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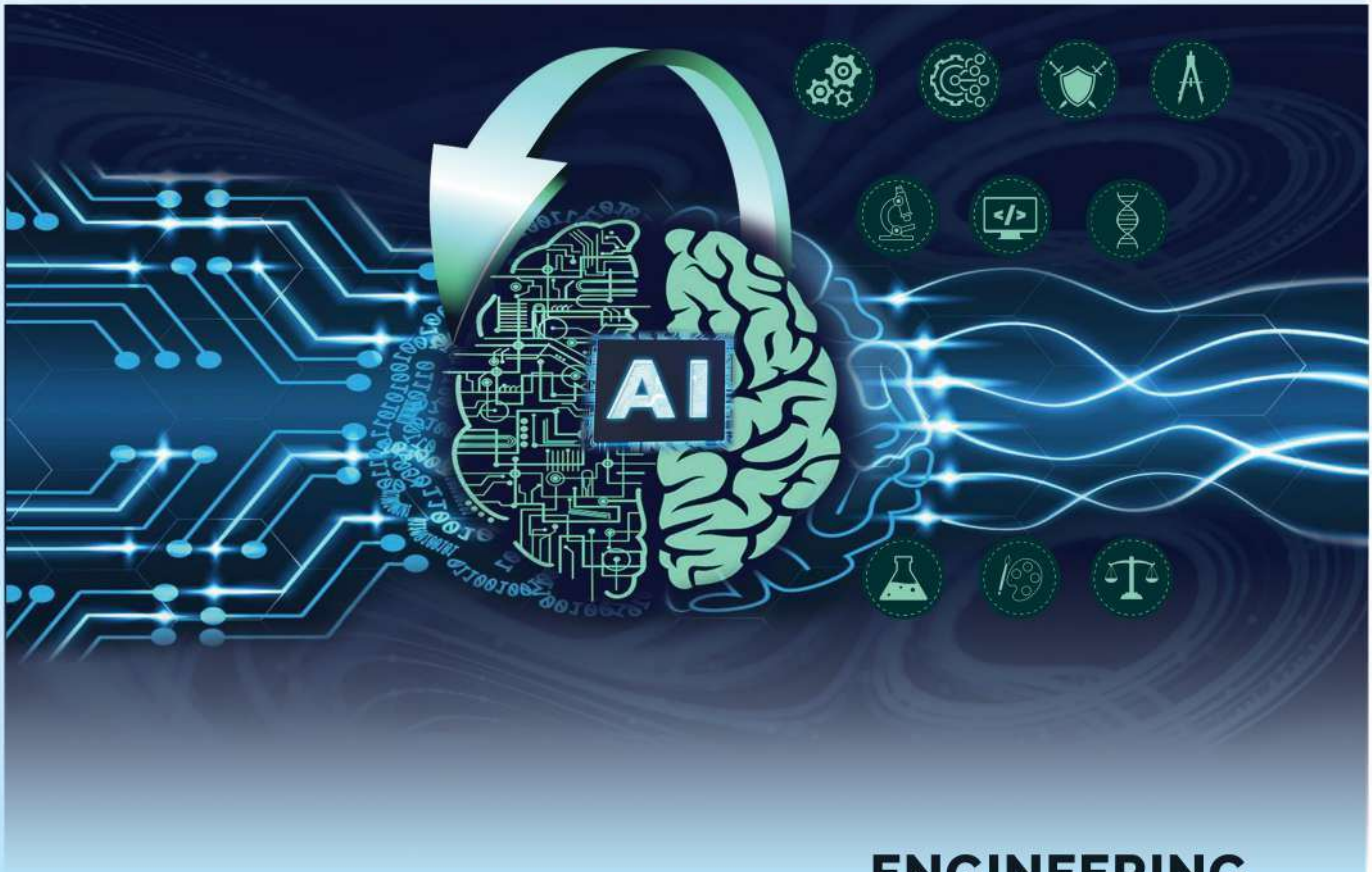
17th INTERNATIONAL RESEARCH CONFERENCE

Unravelling the Paradigm Shift: Revolutions in the Era of AI

26TH - 27TH SEPTEMBER 2024



ENGINEERING ABSTRACTS

General Sir John Kotelawala Defence University

17th INTERNATIONAL RESEARCH CONFERENCE

UNRAVELLING THE PARADIGM SHIFT: REVOLUTIONS IN THE ERA OF AI

ENGINEERING

ABSTRACTS

General Sir John Kotelawala Defence University
Ratmalana, Sri Lanka.

KDU PRESS

This book contains the abstracts of papers presented at the **Engineering** Sessions of the 17th International Research Conference of General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka held on the September 26–27, 2024.

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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 a great pleasure to issue this message on the occasion of the 17th International Research Conference - 2024 of General Sir John Kotelawala Defence University, themed "Unravelling the Paradigm Shift: Revolutions in the Era of AI." This conference serves as a significant platform that brings together the brightest minds in academia, industry, and research to explore the impact of artificial intelligence across various disciplines including engineering. The Engineering track of the conference includes four dedicated sessions—Electrical, Electronic & Telecommunication, Biomedical, Civil & Building Services, and Mechanical, Mechatronic, Aeronautical, & Marine Engineering—that reflect the diverse and evolving landscape of modern-day engineering research.

The idea behind organizing this conference is to create an atmosphere of research and innovation, encouraging students and young faculty members to contribute to the research community. In today's fast-paced world, science, technology, and engineering are, becoming increasingly interdisciplinary and undergoing rapid changes especially with the growth of artificial intelligence. The ongoing research in AI has profoundly impacted the way we interact with technology and the speed at which engineering advancements occur. Our commitment to nurturing a research-oriented environment aligns perfectly with the demands of this dynamic era, where innovative ideas are a necessity. I extend my deepest gratitude to the IRC central organizing committee for their tremendous efforts in bringing this event to fulfillment. I also thank our esteemed plenary speakers, technical session chairs, technical session judges, department heads, academic and non-academic staff, and all contributors who have played a role in making this conference a reality.

As the Dean, I am proud to witness the remarkable growth and success of this conference. I am confident that the interactions and knowledge shared here will inspire future innovations and collaborations. I wish all the participants a fruitful and inspiring conference and look forward to the continued success of this prestigious event.

Prof. Dr. Ing. Thushara Weerawardane
BSc (Moratuwa), MSc (Germany), PhD (Germany), CEng (UK), MIEEE, MCSSL Dean, Faculty of Engineering General Sir John Kotelawala Defence University

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ORAL PRESENTATIONS

ID 269

Integration of Image Processing with Underwater Rover to Monitor Coral Growth

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This research outlines the integration of image processing with an Aquabot, underwater rover to monitor the growth of corals. The designed system is composed of an underwater vehicle, a floating station for communication, and a coral monitoring unit. This monitoring unit is capable of classifying the coral type and also to identify available diseases on the coral. Communication occurs through a combination of wired and cloud methods. The coral disease detection unit was evaluated based on a data set of 121 images containing 489 instances of coral disease and the coral varieties detection model was evaluated based on a dataset of 124 images containing 492 instances of coral varieties. These images were taken from coral reefs and coral nurseries around Sri Lanka. In both cases the models identified the diseases and varieties correctly with overall confidence levels of 33.1% and 59.6% respectively. The two models achieved box precision of 0.346 and 0.679, the box recalls of 0.331 and 0.558, the mean average precision (mAP50) of 0.295 and 0.596 and the mean average precision at IoU thresholds of 0.5 to 0.95 (mAP50-95) of 0.188 and 0.425 respectively. The results of the evaluations show that both models are effective for their respective tasks. This study introduces a combination of AquaBot and an image processing system, which is capable of real time monitoring and identification of corals and their diseases.

