ACCIMT RESEARCH SYMPOSIUM 2024

"Excellence of Research, Technology & Innovation"

PROCEEDINGS

18 December 2024

Arthur C Clarke Institute for Modern Technologies
Katubedda, Moratuwa

ARTHUR C CLARKE INSTITUTE FOR MODERN TECHNOLOGIES

Our Vision

To be a leading innovation center for Modern Technologies in the region

Our Mission

To develop foster and facilitate the domestic base of modern technological capabilities through innovation, R&D, training, industrial services and international collaboration

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MESSAGE FROM THE DIRECTOR GENERAL

Eng. (Mrs.) Kamani Ediriweera

Acting Director General,

ACCIMT, Katubedda,

Moratuwa.

It gives me great pleasure to extend my warmest greetings to all contributors and participants of the ACCIMT Research Symposium 2024. This year's theme, "Excellence of Research, Technology, and Innovation" underscores our institute's commitment to address pressing challenges and provide innovative solutions that create meaningful impact in diverse fields of science and technology.

The symposium serves as a vital platform for fostering collaboration, sharing ideas, and celebrating the achievements of our research community. The dedication and hard work evident in the proceedings reflect the spirit of innovation and excellence of ACCIMT.

I am confident that the insights and findings documented here will inspire further exploration, spark transformative ideas, and contribute to the advancement of science and technology.

On behalf of the Arthur C Clarke Institute for Modern Technologies, I extend my heartfelt gratitude to the organizing committee, the contributors, and the reviewers for their efforts in making this symposium a success. May this publication serve as a testament to the outstanding work achieved and a beacon for future aspirations.

I wish this event be a great success.

KEYNOTE ABSTRACT

Prof. K. P. S. Chandana Jayaratne

Head, Department of Physics and

Director, Astronomy and Space Science Unit,

Department of Physics, University of Colombo,

Colombo-03.

Distinguished Guests, Esteemed Colleagues, Engineers, Researchers, and Friends,

It is both an honour and a privilege to address you at this momentous occasion—the ACIMT research symposium to mark the 40th Anniversary of the Arthur C. Clarke Institute for Modern Technologies. This milestone not only celebrates the rich history and remarkable achievements of this institution but also reaffirms our commitment to innovation, collaboration, and forward-thinking research.

Over the past four decades, the Arthur C. Clarke Institute has stood as a beacon of technological advancement, engineering research and development, scientific inquiry, and dedication to addressing both local and global challenges. From groundbreaking technological research to fostering interdisciplinary collaboration, this institution has played a pivotal role in shaping modern engineering and technological landscapes and contributing to Sri Lanka's development.

As we gather here for this Research Symposium, it is important to reflect on the remarkable journey that has brought us together and to chart a path toward the future. Today, the world is at the intersection of technological revolutions—artificial intelligence, space exploration, renewable energy, and digital transformation—all of which require innovative research and a shared commitment to discovery. Our responsibility as research engineers, scientists and technologists is to harness the power of collaboration, knowledge, and innovation to create solutions that are sustainable, inclusive, and transformative.

The *Arthur C. Clarke Institute* has long embodied the spirit of exploration and scientific curiosity that has defined the legacy of its namesake, the legendary science fiction writer and visionary thinker, Sir Arthur C. Clarke. His insights into the role of science and technology as agents of change continue to inspire us as we endeavour to tackle the technological frontiers of today and tomorrow.

The idea of having such a symposium annually was initiated during the tenuer of my chairmanship of the ACCIMT. I would like to extend my deepest gratitude to all participants,

partners, and contributors who have supported this journey and helped make this event a reality.

Let this 40th Anniversary of ACCIMT not just mark the celebration of history but inspire a bold vision for the future. Together, we can continue to explore, innovate, and shape a better tomorrow.

Thank you, and I wish you a productive and enlightening symposium.

Prof. K P S Chandana Jayaratne
Former Charman of the ACCIMT (2022.09.08 to 2024.09.30)
and Head of the Department of Physics, University of Colombo
2024.12.17

Personal Security/Alarm Device Against Crime

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In Scandinavian countries there are times that most of the day is in dark and the chances for crimes are at a high level. Crime prevention has become essential especially during the long dark periods. Alarmwear which is a comprehensive crime preventive solution to prevent and avert crime, is a high-tech, miniature, innovative product designed & developed in Sri Lanka for the European market with the aims of elevating high tech electronic manufacturing industry and contributing to foreign exchange earning in Sri Lanka. Alarmwear product package consists of a waistband with a LED strip, a handheld alarm and a smart app, which are synchronized together but can use separately as well. The system is to be operated in four cases representing different communication requirements between the three parts. For the product package to work as a system, the LED strip and the handheld alarm needs to be paired by Bluetooth to each other as well as to the smartphone. The alarm consists of a hand held unit with a sprint which will be activated once the sprint is pulled out. The LED strip is activated either by the alarm or mobile phone. When activating the hand-held alarm (by pulling out a sprint), the LED-strip in the waistband shall change colour from blue to white, a trigger shall be sent to the smartphone application (compatible with both Android or iOS) and then the application will send an alarm to pre-defined receivers. The LED-strip shall be powered by a power bank. Both the LED strip and the hand held unit complies with CE certification as well as IP67.

Keywords: waistband, LED strip, handheld alarm, smart app

Automatic Water Level Control Using PLC and SCADA

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Most of the time, we require to manage the water level for several applications in our day-to-day processes, such as reservoir intake, which is mostly used to draw the water from earthen dam reservoirs and, in industries to monitor the level of water for several purposes, etc. Because a large amount of water is wasted from various applications, controlling the level of the water supply is an important requirement nowadays. Previously manual and conventional control methods were used to control the level of water whereas automation technologies now provide real-time monitoring and remote control of the system based on parameter variations, while minimising human inputs and eliminating human error via precise machine control and monitoring. Automation plays an important role in the global economy and in our daily lives by increasing productivity. Some of the widely used automation tools are Distributed Control Systems, Human Machine Interface, Supervisory Control and Data Acquisition (SCADA), Programmable Logic controllers (PLC), etc. As an example, take the reservoir intake, which is widely used to draw the water from an earthen dam reservoir. It essentially consists of an intake tower constructed on the slope of the dam at a place from which intake can draw a sufficient quantity of water even in the driest period. Intake pipes are fixed at different levels so as to draw water near the surface in all variations of water level. In this study we decided to implement a two-level automatic water control system using PLC and SCADA. This SCADA system monitors the two levels of water in the reservoir or sump, depending on the application. When the water reaches each level, the outlet valve assigned to that particular level automatically turns on, and the water is pumped to the overhead tank, where it is distributed based on its level. Manual control incorporates the capability to open three valves as needed during incidents. This system can be easily modified to accommodate different numbers of levels and various liquid densities for a variety of applications.

key words: Supervisory Control and Data Acquisition (SCADA), Programmable Logic controllers (PLC), Human Machine Interface.

