

Academic Sessions 2026

*Knowledge, Innovation, and Resilience:
Towards Sustainable Futures through Technology*



Abstracts

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*Knowledge, Innovation, and Resilience: Towards Sustainable Futures
through Technology*

PROCEEDINGS

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Sri Lanka

**Proceedings of the Vice Chancellor's Awards
and Academic Sessions 2026**

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Message from Chairman



It is a great honour and pleasure to welcome you to the Vice Chancellor's Awards and Academic Sessions 2026, hosted here at the Faculty of Engineering, University of Ruhuna. I extend my warm greetings to all participants. This occasion reflects our University's enduring commitment to academic excellence, scholarly integrity, and innovation. It brings together our entire community to celebrate achievements, recognise outstanding contributions, and foster meaningful interdisciplinary collaboration.

It is especially gratifying for the Faculty of Engineering to host this distinguished event once again, nearly a decade after we last did so in 2017. As the annual gathering rotates among the ten faculties—including the Faculty of Postgraduate Studies—we consider it a privilege and a profound honour to welcome you as your hosts for 2026.

This year's theme—**Knowledge, Innovation, and Resilience: Towards Sustainable Futures through Technology**—is both timely and forward-looking. It speaks to our shared responsibility as academics and professionals to apply knowledge and technological progress in building resilient systems and sustainable societies. In confronting today's global and local challenges, research-driven innovation will be essential in shaping a better future.

I am delighted by the enthusiastic response to this year's Academic Sessions, with more than 120 abstracts submitted from across all ten faculties—a clear reflection of the breadth and vitality of research at this University. These Sessions offer a vital platform for sharing findings, exchanging ideas, and advancing scholarly dialogue. The Vice Chancellor's Awards recognise exceptional dedication, academic excellence, and service to our community. On behalf of the Organising Committee, I extend warm congratulations to all awardees and presenters. Your achievements bring distinction to yourselves and enhance the University's reputation nationally and internationally.

I thank the Vice Chancellor for his leadership and steadfast commitment to excellence, and the Deans, academic staff, evaluation panels, session chairs, reviewers, administrative staff, and students whose efforts made this event possible. Wishing you all a productive and memorable Vice Chancellor's Awards and Academic Sessions 2026.

Prof. Sudhira De Silva
Chairman/ Vice Chancellor's Awards and Academic Sessions 2026
University of Ruhuna



Message from Vice Chancellor



It is an immense pleasure for me to extend my warmest greetings to all participants of the Academic Sessions and Vice Chancellor's Awards 2026 at the University of Ruhuna. This esteemed annual event highlights our strong dedication to excellence, innovation, and societal improvement by showcasing the research accomplishments of our students and academic staff.

The theme for this year, "Knowledge, Innovation, and Resilience: Towards Sustainable Futures through Technology," is both timely and visionary. In an era defined by rapid technological advancement, the role of universities extends far beyond the traditional boundaries of teaching and learning. Universities are now called upon to serve as engines of innovation, carrying a collective responsibility to generate knowledge that addresses real-world challenges and to drive innovation with clear purpose and responsibility.

The University of Ruhuna is deeply devoted to developing a dynamic and inclusive research culture that enables all members of its academic community to contribute meaningfully to knowledge dissemination and innovation. By actively encouraging interdisciplinary collaborations, we seek to address complex societal and global concerns, while strategic partnerships with local and international universities further broaden our research's reach, relevance, and impact.

I commend the organizing committee of the Vice Chancellor's Awards and Academic Sessions 2026 led by the Faculty of Engineering for undertaking this responsibility and creating a successful forum that encourages cross-disciplinary and forward-looking research, in line with national and global concerns. Furthermore, I extend my sincere appreciation to reviewers, contributors, and all participants for their tireless commitment to making this event a meaningful and impactful academic endeavor.

Senior Prof. P. A. Jayantha
Vice Chancellor
University of Ruhuna



Recipients of the Vice Chancellor's Awards – 2025

Award of Emeritus Professorship
Senior Professor K.A.P.W. Jayatilaka
Department of Biochemistry
Faculty of Medicine

Oration-2026
Prof. G.G. Tushara Chaminda
Faculty of Engineering

Most Outstanding Scholar
Dr. K.G. Priyashantha
Faculty of Management and Finance

Most Outstanding Young Researcher
Dr. K.L. Kushan Sudheera
Faculty of Engineering

Most Outstanding Staff Innovator / Inventor
Prof. A.P. Attanayake
Faculty of Medicine

UOR Tier 4 Star Award
Senior Prof. Ajith Nagahawatta
Faculty of Medicine

UOR Tier 4 Star Award
Senior Prof. D.A.L. Leelamanie
Faculty of Agriculture





**Recipients of the Best Presenter Awards
Academic Sessions 2025
Technical Sessions (Oral)**

Agriculture, Environment, and Biological Sciences

Mr. H. K. M. S. Kumarasinghe

Department of Crop Science

Faculty of Agriculture

Engineering, Technology and Applied Sciences

Mr. R. Saahith Ahamad

Department of Electrical and Information Engineering

Faculty of Engineering

Education, Humanities and Social Sciences

Dr. Wijerathna Bohingamuwa

Department of History and Archaeology

Faculty of Humanities and Social Sciences

Human Health, Pharmaceuticals, and Medicine

Dr. H.W.A.S. Subasinghe

Department of Pharmacy

Faculty of Allied Health Sciences

Economics, Finance, and Management

Mrs. D.M.R. Deepika

Department of Management and Entrepreneurship

Faculty of Management and Finance





**Recipients of the Best Presenter Awards
Academic Sessions 2025
Technical Sessions (Poster)**

Agriculture, Environment, and Biological Sciences (Session 1)

Ms. M.D.H. Lakmali

*Department of Bio Systems Technology
Faculty of Technology*

Agriculture, Environment, and Biological Sciences (Session 2)

Mr. A.M.K.C.J. Costa

*Department of Limnology and Water Technology
Faculty of Fisheries and Marine Sciences & Technology*

Engineering, Technology, and Applied Sciences (Session 3)

Dr. H.G.S. Mayuranga

*Department of Civil and Environmental Engineering
Faculty of Engineering*

Education, Humanities and Social Sciences

Mr. S.M.A.P. Rathnasiri

*Department of History and Archeology
Faculty of Humanities and Social Sciences*

Human Health, Pharmaceuticals, and Medicine

1. Mr. M.A.T. Hasanka

*Department of Pharmacy
Faculty of Allied Health Sciences*

2. Ms. T.P.G.A. Uthdesha

*Department of Pharmacy
Faculty of Allied Health Sciences*





Keynote Speech

Research in the Era of AI and Advanced Technologies: Bridging Disciplines and Putting Human at the Centre



The rapid advancement of Artificial Intelligence (AI) and other Advanced Technologies (AT) has significantly transformed the way research is conceived, conducted, and translated into impacts in the real world. However, this transformation is not only technological but also it is structural. Research today is increasingly considered by the convergence of disciplines, the integration of knowledge systems, and a growing emphasis on societal relevance. Across disciplines, emerging AI-driven tools have enhanced data analysis and enabled solutions to complex problems that were previously unattainable. However, this technological change has also redefined the nature of research collaboration, increasingly moving it beyond traditional disciplinary boundaries towards multidisciplinary, interdisciplinary and transdisciplinary research. Furthermore, it calls for partnerships that extend beyond academia, involving users, communities, and stakeholders as active contributors to knowledge creation.

This keynote presents how research in the era of AI and AT evolved, with particular emphasis on the growing importance of interdisciplinary and transdisciplinary research. The challenges associated with bridging disciplinary gaps, including differences in methodologies, terminologies, and research cultures, will be highlighted. Central to this discussion is the argument that, despite rapid technological progress, humans must remain at the centre of the research process. Advanced technologies should support the research but not replace human thinking, decision-making, and ethical judgment.

