KDU IRC
INTERNATIONAL RESEARCH CONFERENCE 2023

16th INTERNATIONAL RESEARCH CONFERENCE

ACHIEVING RESILIENCE THROUGH DIGITALIZATION, SUSTAINABILITY AND SECTORAL TRANSFORMATION

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 16th International Research Conference of General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka held on the September 7–8, 2023.

Tel : +94 71 021 9392
E-Mail : irc2023@kdu.ac.lk
Website : https://irc.kdu.ac.lk/2023

ISBN: 978-624-5574-99-5

Published on September 07, 2023.

Coverpage is designed by Mr. Anuradha Nanayakkara.
Book is designed and typeset using LaTeX.

Published by
General Sir John Kotelawala Defence University,
Ratmalana, Sri Lanka.

Conference Chair
Dr Aruna Dharshan de Silva

Conference Secretary
Dr Thamarasi Senaratne

Conference Co-Secretaries
Mr Dulitha Hewadikaram
LCdr Sujith Senadhipathi
Mr Sithija Priyankara Fernando

Steering Committee

Brigadier DCA Wickramasinghe USP USACGSC – President

Cmde (E) MCP Dissanayake
Col RKARP Ratnayake RWP USP psc
Lt Col JDB Jayaweera RWP RSP psc

Prof KAS Dhammika
Prof CL Goonasekara
Snr Prof SR de Senevirathne
Dr HR Vidanage
Mr VD Kithsiri
Dr LS Liyanage
Dr KW Samarakoon

Editorial Committee

Session Coordinators

Defence and Strategic Studies	**Col RKARP Ratnayake** – President Maj DAH Egalla Mr KKP Ranaweera
Management, Social Sciences and Humanities	**Mr WAAK Amaratunga** – President Ms MPM Waleboda Mr KPJ Bemidu Ms BCT Wickramasinghe
Medicine	**Col (Prof) A Balasuriya** – President Dr GRNN Waidyarathna Dr LS Kaththiriarachchi
Engineering	**Prof TL Weerawardane** – President Dr NS Miguntanna Dr DDTK Kulathunga Mr IMCWB Kohombakadawala
Law	**Mr WS Wijesinghe** – President Ms BKM Jayasekara Ms KMMM Jayathilake
Allied Health Sciences	**Surg Capt NRP Perera** – President Dr DDN Wimalarathna Mr ARN Silva Ms MDC Silva
Built Environment and Spatial Science	**Dr AH Lakmal** – President Archt NMRAT Nawaratne Ms SMM Sanjunee Ms WN Kawmudi Syr NV Wickramathilaka Mr WKD Ramese
Computing	**Dr ADAI Gunasekara** – President Dr MWP Maduranga Ms WMKS Ilmini
Basic and Applied Sciences KDU-CARE	**Prof TL Weerawardane** – President Dr HS Jayasinghearachchi Dr GU Jayaweera Dr AI Kuruppu

Technology	**Prof KMGP Premadasa** – President Prof PG Rathnasiri Mrs RMDS Rasnayake
Criminal Justice	**Deshabandu Prof MADSJS Niriella** – President Mr B de Silva Ms KGL Chamuddika

Contents

Page

Power Generation through Wastewater using Microbial Fuel Cell 2

Analysis on the Components of a Crisis Management Model to be Developed for the Sri Lankan Construction Sector 3

Evaluate the Performance of Sri Lanka Navy Built Brackish Water Reverse Osmosis Plants in Chronic Kidney Disease of Unknown Etiology Impacted Areas in Sri Lanka 4

Quantifying the Impact of Uncertain Material Parameters on Pavement Response using an Inverse Modelling Technique 5

Internet of Things Intravenous Bag Monitoring and Alert System 6

Advancements in Manikin Technology: Enhancing Realism and Effectiveness in Nursing Education 7

An Overview of Techniques of Acoustic Analysis for the Detection of Obstructive Sleep Apnea 8

Thermography and Thermal Sensors as a Breast Cancer Early Diagnostic Technique: A Review 9

Gesture Controlled Glove for a Military Team's Communication 10

Design of an Active Flow Control Method for a 3-D Wing 11

Development of a Low-Cost Energy Harvesting Floor Tile that Operates from Footsteps . . 12

Empirical Feasibility Study to Design and Build Rigid Hull Inflatable Boat for Special Operation Units in Sri Lanka Navy 13

Development of a Dough Dividing Machine with Counting Ability for Local Bakeries in Sri Lanka 14

Automatic Clothesline Retrieval System for Domestic Purposes 15

Investigation of Trends in Multiday Extreme Rainfall 16

Estimation of Probable Maximum Precipitation in the Context of Climate Change 17

Preliminary Wave Energy Assessment to Setup a Breakwater Type Oscillating Water Column Ocean Wave Energy Converter at Hambantota Port, Sri Lanka 18

Application of HEC-RAS 2D Model to Simulate Scour Depth Around Bridge Piers: A Case Study on Hanwella Bridge, Sri Lanka 19

Automatic Clothesline Retrieval System for a Balcony 21

Design and Fabrication of a Coconut Sorting Machine 22

Aerodynamic Performance of Smooth Selectively Superhydrophobic Flat Plates: A Numerical Approach 23

Implementation of Arduino based Internet of Things Home Automation Systems in Sri Lanka 24

Gripper-Enhanced Fabric Cut Piece Sorting System based on Defects 25

Development of Intelligent Outdoor Camera Sabotage Detection System for Large Scale Camera Systems using Deep Learning 26

Review on Intra-Body Communication using Galvanic Coupling for Wearable Devices . . . 27

Indoor Human Following Assistive Robot with Fall Detection Capability for the Elderly and the Differently Abled 28

Design and Develop an E-Rickshaw as a Sustainable Energy Solution 29

Development of a Novel Sanitization Method for Aircraft Lavatory 30

Software Defined Radio Based Drone Detection using Machine Learning Algorithm 31

Continuous Blood Glucose Monitoring Techniques: A Review 32

Development of an Efficient Automated Tea Making Machine with Customized Ingredient Levels 33

Modern Accident Alert System for Vehicles using Global Positioning System Technology . . 34

Advances in Muscle Fatigue Detection: A Comprehensive Review 35

Review on Mathematical Models used to Estimate Inner Temperature Variations of Female Breast 36

Smart Gas Leak Management System 37

Development of an Automated Clothesline System 38

Water Treatment Efficiency of Aerator and Roughing Filter in Treating Groundwater : A Case Study in Mullaitivu of Sri Lanka 39

Barriers for Pedestrian Related Road Crash Analysis in Identifying Engineering Countermeasures 40

ORAL PRESENTATIONS

ID 040

Power Generation through Wastewater using Microbial Fuel Cell

GDSSR Samarasinghe[1#] and MB Samarakoon[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]sachithsam11@gmail.com

Abstract

A Microbial Fuel Cell (MFC) is a device that converts chemical energy into electrical energy with the help of microorganisms. This research uses MFC to compare the power generation from two wastewater samples using carbon and copper electrodes. It is currently underway to explore the feasibility of utilizing MFC technology in Sri Lanka to generate electricity while simultaneously treating wastewater and identifying the system which produces the maximum electricity. Among the MFC technology systems, the Batch mode dual-chambered MFC system has been used throughout the research. This research compared four scenarios using 8 MFCs, each with two unique wastewater samples and electrodes. One litre of wastewater could produce an optimum voltage of 694.0 mV using copper Electrodes and 545.1 mV using carbon electrodes. The two wastewater samples, the effluent of a factory and a treatment plant inlet, have been comparatively tested on their performance. Parameters like Biochemical Oxygen Demand 5 (BOD5), Chemical Oxygen Demand (COD), total nitrogen, total phosphorus, pH, and temperature have been tested by a laboratory to check the possibility of treating the wastewater while generating electricity. Wastewater samples were successfully neutralized with a pH level of 6.8-7, BOD5 levels decreased by 7 mg/l and 6 mg/l, COD values dropped by 30 mg/l and 16 mg/l, total nitrogen levels reduced by 12.6 mg/l and 11.2 mg/l, total phosphorus levels decreased by 0.3 mg/l and 0.1 mg/l, in plant inlet and factory effluent respectively at room temperature after using MFCs.

