



16th INTERNATIONAL RESEARCH CONFERENCE

ACHIEVING RESILIENCE THROUGH DIGITALIZATION, SUSTAINABILITY AND
SECTORAL TRANSFORMATION

TECHNOLOGY

ABSTRACTS



General Sir John Kotelawala Defence University
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ORAL PRESENTATIONS

Performance Evaluation of Solar Hot Water Collector Comprising Modified Loop Heat Pipes

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Abstract

At present, popularity of Solar Hot Water Heater Systems (SHWHS) is growing rapidly as it employs the pollution free green energy technology. With this high demand on Hot Water Solar Collector (HWSC) systems, worldwide manufacturers of the HWSC systems are conducting research to develop a high efficiency HWSC system by using modified Loop Heat Pipes (LHP). In this study, main objective is to demonstrate the fabrication and performance enhancement of SHWHS by deploying modified LHP. In the fabrication process working fluid consideration and the compatibility of the heat pipe material with the selected fluid is directly affected to the whole efficiency of the system. HWSC is fabricated with 4 LHPs made from copper with a total loop length of 120 cm. Acetone was selected as the working fluid and indoor testing was carried out for different acetone volumes to determine the optimum filling ratio inside the LHP. Daily outdoor performance tests were conducted for the period of 6 hours at the ground level when the tank volume is filled with 15 L of water. Mean water temperature of the storage tank increased up to 43°C in outdoor test and 53°C in indoor test. The mean system efficiency at the end of 6 hours is estimated. The mean system efficiency for outdoor tests was less than that for the indoor tests. Long term outdoor tests should be recommended to find more meaningful information to domestic and commercial end users.

Keywords: *Hot Water solar Collector, Loop Heat Pipe, Heat Pipes, Solar Hot Water Heating System*

A Case Study of Mass Concrete Footing Construction for a High-rise Building Development in Sri Lanka

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Abstract

Currently, scale down mock up test is widely practiced in construction industry to predict the possible temperature rise and temperature differential in mass concrete construction. Also, it can be used to validate the finite element thermal and structural models and thereby correctly predict the risk of thermal cracking in actual mass concrete structures. Accordingly, a case project was selected to verify the prediction accuracy of cracking risk in mass concrete structure. This study results show that the combination of finite element modeling and scale-down mock up test is the most suitable way to predict the possible thermal cracking risk in mass concrete structural elements. This can be mainly applied to identify the suitable insulation material for the mass concrete construction to prevent the structure from early age thermal surface cracking. Further, this study proves that widely practice maximum allowable temperature limits 20°C is more conservative for medium grade mass concrete construction in tropical countries like Sri Lanka and it contribute to increase the cost in curing plan.

Keywords: *Mass concrete, Thermal cracking, Mock up test, Finite element modelling*

Smart System for Human Nail Disease Diagnosis and Underlying Systemic Disease

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Abstract

The aim of this research is to develop a smart system for human nail disease diagnosis and predicting underlying systemic disease. Nail disease is a common problem affecting millions of people worldwide, and some nail diseases can be a sign of internal systemic diseases. Diagnosis of nail diseases at an earlier stage could potentially result in improved chances of recovery and extended lifespan. The proposed smart system aims to detect nail disease by examining the colour and shape patterns of the nail, determining the severity of the disease based on the spread area, and analysing the symptoms patient may have by utilizing state-of-the-art technologies such as image recognition, object detection, machine learning, and deep learning. This system could also be integrated with electronic medical records to track patient history and facilitate communication between healthcare providers. According to the performance evaluations, the proposed method for identifying nail diseases, severity level, and internal systemic diseases has produced results with an accuracy ranging from 82% to 98%. Developing a smart system for human nail disease diagnosis and underlying systemic disease can revolutionize how healthcare providers diagnose and treat nail diseases, potentially improving patient outcomes and quality of life.

