



CONFERENCE PROCEEDINGS

THE 2nd RUHUNA INTERNATIONAL CONFERENCE ON INNOVATION AND TECHNOLOGY

"Advancing a Sustainable and Resilient Society through Technological Innovations"

01st November 2024



**Faculty of Technology - University of Ruhuna
Sri Lanka**



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Proceedings of the 2nd Ruhuna International Conference on Innovation and Technology- RICIT 2024

*Advancing a Sustainable and Resilient Society through Technological
Innovations*

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ISSN: 3021-6834

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Tel: +94 41 2294750

MESSAGE FROM THE VICE-CHANCELLOR, UNIVERSITY OF RUHUNA

With immense pride and excitement, I send this message for the Second Ruhuna International Conference on Innovation and Technology (RICIT 2024), organized by the Faculty of Technology, University of Ruhuna. Focusing on the theme: *"Advancing a Sustainable and Resilient Society Through Technological Innovations,"* this event serves as a platform for academics, researchers, industry professionals, and students to present cutting-edge research across diverse fields, including Science and Agriculture, Engineering, Technology, Computer Science, and Management.

RICIT 2024 provides a dynamic platform for academics, researchers, industry professionals, and students to showcase their latest findings across multiple disciplines, including Science and Agriculture, Engineering, Technology, Computer Science, and Management. I am delighted to witness how this event attracts participants from both national and international communities, underscoring the relevance and impact of our academic endeavors. I am eagerly awaiting how the Faculty of Technology is preparing the students for Industrial Revolution 5.0 while transitioning from Industrial Revolution 4.0.

As the Vice Chancellor of the University of Ruhuna, which is committed to academic excellence and sustainable development, I am proud of our progress in fostering research that advances knowledge and addresses pressing societal challenges. This conference aligns with our university's mission to facilitate knowledge exchange, technological transformation, and innovation, essential tools for sustainable development.

I extend my warmest wishes to the organizing committee for their efforts in making this event a success. A special welcome is extended to Professor Xiaodong Yang from the South China Sea Institute of Oceanology, Chinese Academy of Sciences, whose insights as the keynote speaker will enrich the discussions and collaborations fostered by the conference.

May this conference spark groundbreaking ideas and foster meaningful collaborations that drive technological innovation toward sustainable development. I extend my best wishes to all participants, presenters, and organizers for a productive and successful conference.

Senior Professor Sujeewa Amarasena

Vice Chancellor

University of Ruhuna

01 November 2024

MESSAGE FROM THE DEAN, FACULTY OF TECHNOLOGY, UNIVERSITY OF RUHUNA

I am pleased and delighted to write this message for the second international research conference (RICIT 2024) organized by the Faculty of Technology, University of Ruhuna. After seven years of faculty establishment, the first international conference was held last year. As a leading technology faculty of the country, this research conference is an opportunity to explore new frontiers in knowledge and innovation through the advances in technology to the pressing issues of many fields relevant to science and technology. We in the Faculty of Technology will cater to improving the quality of technologists in Sri Lanka by producing quality graduates in technology to fill the vacuum of skilled technologists in the industry. Already it is happening.

This conference brings together a diverse community of thinkers, creators, and problem-solvers. I encourage you to engage actively and share your insights, ask questions, and collaborate. The spirit of inquiry and cooperation is what drives us forward and leads to meaningful advancements. I am excited about the potential outcomes of our discussions and the new partnerships that may emerge from this event. Together, we can push the boundaries of knowledge and create impactful solutions that resonate far beyond these walls.

This time also the faculty organizes a student's innovation showcase to share their innovative ideas to industry and academia. This would be a great opportunity for them to find out about the possibility of commercializing their products through potential industry partners.

As the dean of the faculty, I would like to express my sincere gratitude for the commitment and enthusiasm of the organizing committee. Let's make this conference a transformative experience!

Professor P.K. Subash Jayasinghe

Dean

Faculty of Technology

University of Ruhuna

01-November-2024

MESSAGE FROM THE CONFERENCE CHAIRPERSON

It is indeed with great pleasure and honor that I welcome you all to the Second Ruhuna International Conference on Innovation and Technology (RICIT 2024) along with the Product Showcase organized by the Faculty of Technology, University of Ruhuna, Sri Lanka on November 1st, 2024. It has been a great honor and privilege to serve as the chairperson of this conference. This is the second conference of the faculty and it has now become an annual calendar event of the Faculty of Technology to disseminate the research knowledge to the society.

The conference is held with the theme of “*Advancing a Sustainable and Resilient Society through Technological Innovations*” and with four key areas: Science and Agriculture, Engineering and Technology, Computer Science and Management and Entrepreneurship. The conference provides a platform to share and disseminate new knowledge and the research findings on technology to the society. It is glad to note that this year’s edition has more than 60 out of 90 abstracts and the product showcase has more than 90 innovative products.

On behalf of the organizing committee of RICIT 2024, I express our sincere thanks to our Chief Guest, Guest of Honor, Keynote Speaker, reviewers, authors, financial sponsors, and others who supported us to organize this event successfully, and I would like to extend my sincere appreciation for all my team members for their hard commitment to success the event.

Finally, I congratulate all the authors and wish all participants a fruitful day in RICIT 2024 of the Faculty of Technology, University of Ruhuna.

Dr. Wathsala Rajawatta

Senior Lecturer

Department of Biosystems Technology

Faculty of Technology

University of Ruhuna

Chairperson – RICIT 2024

KEYNOTE ABSTRACT

Structural and Mechanical Controls on Earthquake Ruptures Along the Eastern Makran Subduction Zone

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The co-seismic rupture of subduction megathrust earthquake exerts a major control on the earthquake magnitude and size of resulting tsunami, understanding what factors control the co-seismic rupture is thus essential to assess a margin's ability to generate large earthquakes and tsunamis. The morphology and frictional strength of the plate boundary fault at subduction zones have long been proposed to control the seismic rupture propagation during megathrust earthquakes, but with controversial views. This is largely because there is very few the direct observation of the spatial relationship between these key parameters. The eastern Markan Subduction Zone has favorable conditions for large earthquakes, such as the 1945 Mw 8.1 and 2017 Mw6.3 earthquakes. Rupture of these two events have been well constrained to a relatively concentrated spatial distribution. Along strike, the Little Murray Ridge has been subducted partially beneath the Makran wedge, adding structural complexes. Here, we used the high-resolution seismic profiles, multibeam bathymetry along the eastern Makran accretionary wedge to map the fine structure of plate interface fault, which is combined with the Critical Taper Theory to estimate the spatial variation of basal strength. We then compared these structural and mechanical variations along the megathrust with the distribution of the two historical ruptures. We observed that low shear strength in non-ridge subducted segments facilitates the 1945 and 2017 rupture propagation, contrasting with high-strength area associated with the ridge subduction impeding them. The research underscores the significant control of fault morphology and strength in seismic rupture behavior, offering insights for seismic hazard assessment in subduction zones.

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Impact of Green Supply Chain Management Practices on Economic Performance in the Context of Sri Lankan Food & Beverage Industry

Evidence from Galle District

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Abstract

The emerging global context accentuates green supply chain management beyond traditional supply chain practices emphasizing its positive consequences on businesses and the environment. Hence, it has become imperative to investigate the impact of green supply chain management practices on economic performance. Notwithstanding, there is a dearth of studies conducted to determine the effect of GSCM practices and economic performance in the Sri Lankan context. Food and beverage firms in Sri Lanka have been considered as the population of the study. In contrast, 100 food and beverage firms located in the Galle district have been selected as the sample of the study using convenience sampling techniques that are actively adopting green practices. A structured questionnaire which consisted of demographic questions and scale questions was distributed to relevant respondents and collected data were analyzed via SPSS software employing both descriptive and inferential analysis with correlation and regression analysis. According to study findings, green purchasing, eco-design, reverse logistics, and investment recovery have a positive significant impact on economic performance while internal environmental management does not show any statistical significance with economic performance. Continuing green purchases, adopting eco-friendly materials and packaging, recycling, reusing, and reducing wastage provide valuable insight for industry leaders who seek sustainable models in the food and beverage industry as they directly affect economic performance. Further, this study provides valuable insight into the interconnection between GSCM and economic performance in the context of developing nations.

Key Words: *Eco-design, Economic performance, Food and Beverage industry, Green Supply Chain Management*

**Not presented at the conference*

The Influence of Wearable Fitness Devices on User Behavior and Performance: A Case Study of Fitness Watches and Bands in Sri Lanka

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Abstract

The influence of wearable fitness devices on user behavior and performance in Sri Lanka reveals significant insights into adoption trends, usage patterns, and their effectiveness in enhancing fitness outcomes. Data was collected from rural and urban populations, with a significant response from undergraduates and working professionals, which is 95% by questionnaires. The study found that while the majority of users utilize these devices for basic functions such as step counting, there is strong evidence that fitness routines and goals are positively influenced by the continuous data provided by these devices. Research findings reveal substantial benefits for users in terms of improved fitness outcomes and the ability to adjust exercise routines based on real-time data. Among the participants, 70.5% report using wearable devices primarily for step counting expressing satisfaction with the results. This indicates a strong correlation between device usage and user satisfaction in achieving basic fitness goals. Athletes reported a 53.3% improvement in performance metrics due to the use of wearable devices, underscoring the potential of these tools to enhance athletic performance. The results also revealed that 73.9% of users experienced positive health outcomes, which highlights the potential health benefits associated with regular use of wearable fitness technology. Users also report positive health outcomes, frequently expressing dissatisfaction due to the devices' technological limitations, such as short battery life, high costs, and connectivity issues, which can hinder their long-term usability and effectiveness. These findings underscore the critical role of wearable fitness devices in promoting fitness and health across Sri Lanka but also highlight the pressing need for more affordable and reliable options tailored to the broader population.

Keywords: *Effectiveness, Fitness, Sri Lanka, Wearable*

Factors Affecting Intention to Adopt Digital Transformation in Government Higher Education Institutions: Evidence from Academics of a Selected State University in Sri Lanka

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Abstract

This study examines significant factors affecting the intention to adopt digital transformation at a selected Management Faculty of one of the state universities in Sri Lanka. The main objectives of this article are to identify the level and the factors affecting to intention to adopt digital transformation and to propose recommendations to enhance the intention to adopt digital transformation in a selected Management Faculty of one of the state universities in Sri Lanka. The study was conducted using quantitative research methods. The population was 194 academic staff; among them, 66 members were selected using a stratified random sampling method. A survey was conducted using a self-administered questionnaire and both descriptive and inferential statistics were used to analyze data. The study highlights social influence, facilitating conditions and the knowledge of digital transformation significantly affect in intention to adopt digital transformation. The results of this study offer valuable insight into the thinking patterns of academic staff and decision-making related to the intention of digital transformation adoption and can be used as a practical guide to improve digital transformation platforms and strategies. This admits certain limitations, including the omission of temporary assistant lecturers from the sample size and the potential effects of scholars' sabbatical absences. This study fills a gap in the literature focusing on the digital transformation of higher education and public service delivery in Sri Lanka. Conclusively, it lays a foundation for future research focusing on different geographic regions and also students' perspectives.

Keywords: *Awareness, Digital Transformation, Facilitating Conditions, Knowledge, Social Influence.*

Factors Influencing on User Acceptance of Mobile Payment Channels in Sri Lanka; with Special Reference to Virtual Wallet

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Abstract

The financial landscape in Sri Lanka is undergoing a significant transformation as institutions increasingly adopt cashless payment methods. This shift aims to reduce reliance on physical cash within the economy and implement new regulatory frameworks, profoundly affecting cultural practices. Cashless payment systems provide users with enhanced convenience, security, and efficiency, appealing particularly to Generation X and Generation Y, who are moving away from traditional paper currency. Furthermore, global economies are also adopting cashless policies to streamline their financial ecosystems. This study investigates the influence of perceived ease of use, perceived usefulness, perceived trust, and perceived user mobility on the adoption of mobile wallets (M wallets) as a preferred mobile payment channel. Data were collected via a questionnaire from a sample of 128 respondents selected through simple random sampling. Analysis conducted with IBM SPSS 25.0 revealed that all examined factors demonstrate a moderate positive relationship with customer adoption of M wallets. However, this research has limitations, including a relatively small sample size that may not fully represent the broader population and reliance on self-reported data, which could introduce bias. Future research should explore barriers to adoption in rural areas, conduct longitudinal studies to assess changes over time and examine the impact of government policies on cashless payment adoption to enhance digital financial inclusion in Sri Lanka. The findings provide valuable insights for M wallet providers, enabling them to evaluate potential returns on future investments in this sector.

Keywords: *M wallet, perceived ease of use, perceived usefulness, perceived trust, perceived user mobility*

**Not presented at the conference*

Development of a Zero-Plastic Waste, Cost-Effective, Bio-Degradable, and Eco-Friendly Carbon Ink Pen

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Abstract

Approximately 1100 tons of carbon waste is removed from different sectors in Sri Lanka. This project focuses on a product that features a bio-degradable pen made with wooden material and a carbon ink core, ensuring eco-friendliness. Cedar wood is the most preferred material used for the outer casing of the proposed pen. Dimensions of the created wooden pen are an outer diameter of 7mm, an inner hole diameter of 1.5-2.0mm range, and a length of 143mm. As a novelty, using plastic carbon tubes is prevented during the design, instead a low-thickness UV resin is used which enhances the ink's continuous flow. A hard type UV resin is used as the inner coating because of the shorter curing time and durability, with the purpose of coating and sealing ink from the outer casing. The resin is compressed into the pen hole by a needle. A compressed airflow is fed to the pen hole to facilitate an even spread out of the resin inserted. After 20-25 minutes of drying process, low viscous carbon ink is filled in until it reaches a rate of 95% of a perforated pen hole length according to standards. The weight of the proposed pen will be approximately 4.50-4.80g, in comparison the plastic pen comprises 4.94-6.10g. A weight reduction of approximately 21% has been achieved from the proposed pen. When considering the decay lifetime of the proposed pen, it takes 2 to 3 years to decay without any specific decay treatment method while the existing plastic pen will take 20 to 500 years to decay. In the future implementation, the clip of the pen can be designed using bio-degradable materials, while there is a possibility of splitting the product into two distinguished portions as a pen and a pencil.

Keywords: *bio-degradable, sustainability, wood, eco-friendly, UV resin-coated*

Image-Based Robotic Framework for Automated Bottle Handling in Beverage Production Lines

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Abstract

Beverage production is one of the major food processing industries in the world. In Sri Lanka, some of the production processes in the beverage industry are automated and some are not. It is identified that in production lines, the fallen bottles are handled manually, which increases production downtime. Bottle repositioning is a labor-intensive task. I suggest specifying the human errors and safety risks that are unavoidable. It is a major concern to develop an automated production line for repositioning fallen bottles. Manual handling will increase the manufacturing lead time and decrease production profits. Therefore, a framework is designed from an automated approach implementing artificial intelligence (AI) and robotic technologies to detect and reposition fallen bottles, minimizing production inefficiencies and I suggest specifying the ergonomic hazards. The proposed strategy utilizes computer vision techniques to identify fallen and upright bottles by their orientation from the camera live feed. Pose estimation techniques calculate the spatial coordinates, distance from the base of the robotic arm, and angles of fallen bottles. This pose data is transferred to arm controller software running inverse kinematics algorithms, which generate accurate G-code instructions for the robotic arm. The two microcontrollers in the system execute these instructions which enable the robotic arm to reposition fallen bottles correctly. The developed prototype accurately classifies the “Fallen” and “Upright” bottles, by detecting the fallen bottles by determining their poses using computer vision techniques and making robotic arm manipulation using the generated G-code through inverse kinematics to put down the falling bottles. These procedures ensure accurate bottle handling in production lines. In addition, this system provides a lower cost of manual labor and an improved product. Furthermore, it eliminates ergonomic hazards associated with manual interventions thereby improving workplace safety. The combination of artificial intelligence and robotics can optimize industrial processes, improving operational efficiency and establishing safer workplaces.