Through the experiences of research in bionics and assistive robotic technology, how AI and AT can be used to carry out research by empowering and keeping humans in the loop will be explained. These bionic-related research brings together expertise from engineering, biomedical sciences, rehabilitation, and computing, including AI, demonstrating how collaborative research can restore mobility, independence, and dignity to individuals. Furthermore, the keynote will present selected examples from research in bionics and assistive robotic technologies, to show that humans must remain at the centre of the research process. In these projects, AI are employed while following interdisciplinary approaches. These examples show how advanced technologies can augment human capability while preserving autonomy and dignity.



At the last phase, this keynote encourages a research culture that balances technological intelligence with human values. Such an approach is essential for ensuring that modern research not only advances scientific knowledge but also contributes meaningfully to human well-being and societal progress.

Senior Professor. R. A. R. C. GOPURA
Department of Mechanical Engineering
Faculty of Engineering
University of Moratuwa



About the Keynote Speaker

Ruwan Gopura earned his B.Sc. Eng. degree with honors in Mechanical Engineering in 2004, followed by an M.Eng. degree in Manufacturing Systems Engineering, both from the University of Moratuwa, Sri Lanka. He later pursued a Ph.D. in Robotics and Intelligent Systems at Saga University, Japan, in 2009. Subsequently, he engaged in postdoctoral research in bio-robotics at the same institution. Currently, he is a Senior Professor in the Department of Mechanical Engineering at the University of Moratuwa and serves as the Dean of the Faculty of Graduate Studies in the same University.

Prof. Gopura played a pivotal role as the founding Head of the Department of Medical Technology in the Faculty of Medicine at the University of Moratuwa. He also held the position of Director/Research at the university from February 2021 to January 2024. His past leadership roles include serving as the Head of the Department of Mechanical Engineering. Prof. Gopura is recognised for his expertise in developing bionic devices, such as robotic prostheses, orthoses, and exoskeletons. He has authored over 180 research articles, including publications in peer-reviewed journals and conferences, and holds multiple patents.

In addition to his academic contributions, Prof. Gopura serves as an academic editor for several journals. He was the chairperson of the IEEE Sri Lanka Section in 2020 and the IEEE Robotics and Automation Society Sri Lanka Section from 2017 to 2020. He was also the secretary of the IEEE Sri Lanka Section in 2015 and the IEEE Robotics and Automation Society Sri Lanka Section from 2012 to 2017. He is one of the distinguished lecturers in IEEE EMBS for 2025–2026. His work has been acknowledged with numerous research awards and grants.



Oration-2026

The Contribution of Pharmaceutical Pollutants in Sri Lankan Waters to Antibiotic Resistance

Prof. G.G. Tushara Chaminda
Department of Civil and Environmental Engineering
Faculty of Engineering
University of Ruhuna

Introduction and Background

Assessing urban water vulnerability is vital but complex for ensuring water resilience. Integrated water management helps reduce negative social, economic, and environmental impacts while addressing the growing need for safe water (Honda et al. 2016; Kumar et al. 2019b).

The emergence of new human-made compounds, known as “emerging contaminants” is raising concerns due to their harmful effects on ecosystems and human health (Gogoi et al. 2018). Those emerging contaminants in water are a global challenge, as they are unregulated and not fully understood. Conventional wastewater treatment plants do not completely remove these pollutants. Many of the United Nations’ Sustainable Development Goals (SDGs) include reducing emerging contaminants and their discharge into water resources. Some scientists argue that these emerging pollutants may harm the SDGs and even threaten their achievement (Domingo-Echaburu et al. 2021).

Those emerging contaminants such as multi-drug resistant microbes and Pharmaceuticals and Personal Care Products (PPCPs) in urban waters have become vital in urban sustainability issues. The vulnerability related to concurrence of emerging contaminants, source identification, and indicator selection requires further study. Pharmaceuticals are chemicals used in medicines to treat or prevent illnesses, including antibiotics, painkillers, beta-blockers, and lipid regulators (**Tushara Chaminda, G.G.** et al. 2013a). Once consumed, some pharmaceuticals are transformed during metabolism while others remain unchanged before all are excreted along with urine and faeces. Potential concerns from the environmental presence of these emerging contaminants, such as pharmaceutical contaminants, include abnormal physiological processes and reproductive impairment, increased incidences of cancer, the development of antibiotic-resistant bacteria, and the potential increased toxicity of chemical mixtures (Gogoi et al. 2018). Upon discharge of treated sewage into receiving water bodies, residual pharmaceutical contaminants may be diluted or blended with contaminants from other discharge points, runoff, and seepage (**Tushara Chaminda, G.G.** et al. 2013a).

Limited data on the effects, fate, and concentrations of emerging pollutants



like pharmaceutical contaminants make regulation and management challenging for governments. While research on pharmaceutical contamination in water sources is common in developed countries, such studies remain scarce in developing nations, including Sri Lanka (Honda et al. 2011; **Tushara Chaminda, G.G.** et al. 2013b; Kumar et al. 2019b; Do et al. 2021; Kumar et al. 2021). Urban waters are becoming significant pharmaceutical contaminants' sources, but is there enough capacity to address this issue? Since the quantity, type, and patterns of pharmaceutical contaminants usage are geographically varied, their occurrence in the urban water environment may differ in Sri Lanka compared to other countries. What is the vulnerability to such emerging pollutants in the urban waters of Sri Lanka? Therefore, we have undertaken several research studies over the past six years with the following objectives.

1. Evaluate the comparative prevalence of Pharmaceuticals Contaminants and Antibiotics in Urban waters in Sri Lanka.
2. Use Pharmaceuticals Contaminants as markers to detect faecal pollution in groundwater and surface water.
3. Assess the prevalence of antibiotic-resistant bacteria (ARB), antibiotic resistance genes (ARG).

Some of our research outputs from those studies can be considered the first-ever research publications in this field regarding the Sri Lankan context. We collected water samples at the influents and effluents from sewage treatment plants (STPs), hospital discharge, river waters (Kelani and Gin), and urban canals in Galle and Colombo. Samples were analysed for pharmaceutical parameters at the laboratories in Tokyo, Japan, using LC-MS/MS coupled to a triple quadrupole mass spectrometer. Water samples were pretreated at the University of Ruhuna and preserved and frozen before transportation to Tokyo, Japan. The method quantitation limit for all analytes ranged from 0.005 to 0.15 ng/L (Do et al. 2021). We also tested for antibiotic resistance of *E. coli* bacteria in Kelani and Gin rivers, urban canals, and STPs in Galle and Colombo. The isolated *E. coli* colonies were evaluated for resistance to six antibiotics such as levofloxacin (LVX), ciprofloxacin (CIP), norfloxacin (NFX), kanamycin monosulphate (KM), tetracycline (TC), and sulfamethoxazole (ST). The Kirby-Bauer (KB) disc diffusion method, as described by (Honda et al. 2016), was employed at the Environmental Engineering Laboratory of the University of Ruhuna in Galle. Real-time quantitative reverse transcription PCR (qRT-PCR) analysis of antibiotic resistance genes (ARGs) was subsequently performed in Japan. Principal component analysis was performed to characterize the resistance patterns of the samples.

Prevalence of Pharmaceuticals in Urban Waters in Sri Lanka

We screened for 82 Pharmaceuticals from sewerage treatment plants (STPs) and detected 20 pharmaceuticals. The concentrations of detected pharmaceutical compounds in raw wastewater from the Hikkaduwa STP and hospital effluent (Karapitiya) were comparable with those frequently detected in previous studies in developed countries (Quyen et al. 2021). Acetaminophen (antipyretic) and Caffeine (stimulant) accounted for the highest total concentrations in STP influent and hospital discharge. Carbamazepine (Neuroactive drugs), Cotinine (Tobacco metabolite), Sulfamethoxazole (Antibiotic), Sulfapyridine (Antibiotic), Atenolol (Beta-blocker), and Acesulfame (Artificial sweetener) were other detected pharmaceutical parameters in raw sewerage and treated effluents of municipal STP and hospital effluent as well. Acetaminophen is a widely used over-the-counter medicine and is often detected at high concentrations in domestic wastewater (Tushara Chaminda, G.G. et al. 2013a; Tushara Chaminda, G.G. et al. 2013b). The Acetaminophen concentration of raw sewage of Hikkaduwa STP was detected to be up to $43 \mu\text{g/L}$, while Caffeine was up to $69 \mu\text{g/L}$. Despite the high concentrations, we found that Acetaminophen and Caffeine were generally removed up to 99% in the Hikkaduwa STP. Carbamazepine, Atenolol, Sulfapyridine and Sulfamethoxazole were also detected up to 0.24, 0.48, 0.47, and $0.20 \mu\text{g/L}$ in municipal STP in Hikkaduwa. Unlike acetaminophen, it was observed that Carbamazepine and other detected pharmaceutical parameters were not adequately removed during the biological treatment process in Hikkaduwa STP.