Keywords: *Nail diseases, YOLOV5, CNN, Mask R-CNN, Underlying systemic disease, Image processing*

Implementation of SMS Base Pulse Oximeter for Early Identification of “Silent Hypoxia” Patients

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Abstract

COVID-19 infected patients are diagnosed with “silent hypoxia” in absence of dyspnea. Hypoxemia, is a life-threatening medical condition which drops the oxygen saturation to 80% - 85% suddenly. However, due to hospital capacity limitations, the majority of Covid-19 patients were treated at home. But regular monitoring of SpO₂ level was essential to diagnose silent hypoxia for immediate hospitalization and provide the medical assistance. In this project work, a low-cost user-friendly Short Message Service (SMS) base pulse oximeter to measure SpO₂ level for early diagnosis of “Silent hypoxia” in COVID-19 infected patients is implemented to minimize the risk. This novel remote monitoring design of the SMS based-pulse oximeter is combined with a Global System for Mobile Communications (GSM) module in order to send a SMS to the clinician about the condition of the patient. Further, if the patient is diagnosed with “silent hypoxia”, clinician will be informed automatically with a high-prioritized SMS. To validate the performance of the new device, United States Food and Drug Administration (FDA) approved pulse oximeter was used. According to the results, $P > 0.05$ which implies that there is no significant difference and good correlation similarities exist between them. This design contributes to reduce the mortality rate of Covid-19 patients and critical conditions. Alternatively, the novel design improves the self-confidence of the patients, hence the mental stability during the period of home-quarantine. This design can be further improved to facilitate emerging technologies such as Hospital to Home and Virtual Doctor in order to provide remote monitoring facilities to patients with other conditions as well.

Keywords: *COVID-19, Pulse oximeter, Silent hypoxia, Home quarantine, GSM module*

Feasibility of ^{177}Lu Lutetium Radioisotope Production Using Natural Ytterbium for Targeted Radiotherapy

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Abstract

Research related ^{177}Lu is most attractive in the last decade due to its applications in both cancer treatments and applications in diagnostic imaging of nuclear medicine. ^{177}Lu is not yet used or imported for either nuclear medicine applications or research level applications in Sri Lanka. This study made a ^{177}Lu radioisotope using exciting facilities for cancer research applications. Natural stable Yb sample was irradiated with neutron flux to produce ^{177}Yb , subsequently, it decays to the final product ^{177}Lu undergoes ^{176}Yb (n,γ) ^{177}Yb ^{177}Lu nuclear reaction, and which has a half-life of 6.7 days. Characteristics of Lu were studied using sample spectrum by irradiation of a naturally stable sample of Lu compound. In this method, ^{177}Lu can be purely chemically separated from Yb contaminations to produce carrier free end product. Irradiation and decay cycle of ^{177}Lu was studied and measured the final product activity using gamma spectroscopy. Theoretically calculated each irradiation decay cycle was compared with the end product during the first three cycles of production. 0.9725 g of natural Yb sample produced 13.30 ± 0.30 Bq/g activity after three irradiation cycles, which agreed with theoretical calculations. The amount produces using this method is sufficient to carry out laboratory-level cancer research in Sri Lanka.

Keywords: *Radioisotopes, Neutron activation, Gamma spectroscopy, ^{177}Lu , ^{176}Yb*

Scanning Tunnelling Microscopy Investigation of Naturally Occurring Graphite Surface

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Abstract

Scanning Tunnelling Microscopy (STM) has emerged as a powerful tool for investigating the potential of graphene as a substrate for molecular absorption, attracting considerable attention in nanotechnology and materials science. In this study, the molecular absorption characteristics of graphene utilizing a cutting-edge STM system were observed. STM images of graphene on both graphite surfaces and commercially available Highly Ordered Pyrolytic Graphite (HOPG) at room temperature were obtained and compared. Naturally occurring graphite samples from Sri Lanka were used To ensure the highest level of purity. These samples are renowned for their exceptional purity. The STM system was used to acquire constant current and height mode images for three samples, including commercially prepared HOPG and the naturally occurring graphite samples. The naturally occurring sample exhibited the distinctive honeycomb structure of graphene with minimal distortion, indicating its superior quality at low sample bias conditions. The STM images obtained for the commercially prepared HOPG samples were comparable to those of the naturally occurring samples, affirming their high quality and limited presence of surface defects and faults. Overall, the results of this study underscore the significance of STM analysis in unravelling the molecular absorption properties of graphene. Moreover, they highlight the immense potential of graphene as a promising substrate for diverse applications, such as molecular electronics, catalysis, and sensing. The insights gained from this research pave the way for future advancements in graphene-based nanotechnology.