Keywords: *Artificial Intelligence, Computer Vision Techniques, Pose Estimation, Inverse Kinematics, Robotic Arm*

Designing of an Efficient Mini Hydraulic Forklift

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Abstract

This research presents the design and development of a compact mini hydraulic forklift to enhance material handling efficiency in confined spaces, a prevalent challenge in modern industries. The project emphasizes key factors such as maneuverability, lifting capability, safety, and cost-effectiveness. The forklift, constructed using high-strength steel and equipped with a piston-type hydraulic hand pump, is designed to lift to 1200 kg. Finite Element Analysis (FEA) confirmed the design's structural integrity, with a maximum bending stress of 3.834 MPa and deflection of 0.019 meters. Additionally, a factor of safety was incorporated to ensure reliability. Prototype testing compared the forklift's performance against traditional engine hoists, demonstrating a 20% faster lifting speed and reduced operator exertion, improving efficiency. Key parameters tested included lifting speed, stability under load, and operator fatigue. Design features such as small tires and a low center of gravity enhanced stability and maneuverability, making it suitable for use in limited spaces. The forklift's compact design and ergonomic improvements reduced operator fatigue, boosting productivity in industrial settings. Future work will optimize the hydraulic system and further reduce weight and cost. Thus, this project offers valuable insights and a robust approach to designing efficient, safe, and cost-effective material handling solutions.

Keywords: *Material Handling, Compact Design, Hydraulic System, Finite Element Analysis, Ergonomics*

Development of Floor Tile Space Grouting Mechanism

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Abstract

This research project mainly focuses on the development of a floor tile space grouting machine. The traditional method has lots of drawbacks and challenges. The manual grouting process is labor-intensive and time-consuming, and it poses significant ergonomic risks to workers. Currently using grouting machines also has some limitations and disadvantages. It includes wastage of raw material because that machine applies the grout to the total tile surface area, and ineffective time consumption to cleaning the floor. Moreover, that machine needs a power resource to operate that machine. So, it limits the area that can operate at one time. The main purpose of this research project is to overcome those drawbacks and challenges. The machine's design features a screw extruder mechanism. The force required to extrude the grout mixture is determined by experimenting using a syringe and a digital spring balance. After finding the force required to apply grout, other design calculations were done. To assess the ergonomic risks of manual grouting, REBA (Rapid Entire Body Assessment) analysis is carried out and it has shown that manual grouting is a higher risk level than using the machine. When applying the grout for 1m in the manual method it takes 3 to 4 minutes. But using this machine it takes only 1.32 min. Therefore, it is concluded that the developed grouting mechanism is less ergonomic risky and is an efficient method of grouting the floor tiles. In terms of limitations, this machine can't apply the grout to the corner tile spaces which are very near to the walls. As well as this machine little bit heavy. In the future, this machine can be developed to automate using a line follower robot. It will help to reduce manpower usage and there can be a flexible nozzle to apply the grout to the corner spaces.

Keywords: *Extruder, Grouting Mechanism, Tile space*

Smart Bench Vise

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Abstract

Traditional bench vises require manual force to clamp work pieces, which often results in excessive tightening, inaccuracies in force application, and several safety limitations. One of the key safety concerns involves the lack of controlled force application, which can lead to unintended injuries or damage to the work piece due to unpredictable tightening. These challenges necessitate an improved design, leading to the development of a smart bench vise that incorporates stepper motors, load cells, and a user-friendly interface to prevent over-tightening while enhancing precision and safety. The technology driving this smart bench vise is based on Arduino programming, specifically utilizing the Arduino Uno due to its flexibility in managing multiple sensors and its ease of integration with other electronic components. The device automates the clamping and unclamping processes, enabling consistent and precise force application at the touch of a button. When the user inputs the desired clamping force (this force can be found through experiments or theoretical calculation) via the interface buttons, the motor initiates the clamping process, rotating the lead screw to close the moving jaw. This rotation is converted into linear motion, gradually increasing the clamping force on the work piece. Once the predetermined force is reached, the motor automatically halts, ensuring that the clamping force is applied accurately without exceeding the set limits, thereby preventing over-tightening and minimizing the risk of damage. Various materials, including plastic, aluminum, and steel, were used in the experimental phase to assess the required clamping force for different material thicknesses (10mm, 30mm, 50mm, and 60mm). The experimental results indicated that the smart bench vise significantly reduced clamping time compared to traditional vises while maintaining high precision and safety. While the current design effectively prevents over-tightening, future research could focus on expanding its force range, incorporating automated material detection, enhancing the user interface with touch screens, and adding wireless connectivity for remote operation.

Keywords: *Smart bench vise, force control, Arduino Uno, stepper motor, automated clamping*

Development of an Automatic Smart Side Stand

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Abstract

The development of an automatic smart side stand for motorcycles aims to enhance rider safety by preventing accidental riding with the stand deployed. This research introduces a smart side stand system, utilizing Arduino as the core microcontroller due to its ease of use, cost-effectiveness, and ability to handle real-time operations efficiently. Arduino provides the flexibility to integrate sensors and control systems, making it ideal for this application. When the motorcycle's ignition switch is turned on, the system retracts the side stand automatically, preventing accidents caused by riding with the stand down. Similarly, the stand deploys automatically when the motorcycle comes to a stop, and the ignition is switched off, ensuring added convenience for the rider. This mechanism eliminates the risk of human error during stand operation. The research focuses on optimizing the system for quick response times and ensuring compatibility with various motorcycle models. The automatic smart side stand is tested under different conditions to assess its performance, reliability, and user-friendliness. The results show that the system significantly reduces the risk of accidents related to stand misuse, enhances rider safety, and offers a convenient, user-friendly experience. As a final result, the Arduino-based smart side stand system not only met the research goals but exceeded expectations in terms of safety, convenience, and reliability. The successful implementation of the system demonstrated its practicality for modern motorcycles, with potential for future improvements such as wireless connectivity and integration with other smart vehicle technologies. Finally, a solution is expected to contribute positively to rider safety in both urban and rural settings.

Keywords: *Automatic smart side stand, Motorcycle safety, Arduino technology, Automation, Rider convenience.*

Precision Control of Robotic Hand Using Real-Time Finger Tracking

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Abstract

In hazardous environments such as bomb disposal, medical treatment in contaminated zones and handling dangerous chemicals, the need to perform tasks with human precision without risking harm to human operators is paramount. Thus, this research presents the development of a teleportation system, featuring a master hand that controls a robotic hand through real-time hand gestures, offering a solution that leverages advancements in robotics and image processing technology. The system employs a Raspberry Pi as the central control unit, utilizing Open CV to detect images and recognize hand gestures, which are then translated into precise actions performed by the robotic hand. Hand gesture recognition is achieved using advanced image processing algorithms, ensuring accurate and responsive control. The real-time performance of the system was rigorously tested, demonstrating an average response time of approximately two seconds. This capability allows for immediate and intuitive control, enhancing the safety and efficiency of operations in dangerous scenarios. The findings of this research highlight the potential for robotic hands to replace human hands in perilous tasks, significantly reducing the risk to human operators while maintaining the dexterity and functionality required for complex operations. The integration of robotics with real-time gesture recognition represents a significant step forward in the development of safe and effective tools for hazardous environments.

Keywords: *teleoperation system, real-time, hand gestures, raspberry pi, OpenCV*

Ammonia and Dissolved Oxygen Maintaining System for Shrimp Farming

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Abstract

Shrimp aquaculture is a key industry in Sri Lanka, contributing significantly to nutrition, employment, poverty reduction, and foreign exchange. However, a decline in shrimp production rates has been observed due to factors such as rapid population growth, environmental pollution, and climate change, negatively impacting the freshwater shrimp sector. Though managing the water quality parameters can enhance production, little attention has been given to innovative water quality management strategies in shrimp farms. Traditional monitoring systems in shrimp farms are outdated, time-consuming, and lack real-time functionality, making it difficult to maintain optimal water conditions. To address this issue, our study presents a real-time monitoring system for freshwater shrimp farms. The system integrates microcontroller-based devices and visualization tools to continuously monitor key water metrics such as pH and dissolved oxygen levels. The system activates when DO levels drop below 6.5 ppm or when pH values exceed 8.25, as per optimal shrimp farming conditions. Conversely, it remains inactive when pH levels fall below 7.5 or DO levels rise above 8.25 ppm. The system operates based on fuzzy logic rules, adjusting to the varying pH and DO levels to maintain water quality within the optimal range. The system includes an automated mechanism for deploying anti-ammonia tablets when water quality deviates from safe thresholds. During nighttime, when oxygen levels naturally drop, the system monitors dissolved oxygen concentrations and activates tractor-powered emergency aerators if levels fall below acceptable limits. Small-scale aeration systems are also integrated into hatcheries, ensuring adequate oxygen supply throughout the shrimp lifecycle. This real-time automated system improves shrimp farming efficiency by optimizing water quality and reducing manual intervention. Although designed for large-scale operations, testing in a smaller tank limits insights into its scalability. Future research should focus on enhancing tank design to better remove waste and improve shrimp health.

Keywords: *Shrimp Aquaculture, Real-time Monitoring, Water Quality Management, Fuzzy Logic Control, Automated aeration*

**Not presented at the conference*

Design, Development, and Performance Analysis of a Quadruped Robot for Educational and Industrial Application

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Abstract

This project details the design, development, and evaluation of the Dingo quadruped robot, with a focus on educational applications and small-scale automation tasks. The robot integrates mechanical, electronic, and control systems to achieve dynamic and stable locomotion across diverse terrains. A custom gait control algorithm based on inverse kinematics ensures smooth leg coordination. The control system takes input from a 9-axis IMU sensor, continuously monitoring orientation and movement to correct joint angles and maintain stability and controllability during operation. The robot is primarily programmed in Python, leveraging the ROS Noetic framework for communication and control. High-level control is managed by a Raspberry Pi 4B, while an Arduino Nano processes sensor data, including voltage and temperature monitors, to optimize motor control and energy management. The quadruped uses DS3240 digital servos for precise leg movements, allowing traversal of uneven terrains with balance and stability. Sensors enhance the robot's adaptability, making it suitable for tasks requiring flexibility. Applications range from educational robotics, providing a platform for learning control systems, to small-scale automation in fields like agriculture, inspection, and exploration. The Dingo quadruped is designed as a research platform, offering potential for future improvements. Enhanced autonomy through AI-based algorithms and machine learning could improve decision-making. Energy efficiency can be optimized with energy-efficient motors, low-power sensors, and improved power management systems. Advanced sensor integration, including LIDAR or stereo cameras, and force sensors will enhance environmental awareness and stability. Further control system enhancements will improve gait and navigation. This project builds on the foundational work provided by the original developers of the Dingo Quadruped platform.

Keywords: *quadruped robot, gait control, inverse kinematics, Raspberry Pi 4B, Python, ROS Noetic.*

Design of an Automated Fabric Loader for Spreading Machines

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Abstract

In the apparel industry, fabric loaders feed the fabric rolls to spreading machines. Those fabric loaders are optimized only for roll-form fabrics. Textile manufacturers relax the fabric rolls for most types of fabrics, from pure cotton to silk and wool into fabric bales to remove built-in fabric tensions. These relaxed bale-form fabrics are manually loaded into the spreading machines. This process takes considerable time and labor and affects the efficiency of the fabric spreading process. The main aim of this research is to design and implement an automated fabric loader that can efficiently load and unload roll-form and bale-form fabrics to the spreading machine. The potential advantages of designing an automated fabric loader include reducing manual intervention, improving workplace safety, and eliminating labor shortages. It also increases product quality as less fabric is damaged due to manual loading, decreasing lead times and manufacturing costs. The initial step of this research involves a CAD design. Next, a robust, lightweight frame will be designed to support the entire system. The loader will be equipped with two specialized feeding systems: one for roll-form fabrics and another for bale-form fabrics allowing for seamless transition with various fabric types. An integrated electronic control system with sensors will detect fabric types, dimensions, and positions, ensuring precise handling and minimizing damage. A built-in conveyor transports fabric from the loader to the spreading machine. Additionally, an interface will be added to the system to set parameters, monitor the loading process, and troubleshoot any issues quickly, enhancing user experience and operational efficiency. The proposed automated fabric loader represents a significant advancement in the apparel industry enhancing overall production throughout in textile manufacturing.

Keywords: *Automation, Efficiency, Fabric, Loading, Spreading*

**Not presented at the conference*

Finite Element Modeling of the End Milling Process for Cutting and Impulsive-Force Prediction

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Abstract

This study aims to predict the cutting and impulsive forces in an end-milling operation using Finite Element Modeling and Analysis (FEMA). The cutting tool and work piece are modeled using Solid Works software, and the FEM model is developed and simulated in Abaqus software. Specified cutting conditions, including feed rate, spindle speed, axial depth, and radial depth, are considered to simulate and analyze the cutting forces. Two FEM models are examined: one that excludes temperature effects and another that includes them. FEM simulations are performed to investigate how changes in these cutting parameters affect the cutting forces during the operation. Results are presented in graphs and data sets showing the variation of cutting forces over time for both models. The model comparison reveals that temperature reduces cutting forces as it should. The proposed study highlights changes in cutting parameters, such as feed rate and spindle speed, which lead to noticeable variations in cutting forces. The findings reflect the effect of cutting parameters. When radial depth decreases cutting forces will decrease because chip thickness decreases. When we decrease axial depth cutting forces will decrease because chip length will decrease. Also, when we increase the feed rate cutting forces will increase because chip thickness will increase. Finally, when we increase spindle speed Cutting forces will increase rapidly because both chip thickness and chip length rise together. These predictions provide valuable insights for optimizing machining processes, allowing adjustments to cutting parameters to improve efficiency, tool life, and machining quality, and help develop adaptive controls in CNC machines which are not in the scope of this study and hence remain a future work. Finally, the accurate prediction of cutting forces using FEM makes it a reliable tool for process planning and optimization in manufacturing.