Keywords: *Microbial fuel cell, Wastewater treatment, Effective parameters, Bioelectricity*

ID 051

Analysis on the Components of a Crisis Management Model to be Developed for the Sri Lankan Construction Sector

SP Ranasinghe[1#] and R Abeysekara[2]

[1]International Institute of Cambodia University of Technology, Phnom Penh, Cambodia
[2]IDM Campus, Dehiwala, Sri Lanka

[#]s.prasanshani@iic.edu.kh

Abstract

The construction sector in Sri Lanka is one of the diversified sectors. Further, it is one of the main contributors to the economy of the country. In addition construction sector is highly labor-intensive. In the recent past, the sector has faced many challenges due to many different types of crises such as the COVID-19 pandemic, the economic crisis in the country etc. Therefore, the need for a crisis management model is identified. This research focuses on the components to be considered when developing a crisis management model for the construction sector in Sri Lanka. The research is conducted as quantitative research where the conceptual framework is developed from the literature review and based on the same, a questionnaire survey is conducted. The research participants include industry experts who have many years of industry experience. The outcomes of the data analysis are represented in this paper together with a discussion on the findings of the research. Accordingly, the components to be considered in the development of a crisis management model in the construction sector have been identified in this research. The final data analysis has been used for the purpose of understanding the components to be considered when developing a crisis management model.

Keywords: *Crisis in construction, Crisis management, Crisis management model*

ID 189

Evaluate the Performance of Sri Lanka Navy Built Brackish Water Reverse Osmosis Plants in Chronic Kidney Disease of Unknown Etiology Impacted Areas in Sri Lanka

MCP Dissanayake[1#], NVL de Silva[1] and MCH Chandrasiri[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]dissanayakemcp@kdu.ac.lk

Abstract

The epidemic of Chronic Kidney Disease of unknown etiology (CKDu) has become a health catastrophe for over 3.6 million population in Sri Lanka. Though the etiology of CKDu is unknown, studies revealed the synergic effects of Arsenic and Cadmium as their triggering factors. Consequently, some researchers have emphasized that the quality of drinking water might be the cause of this life-threatening crisis. Sri Lanka Navy (SLN) introduced a sustainable water supply concept in CKDu-impacted areas and provided safe drinking water to more than 2 million people since December 2015 through 1,000 Brackish Water Reverse Osmosis (BWRO) plants. As a result of that, the CKDu prevalence in Sri Lanka drastically came down. However, the membrane fouling in several places is a major drawback which declines permeate flux and the lifetime of the membrane, and increases transmembrane pressure (TMP). To find a suitable solution to minimize membrane fouling, a group of researchers decided to assess the performance of SLN-built BWRO plants based on the quality of product water to achieve Sustainable Development Goals No 6. The groundwater of Dug well (water source) had raised unacceptable levels of alkalinity (94.45%), TDS (61.11%), and hardness (83.34%) as per specified standards. Subsequently, it was revealed that the Fluoride level (< 5mg/L) of the product was lower than defined standards and leading to health issues. SLN-built BWRO plants are 100% operational and supply purified water as per World Health Organization and Sri Lanka Standards to CKDu impacted community. It is recommended to enhance the recovery ratio up to 75%, mix permeate with pre-treated water and improve the minerals level of product water. Further recommends integrating Softner filter to pretreatment process when feed water has more hardness, then treat the reject water and release to the atmosphere.

Keywords: *Brackish water reverse osmosis, Chronic Kidney Disease of unknown etiology, Safe drinking water, Sri Lanka Navy*

ID 347

Quantifying the Impact of Uncertain Material Parameters on Pavement Response using an Inverse Modelling Technique

P Kathirgamanathan[1#] and M Vignarajah[2]

[1]Faculty of Engineering, University of Jaffna, Jaffna, Sri Lanka
[2]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]pkathir@jfn.ac.lk

Abstract

Accurate modelling of pavement response plays a critical role in the effective design, analysis, and maintenance of road infrastructure. However, the presence of uncertainty in material parameters can significantly compromise the reliability and accuracy of such models. This study focuses on investigating the impact of uncertain material parameters on pavement response by employing an inverse modelling technique. The objective of this research is to utilize an inverse modelling approach to assess the influence of uncertain material parameters on Uzan's model, a commonly used model for pavement response. The study considers measured stress and strain values obtained from tyre and Falling Weight Deflectometer load conditions applied to granular materials. The inverse model is formulated as a nonlinear least squares minimization problem, in conjunction with a finite element model that analyses the deformation of flexible pavements. Through the application of the inverse modelling technique, this study aims to determine the extent to which uncertain material parameters affect the accuracy of pavement response predictions. By comparing the predicted pavement behaviour derived from the inverse model with actual measured data, the influence of uncertain parameters can be quantified. The outcomes of this research contribute to advancing the understanding of the complex interplay between material parameter uncertainties and pavement response.

Keywords: *Finite element modelling, Inverse problem, Parameter estimation, Pavement response*

ID 223

Internet of Things Intravenous Bag Monitoring and Alert System

BHMD Wijesinghe[1#] and DDGR Karunarathne[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]38-eng-21-0032@kdu.ac.lk

Abstract

This research highlights the need of an Internet of Things (IoT) Intravenous (IV) Bag Monitoring and Alert System in the medical industry, especially in developing countries like Sri Lanka, and how it can be designed. One of the most important tasks which should be given proper care and attention is IV therapy, which is a medical technique used to deliver medication, fluids and nutrition directly into a person's vein. However, IV treatment requires routine inspection and replacement which is done manually by the medical staff. This can be a difficult and worrisome task in busy hospitals as it is inconvenient to attend to every patient individually while attending to other important tasks as well. Hence, as a solution to this problem, this research introduces an IoT based IV Fluid Monitoring and Alert System which detects the weight of the IV bag as the fluid level goes down and displays the weight of the IV bag on a Liquid Crystal Display display in a common place where the medical staff can easily observe. Also, the nurse in charge can monitor the IV level with her phone while alert notifications are sent at required levels when the IV fluid is gradually decreasing.

Keywords: *IV fluid, Arduino, IoT*

ID 441

Advancements in Manikin Technology: Enhancing Realism and Effectiveness in Nursing Education

UH Abeysuriya[1#], KG Samarawickrama[1], WLPK Wijesinghe[1], IMCWB Kohombakadawala[1], SAC Dalpatadu[2], JRS de Silva[3], and EHADK Hewadikaram[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka
[2]Faculty of Medicine, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka
[3]Lady Ridgeway Hospital, Colombo, Sri Lanka

[#]uviharsh@gmail.com

Abstract

With the modern advancement of technology, use of manikins plays a major role in nursing education. Manikins are anatomically accurate simulators that replicate human physiology and provide a realistic representation of patients in various clinical scenarios. The historical development of manikins originated from 18th century by introducing the anatomical models in nursing education. The simulation-based training was evolved by the manikins as rudimentary mechanical simulators enabled the learners to practice basic skills, such as bandaging or intramuscular injections, on realistic models. With the technological progression, different types of manikins have been developed based on level of fidelity, functionalities incorporating realistic physiological responses and educational outcomes for nursing students to develop a wide range of skills and competencies. With the diversity of manikins, the nursing students are exposed into realistic complex clinical scenarios where they enhance their clinical skills, critical thinking and decision-making abilities in a safe and controlled environment. Several future trends and challenges are expected to alter the development and usage of manikins in nursing education with the integration of embedded sensors, wireless connectivity, virtual and augmented reality. Ongoing research, interdisciplinary collaborations and adherence to ethical considerations are necessary to enhance the effectiveness and realism of manikin-based simulations and to ensure that manikin-based education remains aligned with evolving educational needs and professional standards.