Design and Develop an Innovative Prototype for Predictive Maintenance (PdM) by Integrating Vibration Analysis, Electrical Signature Analysis and Thermal Signature Analysis

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Vibration analysis provides insights into mechanical faults such as imbalance and misalignment. Electrical signature analysis detects electrical anomalies including insulation degradation and motor faults, while thermal signature analysis identifies temperature-related issues like overheating and poor insulation. Predictive Maintenance (PdM) using Electrical Signature Analysis, Vibration Analysis, and Thermal Signature Analysis represents a comprehensive and effective strategy for ensuring equipment reliability and reducing downtime. The integration of these techniques offers a comprehensive, real-time assessment of equipment health, enhancing fault detection accuracy and predictive maintenance capabilities. This holistic approach not only improves equipment reliability but also extends asset lifespan and reduces maintenance costs. As technology continues to advance, the effectiveness and accessibility of PdM systems are expected to grow, making them a crucial component of modern industrial maintenance practices. The paper discusses the techniques of design and development of an innovative unit to measure vibration analysis of imbalance, misalignment or bearing faults with 1 HP three-phase motor. Adash vibration meter A4900 is used to measure vibrations and FLIR E4 thermal imaging camera is used to measure the thermal images.

Key words: Predictive Maintenance, vibrations Analysis, Electrical Signature Analysis, Thermal Signature Analysis

Touchless Water Tap

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Touchless handwashing is one of the best ways to remove germs, avoid getting sick and prevent the spread of germs to others, whether we are at home, at work, traveling, or out in the community. During the Covid pandemic, keeping hands clean was especially became important to help prevent the virus from spreading. Both prevailed economic crisis and the Covid Pandemic, during 2021-2022, gave a motivation to design and build a proto-type for a Touchless 'Water Tap' which is affordable and reliable as the ones imported. Detection Range, Response time and the Sensitivity were the three main parameters that had to be considered to give advanced and flexible operation to the end user. At the beginning there were two approaches based on Ultrasound & Infra-Red (IR). The low cost Ultrasound sensor was not up to industrial standard, and it gave unstable operation. The selected IR sensor gave false triggering for sunlight resulting it beyond commercial use. Sensor with Signal encoding capability was used to overcome the difficulties experienced in above two methods. Low cost Timer IC (NE555) in Mono-stable Mode was successfully used to detect the reflected signal from the obstacles. To increase the reliability, two identical Circuit Boards were inserted in selectable manner, if one fails other could be selected. Other basic methods were used to eliminate the false triggering when power ON/OFF and fluctuates. After some test operations in actual conditions it was intended to make further improvements for the reliability of the system components like solenoid and power transistors and to deploy this proto-type as more innovative product to the local market.

Key Words: Ultrasound, Infra-Red, Solenoid, proto-type

Design and Implementation of a Store-and-Forward APRS Digipeater for 2U Nano Satellites: A Case Study from the BIRDS-X Project

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The Arthur C. Clarke Institute for Modern Technologies (ACCIMT) participated in the BIRDS-X APRS payload competition hosted by Kyushu Institute of Technology (Kyutech) in Japan to develop an APRS Digipeater payload for a 2U nanosatellite. This payload, designed to facilitate store-and-forward communications, beacon transmission and digipeating, in VHF Amateur Radio Frequency band. The Payload follows the stringent interface control requirements set by Kyutech, focusing on power consumption, weight limitations, and communication protocols.

Advanced technologies, such as satellite technology, are important for a country's improvement in the technical field and for adding value to its technological sectors. This satellite project supports capacity development, benefiting scientific research and education across the nation. The successful implementation of this payload not only enhances Sri Lanka's capabilities in satellite technology but also contributes to global efforts in advancing nanosatellite communication technologies.

The payload system incorporates key components such as the PIC18F48J11 Interface IC, STM32F103C8T6 Terminal Node Controller (TNC) IC, RADIOMETRIX BiM1H-145.825-10 VHF transceiver module, Flash Memory. The developed firmware facilitates seamless communication with the On-board Computer (OBC), managing the transition between receive and transmit modes while ensuring reliable data processing and storage.

This case study highlights the challenges encountered during development, such as PCB production and obtaining the required electronic components, especially the transceiver module. The ACCIMT team overcame these obstacles by leveraging in-house resources and international collaboration.

Keywords: Nanosatellite, APRS, Digipeater, Payload system, TNC

Development of Agriculture Drone Demonstrator for Liquid Fertilizer Spraying

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This research focuses on design and development of a liquid fertilizer spraying drone prototype for precision agriculture. Precision agriculture which is the science of improving crop yields together with efficiencies across the agricultural domain with the use of data and technology driven tools plays a vital role in the current society. Among the tools used in precision agriculture, the use of UAV systems carries a significant importance as these tools have the possibility to be used for both data acquisition and implementation phases. In this context, the use of UAVs for vegetation mapping and selective spraying of fertilizer pesticide has the potential to improve efficiency of cultivations and mitigate inherited risks of hazardous chemicals across the agricultural production cycle. Labor reduction due to autonomous nature, chemical and pollution reduction due to selective spraying and precise and uniform fertilizer distribution can be identified as major advantages of using UAVs for agriculture.

Today most of the spraying drones face control dynamic challenges such as dynamic Center of Gravity due to dynamic weight and sloshing. Another problem is that the low flight time due to high structural weight. The drone was designed mainly to address the above-mentioned problems. The initial structure was constructed by modifying an existing structure of a smaller hexacopter. The structure was modified by reducing the bending moments and loads on the load-bearing elements, thereby decreasing the overall weight of the structure. Also, the landing skids and motor arms were modified so that any type of fertilizer tank could be installed easily for testing purposes. Flight tests were carried out and the fine tuning of the parameters of the autopilot system was completed. The total takeoff weight of the fabricated drone was around 25 kilograms with 10 liters of spraying liquid. Estimated maximum flight time was around 15 minutes with the spraying liquid. The weight without the spraying liquid was around 13 kilograms and it was flown successfully for 30 minutes without spraying liquid. Four 6S(22.2V) 9500mAh LiPo batteries were used for the flights Reinforcing some parts using carbon fiber and using a custom-made fertilizer tank with baffles were identified as future improvements for the drone.

Keywords: Drone, UAV, Precision agriculture, Sloshing, Dynamic center of gravity

Developing a Low-cost, Polarimetric Radar System using MIT Coffee Can Radar

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This research introduces a novel, cost-effective approach to developing a polarimetric radar system, leveraging the MIT coffee-can radar as a foundational platform. Polarimetric radar enhances traditional radar capabilities by analyzing backscattered signals across multiple polarization states, yielding richer information for target detection, classification, and surface characterization. In this study, we transform the basic MIT coffee-can radar architecture to support dual-polarization measurements, involving the design of horizontally and vertically polarized antennas and the incorporation of polarization-switching mechanisms to enable flexible transmission and reception. These modifications are achieved through the development of dualpolarized antennas and the integration of specialized signal processing algorithms, enabling the capture and analysis of horizontal-horizontal (HH), vertical-vertical (VV), horizontal-vertical (HV), and vertical-horizontal (VH) backscatter components. The enhanced radar system can extract critical polarimetric properties, including differential reflectivity, depolarization, and other polarimetric signatures, to improve the accuracy of object identification and surface parameter assessment. Compared to its single-polarization predecessor, this setup exhibits a substantial improvement in cross-polarization isolation, achieving enhanced isolation between orthogonal polarization channels, which contributes to the system's ability to resolve detailed characteristics of observed objects. This added capability enables the system to detect and classify variations in target shape, orientation, and material properties, improving target characterization and classification accuracy in diverse environmental conditions. Calibration challenges, an integral part of maintaining polarization purity and phase coherence between channels, are also addressed, ensuring that the polarimetric measurements remain reliable and accurate. Through a series of simulations and experimental validations, we demonstrate the feasibility of upgrading a low-cost radar system to a polarimetric configuration capable of distinguishing between complex target types and material properties. Our findings emphasize the potential for utilizing inexpensive components to create advanced radar systems suitable for applications such as remote sensing, environmental monitoring, object classification, and even traffic management. This work opens avenues for further development of accessible polarimetric radar technologies, facilitating their broader use in scientific and industrial domains.