Keywords: *FEM, End-Milling, Cutting Forces, SolidWorks, Abaqus.*

A deep Learning framework for Black Tea Grade Identification in Low Country, Sri Lanka

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Abstract

Sri Lanka is renowned worldwide for its tea production, with Low Country black tea grade playing a pivotal role in driving the nation's economy. Identifying black tea grades is essential for quality assurance, pricing, and standardization, enhancing the market demand and preserving tea production quality. Traditional black tea grading methods in tea factories rely on manual labor and subjective evaluation, leading to inconsistencies and inefficiencies that can impact quality and pricing. This study introduces a deep learning and Image Classification approach to automate black tea grading, focusing on four main black tea grades: OPA (Orange Pekoe A), BOP (Broken Orange Pekoe), OP1 (Orange Pekoe One), and P (Pekoe). For this research, images were collected from multiple tea factories in different low-country regions, focusing on factors identifying features such as dry tea leaves color, shape, and size. To ensure accuracy, an 80/20 training and testing split was applied to a dataset of approximately 1,000 images, maintaining a 1:1 ratio, allowing for the clear identification of the components of a single dry tea leaf. After preprocessing the dataset to an image resize of 80x80 pixels and labeling, four CNN models that are Alex Net, VGG16, VGG19, and a custom CNN model were trained and tested. Each model performed well, among which the VGG16 model achieved the highest accuracy of 99.69%, confirming a high ranking among the four black tea grade samples, which is a great approach to automating the identification process. This automated grading framework reduces human error and labor while providing a scalable and objective solution for the tea industry, leading to more consistent grading standards. This CNN-based automated grading framework enhances quality assurance and production efficiency while reducing human error and labor. It provides a scalable and objective solution for the tea industry, paving the way for consistent grading standards and supporting Sri Lanka's tea sector in maintaining competitive, high-quality production.

Key Words: *Black Tea Grades Identification, Deep Learning, Image Classification, Low Country Sri Lanka, Convolutional Neural Networks (CNN) Models*

AI-Driven Corrosion Detection in Coastal Cars: A Comparative Study using YOLOV8n, Efficientnet, and VGG16

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Abstract

Corrosion of cars is one of the major factors that affect the operational and resale value of a used car in Sri Lanka. Identification of coastal corrosion among many types of corrosion by visual observation has become a major challenge in the automobile market. This research aims to evaluate the accuracy of three selected Deep Learning Models (DLM) named YOLOv8n, EfficientNetB7, and VGG16 in the aforesaid identification process. An expert-verified dataset of 1444 images shows the corrosion in both inland (I) and coastal (C) cars. Furthermore, the dataset included vehicle-specific metadata such as distance to the beachside, drive hours in coastal areas per day, and car age to enhance classification accuracy. The training process of EfficientNetB7 and VGG16 was executed on 20 epochs, while YOLOv8n required 50 epochs, all using an Adam optimizer with varying learning rates. The models combined image analysis with metadata through concatenation and ensemble techniques to classify the corrosion as either coastal or inland. The results revealed that the Efficient Net B7 model reached the highest accuracy (84.08%). Moreover, the VGG16 model achieved a moderate accuracy (73.79%), while YOLOV8n had the lowest accuracy at 67.59%, primarily due to its architecture being optimized for object detection rather than image classification. The study concluded that classifying car corrosion based on its region can be achieved by the Efficient Net B7 model due to its architecture which is designed to optimize the network's depth, width, and resolution simultaneously. Also, Its' Neural Architecture Search (NAS) and model scaling led to higher performance than the others. However, the DLM selection and fine-tuning are crucial for addressing such a complex classification. Additionally, future work should focus on upgrading the architecture of EfficientNetB7 into a lightweight version and implementing a user-friendly mobile application for coastal corrosion detection.

Keywords: *Automobile Market, Coastal Car Corrosion, Deep Learning Models, EfficientNetB7, Neural Architecture Search*

Predicting the Recovery Status of Ischemic Stroke Patients Undergoing Ayurvedic Treatment Using a Machine Learning Model

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Abstract

Ischemic stroke is a type of stroke disease that appears due to a violation of blood circulation in the blood vessels of the brain. People aged 40-60 are highly affected, and men are more significantly impacted due to lifestyle factors such as smoking, unhealthy eating habits, and excessive alcohol consumption. Ayurvedic treatment emphasizes a balanced lifestyle, natural therapies, and dietary interventions, which are considered a beneficial traditional approach for stroke recovery. Collecting patient data and analyzing it to determine their health status requires a significant amount of time. To address this issue, a machine learning approach using a decision tree model has been developed to predict recovery status in ischemic stroke patients following Ayurvedic treatment. This model helps healthcare professionals assess patients' post-treatment conditions more efficiently. The data collection process involved gathering patient records from neurology and Ayurvedic treatment units, including laboratory results, demographic information, and treatment adherence data. Preprocessing steps, such as handling missing values, feature selection, and normalization, were applied to ensure the quality and usability of the data for the model. In conclusion, a system is developed to analyze each patient's improvement level across various conditions and predict their health status, specifically focusing on identifying recovery levels, facilitating the inclusion of new data, and providing a clear display of the analysis results.

Keywords: *Ischemic Stroke, Blood Vessels, Neurology, Decision Tree, Normalization*

Evaluating Internet Satisfaction of Sri Lankan Router Users: A Supervised Data Mining Approach

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Abstract

In this digital era, the internet transforms individual communication, access and obtaining formation, and other various activities. The primary objective of this study is to develop a model to determine internet satisfaction among users who use routers to connect to the Internet in Sri Lanka. The web interface was created to predict the satisfaction level and it helped to enhance and achieve the primary objective. A Google Sheet survey was done to collect data, focusing on a diverse sample including 1026 users. Supervised data mining algorithms, including Linear Regression, Lasso, Decision Tree, and Random Forest Regression, were used for this study. Then, collected data was analyzed enabling the identification of patterns and relationships among variables related to internet satisfaction. This research contributes to understanding internet satisfaction in the specific context of Sri Lanka. As the key determinants of internet satisfaction, this research identified, highlighting the pivotal role of internet speed, reliability, and the value for money that is spent on the internet. Various supervised data mining techniques enhance the predictive accuracy of satisfaction levels and provide a comprehensive perspective for targeted improvements in internet services. The final model's accuracy is 0.8924612. This study focused on specific variables and other unexplored factors that may influence internet satisfaction. Future studies could incorporate additional dimensions for a more holistic analysis. Based on findings, future research could explore the impact of cultural factors on internet satisfaction. Understanding how cultural nuances influence user preferences and expectations would contribute to more tailored and effective service improvements. Apart from that, this study only considers the provinces in the country. In the future, it is necessary to go deep and gather data covering all the districts. The study's outcomes have implications for internet service providers, and technology developers aiming to elevate user satisfaction among the Sri Lankan population.

Keywords: *Internet satisfaction, Linear Regression, Random Forest Regressor, Supervised data mining*

An Automated Lighting Fixture Creation and Component Identification Framework using Deep Learning and Image Processing

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Abstract

The issue of design of individual lighting installations in large interior spaces is one of the most important spheres of architecture and interior design, as during the design, both accuracy and creativity are needed. The purpose of this research study is to make the generation of such lighting fixtures for the plans automation and use of machine learning with image processing techniques. The system achieved a detection accuracy of 91.7% for floor plan components and an 88% precision in identifying key elements like walls and doors, resulting in a reduction of manual design time by 40% and a 30% increase in design efficiency. The main goal is the application of an automated approach based on Detectron2 and Retina Net to guarantee reliable floor plan recognition, as well as, an identification of floor plan components such as doors, walls, and windows. Aids of image processing also improve the identification and categorization of these standard parts, including the ability to design lighting layouts that incorporate the detected components within the floor layout. Adenau about the effectiveness of this innovative system revealed by the result of this study which offers a great geographical contribution as a tool for the architect or internal designer by reducing the burden of generating the lighting plans. The project also highlights obstacles, especially when handling CAD-produced ground plans, for example. To counter this challenge, the research employs floor plans in image format, making image processing and object detection achievable. However, the study provides a unique contribution to the application of advanced technologies in architectural designing and provides direction in which future research could be carried out to enhance the automated lighting system.

Keywords: *Deep learning, Floor plan recognition, Image processing, Interior design, lighting automation*

An Automated Grammar Checking Approach for Sinhala Handwritten Documents

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Abstract

Sinhala is the mother tongue of most Sri Lankans. The number of Sinhala speakers worldwide is around 20 million. Although many Sri Lankans speak Sinhala fluently, many don't have a deep understanding of its grammatical rules. Special knowledge of Sinhala grammar is required to solve and correct grammatical errors. There are many unique features of the Sinhala language that make it challenging to use it correctly. It is written in letters, and the sentence structure is different from English (subject-object-verb order). Many people find it difficult to apply the grammar rules they learn in the field of education. This leads to common mistakes in written Sinhala. Currently, there are no applications for checking Sinhala grammar in handwritten Sinhala documents. Most existing grammar correction applications require user-typed text and perform the check Sinhala grammar itself only while the user is typing. It can be recognized that there is a significant gap in the resources available for Sinhala to meet the unique challenges posed by handwritten content in particular. Recognizing this issue, this research aims to develop a mobile application that can effectively detect grammar issues in handwritten documents. The proposed solution uses optical character recognition (OCR) technology developed by convolutional neural networks (CNN) to accurately recognize Sinhala characters in handwritten documents. Also, the Natural Language Toolkit (NLTK) and rule-based approach have been used to check the grammatical errors in the identified Sinhala text. The model is trained using a dataset of 7, 0000 handwritten samples collected from various sources covering all Sinhala characters. Apart from this, it is also possible to identify the mistakes in the basic grammar of the Sinhala language by using the rule-based approach. Using these technologies, this application enables all its users to improve their writing skills and develop better language skills, even those who have slight knowledge of grammar rules.

Keywords: *Convolutional Neural Networks, Natural Language Tool Kit, Optical Character Recognition, Rule-based approach, Sinhala handwriting*

**Not presented at the conference*

Automated Identification of Compound Nouns in Sinhala Using Natural Language Processing

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Abstract

This research proposes an automated system for the identification and classification of compound nouns in Sinhala, one of the most complex and crucial features of the language. In Sinhala compound nouns, a prefix is often combined with meaningful stems to convey specific semantic and grammatical roles. As part of this, two major types of Sinhala compound nouns will be addressed in this research, namely *Avya Samasa* and *Dakarartha Samasa*. This study aims to build an effective NLP system for correctly identifying the types of compound nouns. The system studies collocations such as "ගස් ද වැල් ද" forming "ගස්වැල්" and "පරසිරිත්" from "පර" and "සිරිත්". The methodology to be followed is creating a dataset of 6,000 Sinhala compound nouns by using 43 frequent Sinhala prefixes, together with POS tagging to ensure that the stems are valid nouns, verbs, or adjectives. Various machine learning algorithms were applied; these include Random Forest, Support Vector Machines (SVM), and Naive Bayes. The highest accuracy attained was by Naive Bayes at 75%. POS tagging plays a very important role in verifying the grammatical integrity of stems, and filtering out non-compound words when the stem is not meaningful. Results show that this system enhances the classification of Sinhala compound nouns and decreases the complexity of identifying valid compound forms. However, due to the limited NLP resources in Sinhala, as well as the morphological complexity of the language itself, some problems are encountered. The system is of relevance both for linguistic research and teaching, to learners of Sinhala for a better comprehension of compound formations. Future studies may be done to expand the dataset and refine machine learning techniques to increase the accuracy. The limitations of the paper include dependence on the quality of the dataset, and it is challenging to handle all minute differences in the linguistic subtleties in handling different types of compound nouns, where deep learning models may come in handy.

Keywords: *Sinhala language, NLP, compound nouns, POS tagging, Naive Bayes*

Secure Learning Management System (LMS) with Blockchain Technologies

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Abstract

Learning Management Systems (LMS) are essential in digital for managing and delivering online content. However, they face challenges in ensuring document security and integrity, particularly in preventing unauthorized access and maintaining data authenticity. This research aims to enhance LMS security by integrating blockchain technology, especially Ethereum-based smart contracts, which enable decentralized and tamper-proof document management. The proposed framework allows instructors and students to upload and verify academic documents, with all actions recorded immutably on the blockchain, ensuring transparency and traceability. The methodology involves the design and deployment of a smart contract that enforces role-based permissions, enabling only authorized users to perform uploads and verifications. Data collected through blockchain transactions (gas usage, transaction time, and cost ETH) was analyzed to evaluate the system's performance. Results show that document uploads consumed an average of 121,061 gas units and 49.5ms, while verifications required 50,564 gas units and 44ms confirming the framework's efficiency for real-time LMS operations. Although the framework incurs transaction costs, it significantly enhances data security by preventing unauthorized tempering through hash-based validation. In conclusion, the research demonstrates that blockchain technology offers a robust solution for securing academic documents in LMS platforms. However, the scalability of the framework is limited by Ethereum's gas fees, which may affect adoption in large-scale deployments. Future research should explore alternative blockchain platforms to address these cost challenges and enhance scalability.

Keywords: *Blockchain, Smart Contracts, LMS Security, Document Integrity, Ethereum*

Detection and Classification of Complex Java Code Vulnerabilities and Errors Using Artificial Intelligence Techniques

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Abstract

Ensuring the safety of software applications, particularly those developed in Java, is vital because of the risks associated with vulnerabilities such as Cross-Site Scripting (XSS) SQL Injection, incorrect validation of array indices, integer overflow, underflow, and memory allocation issues. This research seeks to create an automated system for identifying and categorizing these vulnerabilities using machine learning methods, thus minimizing the need for manual code inspections and enhancing overall software security. The study entailed gathering Java source code from public repositories and vulnerability databases like CWE and CVE. Essential features such as cyclomatic complexity, the depth of the abstract syntax tree (AST), and control flow metrics were extracted from the code to train machine learning algorithms, including Random Forest, Support Vector Machines (SVM), and Artificial Neural Networks (ANN). The models were assessed using metrics like precision, recall, and F1-score. Preliminary results indicate that Random Forest outperforms other models in identifying vulnerabilities, particularly in handling complex code structures. The system also continuously learns from new data, improving detection accuracy over time. Although deep learning models showed potential, their high computational requirements make them less practical for this task. Future research should focus on expanding the dataset and exploring more advanced machine learning models, such as transformers, to enhance detection capabilities. Finally, this approach could be extended to other programming languages, including Python and JavaScript, to broaden its applicability.

Keywords: *Cross-Site Scripting, SQL Injection, Java Code Vulnerabilities, Machine Learning, Software Security.*

Enhancing Biomedical Literature Summarization Using BioBERT: A Comparative Study with Domain-Specific Large Language Models

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Abstract

In the current era of information overload, summarizing biomedical literature has become crucial. The rapid increase in research publications challenges researchers, clinicians, and policymakers to stay updated on the latest findings. This study evaluates the performance of BioBERT, a large language model (LLM), in summarizing biomedical papers from PubMed. BioBERT's performance was measured using BERTScore, yielding impressive results: an F1 score of 92%, with precision and recall of 88% and 87%, respectively. These metrics underscore BioBERT's proficiency in generating coherent and accurate summaries of complex biomedical texts. A comparative analysis with other models, including ClinicalBioBERT, SciBERT, and BERT, showed that BioBERT outperformed its counterparts, particularly in understanding domain-specific language and capturing critical information efficiently. BioBERT's superior performance positions it as a powerful tool for condensing vast biomedical literature into concise summaries. The findings contribute to ongoing research on the applications of LLMs in healthcare and bioinformatics. By demonstrating BioBERT's effectiveness in summarization tasks, this study highlights the potential of LLMs to streamline information processing, enabling quicker and more accurate dissemination of knowledge. These results emphasize the transformative role of models like BioBERT in the biomedical domain, facilitating better use of research findings and promoting more informed decisions in healthcare. Finally, this study encourages further exploration of LLMs' capabilities in specialized tasks, such as information retrieval and knowledge extraction.