Keywords: *underwater rover, coral growth monitoring, image processing, coral diseases detection, coral varieties detection*

ID 286

Designing a Portable Solar Power Station for Outdoor Activities

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Portable solar power stations with compact solar panels and lithium-ion batteries are useful for outdoor activities like camping and hiking for clean and renewable energy. This paper presents the development of a backpack style portable solar power station with weight less than 6 kg, that delivers 500 W for 30 minutes after one charge. It uses a 100 Ah, 3.7 V, lithium-ion battery with foldable solar panels and delivers sinusoidal 230 V, 50 Hz, AC output through standard socket outlets. Multiple outputs are provided to enable several devices to take power simultaneously, for example charging multiple devices. Solar panel output is fed to a push-pull converter that produces constant 400 V DC voltage for an H-bridge inverter which is operated with sinusoidal pulse width modulation (SPWM) to produce sinusoidal, constant voltage, and constant frequency AC output. The overall design is compact, sustainable, and adaptable to various weather conditions, to provide a green option for outdoor enthusiasts for a better outdoor experience

Keywords: *portable solar power station, backpack, sinusoidal pulse width modulation (SPWM), lithium ion battery*

ID 437

Enhancing Electrical Grid Reliability through Predictive Cycle Detection with Graph Neural Networks

WMKGVB Wijekoon[1#] and HPPP Hettiarachchi[1]

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This paper presents an end-end study focused on improving grid reliability with the application of Graph Neural Networks (GNNs). Graph representation of the electrical grid yields the model of nodes of substations and transformers interconnection of power lines constructed by the data from the National Grid Electricity System Operator (ESO) Data Portal. Based on their connections, node feature updating and encoding by predicting grid reliability with a multi-layered Graph Attention Network (GAT) was employed. In predicting failure regions, the proposed model with rigorously trained and tested state shows higher accuracy compared to existing methods. The results of the model signify the model's capability to efficiently manage large-scale data with actionable insight generation for specific use in cases such as predictive maintenance, which ensures the resilience of modern power systems and integrating renewable energy in the modern power system.

Keywords: *grid reliability, Graph Neural Networks, predictive detection, AI in grid management, preventive maintenance*

ID 491

Edge Computing using FPGA with the Deployment of Neural Networks for General Purpose Application

Kevini Perera[1], Chamod Hettihewa[1], Manupa Wickramasinghe[1#], Ashan Sandanayake[1], Chamali Rajapaksha[1], and Pubudu Pathirana[2]

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Artificial intelligence and deep learning are gaining traction in edge computing to extract insights from Internet of Things (IoT) devices. Hardware accelerators like Field Programmable Gate Arrays (FPGAs) accelerate deep learning efficiently due to their energy efficiency, parallelism, flexibility, and reconfigurability. However, resource constraints of FPGAs pose deployment challenges. This research explores hardware-accelerated applications' dynamic deployment on the Kria KV260 platform with a Xilinx Kria K26 system-on-module, equipped with a Zynq multiprocessor system-on-chip. It presents an innovative solution to dynamically reconfigure deep neural networks by running multiple neural networks and Deep Processing Units (DPU) concurrently. This research advances Edge Computing using FPGAs to facilitate efficient deployment of Neural Networks in resource-constrained edge environments.

Keywords: *FPGA, neural networks, DPU. hardware accelerator*

ID 579

Management of Construction Waste in Building Projects in Sri Lanka

NGP Aparna[1] and TMWRMB Samarakoon[1#]

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Sri Lanka is currently a developing country, with the construction industry playing a significant role in the country's overall development. With the development of large-scale construction projects comes an increase in construction waste. Construction waste has made the construction industry a major contributor to environmental degradation and pollution, causing negative impacts for on the construction industry as well as the country's economy. Therefore, construction waste management is significant for a country's development. Construction waste management in building projects in Sri Lanka was addressed in this study, which identified the dominant types of construction waste, current practices, and issues of construction waste management. The paper concludes by recommending sustainable waste management methods and waste quantification methods.

Keywords: *building projects, construction waste, issues, quantification, Sri Lanka, sustainable*

ID 623

Graphene Oxide as a Corrosion Mitigation Agent in Reinforced Concrete: An Evaluation

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Graphene Oxide (GO) stands out among supplementary cementitious materials due to its exceptional strength and nano-scale characteristics. This study focuses on evaluating the corrosion resistance of Reinforced Concrete (RC) structures enhanced with GO-infused concrete. The study assessed corrosion resistance using the Rapid Chloride Ion Permeability Test (RCPT), carbonation depth measurements, and the Accelerated Corrosion Test Method (ACTM). Moreover, the mechanical properties, including compressive, flexural, and tensile strength, were extensively tested. Concrete containing 0.05% GO showed significant enhancements in compressive, tensile, and flexural strengths by about 25%, 40%, and 41% respectively. RCPT results indicated a 70% reduction in chloride ion permeability at a 0.5% GO concentration, reflecting improved corrosion resistance. These results highlight GO's potential to significantly reduce concrete corrosion, suggesting the need for further exploration in this area.

Keywords: *Graphene Oxide (GO), mechanical properties, Accelerated Corrosion Test Method (ACTM), Rapid Chloride Permeability Test (RCPT)*

ID 692

Analysis on Design Standards of Bus Terminals in Sri Lanka

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Improvement of public transportation along with its infrastructure is a timely need to address its demand. The infrastructure in bus terminals should be developed based on proper standards to ensure the quality of services provided. The existing terminals in Sri Lanka do not fulfil the basic amenities required by passengers and are not sufficiently designed to ensure comfortable movements inside the terminal. The main cause for this is the absence of a proper set of guidelines that can be referred to in designing bus terminal structures and infrastructure. The main objective of this study was to analyze existing bus terminal designs currently in use around the world and introduce a systematic bus terminal design guideline that ensures the provision of complete infrastructure facilities for bus passengers. In the first phase of the study, a terminal classification was introduced to categorize bus terminals in Sri Lanka, with a focus on those in the Western Province, using bus route data obtained from relevant authorities. A thorough analysis of existing bus terminal guidelines from various countries was then conducted, and guidelines that are suitable for the Sri Lankan system were identified. Based on the literature reviewed, a set of design guidelines was proposed for bus terminal designs in Sri Lanka. The basic amenities required in bus terminals were also outlined according to the classified bus terminal types. Additionally, specific functional requirements for bus terminals were highlighted based on a questionnaire survey conducted among passengers and terminal staff, aligning with the terminal classification developed. This study recommends the existing bus terminals follow the prepared guidelines and facilitate the minimum requirements mentioned under the guidelines. It also recommends providing at least the mandatory infrastructure at a terminal, based on the terminal category.