Keywords: *Manikin, Nursing education, High fidelity, Low fidelity*

ID 467

An Overview of Techniques of Acoustic Analysis for the Detection of Obstructive Sleep Apnea

KKN Sadara[1#] and IMCWB Kohombakadwala[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]nisalisadara15@gmail.com

Abstract

The primary focus of this review article is to investigate acoustic analysis techniques for detecting Obstructive Sleep Apnea (OSA). OSA causes the upper airway to collapse partially or entirely during sleep, which reduces oxygen saturation. The existing diagnostic techniques for obstructive sleep apnea, such as polysomnography, are hindered by the challenges related to their cost, invasiveness and limited accessibility. Alternative non-invasive and economical diagnostic methods are therefore required. The purpose of this review study is to analyze the strengths and limitations of the current acoustic analysis techniques as more accessible, non-invasive and cost-effective approaches to detect OSA. Acoustic analysis, which examines the acoustic features of speech, snoring, and breathing, has the potential to serve as a diagnostic method for OSA. This study thoroughly examines the possibility of snoring and speech acoustic traits as diagnostic indications for obstructive sleep apnea, using both automated classification methodologies and acoustic analytic tools (MDVP and PRAAT). By analyzing the existing research outcomes, this article offers a comprehensive overview of the advancements in acoustic analysis for OSA detection. Further research is needed in speech and OSA analysis, considering clinical factors and acoustic properties to establish a comprehensive understanding.

Keywords: *Acoustic analysis, Obstructive sleep apnea, Speech, Voice analysis, Non-invasive*

ID 474

Thermography and Thermal Sensors as a Breast Cancer Early Diagnostic Technique: A Review

MKPSSA Perera[1#], MPA Karunaratne[2], WPLK Wijesinghe[1], and NMA Perera[3]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka
[2]Faculty of Engineering, University of Moratuwa, Katubedda, Sri Lanka
[3]Kings Hospitals, Kirulapana, Sri Lanka

[#]angeloperera@ieee.org

Abstract

Breast cancer is a widespread and devastating disease with significant global morbidity and mortality. Early detection plays a crucial role in improving outcomes and survival rates. However, current breast cancer screening methods, such as mammography, ultrasound, and magnetic resonance imaging, have limitations, including false-positive and false-negative results, high costs and radiation exposure. This literature review examines the potential of thermography and thermal sensors as a non-invasive and radiation-free screening technique for breast cancer detection. Increased metabolic activity around tumor cells leads to temperature asymmetry and alterations in blood flow, which can be detected through thermographic techniques. Research studies have shown promising results, demonstrating high sensitivity and specificity in detecting breast cancer using thermography. Recent developments in breast cancer screening involve the use of surface thermal sensors, such as flexible antennas integrated into wearable bras and thermal sensor arrays. While these advancements show potential, they require further validation and improvements. Thermography and thermal sensors hold promise as a non-invasive, radiation-free, and potentially cost-effective screening method for breast cancer detection and technological advancements are necessary to overcome current limitations to establish its efficacy as a standalone or complementary screening tool.

Keywords: *Breast cancer, Thermography, Thermal sensors, Early diagnosis*

ID 597

Gesture Controlled Glove for a Military Team's Communication

KT Sehan[1#], RMCP Ranasinghe[1] and MRRA Bandara[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]38-eng-0120@kdu.ac.lk

Abstract

Effective and efficient communication through silence is essential for the success of special military operations and the protection of the troops. Soldiers must infiltrate hostile territory in small teams, such as four or eight-man teams, for a variety of operations, including reconnaissance: Long Range Reconnaissance Patrols, sniper operations, hostage rescue, and small team ambush missions and Fight in Build-up Areas. Since it directly affects the success of the mission and the lives of the men engaged, maintaining silence becomes crucial in these circumstances. This paper presents a handheld Set that works with an Arduino based technology for military team's silent communication. The proposed glove leverages advanced sensor technology and gesture recognition algorithms to enable intuitive and hands-free communication for military personnel. The product contains an Arduino board, a transceiver (HC 05 Bluetooth Module), flex sensors, handsfree and gloves. By capturing and interpreting hand movements and gestures, the glove translates them into predefined commands allowing for seamless and discreet communication without the need for verbal cues or traditional devices and traditional methods such as Famous military hand signals, which cannot be used effectively in dense jungles where soldiers may not be visible to one another. The system integrates wireless communication modules to transmit the interpreted signals to team members, ensuring real-time, secure, and reliable communication and to avoid detection by the enemy.

Keywords: *Flex sensors, Silent communication, Gestures*

ID 093

Design of an Active Flow Control Method for a 3-D Wing

KNS Perera[1#], MM Basnayake[1] and SLMD Rangajeeva[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]jamesnipun23@gmail.com

Abstract

This research performs a numerical proof for enhancement of aerodynamic characteristic of a finite wing (Wing of Nanchang CJ-6 Aircraft) which is included with a conceptual design of an active flow control method. The active flow control design is a combination of continuous suction and blowing of air profile over the surface of wing. The effectiveness of active flow control model was tested by changing the number of slots and locations of suction and blowing. The numerical analysis was consisted with Reynolds-averaged Navier-Stokes (RANS) equations which were used in combination with a k-ω SST turbulence model. The optimum results were obtained for locating the blowing slots within the range of 0.3-0.47 in the chord length and suction slots within the range of 0.6-0.77 in the chord length. The Computational Fluid Dynamics (CFD) analysis was carried out at freestream conditions with a Mach number of 0.238, a Reynolds number of 6.166×10^6 and Angles of Attack (AOA) from $0°$ to $15°$. The delaying of point of flow separation at higher AOA was clearly observed and an increment of 30% and 24% in lift to drag ratio was obtained at an AOA of $0°$ and $12°$ respectively. The CFD simulations were performed using openFOAM open-source software by giving the custom boundary conditions for the slot surfaces.

Keywords: *Active flow control, Aerodynamic characteristics, Flow separation*

ID 161

Development of a Low-Cost Energy Harvesting Floor Tile that Operates from Footsteps

WRU Fernando[1#], AMM Abhishek[1] and PMKC Chandimal[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]ruchirafernando98@gmail.com

Abstract

This paper presents the designing and fabrication of a low-cost energy harvesting floor tile that harnesses kinetic energy available in human footsteps. The means of harnessing energy is done by use of several mechanisms such as rack and pinion, shafts, two-way to one-way rotational convertor, and an electric motor which is used as a generator to harness the useful energy to be implemented in electrical appliances. This technology can be implemented in office spaces, crowded areas and can also be integrated into Smart City concepts with great occupancy patterns and intensity. Available models in the markets are expensive and are manufactured by foreign companies. As a result, adopting an efficient and low-cost approach would be beneficial to the Sri Lankan context. The theoretical aspects of the project model design, material consideration of components, motor selection, fabrication, and testing of the designed tile are delineated in the paper. The comprehensive material selection technique has enabled the determination of the most suitable material using Multi-Criteria Decision Making and the ELECTRE III method. The calculated cost per watt of the designed model is 22.50 USD per Watt , which is lower than the available models. This technology can be furnished as per requirement considering flooring area, environmental conditions, and implemented in office spaces, crowded areas and be integrated to Smart City concepts.