Keywords: *Large language models, biomedical text, summarization*

A Model to Reserve Rights of Creations Using a Blockchain Environment

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Abstract

With the advancement of technology, the music industry has become highly technological. This is the reason for the many advantages and disadvantages of the music industry. Copyright infringement is a serious issue that has emerged with technological advancement. Traditional copyright protection platforms' weaknesses are copyright protection drawbacks, and the inability of other parties (without the copyright owner) involved in the creation to get their revenue directly. Therefore, this research introduced a new model with a customizable revenue distribution facility using the Ethereum blockchain and smart contracts for copyright protection. 100 music files were used to determine the success of the model by changing factors such as pitch and speed. In addition to that, the frequency of copyright identification and uploading speed are also obtained. Existing platforms and the research model were compared using descriptive analysis. In this suggested solution, music files are protected through the block encryption method, and the system makes use of smart contracts to control the entire life cycle of digital copyright. The accuracy of the revenue model was checked by calculating the Ethereum gas price and revenue amount. When compared with traditional copyright protection systems, this model has a higher success rate than traditional platforms, and it is a very successful model for copyright owners to protect their creative rights and as a revenue-sharing platform.

Keywords: *Ethereum Blockchain, Copyright Protection, Smart contract, Music Copyright, Blockchain for Music*

* *Not presented at the conference*

Smart Chess Tournament Management: An AI-Enhanced System for Detecting Repetitions, Illegal Moves, and Predicting Missing Moves

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Abstract

This study introduces an innovative Artificial Intelligence (AI)-based system designed to address the challenges encountered in Sri Lankan school-level chess tournaments, which are often overseen by teachers or non-FIDE titled arbiters. The primary objective of this system is to automate the detection of threefold repetitions, illegal moves, and missed moves, thereby enhancing decision-making accuracy and promoting fairness in tournament play. To achieve this, the system utilizes custom rule-based algorithms that achieve 100% accuracy in detecting illegal moves and threefold repetition, alongside a trained Convolutional Neural Network (CNN) developed from a dataset of 176,998 unique chess positions across 10,000 games to predict missing or incorrect moves in the sequence, facilitating effective record sheet correction. Arbiters can input move sequences using algebraic notation, enabling efficient processing by the system. The system significantly reduces the time required for arbiters to adjudicate complex situations, minimizing decision-making errors that could impact tournament outcomes. Furthermore, the system cultivates a respectful and rule-abiding competitive environment, contributing to equitable decision-making in tournaments. Limitations of the research include the reliance on a specific dataset for move prediction, which may affect the generalizability of results. The implementation of Optical Character Recognition (OCR) for scanning record sheets could further enhance efficiency compared to manual entry. Additionally, sufficient hardware performance is required to operate the CNN effectively, particularly in offline contexts. Future research may explore the integration of this technology in resource-constrained environments and the development of low-cost alternatives to improve accessibility and implementation. In conclusion, this AI-driven system enhances the accuracy, fairness, and organization of chess tournaments, alleviating the burden on arbiters and leading to improved competitive outcomes. The findings hold potential for broader implications in chess tournament management, ensuring more reliable and efficient decision-making processes.

Keywords: *Fair decision-making, Record sheet correction, Sri Lankan school chess, Threefold repetition, Tournament management*

Vehicle Road Double-line Violation Detection and Severity Assessment Using Deep Learning

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Abstract

Road accidents remain a significant public safety problem in Sri Lanka, and violation of road double white lines has been identified as a major reason. Conventional traffic monitoring systems based on CCTV cameras and manual observations fail to serve their purpose as they are ineffective in providing accurate and timely detection. Using the advanced features of YOLO V8 and Open CV, this study suggests a deep learning-based system that automates the detection and severity assessment of double-line violations to address these challenges. Model creation involved several steps data gathering, preprocessing, training, and testing. Data collection was performed at high-traffic road areas where double-line violations frequently happen. Six vehicle types were considered for model training and a total of over 2,500 images were annotated after extracting them from high-resolution video frames. The YOLO V8 was selected as the baseline model due to its strong performance in various traffic scenarios, various vehicle types, and environmental conditions, particularly when compared to other tested models, like DERT, and Faster R-CNN. Its robustness has been proven, achieving 90.2% precision and 87.0% recall on testing data. Also, the integration of Open CV enhances the system by marking road lanes and analyzing key regions of interest, which significantly improves detection accuracy. For severity assessment, the system will categorize violations as normal or serious based on calculating the ratio between the vehicle's width and the extent to which it has crossed the double line. Future directions include enhancing the model's capability to detect other types of vehicles and integrating a number plate recognition feature with an alerting system to identify violators and take immediate action. In conclusion, the study presents that the limitations of traditional monitoring systems can be effectively addressed with the use of approaches based on deep learning. This system represents a major advancement in leveraging artificial intelligence to improve traffic management and law enforcement in Sri Lanka.

Keywords: *Deep Learning, Real-Time Monitoring, Traffic Safety, YOLO V8, CNN*

Utilizing Image Recognition and Machine Learning to optimize Rubber Tree Tapping Techniques for Enhancing Yield and Ensuring Tree Health

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Abstract

Inefficient rubber tapping techniques among inexperienced farmers in Sri Lanka are causing significant challenges in the natural rubber industry, leading to reduced yields and tree trunk damage. This issue threatens the sustainability and economic viability of rubber production in the country. While various automated tapping technologies exist, there remains a critical gap in accessible, intelligent tools to guide farmers toward precise, tree-friendly tapping methods. This research aims to develop the Rubber Tapping Assistant Program (RTAP), an innovative application leveraging image recognition and machine learning to provide real-time guidance on optimal rubber-tapping techniques. The primary objectives include collecting a comprehensive dataset of rubber tree images, developing accurate prediction models for tapping techniques, and creating a user-friendly mobile application for farmers. The study uses a multi-layered methodology, combining data collection from rubber plantations, the development of machine learning models using the YOLO algorithm, and the creation of a mobile application interface. RTAP includes a tapping location prediction model using Random Forest, XGBoost, and AdaBoost regressors. A tree distance prediction model utilizes the YOLOv8 classification model. Tree Region of Interest (ROI) point prediction and tapped area damage prediction models employing YOLOv8s, YOLOv9m, and YOLOv10s detection models. These models work collectively to provide comprehensive guidance on optimal tapping practices. Initial results show a mean square error of 0.0073 for tapping location, 99% accuracy for tree distance, and average accuracies of 80% and 60% for ROI and damage models, respectively. The damage prediction model is designed to assess trunk health and suggest appropriate tapping strategies. This research is expected to bridge the gap between traditional knowledge and modern technology in rubber farming, potentially transforming tapping practices and improving the economic stability of Sri Lanka's natural rubber sector.

Keywords: *rubber tapping techniques, machine learning, RTAP, rubber trunk defect detection*

A Comparative Machine Learning Approach for Identification of the Pervasiveness of Obsessive Compulsive Disorder (OCD) among Sri Lankan Undergraduates

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Abstract

Obsessive-compulsive disorder (OCD) is a common mental health problem described by obsessive thoughts and compulsive behaviors. Obsessions are intrusive, unpleasant thoughts, ideas, or desires that cause excruciating feelings. Compulsions are behaviors that an individual participates in to try to eliminate obsessions and reduce suffering. Everyone experiences obsessions and compulsions at some point. The majority of the Sri Lankan undergraduates have OCD but they are unaware of it. According to psychologists, contamination & washing, doubt and checking ordering, and arranging are the most common characteristics shown by students. If the student is aware that they have OCD, they can act to avoid it. These unpleasant thoughts and acts become more irritating as they interfere with students' learning. It also increases students' anxiety and depression. The study aims to develop a computerized model based on a data mining strategy to identify the pervasiveness of Obsessive-Compulsive Disorder (OCD) among Sri Lankan Undergraduates. This model identifies whether the students suffer from OCD as Low Moderate or High Level. Before the development of the model, a formal questionnaire was developed to examine the behaviors of undergraduates, and data was collected from Sri Lankan Undergraduates. This study used three unsupervised machine learning techniques, namely Kmeans, Agglomerative clustering, and DBSCAN clustering for the detection of patterns or relationships among datasets. To find the accuracy of the algorithms the Silhouette value, Davies Boulding value, and the Calinski-Harabasz value were used. Among those algorithms, the best accuracy is shown in the K-means algorithm. Hence, this algorithm has been selected to predict the pervasiveness of Obsessive-Compulsive Disorder (OCD) as low, moderate, or high among Sri Lankan Undergraduates.

Keywords: *Obsessive Compulsive Disorder, Sri Lankan Undergraduates, data mining strategy, unsupervised machine learning techniques.*

Identification of Factors that Affect Social Anxiety Disorder among University Students in Sri Lanka

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Abstract

The cardinal feature of social anxiety disorder (SAD) is fear of being judged, which has an impact on both the emotional and intellectual factors of their lives. Although most of the Sri Lankan undergraduates are suffering from SAD, it remains largely undiagnosed. Hence, this research aimed to assess anxiety levels and develop a prediction model to identify associated factors of SAD among Sri Lankan university students. A Google form was created using a validated questionnaire to collect data. Anxiety level was assessed using the Liebowitz social anxiety scale. Supervised machine learning methodologies were used to assess the correlations of SAD. Of the total 365 respondents, 47.95% were female, 43.29% were male and 8.77% were not revealed gender. The majority; 51.51% belonged to the 22–25-year age group. Among the participants, 78.08% of the students were found to have some form of SAD, with 38.63% experiencing severe SAD, 23.29% moderate SAD, and 16.16% mild SAD. The Random Forest Regressor, XG Boost Regressor, and Linear Regression were tested, and among them, the Linear Regression model was best fitted with the study results, achieving the lowest Root Mean Squared Error ($RMSE = 2.74 \times 10^{-14}$), indicating it performed best in terms of error measurement. According to the model, the most affected factors for SAD were age (0.305), Year of the study (0.249), University (0.173), and relationship status (0.132). The study reveals a high prevalence of SAD among Sri Lankan undergraduates, with significant correlations to age, study year, University, and relationship status. The Linear Regression model proved to be the most effective in predicting factors associated with SAD. These findings emphasize the need for targeted mental health interventions and support services for students while offering a foundation for future research in understanding and addressing SAD in this demographic.

Keywords: *Social Anxiety Disorder, Undergraduates, Associated factors, Machine Learning, Linear Regression*

Media Ethics Violation Detection in Sinhala News Headlines Using Natural Language Processing Techniques

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Abstract

The Sri Lankan media industry has undergone significant transformations in recent years. These changes are often driven by technological advancements and shifting audience preferences. As a result, upholding media ethics in news reporting has become more challenging. Over the years, the majority of machine learning-based research has been primarily devoted only to detecting hate speech, fake news, and offensive statements in developing semantic analysis systems. To tackle this pressing gap the study will aim to develop an automatic solution to uncover unethical reporting practices by identifying offensive patterns in Sinhala news headlines using natural language processing techniques. It will also focus on developing a solution to prevent its detrimental effects from thwarting them. Solution development involved several steps, and the data collection process was done by gathering over 2500 Sinhala news headlines from main digital media portals. Those data were annotated as "violated" and "non-violated" based on the code of ethics introduced by Verité Research Institute. Data preprocessing steps included tokenization, stop word removal, punctuation removal, spelling correction, numeric values removal, non-Sinhala values removal, and encoding. Two classification algorithms, Support Vector Machine, and Logistic Regression were used to train different models considering five feature extraction techniques. They were TF-IDF, N-Gram, Count Vectorizer, Word2Vec, and FastText. Based on the performance evaluated on the testing data, the combination of Support Vector Machine (SVM) with TF-IDF was chosen as the primary model due to its robust performance and adaptability across the vast data set and complex ethical scenarios in news headlines. This selected model outperformed other approaches achieving an accuracy of 91% on the tested dataset. Media ethics encompass a broad and complex field. This research focuses only on detecting violations in selected media ethics practices, specifically marginalization, prejudiced reporting, reporting on suicides, and cases of women abuse. Future research can expand on this work by addressing other ethical concerns in headlines, adding an automatic suggestion feature to correct violated headlines and extending the analysis to broader news content.

Keywords: *Sinhala Natural Language Processing, Media Ethic Violation, Sinhala News Headlines, Violation Detection, Supervised Machine Learning*

Identification of Banana Type According to Banana Tree Using Machine Learning

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Abstract

Bananas play a significant role in agriculture, especially in Sri Lanka, where approximately 29 varieties are cultivated. Proper identification of the types of bananas is essential for maintaining the best crop management practices, including fertilization, irrigation, and control of disease aspects. Identification of banana type by non-experts, done manually, may result in inefficiencies and errors. This research is intended to automate the identification of major banana species, such as Red Banana, Sour Banana, Cavendish, and Ash Plantain, with the help of machine learning coupled with image analysis. For this research, images were collected from multiple banana plantations across different regions, focusing on key identifying features such as petiole nature, color of the petiole, branching style, color of the midrib, and leaf blade base. Including the above features, two image data sets as branching style and leaf upper side per tree were collected. This data has been split into 80% for training and 20% for testing to ensure accurate model evaluation. The labeled data were used in training different machine learning models like VGG16, InceptionV3, VGG19, and a CNN custom model. The CNN custom model performed better among the selected techniques and gave a classification accuracy of 90%. The findings suggest that the custom CNN model can classify the banana types into four categories, which is a great approach to automating the identification process. Nonetheless, there are limitations, particularly the need for a bigger dataset size to cater to different conditions. These limitations could be mitigated in future studies by adding more banana types and a variety of data in the training of the models. From the findings of this research, it is obvious that farmers will be able to enhance crop management by employing this technique to boost agricultural productivity.

Keywords: *Banana Type Identification, Convolutional Neural Network (CNN), Digital Image Processing, Crop Management Optimization, Automated Agricultural Systems*

Real-Time Feedback System for Cricket Shot Defect Detection for Left-Handed Players Using Deep Learning Model

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Abstract

Cricket is a popular global sport that has many disciplines within it like batting, balling, and fielding. The batsman plays a prominent role and over the history game has produced many great batters. This research is focused on the innovative real-time cricket shot classification and feedback system for left-handed batsmen. The suggested methodology aims to address the gap in professional training availability and cost-effective tools for technical improvement for non-professional players. It mainly focuses on three basic cricket strokes: front foot defense, back foot defense, and cover drive, distinguishing between correct and incorrect executions. The model embeds into a feedback system that can accurately classify the correct or incorrect posture of these three shots while giving immediate feedback if the player is playing a wrong shot by calculating the angles between key points using algorithms. This method assists beginners by improving their skills on these 3 shots. The research involved creating a completely new data set of 58 left-handed players across different age groups. This completely new data set consists of 1,960 videos, 490 per shot category, with correct and incorrect shots captured from multiple angles from the offside of the batsman. A 2D convolutional neural network (CNN) was developed for shot classification with the Nadam optimizer. The model demonstrates exceptional performance by achieving 97% accuracy on the test data set. Specifically, the system exhibited low error rates with a 9.7% overall false positive rate and 1.04% overall false negative rate. Further to that backfoot defense classification resulted in a 0.00% false negative rate, a 2.45% false negative for cover drive shot, and a 0.99% defensive false negative rate was demonstrated. Future work on this would involve extending the system to increase the number of cricket shots analyzed and enhancing the dataset to make the classification broader and more accurate.