Keywords: *bus terminal design, design guidelines, terminal operations*

ID 696

Investigation of Stormwater Quality on Different Impervious Surfaces: A Case Study at General Sir John Kotelawala Defence University

RARS Ranasinghe[1#], HK Pathinayaka[1], and NS Miguntanna[1]

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Urban areas produce huge stormwater runoff because of the high number of impervious surfaces such as roads, roofs, buildings, parking lots, walkways, or anything else that does not allow water to penetrate to the ground. During heavy rainfall periods, these stormwater runoffs often overflow and discharge the excess onto nearby streams, rivers, lakes, or other water bodies. This study was aimed at investigating the stormwater quality in different impervious surfaces at General Sir John Kotelawala Defence University (KDU). Focusing on the land use patterns at KDU, key pollutant indicators representing urban stormwater quality, and characteristics of pollutants in wash off stormwater from selected impervious surfaces were analysed. This study used roads, roofs, and parking lots as impervious surfaces to collect necessary stormwater samples and from the first flush flow, twelve samples were collected from different locations within KDU premises. The wash-off characteristics of different impervious surfaces were compared and potential mitigatory measures were proposed to safeguard the receiving water quality.

Keywords: *stormwater quality, impervious surfaces, univariate analysis*

ID 798

Socio-Hydrological Influence of Floods in Kelani River Basin Due to Southwest Monsoon: A Comparative Study

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The relationship between life and water is as old as time itself. Ancient civilizations settled near riverine regions to access water easily which was essential for survival. Though access to water was easy, settlements near low-lying riverine areas frequently suffered from floods. Recent climate changes and increase in urbanization have resulted in rise of flood events and the damages caused by it. The Kelani River Basin in Sri Lanka experiences annual floods with the onset of the Southwest monsoon and damages caused by floods in the region incur substantial losses to the lives and economy while impacting the social status of lives. This study investigated the rainfall, flood levels, and impacts of flood events occurred in two different years in the Kelani River Basin utilizing a holistic approach to evaluate the socio-hydrological status of the region. Through investigations carried out in the domains of hydrology, the study found that the current rainfall trend indicates the possibility of increased flood events in the future. By integrating hydrological data with socio-economic indicators, the study examined how floods during the Southwest monsoon trigger cascading effects on socio hydrology with respect to livelihoods, infrastructure, and environmental sustainability. Key aspects explored include flood frequency, magnitude, duration, and their differential impacts on vulnerable communities due to floods occurred in the two years. Insights from this comparative study contribute to a deeper understanding of socio-hydrological dynamics, while facilitating informed decision-making for sustainable flood management and disaster resilience in the Kelani River Basin and similar environments globally.

Keywords: *socio-hydrology, Southwest monsoon, Kelani river basin*

ID 339

Design and Analysis of Rotor and Airfoil Configurations for Vertical Axis Wind Turbine to Harvest Wind Generated at Highways

MM Kothalawala[1#], RDMHM Ariyarathne[1], HGS Hikkaduwa[1], NVL De Silva[1], KREMSB Ekanayaka[1], MCH Chandrasiri[1], and PS Gauder[2]

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Wind is generated at highways due to the fast movements of automobiles. This study focused on developing a Vertical Axis Wind Turbine (VAWT) to generate electricity for highway lightning and providing an alternative method of power generation in the country by using the wind generated at the highways. The study was divided into two phases and this paper focuses only on the design and optimization of the turbine rotor to enhance its efficiency and improve self-starting capability by selecting the most suitable airfoil profile with enhanced performance. On achievement of the full design, it can be utilized as an energy-efficient vertical axis wind turbine with an automatic speed-controlling mechanism for bad weather conditions like windstorms. Characteristics of the airfoil profile are mainly affected by the performance of the wind turbine. Hence a range of National Advisory Committee for Aeronautics (NACA) airfoil profiles was analyzed using ANSYS fluent software including symmetric, cambered, thin, and thick airfoil profiles to identify the best airfoil profile. Graphs of lift and drag forces vs angle of attack from the ANSYS fluent software had shown that NACA 4415 airfoil profile has less lift force fluctuations, a high lift-to-drag ratio, and a clear stall angle. The insights of this study can be used to understand and develop the energy-efficient Vertical Axis Wind Turbine.

Keywords: *Vertical Axis Wind Turbine (VAWT), self-staring capability, airfoil profile, National Advisory Committee for Aeronautics (NACA), symmetric, lift to drag ratio*

ID 456

Design and Implementation of Operational Level Arduino-Based Marine Two Stroke Engine Simulator

HGS Hikkaduwa[1#], KMPK Senarathne[2], DVP Wijethunga[1], MCH Chandrasiri[1], LAKR Athukorala[1], LBND Rajasekara[1], SADR Maduwantha[1], RGYK Rajapaksha[1], and JPKD Amarathunga[1]

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The maritime industry relies on the operation of a complex machine; the ship's engine is a critical component. Understanding the starting and stopping procedures of a ship engine is essential for the safe and efficient operation of vessels. This paper presents the design and development of a switchboard simulation system, aimed at providing a practical and interactive means of comprehending the intricate starting and stopping procedures of two-stroke marine diesel ship engines. The proposed simulation system leverages the capabilities of Arduino microcontrollers, digital and analog sensors, neo-pixels, and a user-friendly graphical interface to replicate the control and monitoring mechanisms found in actual ship engine rooms, creating a realistic environment for operational-level training of marine engineers before taking appointments onboard ships. The system allows users to interact with various switches, indicators, and instruments, providing an immersive learning experience. The microcontrollers are responsible for processing user inputs and generating appropriate responses, while controllers monitor the status of the simulator. The graphical interface displays the switchboard layout and provides real-time feedback on the engine's condition, ensuring that users can practice and learn in a safe and controlled environment. The designed switchboard simulation system allows users to explore and understand the sequential procedures involved in starting and stopping a ship engine, including the activation of key systems such as the fuel system, cooling system, compressed air system, fuel, lubricating, starting air, cooling and steam systems including electrical power. Users can practice troubleshooting and emergency procedures, thus enhancing their preparedness for real-world scenarios. In conclusion, the implementation of an operational-level engine simulation using Arduino technology provides an effective and engaging method for teaching and learning the complex starting and stopping procedures of ship engines. This technology bridges the gap between theoretical knowledge and practical experience, making it an invaluable tool for maritime education and training.