Acetaminophen is the highest concentrated pharmaceutical compound found in hospital effluent and was detected up to $124 \mu\text{g/L}$ while two antibiotics (Sulfamethoxazole and Sulfapyridine) were detected up to $2.6 \mu\text{g/L}$ indicating the current treatment process used by the Karapitiya STP was not sufficient to remove pharmaceutical compounds. The complicated composition of hospital discharge suggests a longer-term monitoring study. We also collected surface water samples from Galle municipal canals consisting of the Moragoda, Moda, and Kepu Ela, which also receive wastewater from residential areas. Our household survey found that two-thirds of the urban greywater is often discharged above municipal canals in Galle. We detected Acetaminophen and Caffeine up to $4.7 \mu\text{g/L}$ and $21.7 \mu\text{g/L}$ in urban canals within Galle city. Carbamazepine was also detected at low concentrations in those urban canals.

We collected 32 water samples (31 private and one public well) during the 2019 monsoon season from groundwater wells in the Galle area. Four pharmaceuticals at trace levels (ng/L) were detected in groundwater, suggesting that wastewater impacts the septic tanks. Caffeine was detected in 89% of the sample at a maximum concentration of 7.9 ng/L , indicating fecal pollution. Carbamazepine was detected in 42% of wells with a concentration of up to 6.9 ng/L , located close to and downstream of the septic tanks. We detected an antibiotic (Sulfamethoxa-



zole) with concentrations as low as 1.1 ng/L in groundwaters in the Galle area. We also found that Acetaminophen in groundwater was less detectable, suggesting that physical and biological processes within the septic tanks and the saturated zone limit their transfer to the shallow groundwater (Do et al. 2021). Our studies emphasise the potential impact of poor sanitation on groundwater resources and the necessity of sanitation improvement in achieving Sustainable Development Goals in developing countries like Sri Lanka (Do et al. 2021). Therefore, we suggested that a setback distance $> 18 \text{ m}$ is unlikely to protect groundwater from septic tank contamination. Thus, we recommend a more significant vertical separation from septic tanks to groundwater or installing watertight septic tanks where possible.

Pharmaceutical parameters as markers to detect pollution sources in groundwater and surface water

Our studies suggest that Acetaminophen (antipyretic), Caffeine (stimulant), Carbamazepine (Neuroactive drugs) and Acesulfame (Artificial sweetener) can be used for identifying pollutant sources in Galle City. The stimulant, Caffeine, and the artificial sweetener, Acesulfame, are included in everyday beverages, such as tea, coffee, and soft drinks, so black and grey water may contain these compounds. However, the fact that Caffeine is readily degradable and entirely metabolised in the human body suggests that black water is not a significant source and is more likely to be a grey water indicator. However, due to the persistence of Acesulfame during wastewater treatment, it can be used to generalise the impacts of domestic wastewater on surface water. Acetaminophen (antipyretic) and Carbamazepine (Neuroactive drugs) are active pharmaceutical ingredients. As expected, the Carbamazepine level was significantly lower than Acetaminophen in urban wastewater owing to its limited use. Therefore, we suggested using Acetaminophen as an indicator for identifying the impact of untreated human excretion over short distances.

Further, Carbamazepine could be a good indicator for tracking hospital residues over long distances owing to its environmental persistence (Quyen et al. 2021). Our finding of the presence of pharmaceutical contaminants in well waters indicated the vulnerability of the drinking groundwater source to faecal contaminants from the outdated sanitation system. We observed that *E. coli* and total coliform had a significant positive correlation with Caffeine concentration in groundwater. Moreover, a significant correlation was also observed between nitrate and Carbamazepine in groundwater (Do et al. 2021). These results imply that hospital wastewater treatment was not working correctly, accounting for pharmaceutical residues reaching surface water via hidden discharges connected to the drainage system.

Development of Antibiotic Resistance in Urban Waters

Our studies between October 2017 (wet season) and March 2018 (dry season) evaluated the occurrence of antibiotic-resistant bacteria (ARB) and antibiotic-resistant gene (ARG) for six antibiotics: Norfloxacin (NFX), Ciprofloxacin (CIP), Levofloxacin (LVX), Kanamycin monosulfate (KM), Tetracycline (TC), and Sulfamethoxazole (ST) in influents and effluent of sewerage treatment plant (STP) and surface waters in Colombo and Galle using KB disk diffusion method. Samples were collected from two municipal STPs from Colombo and hospital effluent from Galle. On the other hand, we collected water samples at different locations of Kelani River, Gin River, and some urban canals (Wellawatta Canals in Colombo, Moda Ela, and Moragoda Ela in Galle). For all STP samples, at least 50% of colonies showed resistance to all six antibiotics. Our antibiotic-resistant gene (ARG) screening test results were in agreement with the antibiotic resistance bacteria (ARB) test (Sovannlaksmy et al. 2020). Compared to municipal STP, the hospital effluent had more multidrug resistance due to the higher concentration of pharmaceutical products in the wastewater (Kumar et al. 2020c). As previously reported, we also noticed no significant contribution of faecal contamination was found to increase the antibiotic resistance ratio (Honda et al. 2016). *E. coli* prevalence was reduced during treatment, but the remaining bacteria could adapt to antibiotics, leading to further antibiotic resistance. Concerning some countries (India, Thailand, Poland, Ireland, Portugal, Austria, etc.), the STPs in Sri Lanka showed more antibiotic resistance and a consistent increase in antibiotic resistance after the treatment (Kumar et al. 2020c). We further noticed that antibiotic resistance was strongly correlated with fluoroquinolones in every WWTP. Fluoroquinolone-resistant genes (*aac*- (6')-*Ib-cr*, *qnrB*, *qnrS*), β - *lactams* (*ampC*), and sulphonamides (*sulI*) were detected in municipal WWTPs with additional genes for *parC* in the hospital wastewater of Sri Lanka, implying much higher resistance to fluoroquinolones, especially ciprofloxacin (Kumar et al. 2019a). On the other hand, *E. coli* bacteria isolated from Jaela STP's effluent and Galle's hospital effluents (20 m and 50 m downstream) exhibited 100% antibiotic resistance.

We further observed that almost all sampling points in Kelani and Gin rivers and canals contained *E. coli* strains that showed resistance to more than four antibiotic multidrug resistance, alarming health concerns in the future. Our studies suggested high antibiotic resistance in the Kelani River (up to 90%) compared to the Gin River (up to 40%). Wellawatta Canals, Moda Ela, and Moragoda Ela showed more antibiotic-resistant *E. coli* than Gin and Kelani Rivers owing to more pollution and lower flow rates in canals (Kumar et al. 2020b). We found that the resistance percentage for older antibiotics like Sulfamethoxazole (ST) > Tetracycline (TC) was higher than the newer antibiotics in the Kelani River. Further, for non-fluoroquinolone (KM, ST, and TC), higher resistance was observed at down-



stream locations in Kelani River compared to upstream locations, which probably indicates the antibiotic use pattern affecting the resistance. On the other hand, the resistance percentage of fluoroquinolone (LVX, CIP, and NFX) decreased from upstream to downstream in the Kelani River (Kumar et al. 2020a).

The investigation into ARGs in Sri Lankan urban rivers in Southern Province, revealed two distinct distribution patterns, providing insights into their likely sources and dissemination. The *mphA* gene, which provides macrolide resistance, was found at higher concentrations in heavily polluted urban waters like Galle's Moragoda Canal. The *blaIMP* carbapenemase gene, a marker of hospital waste and clinical concern, was found in all three waters in Galle (Moragoda Ela, Gin River, and Kepu Ela) (Shayan 2025).