Keywords: *Footstep power generation, Low-cost power generation, Renewable energy, Two way to one way rotational convertor*

ID 205

Empirical Feasibility Study to Design and Build Rigid Hull Inflatable Boat for Special Operation Units in Sri Lanka Navy

DS Bogahawatte[1#], AATD Priyashan[1], LAKR Athukorala[1], and KA Kurukulaarachchi[2]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka
[2]Director General Engineering, Sri Lanka Navy, Colombo, Sri Lanka

[#]ds-bogahawatte@kdu.ac.lk

Abstract

Sri Lanka is an Island nation and with its geopolitical situation, safeguarding national interest entrusted with the country's naval force. Effective surveillance and search in territorial waters become paramount to deny such threats. United Nations Office for Drugs and Crimes under its Global Maritime Crime Programme in the South Asian region has indicated the feasibility to fund a project, if the Navy is capable of design and build the required boats. The authors being the naval architects in the Navy conducted an empirical feasibility study to understand and solve the critical success parameters to design and build the required boat. This study incorporates (a) to estimate the boat's total hull resistance at the specified maximum speed, (b) to estimate the total propulsive power and select the propulsion power package to achieve the maximum speed, (c) to optimize the Rigid Hull Inflatable Boat dimensional parameters, the centre of weight to improve performance and stability, and (d) to determine the fulfilment of intact stability criteria of the design. The total hull resistance at light running condition was 7.1 Kn. The Mercury diesel Bravo sterndrive unit with model number 4.2 (nominal power 350hp @ 3800 rpm) was selected as the most suited power package for this application. The length overall and the amidships beam were 7.5 m and 3.0 m respectively. The boat is capable of a range of 55 NM, and a maximum speed of 34 Kn. The intact stability fulfils the International Maritime Organization Intact Stability Code requirements.

Keywords: *Intact stability, Propulsive power, Total hull resistance*

ID 273

Development of a Dough Dividing Machine with Counting Ability for Local Bakeries in Sri Lanka

KPCS Kalavitigoda[1#], VDE Gunawardhana[1], D Vidura[1], DS Bogahawatte[1], and FBYR de Silva[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]kalavitigodakpcs@kdu.ac.lk

Abstract

Bakeries often require the assistance of machines in order to effectively and efficiently produce baked goods to supply to customers. However, in countries like Sri Lanka, most bakeries still carry out the dough dividing process manually. Importing a dough dividing machine is expensive due to the added tax and delivery charges. This report looks into the development of a dough dividing machine that has counting ability for local bakeries in Sri Lanka. Some components of this model machine are different to those of the machines available abroad and this is to create a more cost-effective machine. The calculations were carried out for a 2/3 scaled down version of the actual machine, and included calculations and dimensions for the hopper, gears, shafts, coupling, chain & sprocket and information on the selection of the motors and bearings. SolidWorks software has been used to design and carry out finite element analysis on the machine components. In order to count the dough balls produced, Arduino IDE software has been used to write the code for the counting mechanism, which uses an Arduino UNO along with an IR sensor and display to count and display the dough balls that leave the exit of the rounding plate. The ideal speed to rotate the rounding plate was estimated through data obtained from experimentation.

Keywords: *Dough dividing machine, Bakeries, Counting mechanism, Rounding mechanism, Sri Lanka*

ID 466

Automatic Clothesline Retrieval System for Domestic Purposes

DAB Manthika[1], EMHT Ekanayake[1] and KN Perera[1#]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]37-eng-0079@kdu.ac.lk

Abstract

This study addresses a common issue faced by households, focusing on the troublesome task of drying clothes. Unpredictable weather conditions often result in clothes getting soaked and drenched in rainwater, causing unpleasant odors. Working families, with their busy schedules, resort to indoor drying as a solution, unaware that it can lead to unhygienic conditions and allergies. Additionally, indoor dryers are costly, and further outdoor drying requires constant monitoring to check if clothes are dry, adding to the already overwhelming workload. To address these challenges, this project proposes an innovative solution, an automatic clothesline retrieval system that effectively shelters clothes during rain and provides convenient drying options. The system incorporates inputs such as rain presence, light intensity, cloth drying state, and user feedback, which are processed by an Arduino microcontroller. In response, a stepper motor, controlled by a driver circuit, is activated, and the user is notified via a Global System for Mobile Communications (GSM) module about rain events and the drying progress. The stepper motor's rotational motion drives a gear connected to a railing, enabling smooth movement of the clothesline slots between sheltered and outdoor positions. By introducing this system, households can overcome the challenges of unpredictable weather and manual monitoring, ensuring efficient and convenient clothes drying.

Keywords: *Automatic, GSM, Microcontroller, Rain sensor, Stepper motor*

ID 099

Investigation of Trends in Multiday Extreme Rainfall

SN Ranasinghe[1#], WCDK Fernando[1] and SS Wickramasuriya[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]36-eng-0052@kdu.ac.lk

Abstract

Detecting trends in both hydrological and hydrometeorological data series is important in the context of climate change. Even though multiday rainfall has caused disastrous consequences for Sri Lanka in the past, little attention has been given to analyse multiday extreme rainfall data for trends. This paper analyses past extreme rainfall data in the Kelani River basin of a period of 57 years from 1960 to 2016 using both parametric and non-parametric tests to detect trends in a multiday scale. The daily rainfall data was assessed for homogeneity using the RhtestsV4 and extreme rainfall data extraction was done using the Block Maxima method. Modified Mann-Kendall test, Mann-Kendall test, Sen's slope estimator, Linear regression method and the Innovative Trend Analysis method were used in detecting trends in the extreme rainfall data. The study will also help in assessing the suitability of using the Innovative Trend Analysis method for detecting rainfall trends in Sri Lanka. By determining the trends in extreme rainfall data of the Kelani River basin, predictions regarding the future direction of rainfall can be arrived upon and this can aid in preparing for future hazards and risks.

Keywords: *Extreme rainfall, Multiday rainfall analysis, Trend detection*

ID 104

Estimation of Probable Maximum Precipitation in the Context of Climate Change

KMSS Gunathilaka[1#], WCDK Fernando[1] and SS Wickramasuriya[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]sumudumalie.sathsaranie@gmail.com

Abstract

Probable Maximum Precipitation (PMP) estimates are essential when designing hydraulic structures, especially since the risk of the failure of such structures are high. The impact on climate change with PMP has been crucial at present although the concept does not incorporate climate change. Although there are two widely used methods to estimate PMP, this research focused on the statistical method, covering 16 stations of the Kelani River catchment. The daily precipitation records for 57 years were collected and annual maximum daily rainfall series were prepared for all the 16 stations. The study was conducted using five scenarios (S1-S5). The results from Hershfield PMP (S1) emphasizes that the Hershfield enveloping curve has a very high value of frequency factor (K) in low annual average maximum daily precipitation. Thus, the need to modify the curve has arisen as a major objective of this research. Therefore, Modified Hershfield PMP (S2) and Modified PMP in the context of Sri Lanka (S3) are considered. Outlier detection (S4) manifests that, there may be one or more or devoid of outliers deviating from the original concepts of Hershfield. Split sampling (S5) concludes, Standard Deviation is the most influential factor for PMP, which shows the effect of climate change. PMP maps are developed to observe the spatial-temporal variation of PMP, which is the first version in the context of Sri Lanka.