Keywords: *two-stroke engines, operational level marine engine simulator, marine propulsion systems*

ID 742

Transforming Waste into Wealth: Development of a Feedstock-Specific Auto-Thermal Pyrolyzer for Carbonizing Compost Residues in Sri Lanka

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In developing countries, improper disposal of Municipal Solid Waste (MSW) often results in open dumps, with composting only partially managing biowaste. MSW composting yields 50% as residue and hence returns to the dumpsites. This study aimed at designing and developing a gasifier combustor and a pyrolysis reactor to pyrolyze the compost residue. The gasifier combustor provides heat for the pyrolysis process and converts feedstock to biochar through indirect heating. Coconut shell (CS), coconut husk (CH), wood (WD), and a mixture of residue (MR) were used as feedstocks pyrolyzed at temperatures ranging from 500-600°C for 1.5-2 hours and characterized biochar using proximate and ultimate analyses. The results showed that the biochar had volatile content ranging from 33.18 to 47.19%, with moisture contents ranging from 3.29 to 9.43%. The ash content varied from 14.25 to 25.17%, indicating less impurities. The fixed carbon contents ranged from 27.98 to 41.39% while biochar from MR showed the highest value, indicating superior carbon sequestration and biochar stability. Meanwhile, carbonization of CS, WD, and MR yielded 32.91, 27.18, and 28.95% respectively, while CH had the highest yield of 48.52%. These results demonstrated that biochar from compost residue has the potential to enhance compost quality and treat leachate from composting facilities. Further, the carbonization process would benefit municipalities by converting compost residue into a value-added product for various environmental applications.

Keywords: *compost residue, carbonization, biochar*

ID 787

A Preliminary Study on Design and Development of Unmanned Shallow Water Surface Surveillance Craft

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Due to Sri Lanka's ongoing economic crisis, the development of cost effective and advanced technological solutions for surveillance operations in Sri Lankan waters is crucial. This study focuses on unmanned remote-controlled surface vessels (USV), engineered for shallow water surveillance operations. While advanced USV models exist globally, our approach emphasizes creating a high-quality, low-cost alternative that is economically viable and better adapted to the unique maritime and environmental conditions of Sri Lanka. Catamaran type was chosen as the hull shape, as it provides a more stable and safe navigation in various maritime conditions efficiently. This was modelled by using the Rhino 3D modelling software and further analyses were done by Maxsurf Naval Architecture Software. The USV is equipped with an integrated water quality monitoring system iterated with Ph sensor, CCTV camera, and GPS module, utilizing Arduino technology for real-time data acquisition. The system detects toxic substances in water, triggering an immediate alarm and sending the live location to a mobile device via the GSM module. Additionally, the live CCTV camera enhances real-time surveillance capabilities. The USV's remote operation is facilitated by RC transmitter components, ensuring effective control over extended voyages. By addressing both economic constraints and environmental considerations, this study provides a robust, adaptable USV solution for Sri Lanka.

Keywords: *unmanned surface vessel (USV), surveillance, catamaran, water quality, shallow water*

ID 202

Analysing the Difference in Joint Angular Kinematics between Professional and Amateur Tennis Players

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The study aimed to investigate the differences in shoulder, elbow, and wrist angular kinematics between professional and amateur players during various strokes such as forehand, backhand, serve, and volleys. Four players (two professionals and two amateurs) were asked to perform each stroke, and their readings were collected using the Shadow Motion Capture System. The readings were analyzed using Mokka and MATLAB to calculate the joint angles and performance metrics. Professional tennis players exhibit distinct joint angle patterns compared to amateurs. They have larger shoulder and elbow angles on serves, indicating a more powerful stroke. On forehands, professionals have smaller shoulder and elbow angles, suggesting a more controlled swing. For backhands, professionals have larger angles on the dominant hand and smaller angles on the recessive hand, potentially favouring power and control, respectively. Finally, professionals have smaller shoulder angles on volleys, suggesting a more compact and controlled motion. The study showed that professional tennis players have lower joint angles during serves and strokes, indicating better flexibility, control, and refined technique. In contrast, amateurs display higher, less variable angles, reflecting less control and power generation. Professionals also have a larger shoulder joint angle (101.32 degrees) compared to amateurs (94.32 degrees), suggesting better shoulder positioning or flexibility for efficient backhands. Future research should expand the sample size, analyze leg movements, use controlled environments, and employ multiple high-speed cameras. The knowledge gained from the study can enhance training programs, improving performance for players at all levels.

Keywords: *backhand biomechanics, forehand biomechanics, serve biomechanics, tennis kinematics*

ID 259

A Comprehensive Review on the Use of Arterial Spin Labelling MRI for Localization of the Epileptogenic Zone in Drug-Resistant Epilepsy

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Epilepsy is a chronic neurological disease. The mainstay of treatment of epilepsy is Anti-Seizure Medication (ASM). Thirty per cent of individuals develop Drug-Resistant Epilepsy (DRE), necessitating the use of Epilepsy Surgery (ES) or other alternative therapies. Precise anatomical and functional localization of the area of the brain generating seizures— Epileptogenic Zone (EZ) is essential to proceed with ES. Magnetic Resonance Imaging (MRI) can be used to identify anatomic lesions in the brain. However, MRI findings can be inconclusive in some, and cerebral perfusion scans are used in such cases to complement. This comprehensive review focused on the use of Arterial Spin Labelling (ASL) perfusion MRI-paradigm as a highly efficient, non-invasive, non-ionizing, less expensive, imaging technique that is a potential alternative to Positron Emission Tomography (PET). ASL determines Cerebral Blood Flow (CBF) which is altered in the EZ. Compared to PET, ASL does not use radioactive substances, offering a higher safety profile to the patient. Previous research using ASL-derived CBF maps has shown that quantitative analysis provides more accurate EZ localization than qualitative analysis. ASL quantification can be amalgamated with other presurgical investigations in the multimodal reconstruction of the surgical map. Unfortunately, larger studies on the presurgical use of ASL quantification with solid scientific data are currently unavailable in the literature. Therefore, this comprehensive review highlights the increasing importance of ASL perfusion MRI as a valuable and safe method for EZ identification in DRE patients with negative MRI findings, providing a detailed comparison with existing imaging techniques.

Keywords: *Arterial Spin Labelling (ASL), Drug-resistant Epilepsy (DRE), Epileptogenic Zone (EZ)*

ID 483

Biomechanical Analysis of Basketball Shooting Techniques: A Motion Capture Study of Joint Angles and Movement Patterns

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Basketball shooting techniques require precise coordination of joint movements, which significantly influence shooting accuracy and efficiency. This study employed motion capture technology to analyse and compare biomechanical parameters in free throws, jump shots, and lay-ups among five skilled basketball players. Each player completed five trials per shooting technique. The study examined the correlation between minimum knee and elbow angles with shot success in free throws and jump shots. Wrist angle variations were analysed to identify distinct biomechanical profiles for each player. Additionally, knee angles during take-off and maximum height reached in lay-ups were investigated to understand their impact on shooting mechanics. In the free throw trials, the average knee angle was 122.59 degrees with a standard deviation of 15.98, reflecting moderate variability. The elbow angles had an average of 79.28 degrees with a standard deviation of 10.74, showing slightly less variability than the knee angles. The results showed a negative correlation between the elbow and knee angles during free throw and a positive correlation during jump shot. These insights could inform player training and performance enhancement strategies.