Conclusions and Recommendations

Our results imply that the urban drainage systems in Sri Lanka receive both domestic graywater and human excretion, likely due to insufficient on-site sanitation systems. Further, we noticed the potential impact of poor sanitation on groundwater resources and the necessity of sanitation improvement in achieving Sustainable Development Goals in developing countries like Sri Lanka. We detected around 20 pharmaceuticals in urban waters in Sri Lanka. Acetaminophen was dominant in hospital discharge (up to $124 \mu\text{g/L}$), while caffeine was the most significant contributor to STP influents (up to $69 \mu\text{g/L}$). These results imply that hospital wastewater treatment was not working correctly, accounting for pharmaceutical residues reaching surface water via hidden discharges connected to the drainage system. We suggest using caffeine and acetaminophen as indicators for identifying the impact of untreated human excretion over short distances. Further, Carbamazepine could be a good indicator for tracking hospital residues over long distances owing to its environmental persistence. The investigation into ARGs in Sri Lankan urban rivers in Southern Province, revealed two distinct distribution patterns, providing insights into their likely sources and dissemination. Further, we noticed that 50 to 100% of antibiotic resistance in urban waters of Sri Lanka was comparatively higher than that of other countries, alarming that multidrug-resistant had become a significant concern for community health. Our studies imply that urbanization, land use, and lifestyle are the three most critical factors governing multidrug resistance. We strongly recommend continuous monitoring of the urban water sources for pollution load, as ongoing assessments are required for sustainable water management.

References

- Do, Q.T.T., M. Otaki, Y. Otaki, **Chaminda, T.**, and I.W. Sanjeewa (2021). "Pharmaceutical Contaminants in Shallow Groundwater and Their Implica-



- tion for Poor Sanitation Facilities in Low-Income Countries.” In: *Environmental Toxicology and Chemistry* 00, pp. 1–9.
- Domingo-Echaburu, S., L.M. Dávalos, G. Orive, and U. Lertxundi (2021). “Drug pollution & sustainable development goals.” In: *Science of The Total Environment* 800, p. 149412.
- Gogoi, Anindita, Payal Mazumder, Vinay Kumar Tyagi, **Tushara Chaminda, G.G.**, Alicia Kyoungjin An, and Manish Kumar (2018). “Occurrence and Fate of Emerging Contaminants in Water Environment: A Review.” In: *Groundwater for Sustainable Development* 6, pp. 169–180.
- Honda, R., T. Watanabe, Y. Masago, R. Chulasak, K. Tanong, **Chaminda, G.G.T.**, V. Sawaittayotin, K. Wongsila, C. Sienglum, V. Sunthonwatthanaphong, A. Poonnotok, C. Chiemchaisri, and H. Furumai (2011). “Distribution of antibiotic-resistant *Escherichia coli* in Chao Phraya River and its tributaries in Thailand.” In: *Environmental Engineering Research* 48.III. in Japanese, pp. 173–178.
- Honda, R., T. Watanabe, V. Sawaittayotin, Y. Masago, R. Chulasak, K. Tanong, **Tushara Chaminda, G.**, K. Wongsila, C. Sienglum, V. Sunthonwatthanaphong, A. Poonnotok, W. Chiemchaisri, C. Chiemchaisri, H. Furumai, and K. Yamamoto (2016). “Impacts of urbanization on the prevalence of antibiotic-resistant *Escherichia coli* in the Chaophraya River and its tributaries.” In: *Water Science & Technology* 73.2, pp. 362–374.
- Kumar, M., **Chaminda, T.**, and R. Honda (2020a). “Seasonality impels the antibiotic resistance in Kelani River of the emerging economy of Sri Lanka.” In: *NPJ Clean Water* 3.1, pp. 1–8.
- Kumar, M., **Chaminda, T.**, R. Honda, and H. Furumai (2019a). “Vulnerability of urban waters to emerging contaminants in India and Sri Lanka: Resilience framework and strategy.” In: *APN Science Bulletin* 9.1.
- Kumar, M., **Chaminda, T.**, A.K. Patel, H. Sewwandi, P. Mazumder, M. Joshi, and R. Honda (2020b). “Prevalence of antibiotic resistance in the tropical rivers of Sri Lanka and India.” In: *Environmental Research* 188, p. 109765.
- Kumar, M., K. Dhangar, A.K. Thakur, B. Ram, **Chaminda, T.**, P. Sharma, A. Kumar, N. Raval, V. Srivastava, J. Rinklebe, and K. Kuroda (2021). “Antidrug Resistance in the Indian Ambient Waters of Ahmedabad during the COVID-19 Pandemic.” In: *Journal of Hazardous Materials* 416, p. 126125.
- Kumar, M., B. Ram, R. Honda, C. Poopipattana, V.D. Canh, **Chaminda, T.**, and H. Furumai (2019b). “Concurrence of antibiotic-resistant bacteria (ARB), viruses, pharmaceuticals and personal care products (PPCPs) in ambient waters of Guwahati, India: Urban vulnerability and resilience perspective.” In: *Science of the Total Environment* 693, p. 133640.
- Kumar, M., B. Ram, H. Sewwandi, R. Honda, and **Chaminda, T.** (2020c). “Treatment enhances the prevalence of antibiotic-resistant bacteria and an-



- tibiotic resistance genes in the wastewater of Sri Lanka and India.” In: *Environmental Research* 183, p. 109179.
- Quyen, D.T.T., O. Masahiro, Y. Otaki, and **Chaminda, T.** (2021). “Sewage Markers as Determinants to Differentiate Origins of Emerging Organic Pollutants in an Urban Sri Lankan Water Drainage Network.” In: *Water* 13.20, p. 2898.
- Shayan, M.N.M. (2025). “Spatiotemporal variation in bacterial community compositions in urban rivers in Japan and Sri Lanka.” PhD thesis. Hokkaido University.
- Sovannlaksmy, S., R. Honda, **Chaminda, T.**, and M. Kumar (2020). “A review on antibiotic resistance gene (ARG) occurrence and detection in WWTP in Ishikawa, Japan and Colombo, Sri Lanka.” In: *Emerging Issues in the Water Environment during Anthropocene*. Singapore: Springer, pp. 1–14.
- Tushara Chaminda, G.G.**, Hiroaki Furumai, and Variga Sawaittayotin (2013a). “Evaluation of pharmaceutical and personal care products (PPCPs) in downstream of Chao Phraya and in raw sewage in Thailand.” In: *Southeast Asian water Environment-5*. London: IWA Publishing, pp. 159–164. ISBN: 9781780404950.
- Tushara Chaminda, G.G.**, Hiroaki Furumai, and Variga Sawaittayotin (2013b). “Occurrence of pharmaceuticals and personal care product (PPCP) in Thailand waters.” In: *Southeast Asian Water Environment 5*. London: IWA Publishing, pp. 165–172. ISBN: 9781780404950.



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Agriculture, Environment and Biological Sciences



Global Perspectives on PFAS Contamination in Animal-Source Foods: Implications for Food Safety in Sri Lanka

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Per- and polyfluoroalkyl substances (PFAS), particularly the four key compounds PFOA, PFNA, PFHxS, and PFOS (PFAS4), are highly persistent synthetic pollutants with strong bioaccumulative potential. These compounds have documented adverse health effects, including immunotoxicity, endocrine disruption, and developmental impacts. Global evidence indicates that PFAS contamination in animal-source foods—such as milk, eggs, and meat—is more prevalent near industrial or firefighting-related hotspots, driven by exposure through contaminated water, feed, and soil. Concentrations exceeding regulatory thresholds have been reported globally, with PFOS and PFOA frequently dominating contamination profiles. Currently, there are no guidelines for livestock feed, soil, or drinking water for livestock, which complicates exposure assessments in food production systems. To date, no published data exist on PFAS levels in Sri Lankan livestock or animal-source foods. This review synthesizes international findings to identify potential exposure pathways and risks relevant to Sri Lanka's smallholders and other vulnerable livestock production systems, where reliance on groundwater and imported feed may heighten vulnerability. The study emphasizes the urgent need for a national PFAS monitoring and management strategy, incorporating hotspot mapping, routine testing, regulatory limit setting, and farmer training to safeguard food safety and public health in Sri Lanka. In the absence of locally available or affordable analytical capabilities, insights from international experiences in similar contamination contexts can serve as a practical foundation for developing effective initial risk assessment and mitigation approaches. Looking ahead, investing in national analytical capacity, digital surveillance tools, and predictive modeling could enable Sri Lanka to move toward proactive, data-driven approaches to managing emerging contaminants like PFAS.