Keywords: *PMP, Statistical method, Modified enveloping curve, Split sampling, Climate change*

ID 290

Preliminary Wave Energy Assessment to Setup a Breakwater Type Oscillating Water Column Ocean Wave Energy Converter at Hambantota Port, Sri Lanka

MCP Dissanayake[1#] and S Hikkaduwa[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]dissanayakemcp@kdu.ac.lk

Abstract

Oscillating Water Column (OWC) is a type of Wave Energy Converter that transforms the energy of ocean waves into low-pressure pneumatic power. Subsequently, this pneumatic power is taken out by a turbine and converted to electric energy through a generator. The Sri Lankan wave energy resources were assessed and revealed that 12-15 kW/m average wave power can be generated annually and is appropriate to establish large-scale, offshore wave energy converters. The wave climate off the South-East coast of Sri Lanka is encompassed with two different wave types which are long period swell waves and locally wind propagated short period waves due to monsoons. Therefore, Hambanthota Harbor was selected as a research study area and the most appropriate place to fix a breakwater-type OWC. As per the annual and seasonal wave climate of the South-East coast of Sri Lanka, this research focuses on extreme wave occurrences in July and August. In this investigation, firstly a directional, roll, and pitch 'Wave Rider Bouy' was placed inside the Hambanthota Harbour to collect wave climate data from July to August 2019. Then, the same 'Wave Rider Bouy' was placed 4 NM away outside the harbour and wave measurements were obtained. Finally, an analytical study was conducted and revealed that swell wave height and significant wave height were sufficient to generate wave power and feasible to set up a breakwater type OWC ocean wave energy converter at Hambanthota harbour. It is recommended to carry out another study to collect swell wave and significant wave data for continuous three years, to confirm the sustainability of this project.

Keywords: *Hambanthota harbour, Sri Lanka, Break water type oscillating water column, Wave rider buoy*

ID 490

Application of HEC-RAS 2D Model to Simulate Scour Depth Around Bridge Piers: A Case Study on Hanwella Bridge, Sri Lanka

A Thembiliyagoda[1#], K de Silva[1] and N Wijayaratna[1]

[1]Faculty of Engineering, University of Moratuwa, Katubedda, Sri Lanka

[#]thembiliyagodaaw.21@uom.lk

Abstract

Lowering of the level of river bed due to water erosion is denoted by the term scouring. Scouring can transpire around abutments and piers of a bridge. Pier scouring possesses a high threat to the stability of the bridge structures. The formation of vortices in the vicinity of bridges due to obstruction caused to the river flow is the core rationale behind this pursuit. The depth of the hole formed around the bridge pier due to scouring is denoted as the scour depth. Estimation of scour depth at a bridge site is indispensable in terms of the safety and economy of a bridge. Although various researchers around the world have developed numerical formulae and physical models for the simulation of scour around bridge piers, in the context of Sri Lanka, not many studies have focused on this area yet. In this study, HEC-RAS two-dimensional model is used for the determination of scour depth around the bridge piers of the Hanwella bridge built across the Kelani River of Sri Lanka. The change in bed elevation around the bridge pier provides the depth of the scour hole formed due to a considered flood event. As per the results, the hydraulic model coupled with the sediment transport model has produced a reliable estimation of the river bed level change and scour depth around the bridge piers. Further validation of the model results can be accomplished based on a series of laboratory-scale experiments.

Keywords: *Scouring, Piers, HEC-RAS, Kelani River*

POSTER PRESENTATIONS

ID 001

Automatic Clothesline Retrieval System for a Balcony

OU Gunathilake[1#]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]36-eng-0057@kdu.ac.lk

Abstract

The conventional method of drying clothes on a clothesline is widely practiced due to its cost-effectiveness and efficiency. However, unexpected rain showers can negate the drying efforts. Modern-day unpredictable weather patterns exacerbate this issue. To address this challenge, the development of a weather-responsive smart clothesline system is proposed. This innovation integrates rain and humidity sensors into an automatic clothesline retrieval system. This system employs an Arduino microcontroller board to orchestrate a circuit equipped with rain and humidity sensors. These sensors enable accurate detection of weather changes, triggering automatic extension or retraction of the clothesline. Additionally, a real-time clock module restricts system operation to daytime hours, conserving energy during the night. The design is optimized for compact spaces like balconies, offering a tailored solution for urban living. Results from experimental testing demonstrate the system's effectiveness in responding to weather fluctuations. When rain or high humidity is detected, the system promptly retracts the clothesline, safeguarding the drying laundry. During nighttime hours, the system remains inactive, conserving energy and resources. By seamlessly integrating technology with daily chores, this innovation enhances convenience and conserves resources. The successful implementation of this system underscores its potential for broader adoption, contributing to a more sustainable and efficient lifestyle.

Keywords: *Automated clothesline, Energy efficiency, Sensors, Prototype development, Cost efficiency*

ID 006

Design and Fabrication of a Coconut Sorting Machine

DNR Perera[1#], RMAM Rajapaksha[1], KGC Harsan[1], DHRJ Wimalasiri[2], and PPSS Pussepitiya[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka
[2]Faculty of Engineering, Open University of Sri Lanka, Nawala, Sri Lanka

[#]randulapererall1@gmail.com

Abstract

Sri Lanka is among the leading countries in coconut production and holds a significant share in the world coconut product market. However, the process of sorting coconuts is not precise in the Sri Lankan marketplace. This project aims at designing and fabricating an efficient sorting machine for husked coconut. The machine is designed for sorting of husked coconuts according to the size into three categories. It uses the roller conveyor technology, and seven main rollers are used in the design which are driven by a 400 W single phase motor. The center-to-center distance between the rotating shafts is the key feature for the sorting mechanism which was decided after the proper data collection from the related organizations, authorities, employers in the field and the customers. The designed components are tested, and the finite element analysis results were examined to ensure the safe working conditions of the machine. Arduino technology is used to count the sorted coconuts in the three categories. Machinery has improved the quality of life and facilitated the smooth flow of large-scale businesses by increasing economic benefits through the efficiency, accuracy, time management and cost effectiveness. The efforts required in achieving the outputs can be effectively and economically decreased by the implementation of better designs.

Keywords: *Sorting machine, Conveyor, Coconut, Design*

ID 109

Aerodynamic Performance of Smooth Selectively Superhydrophobic Flat Plates: A Numerical Approach

VC Perera[1#] and SLMD Rangajeeva[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]37-eng-0054@kdu.ac.lk

Abstract

The interference to fluid flow over a solid surface is significantly high to such an extent that the fluid in contact with the surface possesses a null velocity. This phenomenon is called the no-slip condition. On the contrary, superhydrophobic surfaces possess significant slip velocities, hence a partial slip condition, enabling significant drag reduction properties when in relative motion with fluids. However, making a complete object superhydrophobic may not necessarily provide the most aerodynamic nor cost-effective solution. A smooth flat plate of 50% slip condition was used as the first step to link the relationship between superhydrophobic area and the drag coefficient using computational fluid dynamics software, OpenFOAM. A greater drag reduction was observed for partially superhydrophobic flat plates compared to a fully superhydrophobic counterpart. The flat plate was made superhydrophobic using five unique approaches in total, both unilaterally and bilaterally in either direction of the flat plate. It was then found that drag reduction did not arbitrarily depend on the total area of superhydrophobicity. Each approach resulted in a unique drag reduction trend with increasing superhydrophobic area. Superhydrophobising the flat plate from the trailing edge towards the leading edge, against the flow direction, provided the best drag reduction characteristics.