Keywords: Cricket, Cricket Shot Classification, Real-time Feedback, Machine Learning, CNN

Identifying Sewing Machine Types According to the Stitches Using Machine Learning

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Abstract

Identifying sewing machine types based on stitches plays a crucial role in ensuring the quality of garment production. For buying companies, to order garment products, it's a requirement to check the quality of the product. Deciding the specific quality of the product manually is a difficult task. Therefore, in the textile industry, there is a necessity for an automated system that can easily identify and verify whether the sewing machine type is correct or not, so the orders can be accepted or rejected easily. The model proposed in this paper helps to detect the type of sewing machine based on the stitches on clothing. This research is significant because it improves the quality control of garment production and ensures that buying companies can verify that orders meet the required standards. With the proposed model not only large-scale garments but small-scale garments can also identify the sewing machine types and solve their day-to-day problems effectively. The main objectives of the research are to create a data set of stitch images, segment the stitch patterns from images, extract features from the segmented images, and train the model to identify the sewing machine types. In this proposed methodology, the Keras Sequential Model has been employed to explore the automated identification of various sewing machine types through their unique stitch patterns. The research methodology involved enhancing image quality by reducing noise, selecting appropriate tools for system modeling, training the model with machine learning algorithms, and comparing the results with manual checks. The model achieved an accuracy of 82.80%. Identifying the defects in fabric during the manufacturing process and automatically categorizing or matching textile colors to improve dyeing and manufacturing processes are significant impacts that can be achieved in the future using the Keras Sequential Model.

Keywords: *Keras sequential model, Stitch pattern recognition, XGBoostVision model*

Analyzing the Preference for Remote Work Due to Sri Lanka's Economic Crisis: Insights from Twitter Data using NLP/ML

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Abstract

An important change in the dynamics of employment has emerged in Sri Lanka due to the economic downturn. Remote work has become a hot topic due to the on-going crisis. This study examines public attitudes toward remote work in Sri Lanka amid the current economic crisis. With the rise of remote work due to employment uncertainties, the research seeks to understand how people view remote jobs in comparison to traditional roles. Utilizing Twitter as the main source of data, the study employed Natural Language Processing (NLP) techniques and Machine Learning (ML) algorithms, including Naïve Bayes, Support Vector Machine (SVM), Random Forest, Logistic Regression, and Gradient Boosting, to categorize tweets from 2020 to 2024 into positive, negative, and neutral sentiments. The results indicated that SVM was the most successful model, achieving an 85% accuracy rate according to precision, recall, and F1 score evaluations. The sentiment analysis showed 41% negative, 30% positive, and 29% neutral sentiments, demonstrating the range of public viewpoints on remote work during this crisis. While these insights are valuable, the demographic limitations of Twitter, which skews toward younger, tech-savvy users, could restrict the broader applicability of the results. Future studies should investigate using other data sources, such as surveys, to gain a wider understanding. The research underscores the significance of hybrid work models and stresses the urgent need for enhanced digital infrastructure and support systems to facilitate remote work in the challenging economic landscape of Sri Lanka. Finally, the study provides valuable insights for policymakers and employers concerning the evolving job scene in Sri Lanka and emphasizes the need for improved digital infrastructure and support systems for remote work.

Keywords: *Economic Crisis, Machine Learning, NLP, Remote Work, Twitter Sentiment Analysis.*

Preliminary Study on the Potential of Voice Characterization Using S-Transformation

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Abstract

Voice characterization is a crucial topic in voice recognition systems, the biomedical field, and other areas. Each person's voice is unique and can reflect their mental and physical state. Various transformations have been applied in voice characterization, including Fourier, STFT, Wavelet, CW, and Gabor. S-Transformation, introduced in 1996, is a relatively new technique that has seen limited use in the acoustic field. This study investigates the potential of S-Transformation for voice characterization using MATLAB software, with results verified against data from Praat software. Using a custom-developed MATLAB code, any sound file in “Wav” format was transformed to generate spectrograms. Fourteen different sound files from 14 speakers, each saying “Hello” in a recording approximately one second long, were used for comparison of inter-speaker voice characteristics. Additionally, five sound files from a single speaker were analysed for intra-speaker variations. For all audio signals, spectrograms were generated, and the pitch and first four formant patterns were manually extracted. The data from the 14 different speakers were plotted and compared with the patterns generated by Praat. The pitch patterns closely matched those generated by Praat, and the first two formants were nearly identical. The other two formants showed some discrepancies, likely due to the lower accuracy of data extraction, leading to some lost data. Intra-speaker variations showed slight differences in patterns but were generally consistent across multiple recordings of the same word. This research concludes that S-Transformation can be used effectively in voice characterization with good accuracy. With improvements in automated data extraction, this method could be valuable in various fields, including acoustics and biomedical applications.

Keywords: *Acoustics, Inter-speaker, Intra-speaker, S-Transformation, Voice characterization*

Assessing Perception of the Effectiveness of Public-Private Producer and Society Partnership (4PS) Model among Tea Smallholders in Ratnapura District

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Abstract

The Sri Lankan tea industry greatly depends on the Tea Smallholding sector, where public and private sector organizations operate in Public, Private, Producer, and Society-oriented Partnerships (4PS) models to address social challenges and drive economic growth. This study investigated the effectiveness of the 4PS model in the technology outreaching process, determined key challenges and success factors, and proposed measures to strengthen the partnership model for sustainable land productivity of Tea smallholders. Further, this study was conducted with 100 tea smallholders in the Ratnapura region using a cluster sampling technique. Primary data was collected through pre-tested questionnaires, focus group discussions, and in-depth interviews and the reliability analysis showed the survey instrument used in the study was reliable and with good internal consistency (Cronbach's Alpha = 0.904). Descriptive analysis and ordinal logistic regression analysis were employed to analyze the data. The descriptive results indicated that 57% of farmers believe the 4PS model is moderately effective, 32% consider it highly effective, and 11% of respondents agree that it is very highly effective. The ordinal logistic regression indicated that the overall model was significant ($P < 0.05$). Further, it exhibited that the effectiveness of the model is 63.5% and showed a positive correlation with smallholder's access to resources, participation in training programs, access to extension services, degree of satisfaction with the model, and adoption of sustainable farming practices, increase the probability of positive income. Therefore, these findings suggest that policymakers should focus on improving access to resources, training programs, and extension services to increase the likelihood of positive income outcomes for tea smallholders through the 4PS model.

Keywords: *extension services, farmer satisfaction, public-private producer and society partnership, sustainable agriculture, tea smallholding sector*

Study on the Level of Adoption of Good Agricultural Practices (GAP) in Tea Cultivation among Smallholders in the Uva Region

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Abstract

Tea Smallholders in Sri Lanka encounter significant challenges due to non-compliance with Good Agricultural Practices (GAP) in tea cultivation, necessitating the urgent implementation of effective adaptation strategies. The GAP in tea cultivation, considers soil conservation, shade management, efficient water management, integrated pest management, and sustainable farming techniques, which are essential for maintaining productivity and environmental sustainability. This study aimed to evaluate the extent of GAP knowledge among tea smallholders in the Uva region and examine their implementation of adaptation measures to address GAP challenges. A randomly selected 100 tea smallholder in the Uva region was selected. Utilizing a cross-sectional and exploratory research design, this study employed diverse data collection methods, including interviews, pre-tested questionnaires, focus group discussions, and field observations, to ensure a comprehensive and multifaceted approach. These methodological approaches facilitated the collection of valuable insights into tea smallholders' awareness and their adoption of GAP. Subsequently, the collected data were analyzed to discern the farmers' knowledge and implementation of adaptation measures in response to GAP challenges. Descriptive statistical analysis and multiple linear regressions were performed to analyze the data using SPSS software. In the Uva region, the majority 52% of tea smallholders exhibited moderate awareness, while 23% of tea smallholders demonstrated a high level of awareness of GAP. Moreover, the adoption of GAP was significantly determined by the education level, income, experience in the field, knowledge of cultural practices of tea smallholders, and extension services. These findings suggest that adopting GAP in tea cultivation among smallholders in the Uva Region is imperative in improving the quality of tea and its sustainability. Further, future research could explore the impact of GAP on productivity and profitability in different study areas of Sri Lanka.

Keywords: *Adoption, Cultivation, GAP, Tea Smallholders*

An Overview of Mechanical Weed Controlling Methods Considering Specialized Brush Cutter Weeder

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Abstract

There are different weed control strategies to control weeds, for example, manual evacuating strategy, substance control, natural control, and mechanical control. Out of all the weed control strategies, mechanical techniques are the most attainable and have enormous outcomes. Mechanical weed control involves the use of various tools and equipment to manage and eliminate unwanted vegetation in agricultural and landscaping settings. One specific tool was designed and developed to be used for this purpose and is called the brush cutter weeder. While considering the mechanical weed controlling methods, the brush cutter weeder is the most applicable alternative for medium-scale farmers because it reduces the efforts that were put in by farmers in terms of money, labor, time, and physical efforts for economical weeding operation and cultivation. The weeding wheels of the brush cutter weeder were modified to add weeds to the top of the crop when using the machine. This can be used as an organic fertilizer for a crop. Finally, this overview shows that there are different kinds of techniques that can be used to control weeds in the field. Based on the research reviews, it can be suggested that the design and development of a bush cutter as a weeder was the best solution for the existing weed-control problems. Not only that, compared to other mechanical weed controllers, this will be a reasonable cost for a farmer.

Keywords: *brush cutter, manual methods, mechanical methods, weeds, weeders*

**Not presented at the conference*

Assessing the Requirements for Extension and Advisory Services of the Cinnamon Industry in the Southern Province: Stakeholders’ Perspectives

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Abstract

Sri Lanka is the origin of *Cinnamomum zeylanicum* also known as Ceylon cinnamon or ‘True cinnamon’. In Sri Lanka, the effectiveness of extension and advisory services for the cinnamon industry has declined in previous years, particularly after it was recognized as a new department. This research sought to investigate the actual need assessment requirement for extension and advisory services within the cinnamon industry of the Southern Province by identifying the specific extension and advisory service needs of cinnamon farmers in the Southern Province, to explore the perceptions and expectations of cinnamon farmers and extension officers in Southern province, to analyze the roles, challenges, and capabilities of extension officers in the cinnamon industry and to propose recommendations for improving extension and advisory services in the cinnamon industry. Consequently, the survey was carried out in Southern Province, involving 30 cinnamon farmers who were selected by purposive sampling method. Additionally, interview information was also collected from the six extension officers at the Department of Cinnamon Development. The data were collected through phone-based interviews. The Friedman test and descriptive tools were used to analyze the data. It was revealed that only 26.7 % of the farmers had participated in extension services over the two years and the majority expressed dissatisfaction with the quality of extension services provided. Farmers revealed the necessity of a higher level of knowledge regarding animal, pest & disease management (mean rank 2.13). In terms of extension services, it was found that while there has been a rise in the delivery of online services (6.67%), farmers still favored the traditional approach (53.3%) for knowledge transfer, particularly through workshops and group sessions. Thus, this study emphasizes the need for changes and reforms in the existing extension system of the cinnamon industry.

Keywords: *Ceylon cinnamon, Knowledge dissemination, Need assessment*

Effect of Ampicillin and Tetracycline on *Xanthomonas* Spp. Isolated from Strawberry Plants with Angular Leaf Spot (ALS) Disease

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Abstract

Fragaria ananassa (strawberry) is a perennial crop belonging to the family Rosaceae. Parallel to the increase in strawberry production, various strawberry diseases have also become common. One such is Angular Leaf Spot (ALS), which can lead to severe losses in yield. *Xanthomonas fragariae*, a Gram-negative rod, has been identified as the causative agent of this disease. Control of ALS is currently achieved commonly through preventive measures such as using disease-free stocks, but these may fail to counter an established pathogen. Therefore, it is important to explore other viable options such as the controlled use of antibiotics. In the current study, we have isolated the causative agent of ALS in strawberries and have evaluated the efficiency of two antibiotics for the potential control of the pathogen. The causative agent of ALS was isolated from diseased plant leaves that showed characteristic symptoms. Based on the colony morphologies on nutrient agar, two isolates, namely I_1 and I_2 were selected, and their Gram's reaction, motility, and selected biochemical characteristics were evaluated for the preliminary identification of the isolates as belonging to the genus *Xanthomonas*. The effect of two commonly available antibiotics; ampicillin, and tetracycline, were tested against the isolates using the agar well diffusion method and both antibiotics showed an inhibitory effect against both I_1 and I_2. Using the broth microdilution method, the Minimum Inhibitory Concentration (MIC) of ampicillin was determined as 250 µg mL⁻¹ and 200 µg mL⁻¹ for I_1 and I_2 respectively, while the MIC of tetracycline for I_1 and I_2 was 300 µg mL⁻¹, and 250 µg mL⁻¹ respectively. Although this study exhibited that antibiotics, ampicillin, and tetracycline can be effectively used against the bacterial pathogen, the practicality for large-scale use as well as the potential environmental and health implications should also be considered before their application.

Keywords: Angular leaf spot (ALS), Antibiotic, Strawberry plants, *Xanthomonas* spp.

Morphological Characterization of *Citrus* Species in Sri Lanka

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Abstract

Citrus, a member of the Family Rutaceae, is recognized for its high nutritional and medicinal value, due to bioactive compounds like alkaloids, tannins, and phenols. In Sri Lanka, the diverse Citrus germplasm has not been fully characterized, and proper taxonomical classification remains incomplete. Therefore, this study aims to fill that gap through the morphological characterization of Citrus species found in the country. Herbarium samples were prepared and authenticated with existing specimens at the National Herbarium, Royal Botanical Gardens, Peradeniya. Morphological traits such as fruit, leaf, tree, and floral characteristics were documented. Quantitative data were scandalized using z-score normalization while qualitative data were encoded into numerical values. Gower distance in R software was used to calculate species similarities, and a dendrogram was constructed using Word’s method in IBM-SPSS software, revealing five distinct clusters. Cluster I included species such as calamansi (*Citrus microcarpa*), yak dehi, ambul naran, kumquat (*Citrus japonica*), tahiti lime (*Citrus latifolia*), key lime (*Citrus aurantiifolia*), nas naran (*Citrus japonica*), konda naran (*Citrus crenatifolia*), and kaffir lime (*Citrus hystrix*) while Cluster II includes lemon-round (*Citrus limon*), lemon-long (*Citrus limon*), peni kudalu orange, rough lemon (*Citrus jambhiri*), and trifoliate orange (*Citrus trifoliata*). The plants in Cluster III included heen naran (*Citrus crenatifolia*), sour orange (*Citrus aurantium*), sweet orange (*Citrus sinensis*), jama naran (*Citrus reticulata*), and philippine red lime (*Citrus limonia*). Citron (*Citrus medica*), Buddha’s hand (*Citrus medica*), and citron hybrid are part of a smaller cluster that joins with grapefruit (*Citrus paradisi*) and sidaran (*Citrus medica*) to form Cluster IV, while pumelo (*Citrus maxima*) belongs to the Cluster V which is exhibited distinct morphological traits. This classification provides a foundation for future research in Citrus breeding, conservation, and genetic studies.