Keywords: Bioaccumulation, Food safety, Livestock, PFAS contamination, Sri Lanka



Effect of Urea and Calcium Nitrate Application Timing as Top-Dressing Fertilizer on Texture Variation of Pickling Gherkin (*Cucumis sativus* L.)

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This study evaluated the effects of fertilizer type (urea and calcium nitrate) and the commencement date of the first top-dress application 10, 15, 20, and 25 days after seedling emergence (DASE), followed by repeated applications every 10 days up to 60 days on the texture variation of pickling gherkin (*Cucumis sativus* L.) during vinegar fermentation. Calcium nitrate was applied with nitrogen content equivalent to that of urea (kg/ha). The experiment followed a factorial randomized complete block design (RCBD) with six replicates. Firmness was measured using a digital force gauge (Newton) in fresh fruits at, 45, 75, and 105 days of fermentation, with ten fruits sampled per-treatment and period. Data were analyzed using two-way ANOVA, and means were separated by Duncan's Multiple Range Test at $p < 0.05$. Results showed that both fertilizer type and top-dress timing had significant effects on fruit firmness, while their interaction was not significant. Calcium nitrate application produced significantly higher firmness compared to urea in fresh fruits (37.16N), 45 days (23.53N), 75 days (19.69N), and 105 days (18.19N) of pickling. Considering the top-dress timing, commencement at 15 DASE resulted in significantly higher firmness at fresh (35.68N), 45 days (25.68N), 75 days (18.95N), and 105 days (17.55N) of pickling. Furthermore, commencement at 20 DASE produced significantly higher values at fresh (32.18N), 75 days (19.73N), and 105 days (18.23N), while commencement at 25 DASE yielded significantly higher firmness in fresh fruits (37.17N), 75 days (18.34N), and 105 days (16.84N). In contrast, plants where top-dressing commenced at 10 DASE recorded significantly lower firmness values in fresh fruits (32.09N), 45 days (18.55N), 75 days (17.40N), and 105 days (16.03N). These results indicate that calcium nitrate and top-dressing initiated at 15, 20, and 25 DASE were most effective for maintaining fruit firmness during vinegar fermentation.

Keywords: Fruit Firmness, Gherkin, Pickling, Top-dress, Vinegar Fermentation



Evaluation of Pelletized Poultry Droppings Fertilizer as an Alternative Nitrogen Source for Curry Chili (*Capsicum annuum*) Cultivation under Protected House Conditions

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Efficient nitrogen management is essential for high-value crops such as curry chili (*Capsicum annuum*), where excessive use of urea can degrade soil and contribute to environmental pollution. This study evaluated pelletized poultry droppings, derived from Single Super phosphate amended with poultry droppings, as a partial or full replacement for urea under protected house conditions, following Department of Agriculture recommended nutrient management practices. The pellets contained 2.2% nitrogen and were applied at levels equivalent to urea (kg/ha). The experiment was arranged in a Completely Randomized Design (CRD) with six replicates per treatment. Five nitrogen-equivalent treatments were applied: T₁—100% urea (control), T₂—75% urea + 25% pellets, T₃—50% urea + 50% pellets, T₄—25% urea + 75% pellets, and T₅—100% pellets. Growth parameters, including plant height (cm), number of leaves per plant, and stem girth (mm), were recorded at 50% flowering stage and at the first harvesting stage. Results showed that there were no significant differences ($p < 0.05$) among treatments, indicating that nitrogen from pelletized poultry droppings was sufficient to support normal vegetative growth of curry chili. These findings demonstrate that pelletized poultry droppings can be used as a sustainable nitrogen source to partially or fully replace urea in curry chili cultivation, supporting environmentally friendly fertilizer management strategies.

Keywords: Curry chili, Nitrogen Management, Organic, Pelletized Poultry Droppings, Urea Replacement



Development of Medium Chain Triglyceride Enriched Milkshake for Ketogenic Diet

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The ketogenic diet (KD) has gained popularity as an effective strategy for weight management. Medium Chain Triglycerides (MCT) are the major fat source of this diet to induce efficient ketosis. However, the products for KD which are enriched with MCT are not accessible in the market. Thus, this study was aimed to develop a MCT enriched milkshake with an optimal ketogenic ratio (KR) and desirable nutritional properties. Four formulations were developed by varying the ratio (%) of soymilk, coconut milk, and MCT oil as 97.7:0:0 (C), 88.77:4.60:4.33 (T1), 86.87:6.92:3.90 (T2), 84.95:9.27:3.45 (T3), respectively. The proportions of the remaining ingredients were kept constant at 2.30%. Sensory, proximate, physicochemical, microbiological analysis were conducted and KR was calculated to assess product quality and suitability for the KD. Sensory evaluation was conducted by thirty semi-trained panellists using a five-point hedonic scale. T2 was selected as the optimal formulation, as it demonstrated significantly higher score for overall acceptability compared to the others. T2 consisted of 60.04% crude fat, 15.82% crude protein, and 22.51% carbohydrates, demonstrating a high-fat and low-carbohydrate profile, suitable for KD. Proximate analysis revealed, crude fiber and crude ash of 0.67% and 0.96% in dry basis, respectively. T2 exhibited a caloric profile in which, fat, protein, and carbohydrate contributed as 77.8%, 9.1% and 13.1% for total energy, respectively, which aligned with KD standards. Ketogenic effectiveness is measured through the KR (Fat/ [Carbohydrate + Protein]), which in this case was calculated as 1.56:1, thus meets the minimum threshold typically required to induce nutritional ketosis. The product shelf life remained at an acceptable level throughout the 4-week refrigerated storage period, as indicated by the steady changes in pH, titratable acidity, and TSS together with microbial counts within safe limits. In conclusion, the formulated milkshake had an optimal KR and desirable nutritional properties that supports the KD.

Keywords: Functional beverage, Ketogenic diet, Ketogenic ratio, Medium-chain triglyceride, Weight management



Environmental Sensitivity of Talalla Coastal Beach: A Tourism Hotspot in Southern Sri Lanka

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Environmental sensitivity refers to the significance of an area in terms of its ecological and socio-economic indicators derived from nature, and how nature responds to ecosystem damage. Talalla coastal beach (1.7 km) is a tourist hotspot and a proposed site for infrastructure development. This systematic investigation aims to evaluate its environmental sensitivity under three main categories based on cleanliness, species distribution, and usage, which serve as essential baseline indicators. Five selected sites during the low tide period in September 2025 were surveyed along the coast. Different importance levels of indicators and their contributions to the sensitivity were hierarchically assessed under three categories: Ecological, Biological, and Utilization sensitivity. Accordingly, the maximum values for each sensitivity were pre-decided as 15, 20, and 25, respectively, by allocating a value of 5 for a considered indicator. The cleanliness status of the five sites was dirty and very dirty, with the abundance of bulky litter (>10 cm) ranging from 24 to 63 (/100 m²). The fine litter (<10 cm) abundance varied between 3–24 (/m²), representing dirty, moderate, and clean status. The distribution of coastal specific flora such as *Pandanus tectorius*, *Ipomoea pes-caprae*, *Premna serratifolia*, *Barringtonia asiatica*, *Scaevola taccada*, *Sesuvium portulacastrum*, *Senna alata*, and *Strophostyles helvola* added higher values to the biological sensitivity for relevant sites. Similarly, the presence of coastal-specific fauna such as *Coenobita cavipes*, *Littoraria irrorata*, *Platorchestia platensis*, *Hyllus semicupreus*, and *Dotilla myctiroides* enhances the ecological significance. The ecological, biological, and utilization sensitivity varied between 4–7/15, 09–19/20, and 06–20/25, respectively. Although the lowest ecological sensitivity value was observed at site 5, its utilization sensitivity was highest, reaching 20 out of 25 due to the presence of a mini harbour, hotels, and other social and recreational activities. The total value of environmental sensitivity at the five sites ranged between 40 and 24 out of the 60. Therefore, the location-specific coastal species need to be protected from external disturbances such as human economic activities, environmental degradation, and hazards. Mapping of the ecological, biological, and utilization sensitivity is recommended for future studies.