Keywords: *Superhydrophobic, Flat plate, Drag reduction*

ID 155

Implementation of Arduino based Internet of Things Home Automation Systems in Sri Lanka

DC Hewavitharana[1#]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]hewavitharanadineth@gmail.com

Abstract

The deployment of microcontroller-based Internet of Things (IoT) home automation systems in Sri Lanka is examined in this review paper, with an emphasis on the subtopics of home automation, irrigation automation, waste management and healthcare automation. By offering a thorough review of IoT and home automation systems, this research intends to close a gap in the existing literature. It is a helpful tool for researchers looking to gain a thorough understanding of the subject and provides information on the significance of the difficulties facing these systems. A thorough evaluation of the literature on Arduino-based IoT home automation systems is undertaken, spanning system design, communication protocols, sensor integration, energy efficiency, user interface and security issues. The paper investigates the uses of Arduino-based IoT solutions in the context of home automation and includes case studies and implementation examples. The studied literature is compared to evaluate the effectiveness and efficiency of Arduino-based IoT solutions across the subtopics. In addition, the evaluation reveals gaps and issues in the field. The paper finishes with recommendations for future research directions and emerging trends based on the review's results. It focuses on developments in home automation technology, prospective applications in Sri Lanka, research opportunities and difficulties. Overall, this review is an excellent resource for researchers and practitioners interested in deploying Arduino-based IoT home automation systems in Sri Lanka, providing insights into the present status of the field and guiding future research.

Keywords: *Arduino, IoT, Home automation*

ID 179

Gripper-Enhanced Fabric Cut Piece Sorting System based on Defects

DC Hewavitharana[1], LTUD Wickramathunga[1], TNN Rajapaksha[1], PSH Pallemulla[1], and HDI Piyumini[1#]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]piyuminihdi@kdu.ac.lk

Abstract

Sri Lanka's garment industry is crucial, contributing significantly to the country's export market. However, current fabric handling methods in Sri Lankan companies are primarily reliant on manual labour, creating a compelling potential for research and development in the field of automated fabric handling. Fabrics present distinct challenges due to their dynamic and static character, needing novel solutions to overcome these limitations. Furthermore, human fabric problem detection achieves just 60% accuracy, emphasizing the importance of automation in this vital sector. Significant benefits can be obtained by automating these processes in textile manufacturers. The fundamental goal of this project is to design and build an innovative system capable of automatically separating and classifying cloth cut pieces based on the presence of defects. Our suggested device includes a cylindrical manipulator outfitted with cutting-edge pinch-like grippers designed exclusively for effective ply separation. To improve defect detection accuracy, we use a custom-trained Convolutional Neural Network (CNN) with a validation accuracy of 80%. We have also created a simple platform for remote control and real-time monitoring of the entire system by using IoT technology. This complete project not only meets the critical demand for fabric handling automation, but it also has the potential to change the garment manufacturing process in Sri Lanka.

Keywords: *Automated fabric handling, Fabric defect detection, CNN, Pinch gripper*

ID 202

Development of Intelligent Outdoor Camera Sabotage Detection System for Large Scale Camera Systems using Deep Learning

KAUR Marapana[1], SMKK Siriwardhana[1], MS Dunukewila[1], HKAYD Kodithuwakku[1#], and TL Weerawardane[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]37-eng-0044@kdu.ac.lk

Abstract

The study presents a newly created camera-tampering detection system for outdoor cameras, aiming to overcome the boundaries of human monitoring. It is intended to be implemented in large scale camera systems to identify frequent tampering events like defocus, occlusion and changes in orientation, and provide real time alerts and visual feedback through a user friendly web portal designed especially for this purpose. The system can effectively recognize and categorize tampering instances by utilizing deep learning algorithms, which reduces dependency on human operators and lowers the risk of human mistake. To detect and categorize tampering, three algorithms are utilized, and the features of each algorithm are listed. Security staff can take the necessary measures to stop potential security breaches or the loss of important surveillance footage by quickly identifying tampering occurrences. The suggested method strengthens the monitoring process's dependability and efficiency, which in turn strengthens the security of the outdoor surveillance infrastructure.

Keywords: *Artificial Intelligence, Machine learning, Deep learning, Camera sabotage detection*

ID 230

Review on Intra-Body Communication using Galvanic Coupling for Wearable Devices

SD Kommalage[1#] and WPLK Wijesinghe[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]savindul11l@gmail.com

Abstract

In recent years, wearable devices have witnessed remarkable advancements, offering numerous possibilities for healthcare monitoring, human-computer interaction, and personalized applications. Intra-Body Communication (IBC) has emerged as a promising communication technique for wearable devices, enabling seamless and secure data transmission within the human body. This review paper presents an in-depth analysis of IBC using galvanic coupling, a prominent method for establishing reliable and efficient communication channels between wearable devices and the human body. The primary objective of this review is to provide a comprehensive understanding of the principles, applications, and technologies of IBC utilizing galvanic coupling. Firstly, we present an overview of IBC, emphasizing its advantages, such as low power consumption, electromagnetic interference immunity and miniaturization potential. Next, the fundamental concepts and working principles of galvanic coupling are discussed, including the use of electrodes, modulation schemes, and signal processing techniques. The paper further explores the wide range of applications for IBC using galvanic coupling. Furthermore, we discuss recent advancements in IBC technology, including novel electrode designs, signal processing algorithms and integration with other wireless communication technologies. By exploring its principles, applications, challenges and prospects, this review aims to advance this exciting field, facilitating the development of more efficient and reliable wearable devices for diverse applications in healthcare and beyond.

Keywords: *IBC, Galvanic coupling, Wearable, Healthcare monitoring*

ID 269

Indoor Human Following Assistive Robot with Fall Detection Capability for the Elderly and the Differently Abled

SL Seneviratne[1#], BCJ De Zoysa[1], AMSE Senaratne[1], EC Padmasiri[1], and PSH Pallemulla[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]seneviratnesl@kdu.ac.lk

Abstract

The number of falls among the elderly people increase each year and the lack of appropriate care and support leads to serious injuries that could also cost lives. Therefore, the elderly and the differently abled people require constant monitoring. It is too costly to hire a caretaker or move the person to a nursing home or to an elder care home. To minimize the risks faced by the person due to falls, to remind the person of their medication, to contact the guardian, if necessary, to alert the guardian when a fall is detected, and to provide company to the person, a robot is developed and implemented. The main objective of the project is to identify the primary and secondary activities of daily living that require assistance for the elderly and the differently abled, to implement human detection, tracking, and fall detection in the robot. Secondly, to design a robot that will assist the elderly and the differently abled in fulfilling a subset of activities of daily living, to optimize the robot for domestic purposes through software validation and verification, and finally to fabricate the designed robot. Human detection, following, and fall detection algorithms are implemented using Python with a Raspberry Pi 4 for processing. Pose estimation will be used to detect the human, build the logic for human following, and fall detection as well. The robot follows the elderly person from behind and detects any falls with an accuracy of beyond 85%.