Keywords: *Graphite, Scanning tunnelling microscope, Surface*

Radio Signal Based Indoor Localization with Histogram-based Gradient Boosting Classifier with LoRa

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Abstract

Indoor localization has gained significant importance in the context of smart cities, driven by the need for accurate positioning and navigational solutions. This research focuses on the application of long range (LoRa) wireless technology and Received Signal Strength Indicator (RSSI) ensemble approaches to address the challenges of indoor localization. While RSSI-based approaches offer simplicity and cost-effectiveness, they suffer from variability and poor accuracy. On the other hand, Machine Learning (ML) techniques hold promise for improving accuracy by leveraging past data and adapting to changing environments, but they require extensive training data and computational resources. Combining multiple technologies, such as RSSI and machine learning, can enhance the accuracy and robustness of indoor localization systems. However, the choice of technique should be based on the specific application requirements, considering factors such as accuracy levels, cost constraints, and system complexity. In this work, an ensemble machine learning based approach is proposed for LoRa based indoor localization systems. Where ML algorithms Extra-trees classifier, Gradient Boost classifier, Random forest classifier, Stacking Classifier, Soft Voting /Majority Rule classifier, Hist Gradient Boosting Classifier and it observed that Hist Gradient Boosting Classifier algorithm is outperforming by providing 99% localization accuracy.

Keywords: *Machine learning, Received signal strength indicator, Pre-processing, Model training, Accuracy*

Field Performance Evaluation of Mechanical Weeder for Paddy

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Abstract

Weeds are a significant impediment to paddy production. Herbicides are commonly used to manage weeds, however they have a number of side effects owing to environmental pollution. Existing commercial power weeding machine in the market have not met the required precision operation in the paddy cultivation in Sri Lanka. Farmers are discouraged to practice the row planting or row seeding which gives high yield giving due to constrains associated with existing weeding machines. Mainly, the drum spacing of paddy weeder is not suitable for Sri Lankan condition. Therefore, this research was mainly focused on design and fabrication of mechanical paddy weeder to be compatible with Sri Lankan paddy cultivation. It comprises of fingers-shaped blades mounted on two cage wheels that were attached to a gearbox using common shaft. Shaft was driven by a 1.6 hp petrol engine. Power generated by engine was transmitted to gearbox through power transmission shaft. Rotation of the cage wheels help for weeding and forward driven movement of the machine at the same time. The field performance evaluation of machine was conducted in Farm Mechanization Research Center, at Mahailuppallama. Results indicated that theoretical field capacity, effective field capacity and field efficiency; 0.0679 ha/h, 0.057 ha/h, and 83%, respectively. Newly designed power weeder required 17.5 man hours per hectare. Machine speed was 0.539 m/s. The average weeding efficiency of machine and fuel consumption were obtained as 60% and 10.4 l/ha respectively.

Keywords: *Paddy, Weeder, Design, Performance*

Analysis of Atmospheric ^7Be concentration in Colombo, Sri Lanka

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Abstract

^7Be is a naturally occurring radioisotope produced in the upper atmosphere when atmospheric oxygen and nitrogen react with cosmic induced protons and neutrons. This process is called spallation. Measurements of ^7Be are used to determine the changes in the upper Atmosphere, such as sudden changes in weather, in the considered area. Measuring ^7Be concentrations in the environment can be used to figure out whether there is an effect from a nuclear release in the area considered. This is the first measurement of ^7Be since there are no other records to be found about the concentration of ^7Be in Sri Lanka. Especially since Sri Lanka is located near the equator, it is important to predict the behaviour of ^7Be around the equator. The radioisotope ^7Be decays into ^7Li with a half-life of 53.22 days and emits a characteristic gamma ray of 477 keV. ^7Be quickly attaches to dust particles in the upper atmosphere and falls to the Earth's surface. The concentration of the isotope can vary due to wind, rain, temperature, and many other environmental factors. This experiment was done to obtain the concentration value of ^7Be at the University of Colombo, Sri Lanka. The measurement was done using samples of surface air from in-situ gamma spectrometry. The average concentration of ^7Be using the in-situ gamma spectrometry method was $3.1 \pm 0.4 \text{ mBq m}^{-3}$. The primary purpose of obtaining this measurement was to establish a reference value for ^7Be concentration in Sri Lanka. This reference value will serve as a basis for conducting further studies that utilize ^7Be as a naturally occurring tracer in various research applications can be done using ^7Be as a naturally occurring tracer.