Keywords: Bulky litter, Coastal species, Environmental sensitivity, Fine litter



Exploring Marketing Constraints and Potential Opportunities for Coconut-Based Products: Evidence from Batticaloa, Sri Lanka

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There is significant potential to improve the marketing of coconut-based products in Batticaloa. However, demand currently exceeds the production of coconut-based products despite many opportunities. Therefore, the present study was an effort to explore marketing constraints and opportunities related to the coconut industry in Batticaloa, Sri Lanka. Simple random sampling was used to select 50 registered coconut farmers and 50 registered coconut-based producers for the study. Primary data were collected through pre-structured questionnaires and field surveys and analyzed with IBM SPSS 25.0 and Microsoft Excel. Descriptive statistics were applied to assess the data. The results reveal a strong positive disposition toward the coconut industry among male respondents, due to the male-dominated farming system in Batticaloa. Surprisingly, no value-added products are currently produced among the sample. The most prominent constraints identified in both local and global markets were, respectively, poor access to market information (81.4%), high input and other operational costs (73.6%), price volatility (83.8%), and lack of government and non-government support (48.4%) for export in Batticaloa. Despite the constraints, considerable local and global marketing opportunities were available, respectively: income generation (85.0%), higher local and global demand (84.0%), creation of employment opportunities (83.4%), earning foreign exchange (81.8%), competitive advantage (78.6%), and coconut tourism (77.2%) in Batticaloa. Based on the findings, the study recommends encouraging community engagement in the marketing of the coconut-based industry and enhancing knowledge regarding value addition of coconut. The respondents of this study demanded that the government establish quality upgrading programs, provide appropriate training facilities to implement suitable marketing strategies, and enhance the use of e-commerce platforms for the marketing process. Therefore, the present study recommends addressing these constraints and identifying opportunities to improve the local and global marketing of coconut-based products in Batticaloa, Sri Lanka.

Keywords: Coastal areas, Coconut-based farmers, Coconut-based producers, Coconut-based marketing, E-marketing



Design and Implementation of a Fixed-Wing VTOL UAV Utilizing Conventional Control Surfaces for Automatic Vertical Take-Off and Horizontal Transition

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This paper presents the development of a compact fixed-wing unmanned aerial vehicle (UAV) capable of automatic vertical take-off and transition to horizontal flight using only conventional control surfaces, without the need for additional tilt mechanisms or actuators. The design combines the vertical lift advantage of multirotor craft with the aerodynamic efficiency of fixed-wing aircraft, offering a lightweight, low-cost, and mechanically simple solution for constrained operational environments. This solution introduces a complex control problem that, once solved and implemented, greatly enhances the mechanical robustness of the aircraft. The UAV was designed and fabricated using a KT foam airframe with a 0.8 m wingspan and powered by a single BLDC motor. Aerodynamic performance was analyzed using 3D CAD simulations and XFLR5, and the resulting aerodynamic coefficients were used to construct state-space models representing both vertical and horizontal flight dynamics, which were then used to develop the flight controller. A custom flight mode, named FIXED_VTOL, was integrated into the open-source ArduPlane firmware to implement the developed flight controller, simplifying implementation to solving the transition problem of the aircraft. The control architecture employed sensor fusion, attitude stabilization, and gain-scheduled PID control for seamless switching between flight regimes. The system was implemented on a Mateksys F405 Wing V2 flight controller and tested using both Software-In-The-Loop (SITL) simulation and physical flight experiments. Experimental results confirmed vertical take-off, reliable attitude control during take-off, and smooth transition to forward flight at approximately 70% throttle. Minor oscillations observed during transition were mitigated through controller tuning. The study successfully demonstrated the feasibility of achieving fully automatic vertical take-off and horizontal transition functionality using standard aerodynamic surfaces of a simple fixed-wing aircraft, reducing mechanical complexity while maintaining stability and efficiency. Future work will focus on integrating automatic vertical landing, enhancing structural rigidity, and advancing control algorithms for improved flight performance in dynamic environments.

Keywords: Hybrid UAV design, Automatic vertical-to-horizontal transition, Conventional control surface VTOL, State-space flight modelling



Formulation of Non-Fat Yoghurt Drink with Butternut Squash (*Cucurbita moschata*) Puree: Optimization Using Response Surface Methodology

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Rising demand for healthier foods has driven interest in low-fat, low-sugar yoghurts, though such reductions often impair quality. Butternut squash (*Cucurbita moschata*), a pumpkin variety shows a strong potential as a natural fat and a sugar replacer due to its rich content of dietary fibre, pectin, starch, and sugars. The current study aimed to optimize the formulation of non-fat drinking yoghurt by incorporating *C. moschata* puree using Response Surface Methodology (RSM). Thirteen yoghurt formulations were prepared, varying the levels of pumpkin puree (4–12%) and sugar (2–6%), according to the Central Composite Design of RSM. The process involved pumpkin puree preparation, yoghurt preparation and blending to produce drinking yoghurt. The yoghurts were analyzed for compositional, physicochemical and physical properties using standard methods. Sensory evaluation was conducted by a panel of 30 semi-trained assessors. Response variables used in the optimization study were the viscosity and the overall acceptability. Data were analyzed using RSM in Minitab (version 17) and ANOVA followed by Tukey's test in SPSS (version 25). Total solids, protein and ash percentages of the yoghurts were varied from 10.26 ± 0.24 to 17.65 ± 0.02 , 3.44 ± 0.01 to 3.62 ± 0.12 and 0.20 ± 0.01 to 0.54 ± 0.14 , respectively. pH varied from 3.85 ± 0.05 to 4.75 ± 0.05 and titratable acidity from 0.72 ± 0.01 to 1.40 ± 0.01 (% lactic acid) and showed a significant variation without any clear trend. A notable increase ($p < 0.05$) in the b^* (yellowness) value and the viscosity was observed with the increase of *C. moschata* puree level in the yoghurt. A non significant ($p > 0.05$) lack of fit observed for viscosity (0.729) and overall acceptability (0.463) indicates that the quadratic model with the independent variables significantly ($p < 0.05$) predict the dependent variables. The optimized formulation, containing 5.51% *C. moschata* puree and 6.60% sugar, achieved an ideal balance of creaminess and natural sweetness and resulted in 3.97 overall acceptability score and 852.94 cP viscosity as predicted by the model which were closely aligned with the desired response values. The findings indicate that *C. moschata* puree can serve as an effective functional ingredient to enhance the quality of non-fat drinking yoghurt.

Keywords: Optimization, Response surface methodology, Sensory, Viscosity, Yoghurt



Physicochemical, Melissopalynological, and Antimicrobial Characterization of Natural Bee Honey from Diverse Agroecological Regions in Sri Lanka

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Honey's characteristics and health benefits depend on its botanical and geographical origin—factors poorly understood in Sri Lankan honey. This study characterised floral sources, geographic origin, physicochemical properties, and antimicrobial activity of honey from diverse agro-ecological regions in Sri Lanka. The bee honey samples were obtained from 14 diverse locations including Low Country Wet, Low Country Dry, Low Country Intermediate, Mid Country Wet, and Up Country agro-ecological regions of Sri Lanka, along with a commercial bee honey market sample to use as a reference. Evaluation of physicochemical, melissopalynological, and antimicrobial properties were carried out according to the previously published standard methods for each sample. The pH range in honey samples varied from 2.59 ± 0.02 to 4.44 ± 0.05 ; Brix value ranged from 71.63 ± 0.21 to $78.40 \pm 0.60^\circ\text{Brix}$, and water activity ranged from 0.61 ± 0.00 to 0.73 ± 0.00 . In melissopalynology analysis, 28 pollen species were identified from 20 plant families. The pollen of plants from family Asteraceae, Myrtaceae, Fabaceae, Rubiaceae, Poaceae, and Malvaceae contributed predominantly. The honey samples obtained from Low Country Intermediate Zone 01, Low Country Dry Zone 03, and Up-Country Wet Zone 03 were of unifloral honey and others were multifloral honey. The bee honey samples from Low Country Intermediate Zone 02 and Low Country Dry Zone 01 had a high pollen density, with an absolute pollen count of more than 1,000,000/10 g. Antimicrobial testing indicated that honey samples obtained from Low Country Dry Zone 01 and Low Country Dry Zone 03 samples had a significant inhibitory effect on *Staphylococcus aureus* and *Staphylococcus epidermidis*. However, tested bee honey samples were not effective in inhibiting the activity of *Candida albicans*. This study demonstrates that morphological and quantitative pollen analysis reliably verifies the botanical and geographical origin of honey, enhancing its commercial value through the exploration of antimicrobial properties.