Keywords: *basketball, free throw, jump shot, kinematics, lay-up; motion capture*

ID 759

Advanced Nanotechnology for Intracranial Pressure Monitoring: A Comprehensive Review of Carbon Nanotube Based ICP Pressure Sensors

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Intracranial Pressure (ICP) is a critical parameter that influences cerebral perfusion and brain oxygenation. Proper monitoring of ICP is vital, particularly for patients with traumatic brain injuries (TBI) and other neurological conditions. Traditional methods of ICP monitoring, including observational, imaging, non-invasive, and invasive techniques, present limitations such as insufficient data, inability to provide continuous monitoring, and potential complications from invasive procedures. Recent advancements in nanotechnology, particularly involving carbon nanotubes (CNTs), offer promising alternatives for ICP monitoring. CNTs exhibit exceptional mechanical and electrical properties, high-pressure sensitivity, and biocompatibility, making them suitable for developing novel pressure sensors. Fabrication of biocompatible and precise high sensitive pressure transducers with carbon nanotubes has been a field that is highly researched and encouraged. This paper explores the potential of CNT-based sensors for ICP monitoring, emphasizing their fabrication, biocompatibility, and biodegradability. Functionalized CNTs demonstrate enhanced biocompatibility and biodegradability, addressing some of the safety concerns associated with pristine CNTs. By leveraging nanotechnology, it is possible to overcome many of the limitations of current ICP monitoring methods, paving the way for more accurate, reliable, and continuous monitoring solutions. This review article explores the significant potential of CNTs in revolutionizing biomedical applications, particularly in the context of ICP monitoring and neurotrauma care.

Keywords: *carbon nanotubes, intracranial pressure, nanotechnology, piezoresistive transducers*

POSTER PRESENTATIONS

ID 78

Self-Sensing Concrete: A Breakthrough in Structural Health Monitoring- A review

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Conventional concrete acts solely as a structural material. It has no or very little sensing property. Self-sensing concrete is fabricated by adding functional fillers such as Carbon fibers, steel fibers, and Carbon nanotubes into a conventional concrete matrix. Stress, strain, crack, or damage in itself of concrete can be sensed through these functional fillers without disturbing or even improving the mechanical properties of concrete. Therefore, self-sensing concrete has both sensing and structural capabilities. Structural Health Monitoring (SHM) is a technology that provides data on the performance of structures at the initial stages before any serious damage occurs. Self-sensing concrete is a promising replacement for the traditional embedded or attached sensors used for SHM which suffer from high cost, low durability, and limited sensing volume. In the recent past much work has been done towards the development of self-sensing concrete and innovative achievements have been obtained. This paper reviews the concepts of smart civil engineering structures, structural health monitoring, self-sensing concrete, sensing mechanisms, conductive additives and concrete matrix. The performance of self-sensing concrete depends on various factors such as the type of external loading, type of functional fillers, concentration of functional fillers, properties of concrete matrix, and fabrication method. Therefore, calibration of self-sensing concrete becomes challenging, making it one of the main drawbacks of self-sensing concrete. The review underscores the importance of continued research and experimentation to unlock the full potential of self-sensing concrete for sustainable infrastructure development.

Keywords: *self-sensing; piezoresistive; smart civil structures; conductive additives; matrix element*

ID 708

The Impact of Plastic Waste as a Partial Replacement for Sand in Normal Strength Concrete

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Plastic waste is a significant environmental concern due to its negative impact on the ecosystem. This study investigated the use of waste plastic as a partial replacement for sand in M15 grade concrete and assessed its effects on the physical and mechanical properties of concrete. Ten concrete mixtures were prepared with varying levels of plastic substitution: 0%, 2%, 4%, 6%, 8%, 10%, 12%, 14%, 16%, and 18%. Concrete cubes measuring 150 x 150 x 150 mm were cast for each mixture to evaluate workability, unit weight, compressive strength, and tensile strength. Slump tests were performed on-site to assess workability. Two cubes from each mixture were cured in water and tested for compressive strength at 7 and 28 days. Results indicated that plastic replacement up to 10% improved mechanical and physical properties compared to conventional M15 concrete. This study highlights the potential benefits of incorporating waste plastic into concrete, including enhanced material properties, cost savings, and environmental benefits. Reusing waste plastic in concrete not only mitigates environmental issues related to plastic waste but also contributes to more sustainable and economical construction practices.

Keywords: *environmental sustainability; recycling; normal strength concrete; plastic waste*

ID 54

Wireless Underground Sensor Network for Soil Monitoring

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This study introduces a wireless underground sensor network (WUSN) for soil monitoring in Sri Lankan rubber plantations. Utilizing LoRa as the platform for communication between underground sensor nodes and an overground base station. we demonstrate that the robust transmission properties of LoRa radio signals are beneficial in difficult environments such as soil. Keeping the goal of long-term operation in mind, we reduce the battery drain by a logistic regression machine learning model that predicts successful transmissions based on soil moisture measurements to reduce powering up the radio interface. With these findings, the battery lifetime of the WUSN nodes is increased by 20%. We demonstrate the proof-of-concept of the WUSN by example measurements of soil parameters such as moisture, temperature and the concentration of nutrients important for the growth of rubber trees. The system allows monitoring the soil parameters in real time which simplifies the observation of rubber tree plantations, but can also be applied to other cultivations.

Keywords: *smart farming, rubber plantation, Wireless Underground Sensor Networks, LoRa, soil condition monitoring, power efficiency, logistic regression*

ID 68

Design and Development of a Wall-Climbing Robot for Wall Inspection and Crack Detection

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Mobile robots have been very popular in industries to perform various tasks. The problem of manual inspection of concrete walls, is that it requires highly trained operatives and various tools to analyze and identify cracks that pose future threats to structural integrity, which is also a dangerous task considering human lives. Our objective here was to introduce a solution to all the above-mentioned problems and to use robotics to make this task even easier. To address this, a wall-climbing robot was designed, developed, and fabricated for wall inspection and crack detection. The robot's design incorporates two ducted fans; one maintains grip on the wall, while the other counterbalances the robot's weight. For locomotion, four directly coupled Mecanum wheels are present. The robot is controlled using a wireless RC transmitter and receiver. The inspection and crack detection system, uses an ESP-32 camera module externally mounted on the robot for wall inspection and a Canny edge detection algorithm integrated into the robot's microcontroller for crack identification. Following these stages, the robot and its crack detection algorithm underwent rigorous testing on various wall surfaces such as concrete, glass, cement and in varied light conditions such as noon, evenings, and cloudy conditions as well to simulate its practicality. We can deem the project successful in the expected disciplines, but with further developments and with more budget, this robot has the potential to go beyond crack detection and work on various other remote uses which is hostile in nature to use manual labor.