Keywords: ^7Be , In-situ gamma spectrometry, ^7Be reference value

From Fields to Skies: Assessing the Viability of Unmanned Aerial Vehicle (Drone) Technology for Precision Agriculture in Sri Lanka

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Abstract

This research paper explores the viability of Unmanned Aerial Vehicle (UAV) technology in Sri Lanka's agriculture sector, focusing on its practical and potential benefits. The research aims to pave the way for seamless integration, enabling Sri Lanka's agriculture sector to harness the full potential of UAV technology. Drones can be used for a variety of crop management applications by frequently taking high-resolution photographs. To increase crop production, it is essential to monitor crops effectively and spray fertilizer and pesticides precisely. However, these methods can also have detrimental effects on people's health and the environment. Therefore, using UAVs can reduce these dangers. Despite the many uses of drone technology, Sri Lankan farmers have difficulty putting it into practice because of concerns with cost and accessibility, technical complexity, and regulatory limitations. The significance of overcoming these issues is emphasized by this study in order to make it easier for Sri Lanka's agriculture sector to utilize UAV technology. The research also emphasizes outsourcing's potential as a viable option and offers suggestions for governments, agricultural stakeholders, and service providers to encourage the broad use of UAV technology. By overcoming these issues, the aim is to streamline the integration of UAV technology in Sri Lanka to improve agricultural methods, raise productivity, lessen negative environmental effects, and protect the health and welfare of farmers and customers. Collaboration amongst stakeholders, suitable infrastructure, supportive legislation, and capacity-building programs are necessary for the successful integration of drones into the agriculture industry.

Keywords: *UAV technology, Precision agriculture, Challenges, Outsourcing*

POSTER PRESENTATIONS

Simulation of Path Planned Differential Drive and Obstacle Avoidance Medicine Delivery Robot Using V-REP CoppeliaSim

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Abstract

The purpose of this research paper is to explore the development of a medicine delivery robot using path planned differential drive and obstacle avoidance techniques. The use of such a robot has the potential to improve efficiency and reduce the risk of transmission of infectious diseases in medical facilities. This paper discusses the concept of a differential drive robot, path planning algorithms, and the factors to consider when using a robot for medicine delivery. Additionally, it presents the design process followed to develop the robot, including defining the requirements, creating a 3D model, programming the robot's motion, adding object avoidance sensors, and integrating with a communication system. While the complete implementation of the planned path was not achieved, significant progress was made in developing the obstacle avoidance functionality.

Keywords: *Differential drive, Obstacle avoidance, Infectious diseases, Medical facilities, Path planning algorithms*

Synthesis and Characterisation of Phase Pure Hydroxyapatite from Bovine Bones

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Abstract

Most bone fractures can heal spontaneously because of the regenerative nature of bone tissue. However, if the defect size exceeds a ‘critical size’, the bone is no longer able to heal naturally. Bone grafts are used to assist in the healing process. Several methods exist for obtaining bone grafts however, due to the drawbacks associated with the mainstream techniques, alternative sources of bone graft-substitute materials are being widely investigated. Hydroxyapatite (HA) obtained from bovine bone has been found to be easier to produce and more cost-effective. The current research focuses on the synthesis of phase pure HA from bovine cancellous bones using a range of techniques that completely removes the organic component and characterisation to investigate that the properties of produced material are similar or better to those currently available. Analysis of the samples with FTIR and XRD showed that the material exhibits properties of highly crystalline HA with its characteristic functional groups similar to bone graft materials currently being used. This is the first report of bovine-derived bone graft material produced in Sri Lanka. The material produced has the potential to be used as a novel low cost bone graft material, provided that necessary regulatory approvals are taken. It is expected that being a third-world country Sri Lanka will greatly benefit from the availability of a low-cost bone graft material.