Keyword: Polarimetric, Polarization

Implementation of Lora-Based Communication Networks for Monitoring Medium Voltage Power Lines

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This research focuses on the development and implementation of an innovative wireless data communication network designed to significantly enhance the monitoring, management, and maintenance processes within power distribution systems, with particular emphasis on 33kV distribution lines. The proposed system employs a Long Range (LoRa) communication network, which is well-suited for its low power consumption, long-range capabilities, and cost-effectiveness. This network facilitates the real-time transmission of crucial data collected from strategically placed sensors throughout the distribution system. These sensors, which are both low-cost and energy-efficient, are tasked with continuously monitoring the operational status of various components within the power grid, as well as detecting and locating faults when they occur.

Upon transmission, the data is received by a centralized control center where it undergoes thorough processing and analysis. The processed data provides valuable insights that are then utilized to optimize system performance, manage power distribution more effectively, and implement timely maintenance operations. The study also explores the feasibility of remote maintenance within the distribution system, leveraging the capabilities of the LoRa network to reduce response times and enhance system reliability.

Additionally, this research evaluates the broader applicability and scalability of LoRa-based networks within the context of power distribution systems in Sri Lanka. The findings aim to demonstrate the potential of LoRa technology in delivering a cost-effective, scalable, and resilient solution for the real-time monitoring and management of power distribution infrastructure, thereby contributing to the enhancement of national power grid operations.

Key words: LoRaWAN, Medium Voltage Power Lines, Communication Networks, Wireless Sensor Networks,Power Line Monitoring, Smart Grid, Remote Sensing ,Data Transmission, Low Power Wide Area Network (LPWAN)

Locally Developed Agro-Meteorology Real-time Automatic Weather Station

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An Automatic Weather Station (AWS) is defined as **a** facility that transmits or records observations obtained from weather measuring instruments in real-time from remote sites. In an AWS, the measurements of meteorological elements are converted into electrical signals through sensors and replace the traditional weather station, either for accuracy, to save human labor, or for measurements from remote areas. It will typically consist of a weather-proof enclosure containing the data logger, rechargeable battery, Radio Frequency link using GPRS to the server, and the meteorological sensors with attached solar panels upon a mast.

The AWS in this context have sensors to detect temperature, wind speed, wind direction, humidity, light, liquid-equivalent precipitation (rain gauge), and advanced detections like Ultra Violet (UV) level measurements, sun shine hours, soil conditions, and environment gases (Carbon Monoxide, Ammonia, NOx, etc.).

Data gathered through the system with further information processing at the webserver is used for decision making, reporting, and analysis for a substantial period using mathematical computation processes, embedding intelligence, and weather data prediction for the future, weather based modeling for disease early warning and plantation conditions and harvest. The completed system is termed as a Real-time climate monitoring weather information system. The solution is an IoT (Internet of Things) product.

Weather parameter monitoring is of utmost importance to meteorology institutes, plantation research institutes, disaster monitoring institutes, agriculture, farming, estates, factories, etc. with the interest in climate for decision making. Information can be easily retrievable to the interested parties in estates, factories, or any related organization from a mobile smartphone, laptop or pc by logging in to the web-based system.

During the last years we managed to design, develop, install, and commission such systems at locations Thalawakele, Beragala, Ragala, Galle, Passara, Uva Highlands, Rathnapura,

Kalawana, Watawala, Thispane, Nuwaraeliya, Loolekondera, Pundalu Oya, Welipenna, Kotapola, Sooriyakanda and Mandaramnuwara in major tea planting areas and three forest reserves Horton Planes, Knuckles, and Sinharaja using a grants (foreign, local) where major stakeholder being Tea Research Institute of Sri Lanka(TRISL), tea estates and tea factories. The data is available via the web portal www.awsdata.lk for browsing, downloading and processing.

Keywords: Automatic Weather Station, sensors, GPRS, IoT, Web Server, Meteorology, Plantation Research, Disaster Monitoring, TRISL, NOx

Review on Radiosondes

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Radiosondes are battery-powered telemetry instrument packages typically carried into the atmosphere by weather balloons. They measure altitude, pressure, temperature, relative humidity, wind speed and direction, and cosmic ray readings at high altitudes. Despite some disadvantages such as limited coverage, operational costs, data transmission challenges, and inaccuracy in extreme conditions radiosondes remain essential tools for gathering atmospheric data. They provide direct measurements of temperature, humidity, and pressure throughout the vertical extent of the atmosphere, making them critical for atmospheric research and weather forecasting. Radiosondes are involved in several key research areas, including weather forecasting, climate change, atmospheric studies, aerosol and trace gas research, satellite calibration and validation, boundary layer studies, investigations of extreme weather events, and educational applications.

This review aims to evaluate local development in radiosonde technology to address some of these challenges. Currently, the Metrology Department of Sri Lanka relies on imported products, which limits the number of radiosondes they can launch each week due to cost constraints. Radiosondes transmit data in real-time through sensing, encoding, modulation, and transmission. RF modules play a crucial role in ensuring reliable transmission, depending on factors such as power consumption, environmental conditions, and regulatory requirements. High-altitude data acquisition systems employ innovative antennas, communication technologies, and modulation techniques to reduce power consumption and improve reliability.

Radiosondes can experience errors in temperature and humidity readings due to radiation heat exchange, which can affect data accuracy. Mitigation strategies include using radiation shields, calibrating instruments, and optimizing design conditions. As per the review it was found that ongoing research aims to address these issues and drive advancements in sensor technology, data transmission, environmental adaptations, and operational efficiency. The ultimate goal is to enhance the accuracy, reliability, and utility of radiosondes for atmospheric observations, thereby improving weather forecasting, climate monitoring, and our understanding of atmospheric processes. Additionally, the review evaluated the Vaisala RS41 radiosonde product (manufactured in Finland) and the Meisei MS-100 radiosonde product (manufactured in Japan). All Meisei radiosondes utilize solar radiation correction for temperature during the daytime, without an infrared radiation correction. The

smallest model, the iMS-100, is used in Sri Lanka. In contrast, the Vaisala RS41 also applies solar radiation corrections for temperature measurements, along with a time lag correction. Significant differences exist in the sensors used in the two radiosondes as well.

Keywords: Radiosonde, High-altitude data acquisition, altitude, pressure, temperature, relative humidity, wind speed and direction

Survey on Radio Frequency Exposure in Colombo - Sri Lanka

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The radio frequency (RF) exposure level of major cities in Sri Lanka has significantly increased during the past years due to the exponential development of the mobile telephone industry. RF sources include cellular mobile base stations, Wi-Fi, Bluetooth, CATV, home security, automobile alarm systems, and transmitting antennas of TV and FM radio. Due to transmission power variations, density of emitting devices, and geographical factors it is difficult to theoretically estimate RF intensities, thus requiring measurements for accurate estimations. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) provides scientific advice and guidance on the health and environmental effects of non-ionizing radiation (NIR) to protect people and the environment from detrimental NIR exposure. The standards published by ICNIRP considering long-term and short-term human health effects are being widely adopted by the majority of countries in the world and international radiation protection bodies such as WHO. Since 2010 Telecommunication Regulation Commission of Sri Lanka has adopted ICNIRP standards.

