator Prototype in Colombo

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As part of the Youth Leadership for Climate Action (YLCA) initiative, carried out by Biodiversity Sri Lanka (BSL) and funded by the British Council, this study investigated how to empower young leaders in climate action by tackling the critical issue of food waste management. Our community intervention involved creating an AI-led Smart Food Waste Accelerator prototype. The first phase of our study involved a baseline survey in the Dehiwala Municipal Council region, employing a mixed-methods approach using key informant interviews (KIIs) and structured questionnaires to gather data from youths aged 18 to 29 on their perspectives on food waste management. A total of 567 responses were collected, revealing significant concerns about the absence of proper food waste disposal methods, with 91% of respondents acknowledging it as a household issue. Alarmingly, 89.45% of participants indicated the lack of appropriate disposal methods, with over 93% relying on local government waste vehicles. Our findings showed an average daily accumulation of 0.67 kg of food waste per household, predominantly comprising meal leftovers. Importantly, 89% of respondents expressed a willingness to purchase the Smart Food Waste Accelerator for their homes, and 96% were eager to understand its features and market availability. The AI-driven solution in this prototype exemplifies the potential for innovative technology to transform food waste management, promoting sustainability and reducing environmental impact.

Keywords: *Smart Food Waste Accelerator, youths, food waste management, innovations, Youth Leadership for Climate Action (YLCA).*

A Review of Key Research and Development Opportunities in the Technological Advancements of Bioprinting

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Bioprinting technology has shown a swift development within the last decade. However, the fundamental limitations of bioprinting technology still need to be addressed. This review aimed to identify limitations, the rationale behind them, the current approaches to solve them, and proposes novel methodologies to address these challenges. The data were collected from several databases, using different combinations of keywords in metadata to precisely identify the technological limitations. The collection was analyzed in depth. The literature in several disciplines ranging from 3D bioprinting, 3D printing, machine learning, stem cell technology, cell biology and transplant medicine, and biomaterials was used to identify the major limitations, current trends, and deficits in the current approaches to overcome the fundamental limitations. From the analysis, the leading three 3D bioprinting technologies were identified, laying the foundation for all other bioprinting technologies. The fundamental limitations, novel approaches, and understandings were compiled. Also, the limitations across the entire bioprinting discipline were separately identified and compiled. Different approaches to solving the existing limitations were scrutinized and possible research avenues and directions were proposed. This understanding of limitations and the proposals may direct young scientists and biomedical engineers to solve them.

Keywords: *biomedical engineering, bioprinting, technological limitations*

Digital Preservation Technology for Traditional Arts in Sri Lanka

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Digital preservation technologies have become indispensable tools in safeguarding and promoting traditional arts in today's digital age. This paper provides a comprehensive overview of the various digital preservation technologies employed for the conservation, documentation, and dissemination of traditional arts. Beginning with an exploration of the challenges faced by traditional arts in the digital era, the paper delves into the theoretical foundations of digital preservation and its significance in the context of cultural heritage in Sri Lanka. The discussion then shifts to the practical aspects of digital preservation, covering a wide range of technologies and methodologies such as digitization, metadata standards, digital repositories, and archival systems. Emphasis is placed on the importance of adopting interdisciplinary approaches that integrate expertise from fields such as computer science, information science, conservation, and anthropology. Furthermore, the paper examines case studies and best practices from around the world, highlighting successful implementations of digital preservation technologies in preserving diverse forms of traditional arts, including folk music, dance, crafts, and oral traditions. These case studies illustrate the various challenges encountered during the preservation process and the innovative solutions developed to address them. Additionally, emerging trends and future directions in digital preservation technologies for traditional arts are discussed, including the use of artificial intelligence, immersive technologies for enhanced preservation, access, and engagement.