Keywords: Antibacterial, Bee honey, Physicochemical, Pollen analysis, Pollen morphology



Development and Evaluation of Biodegradable Nursery Cups Using Eggshell Waste Incorporated with Natural Binding Agents

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The increasing use of plastic nursery containers has raised environmental concerns due to their non-biodegradable nature, while large quantities of eggshell waste remain underutilized. This study aimed to develop and evaluate biodegradable nursery cups using eggshell waste reinforced with natural fibers and a biopolymer binder as an alternative to plastic nursery containers. Eggshells were cleaned, sterilized by boiling for 15–20 minutes, dried, and ground into fine powder. Coconut (*Cocos nucifera*) coir and banana (*Musa sp.*) fibers were treated with 5% NaOH and cut into 2–5 mm lengths. A biopolymer matrix was prepared by dissolving gelatin in hot water with glycerin as a plasticizer. Composite mixtures were molded into nursery cups and air-dried for 24–48 h. Four treatments were formulated based on eggshell-to-gelatin ratio and fiber type: T1 (Eggshell + Gelatin + Coconut fiber, 3:1), T2 (Eggshell + Gelatin + Coconut fiber, 4:1), T3 (Eggshell + Gelatin + Banana fiber, 3:1), and T4 (Eggshell + Gelatin + Banana fiber, 4:1). The cups were evaluated for thickness, weight, water absorption, biodegradability, calcium release, and plant growth performance using chili seedlings, with plastic and cocopeat pots as controls. Significant differences ($p < 0.05$) were observed among treatments for physical, biodegradation, and plant growth parameters. Among all treatments, T4 showed the best overall performance with adequate mechanical stability, moderate water absorption, complete degradation within approximately two months, and superior plant growth response. The gradual release of calcium from eggshells enhanced soil nutrient availability without leaving harmful residues. This study demonstrates that biodegradable nursery cups can be successfully produced from eggshell waste combined with natural fibers and gelatin binder. The T4 formulation is recommended as an environmentally friendly alternative to plastic nursery containers, contributing to sustainable waste utilization and reduced plastic pollution in horticulture.

Keywords: Biodegradable nursery cups, Eggshell waste, Natural fibres, Gelatin biopolymer, Sustainable horticulture



Comparison of Polyunnel Structures on Agronomic and Economic Performances of Salad Cucumber (*Cucumis sativus* L.) Under Warm Humid Tropical Environment

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Protected cultivation offers several advantages for high-value crops such as salad cucumber by providing a better-controlled environment, reducing pest and disease pressure, and enabling year-round production. One of the main factors affecting yield attributes in controlled environmental cultivation is the structural design of the polyunnel. An experiment was conducted to evaluate the effectiveness of two polyunnel designs using salad cucumber (*Cucumis sativus* L. var. Hanyan CU-13502) as the test crop. The experiment compared two polyunnel designs: an improved, naturally ventilated Design (T1) and a conventional design (T2). Data on cucumber growth and yield, tunnel temperature and relative humidity, disease incidence, and cost-benefit analysis were collected. Growth and yield parameters were recorded from thirty replicates per treatment for 90 days from seed germination. Under identical management conditions, T1 demonstrated superior vegetative growth with a significantly higher number of leaves per vine and greater above- and below-ground dry biomass compared to T2. However, time to flowering, vine length, number of fruits per vine, fresh fruit weight, and total fruit yield per vine did not differ significantly between tunnels. Despite similar yield quantities, T1 produced a higher proportion of internationally marketable fruits (dark green fruits without defects and diameter 4.0–3.5 cm), indicating superior fruit quality. Disease incidence was significantly higher in T2, with 70% greater prevalence of downy mildew and powdery mildew, which could be associated with elevated temperatures hence reduced incubation period. Mid-day tunnel temperatures were higher in T2 compared to T1, while relative humidity did not differ significantly. Economic analysis indicated a benefit-to-cost ratio of 1.82 for T1 and 1.63 for T2, with the difference mainly attributable to construction costs. Based on the results of the present study, the improved polyunnel design with effective natural ventilation is recommended for adoption in the warm and humid tropical areas of Sri Lanka to achieve superior product quality and reduced fungal disease incidence in salad cucumber cultivation.

Keywords: Growth and yield, Microclimate, Polyunnel structure, Salad cucumber



Development of a Small-Scale Extruder Machine and Evaluation with the Production of Jackfruit Seed Flour-Based Extruded Snack

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The development of small-scale extruder machines has become increasingly important due to the growing demand for efficient food processing technologies. This study focuses on the design and fabrication of a screw-type extruder machine and the assessment of its performance using jackfruit seed flour as the primary raw material for the production of extruded snacks. Among existing designs, screw-type mechanisms were chosen over piston-type mechanisms due to their simpler operation and continuous processing capability. The fabricated machine consists of essential components, comprising the feeder, barrel, screw, heating system, and die, all mounted on a single integrated frame. The performance of the machine was evaluated at different moisture contents, while the quality of the extruded snacks assessed through physicochemical and sensory analysis. Quality parameters measured as expansion ratio, density, water absorption, and water solubility index. Results showed that for the density, expansion ratio, Water Absorption Index (WAI), and Water Solubility Index (WSI) were $1.11 \pm 0.08 \text{ g cm}^{-3}$, $1.33 \pm 0.02\%$, $3.58 \pm 0.04 \text{ g g}^{-1}$, and $22.85 \pm 0.07\%$ respectively. Regression analysis revealed that the temperature had the statistically significant effect on the expansion ratio ($P < 0.001$). Sensory evaluations were carried out for two treatments by a panel comprising 30 untrained panelists. According to the Friedman nonparametric test, sensory evaluation results for treatment two has the highest preference in terms of color (4.50), aroma (4.25), texture (4.50), flavor (4.50), mouthfeel (4.50), appearance (4.50) and overall acceptability (4.50). In treatment number two, the formulation was composed of 30 g jackfruit seed flour, 49 g wheat flour, 20 g powdered sugar, and 1 g salt. Commercially imported extruders normally cost more than LKR 100,000, whereas the estimated total cost of the small-scale extruder was approximately LKR 13,000. The study concludes by recommending future research on incorporating a vacuum chamber within the barrel to further enhance product quality.