A survey on RF exposure conformity to ICNIRP standards has never been carried out in Sri Lanka. Considering the exponential growth the telecommunication industry has achieved during the last two decade it is vital to investigate RF exposure conformity with respect to ICNIRP standards. Exposure level measurements were carried out using Narda NBM 550 field meter coupled to the ICNIRP-shaped probe ED5091, which is capable of carrying out rapid conformance measurements with frequency emissions ranging from 300 kHz to 50 GHz with evaluation in the time domain. Colombo district was selected for the survey and site selection was carried out giving priority to population density and transmitting site map (including broadcasting and cellular). The finalized survey report contains a complete RF exposure map in accordance with ICNIRP standards covering the Colombo district. Apart from that ACCIMT will copyright the data and will make the data available to researchers for non-commercial redistribution purposes. As a future work RF exposure map in accordance with ICNIRP standards covering the entire country can be published. Apart from using the generated survey as the major conformity document for ICNIPR compliance document in the country, this can also be used as a reference document for TRCSL in providing authorization to construct new sites and also as a general guide for mobile operators in the initial planning stages of new transmission site construction.

Keywords: RF, ICNIRP standards

Advanced Management Information System (MIS) for Buddhist and Pali University of Sri Lanka

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This Management Information System (MIS) is designed to streamline and centralize the operations of the Buddhist and Pali University by integrating several core functions, including nonacademic and academic employee management, Application processing and student registration, student profiles, examination and subject management, stores management, and vehicle management. The system enhances the efficiency of administrative processes by providing an organized platform for nonacademic and academic employee records, tracking students' academic and personal information, and coordinating examination schedules with subject registrations. Nonacademic and academic employee management allows for seamless handling of faculty and staff information and payroll. The student profile system enables real-time updates on student enrollment, attendance, grades, and academic progress. The examination and subject management module ensures the smooth administration of course assignments, exam scheduling, and grading. Stores management oversees inventory and supplies necessary for the Buddhist and Pali University operational needs, while vehicle management tracks university-owned transportation assets, including scheduling, maintenance, and usage. Laravel and Yii are two PHP frameworks used to implement the MIS web-based application which offers a unique set of features and tools to build robust applications. The system incorporates multilevel authorization to ensure data security and controlled access, with role-based permissions assigned to administrators, faculty, and students. This ensures that sensitive data is accessible only to authorized personnel, promoting accountability and maintaining confidentiality across all university operations. By integrating these essential modules into a cohesive system, the MIS fosters greater transparency, improves decision-making, and contributes to the overall operational excellence of the Buddhist and pali university, Sri Lanka.

Keywords: Management Information System, Laravel, Yii

Analysis of Long Distance Public Transport Driving Behaviour Using GPS Data

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The increasing incidence of aggressive driving behaviors stands out as a critical issue contributing significantly to the rising number of fatal road accidents. This issue poses a threat to public safety, directly impacting the well-being of individuals and the economic stability of nations. To effectively mitigate this problem, a comprehensive understanding and measuring of aggressive driving is essential. Analyzing long-distance routes with non-intrusive methods presents additional challenges. These insights are crucial not only for enforcing traffic regulations but also for implementing targeted interventions to control the rising rates of road accidents on a global scale. In response to the above issue, a data-driven approach emerges as a promising solution. Various methods and approaches have been explored to identify and address aggressive driving behavior, ranging from surveys to sophisticated Naturalistic Driving Studies that rely on video sensors and GPS data. However, an approach that relies solely on GPS data proves to be less intrusive and more scalable for large-scale monitoring of driving behavior across diverse road networks. In this framework, unsupervised learning methods based on Auto-encoder and SOM neural networks are considered for unlabeled datasets that enable the analysis of driving behavior without the need for labeled data. The dataset consists of 7.5 million records collected by the National Transport Commission through GPS sensors installed in public buses. The algorithm takes into account driver-dependent parameters such as speed and patterns of acceleration or deceleration, to evaluate driving behavior in one-minute driving events, ensuring smaller segments of trips. Each segment is rated based on the identified behavioral pattern, and the overall trip is rated based on the aggregated segments. Therefore, the final aggressiveness indicator is calculated for the whole trip. Results were obtained for each network considering respective measures based on the type of network. The auto-encoder was trained using MSE as the loss function with a 0.3 validation split. A minimum reconstruction error of 0.007 and a maximum of 0.045 were obtained for the feature set of 8. The SOM was trained on a 2x2 grid, yielding a quantization error of 0.086 and a silhouette score of 0.396. These results were obtained only for data tuples that contain non-zero values for each parameter of the segment. The results may change when zero

values are introduced. As a future direction, these models can be further improved to enhance efficient and safe driving through real-time analysis.

Keywords: Driver Behaviour, GPS data, Auto-encoder, SOM, Aggressiveness Index

Android Mobile Application for Surveying Tea Lands for Estimated Cultivation

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Tea production is one of the main sources of foreign exchange for Sri Lanka while there are no details for export planning. This proposed system is to collect the land data with their status and used them for estimated cultivation for improving the export process. This android mobile application is to collect ground level survey data through the mobile by working around the land and the other relevant information to the tea land surveying. This app aims to streamline processes of getting location information when doing survey and only requires location service. This will enable user to perform on surveying areas which are not with the proper network coverage while displaying the location information on map using locally stored map tiles which can be preset before the surveying. Received location information from the location service are filtered through a software filter to improve the accuracy. Camera API is used to get images of the surveying sites. This can save time by reducing manual inputs of location and overcome the traditional location information devices which are unable to handle easily as a mobile phone. This can contribute to cost savings by improving efficiency, reducing the need for technical staff and traditional surveying devices for surveying. This is designed for scalability can adapt to the changing needs of the organization requirements, accommodating growth without significant disruptions. Analytics and reporting features of the data collecting server can provide valuable insights, aiding decision-makers in making informed choices based on data through the website. Due to well-designed application offers an intuitive and user-friendly interface, reducing the learning curve for new users. This has enhanced accessibility, ensuring that users with different level mobile technology knowledge can effectively utilize its features. Estimated cultivation can be implemented by using land extend details with the other relevant information. This proposed system will be affected to meet the growing global demand for tea while it is one of the most widely consumed beverages in the world.

Keywords: android app, surveying, location service, camera API, offline map

Automated Solid Waste Segregation & Management System Using Machine Learning & Image Processing