Keywords: *wall climbing robot, mobile robot, mecanum wheels, wall inspection, crack detection*

ID 128

Bidirectional Power Conversion Redefined: A review on the Superiority of Dual Active Bridge (DAB) Converters

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Present-day energy systems widely employ the dual active bridge (DAB) converter, which is a very adaptable DC-DC power conversion technology. Its capacity to provide bidirectional power flow while maintaining galvanic separation between the input and output circuits is its main characteristic. Owing to this feature, it is especially well-suited for a variety of industries, including grid applications running at low to medium voltages, battery systems, solid-state transformers, and renewable energy. It is constructed using eight MOSFETs/IGBTs, one driver for each MOSFET, high frequency galvanic isolation transformer, auxiliary inductor, two DC link capacitors, and two semiconductor fuses. Using the MOSFETs, two full bridge circuits were designed, and those two full bridge circuits are connected using the high frequency galvanic isolation transformer. A driver is used for each individual MOSFET, which gives the respective high frequency switching signals to the MOSFET and the switching signals which are generated by the microcontroller are fed to the driver. According to the phase shift ratios of switching signals that are given to the MOSFETS and Dead Time ratio, the direction of the power flow is decided. When it comes to renewable energy, the DAB converter is essential because it effectively connects intermittent energy sources like wind and solar photovoltaic (PV) to the grid or storage systems. It guarantees excellent energy transfer efficiency, permits smooth power conversion, and adjusts to changing input circumstances. Similar to this, the DAB converter controls battery charging and discharging in battery energy storage systems (BESS), enabling bidirectional energy flow and preserving maximum efficiency.

Keywords: *Dual Active Bridge (DAB) converter, bidirectional power flow, galvanic isolation*

ID 178

Development of a Footstep-Powered Energy Harvesting System Using Piezoelectric Materials for Military Applications

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In military operations, which often span several days, relying solely on traditional power sources is impractical, as communication equipment must always remain operational. Although storage can be facilitated using traditional energy generation techniques such as solar panels to store energy for up to four to five days, it often relies on factors like the weather or constant camouflage. Piezoelectric technology is increasingly recommended for military applications over traditional power generation methods. This project proposes a reliable solution by developing an effective footfall energy harvesting system specifically designed for the use in terrains like jungles. With this system, each step soldiers take generates energy, allowing them to recharge their battery backups. This innovation enhances both the operational efficiency and resilience of the soldiers. This environmentally friendly approach has the potential to fulfil the energy demand required for military operations that are conducted in isolated and restricted areas. The proposed system aims to maximize energy conversion while ensuring robustness and reliability under challenging conditions. It also offers a durable and effective solution by harvesting energy from foot traffic and decreasing reliance on external power sources.

Keywords: *footstep energy harvesting, power generation for military applications, piezoelectric power generation*

ID 404

Efficient Smart Home System Using IoT and Arduino for Enhanced Automation and Security

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The purpose of this research is to create the smart home concept that is convenient and safe and at the same time, energy efficient. The technologies that are being used in the system include home automation, smart energy efficient appliances, voice recognition and control, home monitoring through an application, smart security by fingerprint and energy control. Using IoT, the system compels the homeowner to control and monitor the various devices in the home with the objective of reaching the preferred level of comfort and energy conservation. The smart security system employs fingerprints for the identification of people, the same system gives alerts whenever there is an intrusion. In addition, the temperature control option operates in cooperation with an air cooler and a water heater, providing comfort while saving power. This is proven in the result with a success rate of 99% for remote access and 97% accuracy as per the voice command. The initial use of the security system gave a False Acceptance Rate (FAR) of 0% and False Rejection Rate (FRR) of less than 1%. The main benefit of the suggested solution is still in its cost and implementation benefits opposed to the existing smart homes systems, as well as by the flexibility depending on the space. Such implications have emerged to suggest that home automation has the ability to transform conventional homes to be smart and efficient in energy use, security, among other aspects.

Keywords: *smart home, IOT, home automation, fingerprint recognition, remote control, energy efficiency, voice control*

ID 453

Driver Drowsiness Detection and Accident Alert System

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The issue of driving when drowsy remains a global concern in road safety, often leading to accidents due to delayed driver responses. Additionally, the limited awareness of emergency units exacerbates the consequences of such accidents. To address these challenges, we have developed an integrated system aimed at enhancing road safety by mitigating the occurrence of accidents due to drowsy driving and ensuring a swift emergency response when accidents occur. The drowsiness detection system utilizes an IR sensor embedded in a glass frame, focusing on detecting prolonged eye closures, a key indicator of drowsiness. Upon detection, the system triggers a buzzer and vibrator to alert the driver. The accident alert system integrates a GPS and accelerometer module to detect sudden vehicle movements indicative of an accident, automatically sending location-based alerts to specified emergency units via GSM. The methodology involved rigorous testing under various driving conditions to evaluate the system's accuracy and response time, resulting in a drowsiness detection accuracy of 95.7% during daytime and 91.1% at night, with an average end-to-end latency of 3.5 to 6.5 seconds for the accident alert system. This study demonstrates that the proposed system provides an effective solution for enhancing driver safety, with potential for large-scale implementation.

Keywords: *drowsiness detection, accident alerts, emergency response, driver safety*

ID 542

Smart Liquified Petroleum Gas (LPG) Level Monitoring System with Gas Leakage Detection System

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This paper presents the development and implementation of a comprehensive gas monitoring and leakage detection system for Liquified Petroleum Gas (LPG) cylinders, aimed at enhancing safety and efficiency in gas usage. The system integrates load cell technology for precise weight measurements, MQ2 gas sensors for effective leakage detection, and the Blynk application for real-time remote monitoring and alerts. Key achievements include accurate gas level monitoring, timely detection of gas leaks, and seamless remote access, demonstrating significant improvements in gas safety management. Challenges encountered during the project included high costs of electrical components, calibration of the load cell, component failures, and the need for self-taught coding skills. Despite these hurdles, the project successfully achieved its objectives, providing valuable insights into electronic component integration, coding proficiency, and critical problem-solving skills. The report also addresses limitations such as the limited range of the MQ2 gas sensor, the accuracy constraints of the load cell, the need for an external power source, and the structural reliability of wood. Future work is proposed to enhance the system's capabilities, including improved sensor accuracy, expanded detection range, battery-powered operation, and the use of more durable materials. The project's significance lies in its potential to be scaled and customized for commercial use, offering a robust solution for gas safety in various settings. The system's ability to provide real-time monitoring and immediate alerts ensures proactive measures, contributing to safer and more efficient gas usage.

Keywords: *IOT gas monitoring, LPG leak detection, real-time monitoring, MQ2 gas sensor, load cell*

ID 752

Review of Different Business Models Applicable for a Community Microgrid

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The rising global energy demand and CO2 emissions over the past decade have emphasized the need for sustainable energy solutions. Microgrid systems, integrating power generation from renewable energy, and demand-side management offer a promising approach in addressing these challenges. A systematic literature review was conducted with the main aim of exploring the role of business model flexibility in attaining a balance between reliability, sustainability and cost-effectiveness in the process of implementations and operation of community microgrids. Utilizing over twelve research papers sourced from electronic databases and journals such as IEEE, ResearchGate, ScienceDirect, and Google Scholar, the authors systematically reviewed the existing business models related to microgrids. This includes customer owned business models, utility-owned business models, third-party ownership business models, energy service company business models (ESCO), energy-as-a-service models (EaaS), anchor business models, and pay-as-you-go business models. The findings highlight the importance of business model flexibility in balancing reliability, sustainability, and cost effectiveness, thus ensuring the successful implementation of community microgrids.