Keywords: *Indoor, Human-following, Fall-detection*

ID 399

Design and Develop an E-Rickshaw as a Sustainable Energy Solution

MCP Dissanayake[1#], KREMSB Ekanayaka[1], RDMHM Ariyarathne[1], and MCH Chandrasiri[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]dissanayakemcp@kdu.ac.lk

Abstract

Sustainable energy alternatives for local transportation are explored in this essay via the lens of Electric Rickshaws. Rickshaws are often utilized for local transportation. With a focus on reducing negative impacts on the environment and promoting sustainable mobility, the goal is to create alternatives to traditional automobiles that operate on fossil fuels that are both ecologically benign and economical. In the article's first portion, we learn why it's so important to find new ways to use energy in the transportation sector. After that, the article focuses on the rise of rickshaws as a cleaner alternative to traditional automobile. The low cost and the ability to carry a few passengers at once make rickshaws ideal for short trips in heavily populated regions with high levels of air pollution. This paper provides information on the design of electric rickshaws, including the structure, power transmission, power modes, controllability, and stability of the vehicles. In the section titled "Findings and Discussion", we emphasize the many advantages of electric rickshaws as well as the opportunities for their broad use. Countries like Sri Lanka, who embrace this environmentally friendly and economically viable alternative, stand to gain considerable economic, social, and environmental advantages. The effective execution of this project will help to the creation of a transportation system that is more environmentally friendly and efficient in its use of energy, as well as solve the urgent problems of urbanization, pollution, and resource depletion.

Keywords: *E-rickshaw, Sustainable energy solution, Transportation, Clean energy, Environmental impact*

ID 419

Development of a Novel Sanitization Method for Aircraft Lavatory

A Prabhaharan[1#], D Jayatillake[1] and TGT Peiris[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]36-acm-0020@kdu.ac.lk

Abstract

Evaluating the efficacy of aqueous ozone as a disinfectant in the field of aviation and its potential to replace traditional chemical disinfectants is a major task. Aqueous ozone is a sustainable and environmentally friendly disinfection solution that rapidly inactivates a wide range of microorganisms, including bacteria, viruses, fungi, and protozoa. Through a comparative analysis, the research found that aqueous ozone offers several benefits over conventional chemical disinfectants in terms of broad-spectrum antimicrobial activity, extended disinfection capabilities, and eco-friendliness. The study proposes the development of a compact, portable aqueous ozone generator specifically designed for use within aircraft lavatories, which serve as environments with an intensified presence of pathogens, necessitating effective disinfection measures. The research concludes that aqueous ozone is a promising disinfectant for aircraft lavatories, providing an efficient and sustainable solution for maintaining high levels of hygiene and minimizing the risk of microbial transmission and a portable aqueous ozone generator will be a better system to apply. However, practical considerations such as equipment requirements, operational protocols, and regulatory compliance need to be addressed for successful implementation. Overall, this research highlights the potential of aqueous ozone as a replacement for chemical disinfectants in aircraft lavatories, suggesting its adoption can lead to improved hygiene standards and enhanced passenger health-related safety.

Keywords: *Aqueous ozone, Aircraft lavatory, Disinfection*

ID 446

Software Defined Radio Based Drone Detection using Machine Learning Algorithm

WMH Bandaranayake[1#] and HHC Gunathilaka[1]

[1]Centre for Defence Research and Development, Ministry of Defence, Colombo, Sri Lanka

[#]hiroshan.bnayake@gmail.com

Abstract

In this new era, misuse of drones and harmful acts that can be done using drones make it hard to detect and classify drones effectively due to the larger bandwidth and real-time processing. The purpose of this research is to find a better machine-learning algorithm to detect and classify the emitting signals from a drone or a remote controller. We built multiple classification models and trained them over the dataset we obtained using Software Defined Radio (SDR) and drone remote controller. We have compared the performances of all these models and logged their results in terms of prediction accuracies. Based on the accuracy results, K-Nearest Neighbor classifier has given the highest accuracy among all other models.

Keywords: *RF signal classification, Detection, SDR, Machine learning model, Neural network, K-nearest neighbor, Feasibility*

ID 460

Continuous Blood Glucose Monitoring Techniques: A Review

NMS Irugalbandara[1#] and IMCWB Kohombakadawala[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]mindula.irugalbandara@gmail.com

Abstract

Continuous Glucose Monitoring (CGM) is recommended over conventional self-blood glucose monitoring because continuous blood glucose monitoring has become very essential in diabetes management. Diabetes/ diabetes mellitus is a chronic disease that has become a major health issue globally. Mainly, type 1 diabetes and type 2 diabetes need CGM for disease management. The minimally invasive method is the main technique used for CGM in the present day. CGM using non-invasive methods is an emerging field because of the difficulties related to the existing CGM methods/ systems. This review article presents the importance of CGM, existing techniques of CGM and their new approaches, difficulties and drawbacks related to them and the emerging techniques of CGM. The conclusion states that there is an enormous need for a wearable, inexpensive, non-invasive CGM approach that has the same accuracy level as the invasive procedures to be used in diabetes management.

Keywords: *CGM, Diabetes, Invasive, Minimally invasive, Non-invasive*

ID 462

Development of an Efficient Automated Tea Making Machine with Customized Ingredient Levels

RPNV Randeniya[1], ADPV Jayathilake[1], EMUP Ekanayake[1#], PNA Fernando[1], and IM Akarawita[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]udulaekanayaka@gmail

Abstract

In the modern world, there is a growing trend towards automating various tasks for the convenience of humans as it makes work easier and efficient. Automating the teamaking process offers advantages in terms of time and cost savings. While there are automated tea machines available in the market, they lack the ability to adjust ingredient levels according to user preferences, preventing users from obtaining their desired cup of tea. Hence, this research paper proposes a novel design and fabrication steps of an automated tea maker capable of preparing a customized cup of tea based on user inputs for ingredient preferences. The primary objectives were to reduce the tea-making time from ten to twelve minutes to five to eight minutes and provide options for the user to select desired levels of sugar, tea, and milk powder. Through iterative development and experimentation, the teamaking time was successfully reduced to an average of seven and a half minutes, achieving the first objective. Further improvements in calibration offer the potential for additional reductions in the tea-making time. An important objective was to enable users to choose their preferred beverage types, such as tea, milk tea, or malt, along with their desired ingredient levels. Allowing users to input their requirements through a user-friendly Human-Machine Interface and obtain a customized cup of tea accordingly. Whether the user desires a milk tea with low sugar but high tea concentration or any other combination, the system can accommodate their preferences.

Keywords: *Automated tea maker, Beverage selection, Customization of ingredient levels*

ID 500

Modern Accident Alert System for Vehicles using Global Positioning System Technology

PDTN Dakshina[1#] and RMCP Ranasinghe[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]38-eng-6092@kdu.ac.lk

Abstract

This research paper introduces an innovative accident alert system utilizing Global Positioning System (GPS) technology, mainly integrated with Global System for Mobile Communication (GSM), Arduino and accelerometer components. The primary objective of this system is to mitigate fatalities resulting from unforeseen accidents in public areas. By promptly notifying emergency services, hospitals and the police, and including the precise accident location, the system aims to address the critical issue of delayed response and limited awareness. The system operates by triggering an alert whenever sudden de-acceleration of the vehicle indicative of an accident occurs. In less severe accidents, the system retains the capability to continuously transmit the location. This feature is particularly crucial in rural areas during night time when accidents often go unnoticed, leading to unfortunate fatalities. It is disheartening to acknowledge instances where individuals succumb to injuries or experience severe consequences hours after the accident due to the absence of immediate awareness. To further enhance the system's capabilities, future improvements can be implemented, such as incorporating shock sensors, fire alarm systems, and smoke-detecting sensors. These additions would extend the system's functionality beyond deacceleration detection, facilitating a more comprehensive approach to accident detection and emergency response. The research paper delves into the development, implementation and potential advancements of this accident alert system. The findings of this study offer insights into the effectiveness and significance of deploying such systems to minimize fatalities, enhance emergency response, and raise awareness regarding accidents, especially in rural and remote areas. By leveraging advanced technologies, this system serves as a crucial step toward mitigating the devastating impact of accidents and ensuring prompt assistance.