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Solid waste has become a worldwide issue that has been raised through industrialization. In Sri Lanka, hazardous industrial waste is a significant source of waste because people have not focused on the segregation of waste into their basic streams. This study explores the development of a solid waste separation and monitoring system that automatically sorts different types of solid waste using image processing and machine learning techniques. The objectives of this work are to study the problem of the existing solid waste management process in a leading container terminal at Port of Colombo, Sri Lanka, to identify which type of solid waste should be given priority, to develop a sorting algorithm to detect the type of waste using electronic sensor feedback and machine learning techniques, and to develop a web-based system to upload and inspect the waste level in each bin in real time. Finally, a prototype with a sensing mechanism that can sort solid waste (such as metal, tin, can, paper, and plastic) and automatically assign the waste to a specific bin partition according to its type was developed. The construction of the prototype was divided into two parts: i) sensing and ii) mechanical. Metal-based waste is detected using an inductive proximity sensor, whereas plastic, paper, and tin can be detected using Convolutional Neural Networks (CNN), Python, Keras, TensorFlow, and OpenCV. These types of models can be integrated with web cameras to correctly detect and segregate each type of solid waste. The mechanical part assembled a servo motor and stepper motor with the microcontroller to sort the waste type accordingly. The process involves capturing solid waste images (including images of standardized and irregularities) using a web camera, which are then processed through a cascade classifier to identify the Region of Interest (ROI) for waste type. The ROI is resized to 100x100 pixels and passed to a Convolutional Neural Network (CNN) to classify the waste as an example "Tin" or other types. The dataset contains over 500 images of each waste type, converted to grayscale and resized to a standard 100x100 for CNN training. OpenCV and OS libraries are used to load the dataset, and label arrays are created as “0” and “1” for classification. Results were obtained by testing the accuracy of the system. Forty attempts at segregating different types of solid waste in bins were made for the test. The percentage accuracy was calculated using the equation to determine the sensitivity and efficiency of the process. (Tin/Can – 82.5%, Plastic – 72.5%, Metal – 100%, and Cardboard – 67.5%). The outcome of this work shows that the prototype can sort solid

waste successfully, especially plastic waste, and has high potential for future utilization. However, the prototype sensitivity of paper and metal-based solid waste needs to be further improved for the effective segregation of solid waste. The object detection model faced several challenges, including the variability of object appearance from different angles, the impact of lighting on object definition, and objects blending into the background. These factors made detection more difficult. The model offers opportunities for improvement, such as incorporating a stepper motor to rotate during waste segregation, which could enhance accuracy. Adding a second web camera for multi-angle detection may further reduce errors. Additionally, removing the stepper motor's initial position and using advanced deep learning techniques could improve object detection performance.

Keywords: Solid Waste Separation, Image Processing, Machine Learning, Prototype, Convolutional Neural Network, Microcontrollers, Sensors

Handwritten Sinhala Character Recognition Using Deep Learning

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Sri Lanka is the only country that uses Sinhala language as the national language worldwide. The alphabet of the Sinhala language includes 60 characters and they are slightly complex compared to other languages like English. Around 25-30 researches have been done since 1990 regarding Sinhala handwritten character recognition. In pattern recognition technology, Handwritten Sinhala Character Recognition remains mostly unsolved due to the occurrence of many perplexing characters and excessive curveness in Sinhala handwriting. Even the best existing recognizers do not provide acceptable performance for practical applications in the real world. This research aims to improve the performance of handwritten Sinhala Character Recognition by using a new approach based on deep neural networks which have recently given excellent performance in many pattern recognition and machine learning applications. Since the proper Sinhala handwritten character image dataset is unavailable, a data set is constructed. The constructed image dataset contains all 60 Sinhala characters in the alphabet.The constructed dataset contained a total 6000 black and white images in .png format. These handwritten character images were gathered using the MS Paint application. This research construct Convolutional Neural Networks (CNNs) and Gabor initialized Convolutional Neural Networks (GCNN). In addition to that it investigates the performance of the proposed network architecture when introducing the dropout. To apply Gabor initialized CCN, the impact of each parameter of the Gabor filter is also examined. Considering the impact of the parameter to the GCNN architecture, parameter values for proposed GCNN architecture are determined. The training accuracy of the first CNN method is 98 % and the testing accuracy is 90%. According to the literature this is the highest accuracyobtained for 60 Sinhala characters compared with primitive methods. This accuracy is obtained with the 0.5 dropout effect. The Gabor initialized CNN architecture provides 95% training accuracy and 80% testing accuracy. Even though this accuracy is 3% less than the accuracy of the first CNN architecture it converges to the results rapidly. So it saves time and computational cost. Considering the results of implemented CNN architectures and Gabor initialized CNN architecture, best performed architecture is selected for Sinhala Handwritten character recognition process.

Keywords: Handwritten Sinhala Character Recognition, Deep Learning, Convolutional Neural Networks, Gabor initialized Convolutional Neural Networks (GCNN)

Accretion Rate Analysis of Dwarf Nova Systems in Quiescence

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Close binary systems are among the most intriguing and complex stellar formations in the universe. Within this category, Cataclysmic Variable (CV) stars are particularly fascinating due to their unique and dynamic behaviors. These systems involve two stars in close proximity, leading to significant interactions, including mass transfer from one star to another, a process critical to understanding their evolution. The transferred mass forms an accretion disk around the recipient star, gradually funneling material onto its surface. The accretion rate through this disk is a vital parameter in the study of CV systems. However, studying CV stars presents significant challenges due to their considerable distances, resulting in limited observational data, making the accurate calculation of accretion rates difficult. In this study, we introduce a formal method for calculating the accretion rate of Dwarf Nova (DN) stars, a subclass of CVs, during their quiescent state using available data. On one hand, we derive a function for the luminosity in the visual band of the accretion disk, based on its absolute magnitude. On the other hand, we approach the problem using three different methods. The first method assumes that the luminosity is produced by the loss of the total mechanical energy of the accreting particles, and we calculate the accretion rates for several well-known DN stars. However, the temperature profile associated with this method does not align well with spectroscopic observations. To address this, we propose a second method that employs a more accurate temperature profile, though it assumes an accretion disk of infinite extent. The third method refines this approach by considering a finite accretion disk. Accretion rates calculated using all three methods are presented. Throughout these derivations, we utilize several well-established empirical relationships. This study ultimately provides three distinct methodologies for calculating the accretion rate of Dwarf Nova stars in their quiescent phase, offering improved accuracy and insights into these complex systems.

Keywords: accretion disk, cataclysmic variable stars, luminosity

Determination of Precession Period of SU UMa Systems Using TESS Data

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This study aims to determine the precession periods of 10 SU UMa systems, a subclass of dwarf novae known for their characteristic superoutbursts and associated superhumps. SU UMa systems exhibit two types of outbursts: normal outbursts and superoutbursts. The superhumps, which are periodic brightness variations observed during superoutbursts, are generated due to the interaction between the orbital period of the system and the precession period of the accretion disk. To achieve our objective, we utilized data from the Transiting Exoplanet Survey Satellite (TESS). Light curves were generated for each of the 10 SU UMa systems, and the Locally Weighted Scatterplot Smoothing (LOWESS) method was applied to detrend these light curves, removing the superoutburst trends. The Lomb-Scargle periodogram was used to generate the power spectrum, and superhump periods were then determined using the peaks in this power spectrum. We applied a cutoff based on the Nyquist frequency, and frequencies below that threshold were considered to avoid aliasing and improve signal accuracy. Orbital periods were obtained from values reported in past literature. Finally, using the standard equation, $1/P_{pr} = 1/P_{orb} - 1/P_{sh}$ we derived the precession periods for each system.

Table 1: The obtained superhump periods and precession periods of SU UMa systems

System	Orbital period (days)	Superhumps period (days)	Precession period (days)
AK Cnc	0.0651 ± 0.0002	0.06739 ± 0.00008	1.92 ± 0.18
GX Cas	0.08902 ± 0.0018	0.09328 ± 0.00015	1.95 ± 0.87
SU UMa	0.07635 ± 0.00043	0.07935 ± 0.00013	2.02 ± 0.31
V344 Lyr	0.087903 ± 0.000001	0.09115 ± 0.00021	2.47 ± 0.15
V503 Cyg	0.077760 ± 0.000003	0.08144 ± 0.00014	1.72 ± 0.06
V844 Her	0.054643 ± 0.000007	0.05595 ± 0.00005	2.34 ± 0.09
V1504 Cyg	0.06951 ± 0.00005	0.07219 ± 0.00010	1.87 ± 0.08
YZ Cnc	0.0868 ± 0.0002	0.09089 ± 0.00017	1.93 ± 0.12
ER UMa	0.06366 ± 0.00003	0.06578 ± 0.00008	1.98 ± 0.08
IX Dra	0.06482 ± 0.00003	0.06701 ± 0.00020	1.98 ± 0.18

Our study of light curve analysis and precession period determination enhances the understanding of interactions between superhumps and accretion disk dynamics in SU UMa systems.