Keywords: *Citrus*, *Dendrogram*, *Rutaceae*

***In Vitro* Antifungal Activity of Selected Plant Extracts Against *Lasiodiplodia Theobromae*, Causes Mango Stem End Rot**

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Abstract

Phytopathogens are primarily controlled through the application of synthetic products, which can harm human and environmental health. As a result, the use of plant-derived extracts as eco-friendly bioagents has become increasingly popular due to the biologically active compounds present in the plants. This study was conducted to determine the antifungal activity of the ethanol and acetone leaf extracts of *Coccinia grandis*, *Gymnema sylvestre*, *Argyrea pomacea*, and *Erythrina subumbrans* against the causal pathogen of mango stem-end rot. The pathogen was isolated from diseased mangoes and identified as *Lasiodiplodia theobromae*. The pathogenicity of the isolated *L. theobromae* also was confirmed on healthy samples of mangoes. The antifungal activity of leaf extracts was assessed using the food poison technique, with leaf extracts tested at different concentrations of 50, 25, and 12.5 mg/ml. Results indicated that the ethanol extract of *E. subumbrans* at 50 mg/ml showed the highest percentage of mycelial growth inhibition (29.21 ± 0.65 %) followed by the acetone extract of *G. sylvestre* (28.97 ± 0.79 %) at the concentration of 25 mg/ml against the *L. theobromae*. The percentage of mycelial growth inhibition was significantly different among all treatments ($P < 0.05$), which may be attributed to the diverse phytochemicals present in the plant leaves. Therefore, further studies are required to isolate and identify the specific bioactive compounds responsible for these antifungal activities.

Keywords: Antifungal activity, *Lasiodiplodia theobromae*, Leaf extract, Mango stem end rot

A Comparative Study on Quality Parameters of Milk; Based on Selected Milk Collection and Chilling Centers in Sri Lanka

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Abstract

Cow's milk is widely recognized as a vital source of nutrients and is consumed by millions of people globally in various forms. However, in Sri Lanka, there is a notable lack of comprehensive databases regarding milk quality at the grassroots level, particularly concerning regional variations. This study aimed to evaluate the quality parameters of raw milk collected from fifty selected chilling centres across the Uva, North Western, North Central, Eastern, and Central Provinces of Sri Lanka. Collected milk samples were analyzed for fat content, solid non-fat (SNF) content, lactose content, protein content, added water, freezing point, corrected lactometer reading, pH, keeping quality (KQ), solubility index, and alcohol precipitation test to determine the quality of incoming raw milk across different regions, which is essential for ensuring that the milk used in production meets established standards. Milk samples were analyzed by an Ultrasonic Milk Analyzer, pH meter, alcohol test, and Resazurin dye reduction test. The results were analyzed by mean comparison – T-test and process control charts were used to monitor the variations in milk quality parameters over time. The analytical results revealed that the mean values for the selected quality parameters across the sampled regions as follows: pH 6.294±0.28, fat content 4.031±0.24%, SNF content 8.089±0.48%, protein content 3.206±0.19%, lactose 4.732±0.30%, CLR value 26.35±1.71, added water 0.12±0.02%, freezing point -0.5555±0.04 °C, solubility index 0.688±0.04 mg/L, and KQ 2.45±0.01. 83%, 14%, and 3% of samples out of selected milk samples were identified as 77% (-), 72 %(-), and 68 %(-) respectively for the alcohol precipitation test. This indicates the high microbial activity in grass-root milk collection. Among the regions studied in this research, raw milk from the Pothuvil and Gokaralla areas exhibited superior quality, meeting or exceeding established standards.

Keywords: Chilling Centres, Comparative Study, Milk Collection, Quality Parameters, Ultrasonic Milk Analyzer

Evaluation of Antidiabetic and Antiobesity Effects of Underutilized Starch Sources Compared to Refined Wheat Flour

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Abstract

Unconventional and underutilized flours are rich sources of phytochemicals compared to refined wheat flour. Phytochemicals are key secondary metabolites inhibiting digestive enzymes like α -amylase and pancreatic lipase, crucial in glucose and triglyceride absorption. Replacing refined wheat flour with these unconventional flours may offer a natural alternative for managing hyperglycemia and hyperlipidemia without the side effects associated with synthetic drugs. This study explores the antidiabetic and antiobesity activities of flours from Jaggery palm (*Caryota urens*), Palmyra tuber (*Borassus flabellifer*), Defatted Coconut (*Cocos nucifera*), Waterlily seed (*Nymphaea lotus*), Cycad seed (*Cycas circinalis*), and Jackfruit seed (*Artocarpus heterophyllus*), comparing them with refined wheat flour. The inhibitory properties of refined wheat and underutilized flour extract against α -amylase and pancreatic lipase were evaluated using soluble starch and p-nitrophenyl butyrate (p-NPB) as substrates, respectively. Synthetic inhibitors Acarbose and Orlistat were used as positive controls for the α -amylase and lipase inhibitory assays. All analyses were performed in triplicate and compared using Tukey's test. All unconventional flours exhibited significantly higher ($P \leq 0.05$) α -amylase inhibitory activity compared to refined wheat flour, with waterlily seed flour showing the highest activity (2.88 ± 0.27) followed by flours from *Cycas circinalis* (12.07 ± 0.16), Jackfruit seed (15.57 ± 0.14), Jaggery palm (25.26 ± 0.22), Coconut (27.47 ± 2.17), and Palmyra (33.29 ± 1.52). Lipase inhibitory activity of the flours ranged from 46 mg/ml to 21 mg/ml, with Palmyra (23.50 ± 7.62), Defatted Coconut (21.04 ± 5.42), Waterlily (28.49 ± 4.09), and Jackfruit seed (26.88 ± 1.42) showing significantly ($P \leq 0.05$) higher activity than refined wheat flour. Jaggery Palm (44.79 ± 0.91) and *Cycas circinalis* flours (46.96 ± 1.08) had lower ($P \leq 0.05$) inhibitory activity than refined wheat flour. Overall, all flour extracts except waterlily seed flour exhibited weaker α -amylase and lipase inhibition than the synthetic drugs. While waterlily seed flour showed α -amylase activity comparable to Acarbose, its lipase inhibition was inferior to Orlistat.

Keywords: Antidiabetic, Antiobesity, Refined wheat, Underutilized, Flour

*Not presented at the conference

A Study of Meat and Processed Meat Consumption Patterns among Sri Lankan Undergraduates

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Abstract

Protein malnutrition remains a challenging and unresolved health issue among youth in Sri Lanka. This study investigated the socio-demographic factors influencing meat and meat product consumption among undergraduates in Sri Lanka to identify the factors affecting their protein intake. A total of 437 undergraduates in 18 Sri Lankan universities were interviewed via a Google questionnaire of the surveyed students, 90.8% reported consuming meat and processed meat products, while the remaining 9.2% did not. Broiler chicken meat was preferred by 98.5% of those who consume meat, followed by pork (22.2%), mutton (14.1%), beef (13.1%), and other meats (5.8%). The majority purchased meats from supermarkets (73.0%), followed by retail shops (70.3%), farms (14.6%), and households (5.8%). Over half (53.3%) were unaware of a person's daily recommended protein requirement. Considering the processed meat products in Sri Lanka, sausages (90.7%) were the most consumed processed meat product, followed by meatballs (69.3%), nuggets (23.3%), and other products, including ham and bacon (16.8%). The most common reasons for not consuming meat were lack of preference (72.5%), religious beliefs (25.0%), no reason (22.5%), health risks (10.0%), and allergies (2.5%). Among non-meat consumers, primary protein sources were plant-based foods (70.0%) and milk (70.0%), followed by eggs (55.0%), and fish (42.5%). Preferences, health considerations, and religious beliefs emerged as key factors influencing meat consumption patterns among Sri Lankan undergraduates. These findings suggest the need for nutritional interventions, such as educational seminars, dietary counseling services, improved dining hall options, and healthy eating campaigns within university settings. Finally, these programs can improve to enhance students' nutritional knowledge and well-being.

Keywords: *Consumption pattern, Meat, Processed products, Purchasing patterns, Undergraduates*

Development of Sweet Mix Spicy Jam Incorporated With Ripened Banana Pepper (*Capsicum Annuum*) and Ripened Jackfruit (*Artocarpus Heterophyllus*) and Evaluation of Its Quality Parameters

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Abstract

Jam is an excellent option for preserving fruit against seasonal changes. Ripe banana peppers are often under-consumed and prone to high post-harvest damage, despite being cheap at harvest. Jackfruit is seasonal, with much of its yield going to waste during peak season. To mitigate economic losses from post-harvest waste and seasonal fluctuations, a novel jam made from banana peppers and ripened jackfruit offers a solution for creating a more resilient and efficient supply chain. The spicy mixed sweet jam provides a unique flavor experience. Four jam samples (T1, T2, T3, and T4) were developed with varying sugar concentrations of 55%, 60%, 65%, and 70%. Sensory evaluation was conducted by 30 panelists using a 1–5-point hedonic scale, assessing color, taste, flavor, texture, aroma, appearance, spreadability, and overall acceptability. The T2 sample outperformed the others. Physicochemical analysis showed significant variation among samples, with moisture content (24.16%-30.73%), ash (0.318%-0.514%), acidity (0.19%-0.96%), TSS (68%-71%), and pH (3.66-3.84). The T2 sample had the best quality with moisture content (14.39%), pH (3.78), TSS (68%), ash (0.318%), titratable acidity (0.19%), protein (0.6%), and fat (0.02%). Based on sensory and physicochemical analysis, the jam made with ripened banana pepper and jackfruit pulp 40% and 60% added sugar was selected as the best. Future research could explore optimizing the processing techniques or testing the jam's shelf life and consumer acceptance on a larger scale, further supporting sustainable food production and waste reduction strategies.

Keywords: *Banana peppers, Jackfruit, Jam, Post-harvest, Spicy*

Formulation of Instant Porridge Cube from Hingurala Yam (*Dioscorea alata*) Flour, Soybean (*Glycine max*), and Flax Seed (*Linum usitatissimum* L)

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Abstract

Instant Porridge is a very popular food among people regardless of age. This study was carried out to develop a convenient, nutritious, and functional food product to meet the dietary needs of a diverse population. In the formulation of this instant cube, key ingredients were incorporated that have been identified in previous studies as beneficial for alleviating postmenopausal symptoms and ensuring a high carbohydrate content along with other important nutritional elements. This means that it will support hormonal balance and also energize, providing overall nutritional value that makes it fitting for an even bigger audience of people looking for functional health benefits and a nutrient-dense food option. The cube contains Hingurala flour, soybean flour, flax seed flour, curry leaves, garlic, pepper, and coconut powder. Sensory evaluation was performed to determine the optimal formulation with the highest level of consumer acceptance across four treatment samples. The sensory attributes, including color, aroma, viscosity, flavor, mouthfeel, appearance, and overall acceptability, were evaluated by an untrained panel of 30 individuals. The product containing 80% Hingurala flour, 10% flax seed, and 10% soybean flour was selected as the best product considering its sensory attributes. Each attribute received a score exceeding the average value of 4.0. Sensory attributes were analyzed using SPSS Software. It was found to contain 43.27% carbohydrate, 13.96% Crude protein, 23% Crude fat, 2.31% Fiber, 10.13% Ash and 9.63% Moisture. In conclusion, the instant porridge cube selected with the highest consumer acceptance represents an optimal combination of ingredients for making a novel, convenient, nutritious, and functional food product.

Keywords: *Flax seed, Hingurala, Postmenopausal symptoms, Soybean*

Analysis of Functional Properties of Fresh and Dried Mustard, Radish, and Mung Bean Microgreens

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Abstract

Micro greens are immature greens that have gained recognition as functional foods due to their rich phytochemical profile. It consists of a central stem, a pair of cotyledon leaves, and the first true leaves, and these have harvest maturity around two weeks from sowing. Micro greens have excellent sensorial appeal with vibrant colours, delicate flavours, and a crunchy texture, allowing them to be rawly consumed as excellent salad crops. Although microgreens have higher functional benefits it has a challenging limited shelf life of around 3 to 5 days at ambient temperature. This study examined the phytochemical composition of fresh and dried mustard, radish, and mung bean microgreens to evaluate the application of excess microgreens as a culinary powder, dried at 40°C until a constant weight. One gram of equivalent dry-weight basis samples was taken from both fresh and dry microgreens and the methanolic extract of samples was used to evaluate total phenolic content (TPC), total flavonoid content (TFC) and DPPH radical scavenging antioxidant activity (inhibition %). The results indicated dry powder of mustard microgreens has higher antioxidant activity (72.40%) and TFC (51.38%) but lower TPC (42.75%) and radish microgreen dry powder has higher antioxidant activity (23.33%), but lower TFC (55.67%) and TPC (54.20%) than fresh microgreens. Mung bean microgreen dry powder has higher antioxidant activity (84.90%) and similar TFC but lower TPC (42.37%) than fresh microgreens. Dry powder of radish microgreens was reported to have the highest TPC (133.98 ± 0.14 mg (GAE)/g), TFC (203.40 ± 0.70 mg (RE)/g) and antioxidant activity ($80.50 \pm 0.59\%$ inhibition) values. The study found that dried microgreens exhibited higher antioxidant activities and total flavonoid content (in mustard), however, they reported less total phenolic contents than their fresh counterparts in these three varieties. Overall, this study provides information on the suitability of excess microgreens as a culinary powder.

Keywords: Antioxidant activity, microgreens, total flavonoid content, total phenolic content

Explore the Existing Climate Change Resilience Strategies for Low-Country Tea Cultivation

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Abstract

The tea sector is one of the most important agricultural industries in Sri Lanka, providing employment opportunities for over one million people while alleviating poverty in rural regions. However, climate change is affecting the yields and quality of tea production and poses challenges to production techniques. This study focuses on climate resilience strategies recommended by the Tea Research Institute (TRI) for the low-country tea production areas of Sri Lanka. TRI had introduced seven main strategies to fit into the common practices of the region. The three main strategies were selected for this study: drought mitigation in tea plantations, burying of prunings to improve soil fertility and productivity of tea lands, and shade management in tea. These strategies were assessed in this study by conducting a SWOT matrix using both primary and secondary data. Primary data were collected from TRI and secondary data, from scientific articles, government reports, and institutional reports. All the strategies addressed current weather events, and they played a major role in enhancing tea land productivity. From all the strategies, shade management was an important approach given the effects of reducing high temperatures in the microclimate. However, the management needs to consider competition between the tea and the shade species. Unpredictable weather events severely damage tea crops and current strategies failed to address these challenges effectively. According to the SWOT matrix, strategies need to be updated with modern techniques such as IoT and Drona, eco-friendly mulching, and new irrigation methods to mitigate the increasing severity of weather events. Therefore, regular assessments and monitoring of the climate resilience approaches are critical for sustainable tea production. The study suggests further research to assess the effectiveness of the proposed strategies and the implementation of a localized strategy evaluation mechanism.