Keywords: *community microgrid, business model, renewable energy*

ID 373

A Comprehensive Review of Cardiac Output Determination and Radial Pulse Analysis Using Piezoelectric Sensors

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Cardiovascular conditions are a significant cause of death globally, with millions of deaths annually worldwide. To evaluate cardiovascular conditions effectively, the analysis of the arterial pulse wave can be a convenient approach. Radial pulse waves can give more information on cardiovascular function including blood vessel property changes, respiration alterations, and autonomic nerve access. In recent years, a considerable amount of work has been done on the modernization of the use of pulse diagnosis technology which has utilized the available modern technologies. Pressure sensors are common in the detection of pulsatile changes in arterial pressure. Piezoelectric sensors directly convert the pressure signals (mechanical vibrations) into electrical signals as they are sensitive to pressure. Due to their super performance abilities and compatibility with signal processing methods, piezoelectric sensors are one of the choices for capturing radial pulse signals in research setups. The radial pulse wave is mostly used to determine blood pressure, blood flow, arterial stiffness, heart rate, left ventricular stroke volume, systemic vascular resistance, and vascular compliance. Additionally, different estimators, which are used in arterial pulse analysis, and other approaches like Doppler ultrasonography and radionuclide angiography, estimate cardiac output. This review article explores the advancements in determining cardiac output through Radial pulse using Piezoelectric sensors.

Keywords: *cardiac output, Piezoelectric sensors, pulse wave, radial artery*

ID 790

Enhanced Pulse Simulator for Medical and Nursing Students

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This paper presents a sensation pulse simulator for the training of clinical staff. It is expected to provide healthcare students and clinical staff with a comprehensive understanding of pulse for both educational and diagnostic purposes. The challenge of effectively teaching healthcare professionals, particularly in pulse assessment, is a pressing issue in the field. Traditional teaching methods often fail to provide a truly immersive and effective learning experience for students. To address this issue, a prosthetic hand was developed that serves as a valuable tool for students to practice pulse assessment in a controlled, repeatable, and responsive environment. The algorithm was designed to display pulse alongside other vital physical parameters, highlighting any abnormalities for questioning and further analysis. A 3D design of the arm and a box housing the circuit were prepared. The results were presented in the form of graphs derived from the data collected. The results were analysed through a web page developed as a laptop server using Visual Studio software. These visual representations depict the dynamic parameters of heart rate, blood pressure, and SPO2 level over time, providing valuable tools for monitoring and analysing vital health metrics and informing proactive healthcare decisions.

Keywords: *Bradycardia, LCD display, PCB Design, pulse, ESP32, Tachycardia, vibration motor*

ID 800

A Novel Air Bubble Removal System in Infusion Pumps Utilizing Vacuum and Air-Permeable Membrane Technology for Enhanced Patient Safety

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Bubbles of air within the IV infusion lines are dangerous and common where incorrect estimation of fluids is inhibited. In the past, most of the standards included removal of the liquid from the IV tube by pulling out the infusion to remove the bubble; this results in a reduction of the quantity of liquid that is infused into the patient. This paper presents a novel air bubble removal system in combination with an infusion pump. The overall intended procedure is to be set up for a continuous fluid supply through the vacuum type of air filter which involves a vacuum-assisted removal made of an air-permeable membrane through which the air bubbles are filtered out from the IV tube without having to stop the process. It requires the formation of the motor sensor system connected to the pumping equipment and controlled by the Raspberry Pi Pico microcontroller. This system was designed in a way that air bubble formation is reduced and will not require any intervention. Among these, some show how the system provides control over the flow of fluids and how it may be used to enhance the protection of patients and the effectiveness of the overall healthcare program. In conclusion, this solution provides the automation of air bubble removal thus ending fluctuating fluid supply and air embolism. The evolution of infusion pumps will make the device more reliable and safer in the healthcare environment in the future.

Keywords: *air bubble removal, infusion, IV tube, vacuum-assisted removal*

ID 804

Designing an IoT-Enabled Syringe Pump with Remote Monitoring Features

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Syringe Pump is an essential medical device widely used in healthcare settings for the precise and controlled administration of medications, or therapeutic agents to patients continuously via intravenous infusion, particularly in small volumes. However, traditional syringe pumps require constant monitoring by healthcare professionals to ensure accurate delivery, which poses significant risks in situations where interruptions occur or caregiver availability is limited, such as during pandemics and midst of war. This article presents an innovative IoT-enabled smart syringe pump to address the limitations of conventional syringe pumps by integrating remote monitoring features. The proposed device combines a syringe pump motor mechanism with ESP32 WRoom microcontroller, facilitating a customized operational process and an enhanced alerting system. The implementation of this IoT-enabled solution is pivotal in meeting the specific requirements of syringe pump operations while ensuring seamless functionality. This paper details the design process and establishment of wireless communication for real time device performance monitoring. Ultimately, the IoT-enabled smart syringe pump represents a significant step towards enhancing medication delivery efficiency, significantly enhancing patient safety and recovery outcomes in diverse healthcare environments.

Keywords: *ESP32 WRoom, IOT, medication delivery, remote monitoring, syringe pump*

ID 173

Optimizing Vertical Axis Wind Turbines to Suit Sri Lankan Residential Applications

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The increasing global demand for sustainable energy solutions has led to a growing interest in harnessing wind energy. This study focused on the optimization of Vertical Axis Wind Turbines to address the unique challenges and opportunities present in Sri Lanka. The country's tropical climate and diverse topography offer a rich potential for wind energy. Attuning wind turbines for household use presents an innovative approach to meet local energy needs. The study employed a multidisciplinary approach, integrating aerodynamics, structural engineering, finite element analysis, computational fluid dynamics, and environmental considerations to design and optimize a vertical axis wind turbine for efficiency and reliability. A comprehensive review of existing wind turbine technologies and their suitability to Sri Lanka serves as the foundation for this study. A weather pattern analysis is done to understand wind energy generation potential in Sri Lanka. Energy consumption patterns and the energy demand also studied, emphasizing the adaptability of wind turbines in Sri Lanka. This study present a VAWT with less cost per Watt and higher rated power compared to its counterparts in the market. This aims to enhance energy security, reduce carbon emissions, and promote sustainable development in the region. The findings provide insights into the field of renewable energy, with the potential to inspire similar initiatives in other tropical regions facing similar energy challenges.

Keywords: *wind energy, vertical axis, wind turbine, hybrid turbine*

ID 283

Automated Fabric Hook-and-Eye Closure Feeding System

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Pad printing is a popular tampography method used in garment manufacturing for printing a two-dimensional picture onto a three-dimensional object. Currently, Sri Lankan apparel industry utilizes human operators to insert, position and remove fabric pieces for the pad printing process. This study developed an automated solution for the insertion and removal of bra eye closures to a pad printer. The implemented system consists of a vacuum suction gripper coupled with a linear actuator, a fabric separation mechanism, and a vacuum suction generator. The system was designed, fabricated, and tested for validation at an apparel manufacturing facility. Experimental testing in the production environment demonstrated an accuracy of 88% in separating and positioning fabric samples for printing. This study used an innovative approach to automating a labour-intensive process in the apparel industry, showcasing the potential of integrating mechanical design and automation in manufacturing systems.