Keywords: orbital period, precession period, superhump period, SU UMa, TESS

Python-Based Aperture Photometry and Light Curve Generation for Time-Series Analysis of Variable Stars

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Time-series photometry data play a crucial role in astronomy, helping to unravel evolutionary mysteries by analyzing and interpreting the physical properties and behaviors of various celestial objects including variable stars through the tracking of periodic brightness fluctuations. This project focuses on developing and implementing a Python-based program to measure the flux of a target star across a series of 40 Bias, Dark, and Flat Field corrected Flexible Image Transport System (FITS) Charge-Coupled Device (CCD) images, obtained using the 0.5m Astrophysical Research Consortium Small Aperture Telescope (ARCSAT) at the Apache Point Observatory in the USA. The code precisely locates the target star in each image, calculates its centroid, and accurately quantifies its flux using aperture photometry (a method where a circular aperture is placed around the star to capture its light), while background noise is reduced using sigma clipping (a technique to remove noise by discarding values that deviate significantly from the mean). To account for slight positional shifts across images, the algorithm leverages nearby stars, refining the target's coordinates by recalculating its centroid. The `DAOStarFinder` function from the `photutils` (Python Photometry Utilities) library is employed to identify stars within each frame based on local maxima detection, allowing accurate localization even in crowded fields. After retrieving the target's flux in each image, the program saves these values along with the corresponding coordinates and timestamps extracted from each FITS header, enabling the construction of a light curve to represent periodic brightness fluctuations. This workflow provides an efficient approach to handling large sets of astronomical images, making it adaptable for studying variable stars, monitoring transient events, or searching for exoplanet transits. By automating the identification and photometry process, the project streamlines data extraction, supporting high-throughput analyses in astrophysical research.

Keywords: DAOStarFinder, photutils

Radial velocity study of selected bright stars observed at 45 cm telescope at Arthur C Clarke Institute for Modern Technologies

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This study explores the radial velocity measurements of four bright stars, HD 39853, Rigel, Sirius, and Capella using CCD imaging, high-resolution spectroscopy, and the astronomy data reduction software, IRAF. The observations were conducted at the Arthur C. Clarke Institute using a GOTO 45 cm Cassegrain Telescope equipped with a Monk-Gillison type spectrograph, covering the wavelength range from 6300 Å to 6700 Å. The resulting data were analyzed using IRAF to identify Doppler shifts in the spectral lines of the stars. The radial velocities obtained through the RVIDLINES task in IRAF were found to be 80.73 km s^{-1}, 16.89 km s^{-1}, -0.29 km s^{-1}, and 24.85 km s^{-1} for HD 39853, Rigel, Sirius, and Capella, respectively. Additionally, the FXCOR task in IRAF provided a radial velocity of 78.19 ± 0.04 km s^{-1} for HD 39853, with a correlation peak of 0.783.

Table 1: The comparison of the radial velocities calibrated by FXCOR and RVIDLINES methods with the radial velocities recorded in the Simbad Astronomical Catalogue

Star	Radial-velocity obtained by the FXCOR method (km s^{-1})	Radial-velocity obtained by the RVIDLINES method (km s^{-1})	Radial-velocity recorded in the Simbad Astronomical Catalogue (km s^{-1})
HD 39853	78.19 ± 0.04	80.73	81.79
Rigel	-	16.89	17.8
Sirius	-	-0.29	-5.5
Capella	20.35 ± 0.00	24.85	29.19

This study contributes to a deeper understanding of the motion of bright stars and their potential planetary systems, while also offering insights into the presence of undetected companions. Moreover, the research highlights the effectiveness of IRAF software in analysing spectroscopic data, making it a valuable resource for future studies on stellar dynamics.

Keywords: FXCOR, IRAF, RVIDLINES, spectroscopy

The Orbital Period of Eclipsing SU UMa-type Binary Star Systems: A TESS Data Analysis

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This study focuses on the analysis of eclipsing SU UMa-type binary star systems, utilizing data from the Transiting Exoplanet Survey Satellite (TESS). The SU UMa systems are known for their frequent and short-lived outbursts, characterized by the presence of superhumps during superoutbursts. By examining the light curves of OY Car, HT Cas, Z Cha, and V4140 Sgr, we aimed to determine the orbital periods and superhump characteristics of these binary systems. To analyze the light curves and identify the superhump characteristics, the outburst trends were removed from the light curves to obtain detrended light curves. This was accomplished through the application of the Locally Weighted Scatterplot Smoothing (LOWESS) method. Subsequently, the Lomb-Scargle periodogram method was utilized to accurately estimate the orbital and mean superhump periods. The analysis of the eclipsing SU UMa-type binary star systems OY Car, HT Cas, Z Cha, and V4140 Sgr using TESS data estimated their orbital and superhump characteristics. While OY Car exhibited a consistent orbital period throughout the observed time intervals, Z Cha displayed slight variations, suggesting potential fluctuations in the mass transfer rate. Due to limited data availability, HT Cas and V4140 Sgr could not be comprehensively analyzed for superhumps.

Table 1: Analysis of orbital and superhump characteristics of eclipsing SU UMa-type binary stars

System	Orbital period (days)	Superhump period (days)	TESS observation time period
OY Car	0.06313 ± 0.00005	-	2019 April
	0.06310 ± 0.00005	0.06457 ± 0.00005	2019 May
	0.06316 ± 0.00005	-	2021 April
	0.06311 ± 0.00002	-	2021 May
	0.06312 ± 0.00002	-	2023 March
	0.06312 ± 0.00002	-	2023 April
	0.06312 ± 0.00002	-	2023 May
HT Cas	0.07365 ± 0.00002	-	2022 November
Z Cha	0.07444 ± 0.00006	0.07739 ± 0.00006	2018 October
	0.07448 ± 0.00007	-	2018 December
	0.07453 ± 0.00006	-	2019 April
	0.07451 ± 0.00006	-	2019 May
	0.07444 ± 0.00006	0.07736 ± 0.00007	2019 June
	0.07450 ± 0.00006	-	2019 July
V4140 Sgr	0.06141 ± 0.00004	-	2023 July

Keywords: TESS, Eclipsing SU UMa, orbital period

Development of a Remote Sensing based Forest Degradation Index for Assessing Forest Health and Degradation Levels in Sri Lanka

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Natural forests worldwide face constant threats from various factors, resulting in continuous deforestation and degradation that diminish their functional capacity. Effective forest management practices are essential for the restoration of degraded forests. To initiate forest restoration plans, it is crucial to categorize forests at different degradation levels, which helps in formulating policies and implementing targeted management plans for restoring degraded forests and rehabilitating degraded forest lands. In addition, improved assessment of forest carbon stock could be achieved by mapping degradation levels, allowing for more accurate carbon calculations based on specific forest types and their degradation levels. This study aimed to develop a model for assessing forest degradation levels in Sri Lanka using remote sensing, focusing on the optimal utilization of freely available satellite data as a cost-effective approach for developing countries. The proposed method integrates satellite-derived indicators of forest above-ground biomass, bare soil cover, canopy cover, and vegetation water stress. Multispectral indices from Sentinel-2 satellite data were employed, and data integration was conducted on Google Earth Engine a cloud computing platform. A well-collected set of field data was used to enhance the model's accuracy. The newly developed index effectively categorizes forests based on their current health conditions and degradation levels, showing a strong correlation with National Forest Inventory field data. This research has a significant national impact because conducting a country-wide manual analysis is a challenging and costly task due to the variability of natural forests in Sri Lanka. The analysis successfully mapped degradation levels for the Dry Monsoon and Moist Monsoon forest types in Sri Lanka.