Keywords: *Drought mitigation, Burying of prunings, Shade management*

Rapid In-Vitro Propagation of *Plumbago indica* L.: A Sustainable Approach for Conservation and Commercial Production

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Abstract

Plumbago indica L., commonly known as Indian leadwort, is a perennial shrub belonging to the family Plumbaginaceae. Native to Southeast Asia, it is widely cultivated for its ornamental appeal and medicinal uses. The primary bioactive compound of plumbagin, which gives the plant its pharmaceutical value, is predominantly found in the roots. Unfortunately, the plant is rapidly declining in its natural habitats due to over-harvesting and unsustainable collection practices. Conventional propagation methods are challenging due to the plant's slow growth rate and lack of viable seeds. Therefore, this study aimed to establish an efficient and rapid in-vitro propagation technique to meet the growing commercial demand. Nodal segments were collected from mature plants and sterilized using 0.3% Carbendazim and 10% Clorox with different exposure times (5 and 10 min). After a seven-day incubation period, the healthy explants were transferred to MS medium supplemented with 1.0–5.0 mg/L BAP for shoot induction. Shoot elongation was further optimized by transferring the induced shoot buds to MS medium with 1.0–5.0 mg/L GA3 and root induction was achieved by transferring shoots to half-strength MS medium containing 0.2–0.8 mg/L IBA. Fully developed and well-rooted plantlets were acclimatized in coir pellets before being transferred to a soil (1:1) potting mixture. Completely Randomized Design (CRD) was used in all experiments, there were fifteen replicates in each treatment and all the cultures were randomized weekly. MINITAB 17 was used for the statistical analysis, Analysis of variance (ANOVA) was performed and pair-wise comparisons were carried out using Tukey's test. Results showed that the optimal sterilization method was 0.3% Carbendazim for 10 minutes followed by 10% Clorox for 10 minutes, resulting in the highest survival rate (83.34%). The highest number of shoots (3.4 ± 0.91) and the longest shoot length (2.41 ± 0.21 cm) were obtained in MS medium containing 2.0 mg/L and 3.0 mg/L BAP, respectively and the highest shoot length increment (1.03 ± 0.45 cm) was observed with 4.0 mg/L GA3. MS medium supplemented with 0.4 mg/L IBA which resulted in the highest mean number of roots (26.5 ± 3.54) and longest mean root length (2.49 ± 0.31 cm). This study established an efficient in-vitro propagation protocol for *P. indica*, addressing slow growth and seed scarcity, and recommending scaling up for sustainable cultivation to reduce pressure on wild populations.

Keywords: *Acclimatization, direct organogenesis, Plumbago indica, rooting, shoot induction*

Performance of Black Soldier Fly (*Hermetia illucens*) Larvae in Different Growth Substrates

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Abstract

The increasing global population is driving higher demand for animal proteins, such as meat, eggs, and fish, which in turn elevates the need for sustainable animal feed solutions. Black Soldier Fly (BSF) - (*Hermetia illucens*) larvae have emerged as a promising alternative for converting organic waste into valuable biomass, providing a sustainable source of animal protein for animal feed. This study investigates the growth performance and survival of BSF larvae reared on various organic substrates commonly available in Sri Lanka; hotel food waste (HFW), household food waste (HHFW), vegetable waste, layer chicken litter (LCL), and crushed fruit waste with six biological replicates per each treatment. Results indicated that the larvae reared on HFW and LCL achieved the highest (one-way ANOVA, $P < 0.0001$) average weight of 174.38 ± 0.17 mg and 149.85 ± 0.17 mg per ten larvae at the end of the experiment period. The highest larval mortality was observed in HFW and HHFW (Kruskal-wallis Test, X^2 ; 23.6336). Even though HFW achieved the highest larval weight, it also showed the highest motility; hence HFW cannot be an ideal growth media for the growth of BSF larvae. This study highlights LCL as the superior substrate for BSF larvae rearing due to its favourable combination of the highest larval growth and the lowest mortality rate. The efficient biomass production using LCL offers a sustainable approach for the animal feed industry, improving waste management, enhancing sustainable animal husbandry, and promoting agricultural productivity. The growth of BSF larvae can be varying with different moisture contents and temperature of the growth media. Therefore, as a future implication of this study, the growth performance and mortality rates of BSF larvae are essential to be investigated under different moisture and temperature regimes.

Keywords: *Alternative Protein Source, Black Soldier Fly, Growth Performance, Growth Substrates, Waste*

Comparison of Spatial-Based Rainfall Estimation Methods for Matara District, Sri Lanka

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Abstract

Weather significantly influences agronomic production in Sri Lanka. This study develops a spatially based rainfall model for Matara District, analyzing average annual and seasonal rainfall (Southwest monsoon (SWM), First-inter monsoon (FIM), Northeast monsoon (NEM), and Second-inter monsoon (SIM)) using data from 2011 to 2020 (09 rainfall stations). Objectives included creating rainfall maps via interpolation models in GIS, generating Isohyetal maps, and identifying the best interpolation model for rainfall distribution using zonal statistics and spatial analysis. Methods involved raster interpolation techniques Inverse Distance Weighting (IDW), Kriging, and Spline to map average annual and seasonal rainfall. Isohyetal maps portrayed rainfall boundaries, while zonal statistical analysis determined minimum, maximum, and mean rainfall by Divisional Secretariat Division (DSDs) in Matara. Statistical tests (sample test, paired t-test, and One-way ANOVA) assessed the significance of differences between interpolation models within DSDs and seasons at 1% and 5% significance levels. Findings showed significant annual average rainfall variation between southern and northern DSDs. Kotapola DSD recorded the highest mean annual and seasonal rainfall across all interpolation methods: IDW (294.99 mm), Kriging (294.18 mm), and Spline (382.45 mm). In contrast, Dewinuwara DSD had the lowest mean rainfall using the IDW method (153.47 mm), while Thihagoda DSD recorded the lowest values using the Spline (154.69 mm) and Kriging (154.42 mm) methods. One-way ANOVA indicated no significant difference at the 5% level between interpolation types for each rainfall pattern. Mean comparisons revealed the Spline method had the lowest Standard Mean Error (± 6.67) for annual average rainfall, while IDW had the lowest errors for seasonal rainfall during monsoon and inter-monsoon periods. The study concludes that Spline is suitable for mapping average annual rainfall, whereas IDW is best for seasonal rainfall patterns in the district, supported by Isohyetal lines.

Keywords: *Inverse Distance Weighting, Kriging, Spline, Divisional Secretariat Division, Isohyet lines*

Situational Assessment of Covid-19 in Sri Lanka: Descriptive Study

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Abstract

The recent Coronavirus Disease 2019 (COVID-19) outbreak, which originated in China in December 2019, has become a global pandemic, imposing serious health, social, and economic burdens worldwide. In Sri Lanka, the first COVID-19 case was reported on 27th January 2020 by a Chinese national, followed by the first local case on 11th March 2020. Globally, the number of COVID-19 cases has been escalating at an alarming rate, with mortality rates exceeding expectations. This study aims to outline the status of COVID-19 in Sri Lanka and describe the trends in the progression of the disease from 27th January 2020 to 11th August 2021. The required data from 27th January 2020 to 11th August 2021 was collected from the COVID-19 situation reports published by the Epidemiology Unit, Ministry of Health, and Sri Lanka. The data was analyzed descriptively for three distinct outbreak periods using Microsoft Excel to assess the trends in daily new confirmed cases, the total number of confirmed cases, the number of hospitalized COVID-19 patients, the daily reported deaths, and the total number of reported deaths due to COVID-19 in Sri Lanka. From the identification of the first case in Sri Lanka on 27th January 2020 to 3rd October 2020 (First wave), the total number of confirmed cases was 3,396, and the number of confirmed deaths was 13, with a case-fatality ratio of 0.38. During the period from 4th October 2020 to 14th April 2021 (Second wave), the total number of confirmed cases increased to 92,341, with 591 confirmed deaths and a case-fatality ratio of 0.64. However, there was a significant rise in both the total number of confirmed cases and deaths during the next period. From 15th April 2021 to 11th August 2021 (Third wave), the total number of confirmed cases surged to 243,355, and the number of confirmed deaths to 4,736, resulting in a higher case-fatality ratio of 1.94. The transmission of COVID-19 in Sri Lanka was very high, as evidenced by the increase in daily new cases, hospitalizations, and deaths. This underscores the need for increased public awareness and the implementation of more stringent control measures to combat the spread of COVID-19.

Keywords: *COVID-19, Sri Lanka, Situational assessment*

Analysis of Peak Flood Levels and Rainfall Patterns: A Case Study of the Nilwala River Basin

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Abstract

The importance of analysing peak water levels and rainfall patterns lies in its ability to enhance flood risk management and preparedness. Understanding the relationship between rainfall and flooding trends helps identify high-risk areas, guide infrastructure planning, and inform early warning systems, ultimately mitigating the impact of future flood events and protecting communities and resources. The objective of the present study was to investigate a recent anomaly in flood patterns observed in areas located within the Nilwala River Basin (NRB), southern province, Sri Lanka. Although the area typically experiences monsoon-related flooding, an unusual persistent flooding condition was reported recently. The NRB consists of main four gaging stations (GS) named, Thalgahagoda, Panadugama, Pitabeddara, and Urawa. Water levels (WL, m) and rainfall (RF, mm) data were collected from each GS of September, October, November, and December in three consecutive years (2021, 2022, and 2023). Data were analyzed using one-way ANOVA and DMRT to investigate the differences of WL and RF among stations and correlation analysis was conducted to investigate the relationship between RF and flooding patterns. In 2023, all stations recorded their highest peak WLs, with Thalgahagoda (1.69 ± 0.47), Panadugama (5.35 ± 0.99), Pitabeddara (1.84 ± 0.68), and Urawa (1.17 ± 0.51) showing significant increases from previous years ($P=0$ at all GSs), indicating a potential rise in flood intensity. Results showed no statistically significant differences in RF amounts across years at Thalgahagoda, Panadugama, Pitabeddara, and Urawa stations ($P=0.14$, $P=0.32$, $P=0.76$, and $P=0.62$ respectively), with mean rainfall values varying slightly. This suggests that although rainfall did not vary significantly year-on-year, increased rainfall in certain areas may contribute to the elevated flood levels observed. Overall, the results highlight a weaker correlation between rising water levels during flood events and consistent rainfall patterns, emphasizing the need for enhanced flood management strategies and investigation of potential contributing factors, particularly in high-risk areas like Thalgahagoda and Panadugama.

Keywords: Water Level, Rainfall, Flood Patterns, Nilwala River Basin, Flood Risk

Design Consideration for Upgrading Raw Biogas into Biomethane

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Abstract

Biogas is a renewable energy source produced from organic matter and contains impurities such as carbon dioxide (CO₂), Hydrogen sulfide (H₂S), Nitrogen (N₂), and some water vapors. The initiative will involve the development and implementation of an advanced biogas purification system to upgrade raw biogas by removing impurities such as carbon dioxide (CO₂), hydrogen sulfide (H₂S), and moisture, thus enhancing its suitability as a fuel. This study aims to develop a multi-step purification system for enhancing the methane (CH₄) content of raw biogas to over 95% purity for use in vehicle engines. The project will also incorporate a compression and storage system to facilitate the use of purified biogas as fuel. The purification process includes a water scrubber for CO₂ removal, activated carbon absorption for impurity filtration, sodium hydroxide adsorption for Carbon dioxide elimination, iron wool for H₂S removal, and silica gel adsorption for moisture reduction. The prototype was constructed using PVC pipes and a 200L tank ensuring proper material placement and flow control with a pressure gauge set at 2.5 bars. Purified biogas samples were analyzed by GC meter with capillary columns and advanced flow controller technology. These analyses of raw gas samples and purified gas samples demonstrated a significant improvement in methane (CH₄) concentration from 52.24% to 80.49%, with Carbon dioxide (CO₂) levels reduced from 39.27% to 10.46% and Nitrogen (N₂) from 1.11% to negligible levels under 2:2:1 ratio of Sodium hydroxide, Iron Wool and Activated Carbon respectively. This study highlights the effectiveness of the proposed filtration approach in the purification of biogas and the prototype has the potential for further enhancements to achieve a higher purity level of biogas.

Keywords: *Filter, Methane, Sodium hydroxide, PVC pipe, purification.*

Safety Assessment and Health Risk Associated with the Use of Hair Dyes: Chemical Compositions, Toxicities, and Safer Alternatives

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Abstract

Since ancient Egypt, hair coloring has been a common technique. At first, people's usage of hair color was limited to covering up their white and gray hair. The most often used type of dyes is permanent ones, which include ingredients such as hydrogen peroxide, p-phenylenediamine (PPD), and ammonia. Although these chemicals have been connected to several unfavorable health effects, they can penetrate the hair shaft to produce a color that lasts longer. Hair dye allergies, especially those involving PPD, have a well-established history and can manifest as anything from minor skin irritation to life-threatening. The objective of this study is to assess the safety concerns associated with hair dyes and their potential health risks. The review specifically aims to identify the chemical composition of commonly used hair dyes, evaluate their toxicological effects, and suggest safer alternatives. A systematic search of databases including PubMed, Scopus, and Google Scholar was conducted, focusing on peer-reviewed articles. Studies were selected based on their relevance to hair dye safety, toxicology, and regulatory issues. Data on adverse effects, toxicity levels, and safety profiles were extracted and compared. The results indicate significant health risks associated with certain heavy metals in hair dyes, particularly in darker shades, with some products exceeding safe limits. The findings highlight the need for safer formulations and best practices for hair dye application. Limitations include a lack of comprehensive geographical coverage and a need for long-term studies to fully understand chronic exposure risks.

Keywords: *Adverse reactions, Contact dermatitis, Hair colourants, Hair dye, Para-phenylenediamine, Patch test*

Optimization of CTAB DNA Extraction Protocols for Downstream Applications of *Salacia Sp.*

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Abstract

Salacia spp. belong to the family Celastraceae, with some species native to Sri Lanka and listed as endangered or near threatened on the National Red List 2012 of Sri Lanka. The higher content of secondary metabolites in this plant hindered the extraction of sufficient quantities of good-quality DNA for downstream processes like PCR and DNA sequencing. Therefore, this research aimed to optimize the DNA extraction protocol to obtain a high amount of high-quality DNA from *Salacia sp.* in the absence of liquid Nitrogen. DNA was extracted using sixteen different methods fewer than two main protocols based on the CTAB miniprep procedure. Three replicates were maintained for each method. The quality and quantity of extracted DNA were measured using a nano spectrophotometer and verified by electrophoresis. The best protocol for obtaining high-quality DNA from *Salacia sp.* involves the following steps: Immature, healthy leaf samples were collected and stored at -80°C. The frozen samples were ground using a pre-cooled mortar and pestle. The ground material was then mixed with a preheated (60°C) CTAB buffer containing PVP and incubated for 30 minutes. After incubation, the mixture was centrifuged at 13,000 rpm for 10 minutes, and the supernatant was treated with 500 µL of chloroform, followed by another centrifugation at 13,000 rpm for 10 minutes. This extraction step was repeated. The resulting supernatant was mixed with absolute ethanol and ammonium acetate and stored at -20°C overnight. The next day, the mixture was centrifuged at 13,000 rpm for 15 minutes. The pellet was washed with 70% ethanol, dried, and dissolved in ultra-pure water. This protocol effectively yielded the highest DNA concentration ($0.636 \pm 0.339 \mu\text{g}/\mu\text{L}$), with an A260/A280 ratio of 2.008 ± 0.041 , indicating minimal contamination among the sixteen different samples. A distinct DNA band was observed on a 0.8% agarose gel using that method, confirming the quality of DNA. Therefore, this modified method successfully enabled the isolation of good-quality DNA from *Salacia sp.* with a considerable yield.