Keywords: *digital preservation, traditional arts, cultural heritage, digitization, emerging trends*

Predictive Modelling of Breast and Oral Cancer Incidence Trends in Sri Lanka: Utilizing Random Forest Algorithm and National Cancer Registry Data

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Predicting cancer incidence trends is essential for effective healthcare planning and resource allocation. This study utilized the Random Forest model to forecast cancer patterns in Sri Lanka using comprehensive data from the National Cancer Registry spanning 2001 to 2020. The model's performance was rigorously evaluated, demonstrating robust predictive capabilities with accuracies of 89.0% for female breast cancer and 88.0% for male oral cancers. Projections extend to 2030, revealing an upward trajectory in cancer cases, with notable annual variations, particularly in breast cancer among females post-2024. Despite challenges such as limited data availability from private sector sources and variability in diagnostic practices across regions, the study underscores the transformative potential of machine learning in enhancing cancer surveillance and management strategies. By integrating medical and socio-demographic factors into predictive frameworks, this research contributes to advancing understanding of cancer epidemiology in developing regions like Sri Lanka. Moving forward, efforts should focus on refining models through enhanced data integration and addressing modifiable risk factors such as lifestyle choices and healthcare accessibility disparities. This study emphasizes the critical role of predictive modelling in shaping proactive public health policies and interventions aimed at mitigating the increasing cancer burden in Sri Lanka and in similar global contexts.

Keywords: *cancer prediction, random forest, cancer incidence, oral cancer, breast cancer*

A review of Sustainable Construction Practices enabled by Internet of Things (IoT): Case Studies and Innovations

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This review explored the integration of sustainable construction practices with IoT technologies, emphasizing their combined potential to minimize environmental impact and enhance efficiency throughout the construction lifecycle. Sustainable construction focuses on resource efficiency, energy conservation, and the use of renewable materials to mitigate climate change, preserve natural resources, and improve environmental quality. IoT technologies facilitate precise monitoring and management of energy, water, and materials through embedded sensors, enabling adjustments based on occupancy and environmental conditions. Key IoT applications include real-time data monitoring in smart buildings, waste management optimization, and enhanced concrete curing processes. These innovations contribute to reducing carbon footprints, conserving resources, and improving building performance and occupant well-being. Challenges in IoT implementation include technical interoperability, cybersecurity risks, upfront costs, and regulatory complexities, which vary across regions. Developing countries like Sri Lanka face additional hurdles due to limited access to comprehensive digital databases necessary for AI-driven insights and efficient construction management. Addressing these challenges requires digitizing project records, fostering data collaboration, and investing in digital infrastructure and skill development. Overcoming these barriers could position Sri Lanka at the forefront of digital innovation in construction, driving economic growth and enhancing infrastructure resilience. Overall, IoT integration in sustainable construction holds promise for advancing global sustainability goals through enhanced efficiency, reduced environmental impact, and improved project outcomes.

Keywords: *sustainable construction, Internet of Things (IoT), sensors, digital data*

A Review: Night-to-Day Image Translation Leveraging GANs for Enhanced Visual Perception for Autonomous Driving Systems

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Autonomous driving systems hold significant potential for improving safety and efficiency. Their effectiveness is often challenged under low-visibility conditions at night, primarily due to their reliance on visual inputs. This review analysed these challenges by exploring the use of GANs for translating night-time images into their daytime equivalents, thereby enhancing the perceptual capabilities of autonomous systems. A systematic review of the existing literature was conducted by IEEE Xplore, arXiv, and Google Scholar, covering publications from 2009 to 2024. The selection criteria employed specific keywords such as image-to-image translation", "Night to Day image translation", and "autonomous driving systems", focusing on studies directly contributing to the enhancement of visual inputs in low-light conditions. The findings suggest that inherent constraints limit conventional methods like enhancing sensor sensitivity. GAN-based approaches, exclusively those leveraging unsupervised learning paradigms, offer promising alternatives. Hence, the review focused on unsupervised and semi-supervised GANs, which offer robust solutions by eliminating the need for paired datasets and providing greater adaptability in diverse nocturnal driving environments. These methods not only reduce logistical challenges associated with dataset preparation but also demonstrate superior performance in managing the complexity and variability of real-world nighttime driving scenarios compared to traditional and supervised methods. In conclusion, the application of GANs for night-to-day image translation represents a promising path forward for improving the reliability and safety of autonomous systems under low-light conditions. This review provides valuable insights for both practitioners and researchers, highlighting the potential for further refinement of GAN architectures to enhance the operational capabilities in diverse environments.

Keywords: *night-to-day image translation, autonomous driving systems, generative adversarial networks.*

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