Key words – Forest Degradation, Forest Health, Remote Sensing, sentinel 2, GEE

Geospatial Modeling of Electricity Distribution Network

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As a country, Sri Lanka has faced numerous economic challenges in recent years, and among these, the utilities sector has also placed a significant burden on consumers. The sector's poor management has had adverse effects on the country's economic development and the financial well-being. Currently, the electricity sector falls well below international standards, with inefficient functioning being a notable issue. As a result, we experience a generation deficit, weak transmission and distribution infrastructure, poor utility performance, prolonged periods of investment, and maintenance neglect. One of the main reasons for this situation is the inadequate attention paid to asset management. It is common knowledge that any organization expecting to run an efficient day-to-day operation and to manage and develop its services effectively must be aware of its assets, knowing their locations, conditions, performance, and the costs to provide the service. At the same time, making strategic and operational decisions requires adequate knowledge of the enterprise's physical assets. Therefore, proper management in the utility sector, especially concerning the current conditions, is essential. However, in such cases, GIS has emerged as a better solution for providing comprehensive answers to these problems. The conversion of a real-world system into a GIS framework is a comprehensive and challenging task. This is especially true in countries like Sri Lanka, where there is inadequate asset management and complex network designs. In such an environment, the existing system was first converted into a GIS model through the process of abstraction. The initial step was to conceptualize the design, followed by implementing a logical design, before concluding with the final product. Furthermore, a significant challenge has been dealing with the collection of assets in terms of points, lines, and polygons. This task has been accomplished, and following the collection of all relevant data, these assets can now be managed and monitored regularly. In cases of maintenance, these assets can be documented thoroughly, enhancing economic efficiency. The systematic gathering and structuring of asset information are critical for facilitating better asset management practices. With the data now accurately captured within the GIS system, we can ensure a more streamlined and cost-effective approach to infrastructure management and maintenance planning.

Keywords: GIS-based asset management, Data abstraction, Geospatial technology, Points, lines, polygons

Leveraging Remote Sensing and GIS for Mapping and Monitoring Tea Plantations in Sri Lanka: An Object-Based CNN Approach

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Tea production in Sri Lanka has significantly declined over time. Due to the lack of mapping and consistent monitoring of tea cultivation areas, it has been challenging to improve tea production. The use of remote sensing and GIS technologies is both appropriate and efficient for collecting data on tea cultivation spread across large areas. This study aims to leverage satellite imagery to extract land use/cover classes and monitor the condition of tea plants. A pilot project was carried out in 10 tea estates in Kotagala (up-country) where tea is the dominant land use. A combined approach of object-based image analysis (OBIA) with multiresolution segmentation and Convolutional Neural Networks (CNNs) on WorldView-2 (0.5m) satellite images was used to map the extent of tea. Time-series images from Sentinel-2A (10m) were employed to monitor tea plant conditions by calculating the Enhanced Vegetation Index (EVI) and Bare Soil Index (BSI). The overall classification accuracy was 89%, with a Kappa coefficient of 0.86. The vegetation indices revealed clear signs of plant health issues and different pruning stages of the tea plants over time. Additionally, identifying other land use/cover associated with tea cultivation could help locate new areas suitable for tea planting and fuel wood. Further investigation is warranted to enhance the classification accuracy by refining segmentation and CNN parameters. This study demonstrates the significant potential of geospatial techniques, offering valuable insights for decision-making and supporting sustainable tea plantation management in Sri Lanka.

Key words – Tea Mapping, Remote Sensing, OBIA, CNN

Method To Evaluate the Epidemiology of Covid-19 Using GIS and Cartography

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The COVID-19 pandemic poses a global threat to human life, with profound consequences for socioeconomic systems. While governments worldwide are implementing strategies to restore normalcy, Sri Lanka faces significant challenges in returning to pre-pandemic conditions, compounded by the health sector's limited capacity to monitor and assess risks using modern technologies. Additionally, insufficient data collection has led to a collapse of the information base, hindering effective decision-making. This study focuses on Sri Lanka, proposing various COVID-19 risk scenarios based on Hazard, Vulnerability, and Capacity factors. Both remote sensing and non-remote sensing data are utilized, and an Analytical Hierarchical Process (AHP) is applied to calculate the weight of each factor. The resulting GIS-based multi-criteria risk reduction map is validated with district-level patient data, showing significant accuracy, with the Western Province exhibiting 83% accuracy in 2022, compared to 63% in 2021. The North Western Province showed a notable increase from 22% to 93%, while regions like the Eastern Province had lower accuracy, with a rise from 20% to 63%. However, lower accuracy in certain districts can be attributed to data resolution issues and errors in non-spatial data collected by authorities. To enhance district-level risk modeling, incorporating divisional secretarial data, along with local economic, geographical, and political factors, would improve accuracy. The ongoing economic crisis in Sri Lanka has hindered the collection of COVID-19 statistics, limiting further validation. Despite these challenges, the methodology proposed can be adapted for future disaster scenarios, offering a framework for improving response strategies and minimizing risks. This study underscores the critical role of GIS in risk assessment and management, both for the COVID-19 pandemic and other potential future crises, emphasizing the need for continued efforts in data collection and risk analysis to safeguard public health.

Key Words: COVID-19, Analytical Hierarchical Process, Risk maps

Promoting National Collaboration Through Training and Education In Space Technology Applications and Advances Among Government Offices

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The Arthur C. Clarke Institute for Modern Technologies (ACCIMT) is a leading institution in the use of space technology for various national and international applications. Research and development, training, education, and capacity building are crucial components in promoting the use of space technology, thereby benefiting society. In collaboration with the World Food Programme (WFP) for public officers in the Sri Lankan government, five consecutive workshops were conducted across five district divisional secretariats during November 2022 to December 2023 one week for each. The one-week training program, titled “Capacity Building on Earth Observation Applications and Research,” was successfully held for 25 participants from each divisional secretariat, including Kiran, Jaffna, Tissamaharama, Wilpattu, Batticaloa, and Batticaloa in two languages Sinhala and Tamil. Participants included representatives from user departments, with various designations including Divisional Secretaries. The training was enhanced by state-of-the-art facilities and expert faculty from ACCIMT and academia across Sri Lanka. The residential program included lectures, practical sessions, excursions, field visits, group activities, and evening events. Feedback from the participants indicated that the course was highly beneficial, with ratings as follows: excellent (77%), good (20%), average (2.6%), and poor (0.4%). The program significantly enhanced participants' knowledge of Earth observation and geospatial analysis capabilities, which they will apply in their respective roles. Although the full impact on real-life applications is still being tracked, initial reports suggest increased collaboration and knowledge-sharing within government departments. This initiative has opened new opportunities for future expansions, including distance learning programs, joint research projects, and further capacity-building efforts. The program highlights the importance of Earth observation technologies for improving governance, disaster management, and resource management in Sri Lanka.