Keywords: *automated fabric feeding, fabric handling, vacuum suction, fabric gripping, pad printing, hook-and-eye*

ID 289

Numerical Study of Single Stage Travelling Wave Thermoacoustic Generator Through Regenerator Optimization

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Clean energy has become a key factor in the modern world due to the lack of sustainable and clean energy sources. Low-grade thermal energy sources are common in the world and have the potential to fulfil a significant amount of energy demand. The thermoacoustic technology can be utilized to convert low-grade waste heat into acoustic and then into electricity without involving any environmental destruction. Due to the potential of the development of a sustainable energy system, thermoacoustic has become an emerging modern technology. Compared to the standing wave thermoacoustic devices, the travelling wave devices are more efficient due to their phases of pressure and velocity being in the same phase. Research is being carried out worldwide and the effect of the design parameters towards on the energy conversion efficiency of the device needs to be analyzed further. In this study, a single-stage travelling wave thermoacoustic engine was analyzed utilizing an existing computational model that has been validated with experimental data and discussed in literature. The diameter of the regenerator towards the energy conversion efficiency was analyzed. In compliance with the simulation data, a diameter of the regenerator was found to have given a minimum energy conversion efficiency, except, at that point, the conversion efficiency gradually increased by either increasing or decreasing the diameter of the regenerator. During the study, the length of the regenerator and the temperature of the hot heat exchanger were kept constant.

Keywords: *thermoacoustic, travelling wave, regenerator, heat recovery, DeltaEC*

ID 347

Design of an AI-Assisted Digital Flight Data Recording System for Sri Lanka Air Force Light Aircraft

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A flight recorder, commonly referred to as a black box, is regarded as the most crucial source of information in the investigation of air accidents. Since the 1950s, flight recorders have been recognized as essential components of onboard equipment for both military and civilian aircraft worldwide. These devices are invaluable not only for analysing flights after unexpected incidents but also for pilot training, evaluating pilot skills, diagnosing onboard systems, and assessing the performance of aircraft systems. Consequently, flight recorders play a significant role in ensuring high aircraft reliability and aviation safety. This research project introduces a digitalized Flight Data Recorder (FDR) system designed for light aircraft, aimed at enhancing aviation safety. The primary objective of this system is to accurately record essential flight parameters to improve the analysis and understanding of aircraft performance and safety. The system integrates with various sensors, including an accelerometer, and Pitot tube with an airspeed sensor. The paper looks at methodology, design issues, and testing steps of the Flight Data Recorder (FDR) system development. The early stages of this project showed that it had a reliable and accurate system during test flights as well as for collecting and monitoring critical flight data.The integration of more sensors in tandem with AI-driven functionalities to enhance its capacity further will be studied further. These findings provide insights into how important these advanced FDR systems are for light aircraft operations. This AI-enhanced FDR system uses state-of-the-art technology to improve aviation safety.

Keywords: *flight data recorder, light aircraft, aviation safety*

ID 393

Designing a Noise Reduction Propeller System for DJI Matrice 300 Drone

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This study on designing a noise reduction propeller system for the DJI Matrice 300 drone addressed the growing concern of noise pollution, user safety, and regulatory compliance posed by unmanned aerial vehicles (UAVs). The project aimed to develop an innovative solution to mitigate the noise generated by the drone, focusing on the design of a "Toroidal" propeller. Initial assessments of noise levels from standard propeller designs were conducted to establish a baseline for comparison. The Toroidal propeller design was chosen for its potential to reduce noise emissions while maintaining the drone's thrust, overall performance, and flight stability. Using SolidWorks, the propeller design was modelled and then 3D printed for testing. The tests demonstrated a significant reduction in noise emissions compared to standard designs. This outcome highlights the effectiveness of the Toroidal propeller in addressing noise pollution concerns associated with UAVs. The paper concludes by emphasizing the potential impact of the project's findings on the drone industry, particularly in terms of reducing noise pollution, improving user safety, and ensuring regulatory compliance. Future research could explore improvements to the propeller design and its application in different UAV models and environments.

Keywords: *accident alert system, GPS technology, GSM, Arduino, accelerometer, emergency response, fatalities, awareness, rural areas, advanced technologies*

ID 684

Factors Influencing Human Error in the Aviation Industry

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Despite substantial improvements in technological reliability and system safety, human error remains the prominent cause of accidents in the aviation industry. There is a pressing need for enhanced methodologies to model the factors leading to human error incidents. This study employed the errors caused by employees to analyze and model the correlation between causal factors contributing to aviation mishaps. A comparative analysis of documented and non-documented accident/ incident data focused on general aviation maintenance to systematically assess the impact of human errors and identify potential causal factors. The methodology was built upon prior research in understanding causal relationships, utilizing Structural Equation Modeling (SEM) to simulate the complex relationships between accident/incident causation and the triggering factors behind them. Additionally, a framework was established using the Human Factors Analysis and Classification System to pinpoint key areas that the stakeholders of aviation safety should focus on to reduce similar human errors in the future. The findings demonstrate an insightful approach to assessing the quantitative correlations between causative elements, offering insights not easily obtainable from occurrence rate analysis alone. Additionally, the findings elucidate theoretical and managerial implications to minimize human errors, thus enhancing the overall safety and quality of aircraft maintenance. The paper discusses the practicality of the framework, and its potential applicability to the other domains of aviation, and suggests avenues for future research.

Keywords: *human error, aircraft maintenance, aviation accidents, latent conditions*

ID 834

Optimization of the Performances of P 47 Series Fast Attack Craft in Sri Lanka Navy Using AI-Driven Hydrodynamics Analysis

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The P 47 series Fast Attack Craft (FAC) of the Sri Lanka Navy has been designed to achieve a design speed of 40 knots. Presently, the P 47 series consists of 05 No's of FACs namely P 471, P 472, P 473, P 474 and P475 which have the capability of reaching the maximum speed of 40 knots during post-slipping trials on completion of Routine Under Water Maintenance (RUWM) or Hull Cleaning design. However, after one to two months of operation, the maximum achievable speed of the craft is reduced to 25 – 28 knots gradually. This significant performance drop of P 47 series FAC has affected its speed, acceleration, and manoeuvrability. Consequently, this reduction compromises the operational efficacy of the vessels and creates considerable barriers to naval operations. Therefore, this study aimed to investigate the primary causes of these problems and also to propose suitable solutions. A comprehensive analysis using NavCad software and Savitsky method was employed to simulate/model the craft's hydrodynamic behaviour under various load conditions with LCG shifts and adjustments to weight distribution and experimental trials were carried out to validate the theoretical models. This investigation provides empirical evidence and practical solutions for a long-lasting issue of performance reduction in P 47 series FAC in the Sri Lanka Navy while filling the gap of available literature. The research findings enhance the understanding of planning hull dynamics while providing actionable insights for naval architects, engineers and decision-makers. Further, this study provides directions to explore further optimization techniques and real-world applications in future

Keywords: *performance drop, fast attack craft, hydrodynamic analysis, planning hull*

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