Keywords: CTAB, DNA extraction, downstream applications, *Salacia sp.*, secondary metabolites

Polyphenol and Phytochemical Analysis of *Azadirachta indica*, *Lantana camara*, and *Croton laccifercus*: Screening of Potential Plant Candidates for Green Synthesis of CU Nanoparticles

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Abstract

The green synthesis of metallic nanoparticles is more popular due to its eco-friendly and sustainable approach. Plant extracts with bioactive components, such as flavonoids and polyphenols can reduce metal ions to nanoparticles while other secondary metabolites including alkaloids, phenylpropanoids, and saponins act as a capping agent to minimize the agglomeration. This study aims to assess the phytochemical composition of *Lantana camara*, *Azadirachta indica*, and *Croton laccifercus*, to determine their potential for green synthesis of nanoparticles. Water extracts of these plants were subjected to qualitative analysis of flavonoids, alkaloids, tannins, phytosterols, saponins, proteins, and glycosides using qualitative tests: Wagner's Test, Ferric Chloride test, Salkowski's test, Frothing test, Biuret test, and Keller-Kiliani test respectively. The total polyphenol content was determined using the Folin-Ciocalteu test. The results showed that *Lantana camara* and *Azadirachta indica* had the highest flavonoid content, with *Azadirachta indica* having the highest phytosterols level and reducing sugars content. *Croton laccifercus* and *Azadirachta indica* exhibited the highest alkaloid concentration. In terms of total polyphenol content, *Azadirachta indica* had the highest concentration (3.99 mg GAE/g), followed by *Lantana camara* (3.96 mg GAE/g), *Croton laccifercus* (3.09 mg GAE/g). All three plants extracts showed promising potential as bio-reductants for the green synthesis of nanoparticles, with *Azadirachta indica* standing out due to its strong phytochemical profile, making it the most suitable candidate for efficient nanoparticle synthesis.

Keywords: *Capping agents, Phytochemical composition, Bio-reductants, Green synthesis, Nano particles*

Developing Surface Sterilisation Protocol and Multiplication Media for *Sansevieria trifasciata*

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Abstract

Sansevieria trifasciata is a common perennial plant native to West Africa and specifically found in Nigeria and Congo. It is commonly known as “Snake plant” and “Mother-in-law’s tongue”. *S. trifasciata* is a versatile and valuable plant with a wide distribution, distinctive morphology, and several practical benefits, including air purification and less maintenance, contributing to its popularity as an indoor and outdoor ornamental plant. It is a great challenge to produce planting materials through traditional propagation techniques due to the increased demand. Therefore, it will be vital to develop a cost-efficient protocol for *in vitro* propagation of *S. trifasciata*. At the first phase of surface sterilisation, the explants from fully expanded young leaves were treated with 70% (v/v) ethanol for 5 min following five different Clorox™ concentrations (10%, 15%, 20%, 25%, and 30%) separately, each for 20 minutes. Surface sterilisation of leaf explants could not be optimized in Phase I due to severe microbial contamination. Therefore, in Phase II surface sterilisation, leaf explants were treated with three different exposure times of 70% (v/v) ethanol and 30% Clorox™ for 30 minutes. Explants treated with 70% (v/v) ethanol for 20 min followed by 30% Clorox™ for 30 min showed optimised surface sterilisation, resulting in 100% explants survival, 2 weeks following incubation. Cultures were maintained in hormone-free media for two weeks at standard conditions to allow root and shoot elongation. Later, those were transferred to a media supplemented with different concentrations of BAP (1 mg/l, 2 mg/l, 3 mg/l) while maintaining the hormone-free media as the standard. After 10 weeks of incubation, media supplemented with 3 mg/l BAP showed a significantly higher mean number of shoots (4.35 ± 0.67) and mean length of shoots (1.38 ± 0.25 cm) compared to all other treatments. The study demonstrated that the treatment with 70% ethanol (20 min) and 30% Clorox™ (30 min) successfully sterilised the leaf explants of *S. trifasciata* and 3 mg/l of BAP markedly improved the multiplication and growth of shoots, highlighting the significance of developing an optimized surface sterilization and appropriate growth regulation for a successful *in vitro* propagation.

Keywords: Benzyl aminopurine, *In vitro* propagation, Multiplication, *Sansevieria trifasciata*, Surface sterilisation

Phytochemical Profile of Pineapple Peel (*Ananas comosus*) Extract: A Comprehensive Qualitative Analysis

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Abstract

Pineapple (*Ananas comosus*) peel, a by-product of Sri Lanka's fruit processing industry, generates significant waste, with around 50% of the fruit mass discarded during industrial processing. This study aimed to conduct a comprehensive qualitative analysis of phytochemical constituents in the peel extract of the local pineapple variety (Mauritius), commonly discarded as waste. Pineapple peels were obtained from a fruit processing company, sun-dried for two weeks, and extracted using 95% ethanol at a 1:10 peel-to-solvent ratio via maceration over 72 hours. The final extract was obtained using a rotary evaporator at 40°C, yielding 27.48%, 39.35%, and 46.36% for 25 g, 40 g, and 60 g of dried peel powder, respectively. The qualitative phytochemical screening was conducted at intervals of 1, 7, 14, and 21 days using several tests, including ferric chloride for phenols, alkaline reagent for flavonoids, Mayer's and Wagner's for alkaloids, acetic anhydride for steroids, xanthoproteic and biuret for proteins and amino acids, and tests for saponins. This comprehensive screening allowed for a detailed observation of the stability and presence of these bioactive groups across different time intervals. Results indicated a consistent presence (+) of phenols, tannins, alkaloids, saponins, proteins, and amino acids throughout the analysis period, confirming their stability in the extract. However, on day 14, the flavonoids had degraded, and the test came out negative (-), indicating that flavonoids may not be stable when stored for an extended period. Steroids were absent in all tests, confirming this compound group was not present. These findings highlight the stable profile of most bioactive compounds in pineapple peel extract while indicating specific limitations with flavonoid stability. In conclusion, this research provides foundational insights into the bioactive profile of Mauritius pineapple peel extract, supporting the valorization of food waste and the development of value-added products from this discarded resource in Sri Lanka.

Keywords: *pineapple peel, phytochemicals, waste, extraction*

RICIT – 2024

Product Showcase List

Product ID	Product Name	Participant Names
1	Multipurpose Kitchen Equipment	H.N.Madumali M.M.S.Perera
2	Cinnamon Bark Peeling Machine	W.M.K. Chamlika V.O. Mahendra V.A. Malan. T.A.D.I.K De Alwis
3	Enhancing Colorfastness Of Natural Dyes Through Adaptive Dye Solution Preparation System	D.T.D.Jasinghe E.M.T.N.B.Ekanayaka J. C. Panditharathne M. S. A. Marasinghe
4	Integrated soap cutting machine	P.G.S.A.S.Indrapala K. D. Vithanachchi R.M.L Dilshan A.C. Prasad
5	Real-time Air Filter Performance Monitoring System For Large Scale Diesel Generators with Emission Control	W. A. R. A. S. Weerasingha D. A. P. C. Sankalpa K. C. M. Kiriporuge Y. P. K. S. Thilakarathna
7	Semi-automated brake shoe lining Replacing machine	D.L. Ruberu R.P.C.P Rathnasekara E.M.N.N.B. Ekanayaka K.K.Yehen Sandiw
8	Fully Automated Pebbles Filling Machine	W. K. D. K. Lakmali U. G. H. Indeewari S. A. Wickramanayake H. M. I. T. Abesinghe

9	Printed circuit boards faults analyzer	J.Tharmaseelan T.Karishan N. M. Nisath M.F.M.S.Nusaf
12	Exterior Wall Painting Robot	T.D.C. Silva K. B. K. M. Sampath T.D. Mahaarachchi G.K.P.Nimodha
14	Development of Bioplastics clothing material from Orange Peel and cassava.	K.Dinithi Madhushika J.P.T Sathya Kumari I.D. Thathsara B.M.Bingumi Reshana Balasooriya M.D.S.Madushani
15	Semi-Automated Pipe Groove Welding Robot Arm	L V W Muniweera K.M.S.T.Bandara R L Daluwatta K D Dikam
16	Power & Control Panel Monitoring System	W.D.R.S. Chandrajeewa V.A.N.L Amarasiri T. Jayasekara D.D Yasiru Bhashana
17	Cocopeat drying machine	U.R.D.Lakpriya M.M.I.S. kumara H.M. Dilshan Madhushanka A.K.S.S.Nipunsara
18	Automated Elastic Rope Cutter With Defect Detection System	K. L. R. Chamara M. A. T. Dilshan S. G. A. Kushantha V. G. H. N. U. Kumara

19	Automated Bearing Grease Filling Machine	B.K.S.Dareeju H.R.Sachinthana A.K.T. Athauda
20	Pinepassion Bliss(Passion fruit &Pineapple jam development)	P.A.Himasha Tharushi Vimangee B.G Tharushi Dhananjana W.A Shaleeda Nishanthi Jayathilaka
21	Automated Poultry Quality Assurance System For Precise Inspection And Sorting	M.N.N Ahamed M.N.M.Ajimal Husain M.N.M Faslan Thangathurai Miruthuvasan
22	Characterization of Biodegradable Films and food material items Made from Taro Peel (Colocasia esculenta) Starch	M.S.L. Manorathne M.P.G. Menuka Niroshani Herath M.Reshika Janani Perera M.A Nipuni Malsha P.L.Shalani Amanda
23	Parallel Micro-Hybrid Scooter Bike Controller System and Coupling Mechanism	S.A.C.H.Subasingha R.D.K.Gayathra B.L.D.Harsha N.V.P.M.Eranadaka
25	Formulation and evaluation of herbal anti-acne face cream: A systematic approach combining modern technology with traditional ayurvedic practices.	D.G.Dulanjalee Malshani Senevirathne

26	Silver Nanoparticles coated Non-Alcoholic hand sanitizer using Green Tea	D.S.A.R.Kithsiri P.Romini Sadeera M.K. Lochana Lakshani U.P.M.B.S.Kularathna S.H.S.A Premarathna S.M.Nuwanthi Nisansala R.S.Madushani
29	Natural Fat-Burning Toffee	S.J.J.Y.Y.Dilrukshi D.R.Kathriachchi A.S.M.Silva W.D.K.S.Kumara R.A.T.S.Dayananda
32	Eco Potash Liquid Fertilizer	D.M.H.V.S Bandara K.C.L Perera P.M Parindya
33	Made Mosquito Repellent coil using cashew nut shells	D.A.M.M.B Dissanayake Y. M. Kolonne
34	Manufacturing Value Added Ginger Incorporated Toddy Cube	K.A.N.Sandatharaka W.V.W.Sewwandi Aberathna D.M.Jimodi Sanjula J.A.Y.Madhubhashini
35	Natural Lip balm	M.S.D.Weerasinghe E.H.D.C.Sandaruwan
36	Vomit prevention toffee	M.S.D.Weerasinghe E.H.D.C.Sandaruwan P.V.R.L.Siriwardhana
37	Smart Hydroponic tower	M.S.D.Weerasinghe E.H.D.C.Sandaruwan P.K.P.Y.Gamage
38	Production of Jujubes using by aloe vera	W.I.M.D.Udari N.Dhanushika R.A.A.N.Rajapaksha A.A.A.Gunasekara

41	Blue Citrus Cold Cream	B.M.M.H.Bandaranayaka W.I.J.M.Sasanka Sandapium S.N.Nawanjana S.S.Keshiya
42	Ceylon Olives Soap	S.A.S.S.S.Arachchi G.S.S.Gamage D.K.W. Pathinayaka
44	Eco friendly ceiling board using coconut shell powder, banana fiber and corn cob	T.M.M.U.I.Thilakarathna D.S.T.Parindya T.P.G.Naduni Thakshila Alwis
45	Pumpkin Nutrition Bar	H.L.U.A.Kithmini L.P.P Sathsarani A.R.Linara D.R Kathriachchi S.J.J.Y.Y.Dilrukshi
46	Value added foods making by kohila tubers	H.N Madumali E.A.S.H Edirisinghe M.M.S Perera
47	Nutrient infused sweet by Aegle marmelos(මෙලි)	J.G.D.A.Jayawardhana M.P.G.S.Saumyakanthi K.K.H.Gunawardhana R.M.W.S.Kumari M.S.M.Dilshani
48	Novel Food and Beverage Production using Cassava (Beer and Instant Noodles)	H.L.U.A.Kithmini A.R.Linara M.D.I Navod M.G.A.M Mahagama R.M.H.S Rajapaksha
49	Velvet apple cheese	K.C.Jayamini H.D.Madushani

50	Innovative production of Arrowroot Noodles	G.P.K.Buddhika A.B.Mahaarachchi A.G.D.V.N.Aththanayake K.K.T.D.Priyanka
51	Automated pH stabilizer	W.H.S.Sanjaya A.Sobanakanthan M. T. M INZAMAM H.R.C. V. A. Sathsara R.P.S.S.G.Rajapaksha
52	A low-sugar jam with natural preservatives	K.H.M.C Thilakarathna N.W.S.N.Rasanduni
54	Healthy pasta in unripe banana powder	M.K.N.Dulanga L.D.L.I.Sewwandi
60	Exploring The Potential of Pumpkin Based Passion flavored Ready to Serve drink: Mitigating the Postharvest Loss in Related to Pumpkin and Promote Sustainable Consumption.	R.M.H.L.Rathnayaka K.A. Maleesha charuni Kannangara A.M.D.D.Athapaththu R.M.T Sewwandi L.G.P.S.Lakruwani
62	Pumpkin and breadfruit incorporated papadam: A path to sustainable food production systems to reduce post-harvest losses	R.M.H.L.Rathnayaka A.M.D.D.Athapaththu K.A.maleesha Charuni Kannangara R.G.S. Indrananda R.M.T Sewwandi

65	Formulation of herbal sunscreen cream	K.G.A.A.T.S.Gunarathna M.R.Teleesha Samarakoon P.N.D.Senadheera L.G.P.S.Lakruwani M.P.Malisha
66	Scot bonnet incorporate Wood apple sauce	H.M.Sudusinghe N.M.U.W.Nawarathna L.M.S.M Bandara M.M.D.P. Maheepala S.M.M. Wijesinghe M.V. Rukshan
67	Formulation and Evaluation of an Antibacterial Polyherbal Gel for Skin Abscess Treatment: Integrating traditional Ayurvedic Principles with Modern Technology."	M.F.F Hikma
68	Avocado Seed extract incorporated antimicrobial cream	R.P.S.S.G.Rajapaksha
71	Nutri-glow pasta	E.D.N.D.Sandaruwan P.A.Pubuduni Sandamali L. M. S. M. Bandara N. M.U. W. Nawarathna
72	Rippen Banana-Infused Baby Food Instant Mixture	K.S.Kavindya M.D.H.Lakmali W.S.W.Sewwandi D.M.Thilanka Rajitha Kumara R. Dhanusha

74	Development of a value-added product (Tutti frutti) to Prevent Postharvest Losses in Pipinna	H.D.T.L. Rupasinghe N. Nimesha Tharushini Y.P.Nethmi Jayamali Yapa W.B.N.Prasanthima N. M.U. W. Nawarathna
87	Perfume	H.M.A.S.N. Jayathilake N. A. U. K. Gunasekara D. G. D. M. Senevirathne S. H. Thewarapperuma
89	Fiber incorporated muffin	M.D.H.Lakmali D.J. C. Keerthirathne W.S.W.Sewwandi S.A.I. Sampath R.A.D. Dewin Chandula
90	Mango Kochchi Ketchup	D.J. C. Keerthirathne R.A.D. Dewin Chandula G.H.P. Ganegoda W.D.K. S wadduwage W.A.B.Akalanka
91	AI-Driven autonomous Greenhouse robot for precision plant care and monitoring	I A D L L Perera W D kasun P. K. P. Y. Gamage
92	Value added sweet potato Doughnuts	R.G.G.S.M.B. Jothirathna H. S. N. Premasiri R. M. K. P. Bandara



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01st November 2024