Key Words: Space technology, Capacity building, Training and education and Collaboration

Role of Remote Sensing in Potential Fishing Zone Forecasting– Puttalam coastal line

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Since the beginning of recorded history, fish have been a significant source of sustenance for humans, and this trend is expected to continue in the future too. Over 2.7 million coastal communities in Sri Lanka depend on the fishing industry for their livelihoods, and the industry itself generates direct and indirect job possibilities for over 560,000 people, contributing significantly to the country's economic and social growth. Significantly, it meets the nation's population's need for animal protein in excess of 60%. The interior, offshore/deep-sea, and coastal subsectors made up the fishing industry. Fishing contributed 1.3% of the nation's GDP (gross domestic product) in 2017.Nevertheless, due to insufficient domestic production of dried fish and sprats, Sri Lanka remains one of the major importers of fish and fisheries products in South Asia. Each year, the country must import a sizable quantity of dried fish and sprats to meet the excess domestic demand. In 2017, 106,020 Mt of imports were made, with a total value of 33,969 LKR millions. The fluctuations in the maritime environment's circumstances affect the availability, quantity, and dispersion of marine fish populations. In this study, In order to forecast the possible locations in Puttalam coastal for fish aggregation, data on the "changing ocean," in near real time (NRT) observations, is thus needed instead of the "average ocean". Remote sensing (RS) offers synoptic views of ocean environmental fluctuations on fish population abundance and distribution, which may be effectively employed in fishery research and management. In NRT, data from satellite sensors are used to measure sea surface temperatures, sea surface heights, chlorophyll, and water color. Finding the criteria influencing the items is the initial stage in the technique. This study reduces the time it takes to find fish by 30% to 65%, which in turn lowers the cost of fuel and human labor while also giving fishermen and local residents useful information on fish capturing places. Furthermore, it lessens the necessity of traversing the international marine border. This model uses a weighted procedure to create fishing zone suitability sites by incorporating many factors.

Keywords: Remote Sensing, GIS, NRT, GDP

Simulation Modeling for Road Traffic Accident Hotspot Areas Using Space Technology in Western Province, Sri Lanka

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Traffic accidents on the roads are one of the main causes of the global health issue. In the younger population, it is the primary cause of mortality in percentage terms. Out of 50 million injuries, the World Health Organization (WHO) reported in their study that 1.36 million individuals lose their lives on average each year. Road traffic injuries are the main factor for death on 5 to 29 aged younger generation. Furthermore, whereas emerging nations account for 60% of global automobile usage, 93% of traffic deaths worldwide occur in these nations alone. Taking into account Sri Lanka, a small island nation with 22 million inhabitants, around 90% of them are educated. Even still, the Ministry of Transport and Civil Aviation reports that, on average, 2400 people die in a year from 35,000 incidents. The effect of accidents can be lessened by administering first aid as soon as feasible through a road emergency station (RES) that is conveniently located. This study used an integrated fuzzy analytical hierarchy process (FAHP) and space technologies method to assess the optimal position of the RES in Western Province, Sri Lanka. The data for this study was gathered using the various data resources. The feasibility study indicated that the nine primary factors—population, safety, environmental indicators, compatible and incompatible areas within the RES, type of road, accident high crash zones and traffic level—should be taken into account when determining where to locate the RES. These recommendations were derived from the various literature reviews. The FAHP determined the factors' weights and the ideal placement for RESs by using aggregation methods and GIS analysis. High crash zones and known road accident sites as determined by Sri Lanka Police Road Accident Statistics matched quite well on the final result of this study. 67% of the results are consistent with the districts of Gampaha. Additionally, 72% of the Colombo district matches. In Kaluthara districts, it is 69%. The results of this study can assist authorities and decision-makers in achieving sustainable road safety in the case study region.

Keywords: Remote Sensing, GIS, FAHP, RES

Spectrometric Analysis of Tea Flavor Chemicals and Structural Components for Tea Quality Control

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This study explored the use of visible and near-infrared spectroscopy to identify optimal spectral regions linked to flavour compounds and structural materials in tea leaves, aiming to develop a rapid, non-destructive method for quality assessment and grading. Tea samples were collected from a factory, representing four distinct categories: pre-sorted tea (prior to mechanical grading), first-grade tea, second-grade tea, and rejected materials. Each category comprised 100 samples, and spectral measurements were conducted using a calibrated spectroradiometer under controlled conditions at 25°C. Data were captured at 1 nm intervals across the spectral range of 375 nm to 1100 nm, focusing on reflectance patterns.

Spectral analysis revealed that the range between 650 nm and 750 nm was particularly effective for distinguishing between tea grades. This range corresponds to regions with minimal influence from water absorption bands, which are typically observed at wavelengths above 970 nm and around 1200 nm. The measurements, performed on tea samples with stable moisture levels, suggest that the observed spectral differences primarily reflect the intrinsic chemical and structural composition of the tea leaves rather than water content variations.

To further strengthen these findings, future studies should incorporate additional chemical analyses to quantify fibre, moisture, and other key chemical components in dried tea samples. Establishing correlations between spectral features and chemical parameters such as fibre content and flavour compounds would provide more comprehensive insights and enhance the reliability of the method. This integration could also pave the way for developing predictive models to refine tea grading systems further. The spectral signature analysis presented here offers a solid foundation for developing automated systems to classify tea grades, enabling precise discrimination and improving efficiency in tea production and quality assurance processes. These findings highlight the potential of spectroscopy as an efficient alternative to traditional methods, providing a fast, non-invasive, and reliable tool for assessing tea quality.

Key Words: Spectroscopy, dry tea leaves, tea flavour compounds, tea quality assessment

Space Technology-based Approach for Identification of Potential Deep Aquifer Recharge Sites by Rainwater in Ampara District

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Fresh water is one of the main entity for county development. Out of 2.5% global fresh water, only 1% is existing for human consumption. Accurate management of water resources considered as one of the most important needs in the human's life, especially the precipitation is extremely limited and spatially unordered distributed in the arid region. Ampara district of Sri Lanka comes under one of the arid regions in this country. Agriculture is one of the main income source of this region. But due to lack of proper planning and management of the water resource, it has faced severe water shortage for their farming activities. Therefore, introducing an effective alternative way to solve the problem in this region will make strong capacity on their livelihood. All over the world the structure of artificial groundwater recharge through rainwater is proved as one of the green environmental friendly and cost effective solution for availability of freshwater continuous supply throughout the year to farmers gain on their quality of life in this region. A crucial step in locating artificial recharge area is identifying the regions where the local groundwater recharge occurs. The remote sensing approach was employed in this investigation. In this study, Geological maps, data collected from space, and rainfall data are the main data sources used in this analysis. Thematic maps, including those of geomorphology, lineament density, land cover, drainage density, soil, rainfall, slope, and hill shade, are created by processing this data with the space technologies. Based on each thematic map excellence and the data on groundwater recharge value included in the map itself, all thematic maps are scored using the multi-criteria assessment approach. A map of possible artificial groundwater recharge is created by superimposing the scoring results on top of each thematic map. This study concludes that the thematic maps may be used to determine groundwater recharge potential through the efficient application of remote sensing and multicriteria assessment.

Keywords: Remote Sensing, Multi-criteria

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