Keywords: *Bone graft material, Bone fractures, Hydroxyapatite*

Evaluating the Energy Performance of Green Roofs and Their Potential for Reducing Building Energy Demands

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Abstract

The article aims to evaluate the energy performance of green roofs and explore their potential for reducing building energy demands. By examining existing research and case studies, it will analyze the key factors that influence the effectiveness of green roofs in different climates and building types. The findings of this study will provide valuable perceptions for architects, urban planners, and policymakers interested in incorporating green roofs as an effective strategy for sustainable building design and energy conservation. It has to be driven to the future as a modern technological strategy in responsible research and innovations.

Keywords: *Green roofs, Energy performance, Building energy demands, Energy consumption, Energy savings*

Factors Influencing the Optimal Reintegration of Skilled Migrant Returnees in Gampaha District, Sri Lanka

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Abstract

Some of the Nation's consider traditionally, that the return migration has been positively viewed as a popular strategy. There is a question that it is not at satisfactory level of utilization of the experience and knowledge already gathered from their large working period in the employment in various countries with different industry segments. It is needed to find out the causes for not utilizing the knowledge and experience gained through their employment abroad, to achieve the maximum possible personal development, after returning to the country and further to give the contribution to country's industrial developments and take part in enhancing the economy of the country. For this study, details of 600 skilled migrant returnees of Gampaha district in Sri Lanka were collected through a random sample using an available population 8482 of skilled returnees in the district. It is required to understand that Sri Lanka Foreign Employment Bureau (SLBFE) have less accuracy on returnees as there is no compulsory entering of details by returnees at the time of arrivals at the airport or even after some specified period of time. Some personal factors of skilled migrants and some system factors of the relevant authorities in the country are considered to assess the effectiveness of the factors of reintegration, under the conceptual framework. A questionnaire was prepared for skilled migrant returnees, as respondents. Focus group discussion was carried out with the manager-reintegration, some experienced professionals in different professions with many years of overseas experience. Lack of interest, lesser initiatives and reluctant to change are the potential personal factors. Inadequacy of the implemented mechanism to gather returnees' details at the airport and not centralizing the available opportunities in Sri Lanka, in view of deputing skilled returnees are the significant major system factors of the government organizations of the country. In this research study, some of the major personal factors of skilled migrants and some of the major system factors were considered to test their influences on reintegration as that most of the skilled migrant returnees have lack of interest to work in Sri Lanka after their arrival. Five folded reintegration approach which has to be executed by SLBFE, forwarded by the Ministry of Foreign Employment, as an action plan, and prepared with the support of International Labor Organization . First two aspects are considered by this research and balance three aspects are available to consider by the future researches.

Keywords: *Reintegration, Lack of interest, Reluctant to change, Initiatives, Protection*

Enhancing Road Safety for Motorcyclists: A Modified Helmet with Live Monitoring of Eye Aspect Ratio for Driver Drowsiness Detection

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Abstract

Driver fatigue and drowsiness contribute to more than 20% of reported road accidents worldwide, with motorcyclists being particularly vulnerable. To address this issue, this study proposes a modified helmet with innovative features aimed at detecting and preventing rider drowsiness. To estimate driver drowsiness, the study utilizes various techniques, such as monitoring biomedical signals, visually assessing the driver's bio-behaviour through facial images and observing the driver's performance. The proposed algorithm focuses on live monitoring of the Eye Aspect Ratio (EAR) using image processing techniques. High-definition live video is decomposed into continuous frames, and facial landmarks are detected with a pre-trained neural network based on Dlib functions, trained using the HAAR Cascade algorithm. The image processing library, OpenCV, plays a key role in this algorithm's implementation, which is carried out in Python. By calculating the EAR and continuously monitoring it against a predetermined threshold value, the algorithm can detect blinks and micro-sleep episodes. The detected blinks and the level of drowsiness are displayed on the monitor screen, accompanied by a vibration warning for micro-sleep detection. In conclusion, this study presents an effective algorithm that leverages live monitoring of the EAR through image processing techniques to estimate driver drowsiness. Its implementation demonstrates promising results in identifying blinks, assessing drowsiness levels, and providing timely warnings to mitigate the risks associated with driver fatigue and drowsiness, thereby enhancing road safety for motorcyclists.

Keywords: *Motorcycle accidents, Bio-behaviour analysis, Neural network, OpenCV, Eye aspect ratio*