Keywords: *Accident alert system, GPS technology, GSM*

ID 529

Advances in Muscle Fatigue Detection: A Comprehensive Review

GACS Gurugoda[1#], BMAT Perera[1], DMGM Dissanayake[1], and IMCWB Kohombakadawala[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]38-eng-0103@kdu.ac.lk

Abstract

Muscle fatigue measurement is crucial in various domains, including occupational health and safety, as muscle fatigue adversely affects cognitive and motor performance, leading to reduced productivity and increased injury risks. Wearable systems offer promising solutions for muscle fatigue monitoring, enabling continuous and long-term assessment of biomedical signals in unattended settings with comfort and non-intrusiveness. These systems facilitate performance optimization, injury prevention, training load management, individualized training programs, rehabilitation and recovery. Surface electromyography signals are commonly utilized by some systems to extract features and classify muscle fatigue. Additionally, the utilization of goniometers, which are used in kinematic analysis, and other innovative approaches like tissue Doppler imaging, demonstrates promising potential for detecting localized muscle fatigue in wearable devices. This review article explores the challenges and advancements in muscle fatigue monitoring through wearable devices and discusses the diverse applications of these technologies

Keywords: *Muscle fatigue, Detection, Monitoring, Wearable, Non-invasive*

ID 558

Review on Mathematical Models used to Estimate Inner Temperature Variations of Female Breast

PLLM Alwis[1#] and WPLK Wijesinghe[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]mihirialwis1308@gmail.com

Abstract

Breast cancer is a leading cause of mortality among women worldwide. Temperature-based techniques have emerged as a promising approach for breast cancer detection and prediction. This literature review aims to comprehensively analyse the existing research on mathematical models developed to predict the temperature gradient between the surface and core of the female breast. Various mathematical models, including Penne's bioheat transfer model, Wulff's model, Klinger's model, Chen and Holmes' model and the porous media model have been investigated. Strengths and limitations of each model, as well as their application in breast cancer risk prediction have been examined. Additionally, the utilization of breast models, sensors, and validation techniques has been explored. The review highlights the need for further research to address the limitations of existing models and improve their accuracy in breast cancer diagnosis. The findings provide valuable insights for advancing temperature-based approaches and enhancing early detection strategies.

Keywords: *Breast cancer, Temperature-based techniques, Mathematical models, Bioheat transfer, Temperature gradient, Breast models, Sensors*

ID 559

Smart Gas Leak Management System

BMDP Rathnayake[1#], RMCP Ranasinghe[1] and ERMCK Rajapaksha[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]38-eng-0046@kdu.ac.lk

Abstract

Smart Liquefied Petroleum Gas (LPG) leakage management system is designed in a way to enhance residential safety. An intelligent system which is capable of timely detection and resulting in the best appropriate response is required as LPG leaks pose a significant risk in households. The system utilizes two MQ-2 gas sensors positioned near the gas cylinder and the gas cooker for broad coverage. After detecting a gas leak, the system undergoes a few processes like activating an exhaust fan, opening windows for ventilation, cutting off the power supply of the whole house and a loud buzzer is triggered to alert the occupants. Moreover, the system is integrated with a mobile application via Bluetooth, allowing home users to remotely control any component in the system. More importantly the system bears a notification feature, sending alerts to users' mobile phone when there is a gas leakage. The effectiveness of the system is demonstrated by the experimental results. The research contributes to the field of smart gas leak management systems, developing residential safety and enabling dynamic gas leak detection and response mechanisms.

Keywords: *LPG, Real-time response, Mobile alerting system, Power control mechanism*

ID 567

Development of an Automated Clothesline System

ML Saputantri[1#], GK Dhananjaya[1], JACA Perera[1], and UAND Ubeysiriwardana[1]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]38-eng-0089@kdu.ac.lk

Abstract

This study presents the design, fabrication and integration of various sensors to solve the problem of drying clothes outside. This design is mainly aimed at overcoming challenges related to unexpected rain, getting clothes in when it is dark and remote controlling capabilities. Traditionally, the method of drying clothes outdoors requires manpower, to put the clothes and to get them in. This causes various inconveniences to people. The proposed system addresses many of those concerns and gives positive feedback. By detecting the change in weather and darkness, this system will automatically shelter the clothes in a sheltered area ensuring that the clothes are dry and undamaged. In addition, this system possesses the ability to be controlled remotely and manually making it user-friendly. Furthermore, this will help positively with domestic chores and demonstrate the advantages of using technology to assist day-to-day activities. This paper explains the detailed methodology, conceptual designs, and results of the system.

Keywords: *Fabrication, Automatically, User-friendly*

ID 588

Water Treatment Efficiency of Aerator and Roughing Filter in Treating Groundwater : A Case Study in Mullaitivu of Sri Lanka

ME Sutharsan[1#] and N Anoja[1]

[1]National Water Supply and Drainage Board, Jaffna, Sri Lanka

[#]edsutharsan@yahoo.com

Abstract

The paper describes an investigation into the efficiency of the water treatment process used in the Mullaitivu well field in Sri Lanka. The well field experiences significant groundwater extraction, approximately 1,440,000 liters per day, due to developments and resettlements in the area over the past decade. However, the groundwater quality does not meet the standards set in SLS 614: 2013 on a few occasions. The treatment process includes a fountain-type aerator with four drops with varying heights and vertical-flow roughing filters. The water then passes through four medial filter layers in the roughing filters, each with different particle size and layer thickness. To assess the effectiveness of the treatment process, water samples were collected at regular intervals of 6 hours during 72 hours of continuous operation. The samples were taken before and after aeration and after passing through the roughing filters. The selected water quality parameters tested in the study were turbidity, color, total iron, and manganese. The results showed that the treatment process significantly removed color and total iron from the raw water with removal efficiencies of 84% and 88% respectively. Additionally, the treated water's turbidity was well below the threshold limit of 2 NTU in 100% of the treated samples, the treated manganese level was below the limit of 0.1 mg/l, and the treated total iron level was below the limit of 0.3 mg/l specified in SLS 614:2013 for drinking water. Based on the findings, the paper recommends including pre-chlorination in the treatment process to enhance oxidation and increase the total iron and manganese removal efficiency.

Keywords: *Aerator, Color removal, Groundwater, Manganese removal, Roughing filter, Turbidity removal*

ID 601

Barriers for Pedestrian Related Road Crash Analysis in Identifying Engineering Countermeasures

TWKIM Dias[1#]

[1]Faculty of Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka

[#]ishanidias@kdu.ac.lk

Abstract

Non motorized transportation is one of the trending transportation modes in a world where sustainable transportation is considered as vitally important. They, being the most vulnerable road users in the road, people are not so much motivated to walk, mostly as short trips rather than for recreational walking. On an average, 686 pedestrians are killed on roads in Sri Lanka per year. It is important if engineering countermeasures can be taken either to reduce the number of pedestrian crashes or to reduce the crash severity of the same. In order to do so, there need to be sound evidence pointing at significant parameters in pedestrian crashes that can be addressed by engineering countermeasures. However, Sri Lankan crash reporting system maintained by Sri Lanka Police have limited entries to carry out such a detailed study. Hence this paper has carried out an assessment of the current crash reporting system and matched it with globally accepted minimum crash reporting criteria as well as frequently used pedestrian crash analyses around the world. The findings were limited to engineering parameters such as road geometry, presence of road work zone, etc. Many details are not directly available, and the researcher is forced to collect data from secondary sources to map with the crash site. As a result, this paper has identified different data sources that can be used in pedestrian crash analysis other than the data directly from the Police database, also has identified missing but important data entries such as road alignment.

Keywords: *Pedestrian crashes, Engineering countermeasures, Crash reporting, Sri Lanka*