Keywords: Extruded snack, Jackfruit seed flour, Single-screw design, Small-scale food extruder, Value-added snack



Effect of Storage Conditions on *Staphylococcus aureus* Found in Giant Freshwater Prawn

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Ensuring microbial safety of the commercially important giant freshwater prawn (GFP), *Macrobrachium rosenbergii*, is crucial given its rising commercial value and sensitivity to postharvest handling conditions. *Staphylococcus aureus* is a major foodborne pathogen of concern in crustaceans; however, its behaviour under different storage conditions remains poorly understood. This study examined the growth of naturally contaminated *S. aureus* on GFP stored under three standard postharvest methods. A total of 72 fresh male prawns (average weight, 440 ± 38 g; length, 30 ± 4 cm) from the Ridiyagama Reservoir, Sri Lanka, were transported under chilled conditions and randomly assigned to three treatments (n=24 per treatment): (i) ice storage (1:1, w/w), (ii) freezing at -20°C , and (iii) blast freezing at -35°C followed by storage at -20°C . Microbiological counts were performed at three-day intervals from day 0 to day 21, following ISO standard procedures, with analyses performed in triplicate at each time point. The initial (day 0) *S. aureus* count in GFP was 269 ± 63 CFU/g. *S. aureus* showed significantly different survival patterns ($p < 0.05$) across the three storage methods. Ice-stored samples exhibited continuous and substantial growth, reaching a $3,977 \pm 440\%$ increase by day 21, with three distinct proliferation phases: a gradual increase during days 0–9 ($83 \pm 19\%$), a moderate rise from days 9–15 ($575 \pm 76\%$), and a sharp escalation during days 15–21, resulting in a net increase of 3,402% in the final phase. Conversely, freezing at -20°C led to a gradual decline in *S. aureus* counts ($56 \pm 4\%$ of initial levels by day 21), whereas blast-freezing resulted in the greatest reduction, with counts at $28 \pm 5\%$ of the initial level. Prawns stored on ice exceeded international microbial limits after day 12, whereas both frozen treatments remained within regulatory limits established by the European Union (EU), Asian, and Oceania standards throughout the storage period. These results indicate that ice storage promotes *S. aureus* growth due to favourable conditions, whereas freezing, particularly blast freezing, decreases the pathogen's persistence. Rapid freezing thus provides superior microbial safety for GFP and should be prioritised in postharvest handling systems to uphold product quality and compliance with international standards.

Keywords: Food-borne pathogens, Frozen seafood safety, Giant freshwater prawn, *Staphylococcus aureus*, Storage temperature



Carbon Dioxide Emissions from Model Soil Aggregates Incorporated with Organic Amendments: Effects of Organic Matter and Water Repellency

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Model soil aggregates incorporated with organic amendments (OAs) can serve as nutrient-rich potting media. The OAs can induce water repellency (WR) in model soil aggregates restricting moisture availability for the organic matter (OM) decomposition. Decomposition of OM can reduce carbon dioxide (CO₂) emissions temporally due to limited substrate availability to the microorganisms. On the other hand, the decomposition loss of OM can reduce WR, which in turn increases CO₂ emissions. However, the net effects of these OM and WR variations on CO₂ emissions are still unclear. This study explored CO₂ emissions from OAs-incorporated model soil aggregates considering the effects of OM and WR. Surface Ultisol soil from Mapalana, Sri Lanka, was amended with 5 types of air-dried and/or ground OAs (mahogany and casuarina litter at an early decomposition stage, goat and cattle manure less than one week old, compost) at 15% (w/w) rate. Using these samples, uniform model aggregates (1×1×0.5 cm) were prepared and kept under laboratory conditions for over 15 weeks, maintaining initial air-dried moisture contents. Weekly, CO₂ emissions (trapping by NaOH), WR at the same initial moisture contents (persistence; water drop penetration time, degree; sessile drop contact angles), and OM% (Walkley-Black and Loss on Ignition methods) were measured. Both OM% and WR decreased temporally due to decomposition. The CO₂ emissions consistently decreased within the first three weeks (initial stage) and then (later stage) showed emission pulses on certain days. According to ANOVA, the effects of OM% on CO₂ emissions were statistically significant ($p < 0.05$) during the initial stage. In the later stage, the statistically significant ($p < 0.05$), non-linear, negative correlation between CO₂ emission pulses and the corresponding contact angles indicated that decreasing WR improved water penetration and microbial access, thereby increasing CO₂ emissions. The interaction effects between the OM% and the degree of WR on CO₂ emission pulses were significant ($p < 0.05$) in addition to their individual effects in this stage. Overall, the initial CO₂ emissions from OAs-incorporated model soil aggregates were regulated by OM%, while the latter were influenced by both OM% and WR.

Keywords: Carbon dioxide, Decomposition, Model aggregates, Organic amendments, Water repellency



Effects of Different Plant and Residue-Derived Ashes on Ameliorating Soil Acidity in Paddy Soils of the Low Country Wet Zone, Sri Lanka

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Soil acidity is a major constraint limiting paddy productivity in the Low Country Wet Zone (LCWZ) of Sri Lanka, while the high cost and limited availability of conventional liming materials such as dolomite restrict their use among farmers. Although wood ash has long been recognized as a liming agent, comparative information on the effectiveness of locally available plant and residue-derived ashes compared with dolomite remains limited. Therefore, this study aimed to evaluate the comparative liming effect of different ash sources. An eight-week laboratory incubation experiment was conducted using acidic paddy soil collected from the Regional Rice Research and Development Centre, Bombuwela, Sri Lanka. Treatments were arranged in a Completely Randomized Design with four replicates. Ashes (2 t ha⁻¹) derived from rubber (*Hevea brasiliensis*), cinnamon (*Cinnamomum verum*), alstonia (*Alstonia macrophylla*), and rice husk (*Oryza sativa* residue) were applied, along with dolomite and an unamended control, with recommended rates of N, P, and K fertilizers (urea – 40 kg/ac, MOP – 44 kg/ac, TSP – 20 kg/ac, respectively) as per Department of Agriculture guidelines. The ashes were produced under open combustion conditions, with recorded pH ranging from 9.5 to 12.9. Soil moisture was maintained at 50% of field capacity, and weekly measurements of pH, EC, available P, exchangeable K, and organic matter (OM) were conducted. All ash treatments significantly ($p < 0.05$) increased soil pH compared to the control, while cinnamon ash exhibited the highest liming efficiency in week 2, raising soil pH from 4.65 to 6.0. However, dolomite-treated soil showed significantly ($p < 0.05$) higher pH (5.67) in week 8. Cinnamon ash-amended treatment increased available P (from 4.4 to 17.56 ppm) and exchangeable K (from 17.93 to 258.48 ppm) by week 8. EC values increased in all treatments, with significantly ($p < 0.05$) highest EC (278.25 $\mu S/cm$) observed in cinnamon ash-treated soil. Organic matter content improved significantly ($p < 0.05$) in rubber (8.8%) and alstonia (8.2%) amended treatments compared to the control. The findings suggest that using locally available cinnamon wood ash could provide an affordable and sustainable alternative to dolomite for ameliorating acidic soils in the LCWZ. Field-scale validation is recommended prior to widespread agricultural adoption.

Keywords: Acidic paddy soils, Ash amendment, Liming effect, Nutrient dynamics



Spatial Variability of Soil Organic Carbon Stocks in the Mangrove Ecosystem of Koggala Lagoon, Sri Lanka

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Mangroves in Sri Lanka serve as critical blue carbon sinks, yet their sediment carbon storage remains understudied, limiting their incorporation into national climate change mitigation strategies. This study presents the first quantitative assessment of soil organic carbon (SOC) stocks in the mangrove ecosystem of Koggala Lagoon, located in the southern province of Sri Lanka. Soil samples were collected from ten sites using cylindrical corers at depths of 0–15 cm and 15–30 cm. Samples were processed using standard procedures including oven-drying, the Loss on Ignition (LOI) method for organic matter determination, and conversion to SOC stocks expressed in Mg C ha⁻¹. Results revealed substantial spatial variability in SOC stocks across the lagoon, ranging from 14.74 to 66.93 Mg/ha in the topsoil layer. High-performing sites (Site 02: 66.93 Mg/ha; Site 07: 59.16 Mg/ha) demonstrated carbon storage potential more than 4.5 times greater than low-performing sites (Site 03: 14.74 Mg/ha). Unexpectedly, several sites exhibited atypical vertical carbon distribution patterns, with Site 10 showing higher subsoil carbon content (72.55 Mg/ha) than topsoil (47.19 Mg/ha), suggesting complex sediment dynamics potentially influenced by deep-rooted vegetation or historical land use. These findings have critical implications for blue carbon accounting and conservation strategy. The heterogeneous distribution of SOC stocks indicates that national carbon inventories and credit schemes must avoid generalized assumptions to prevent overestimation. The study confirms Koggala Lagoon mangroves as significant carbon reservoirs and emphasizes the necessity of their conservation as natural climate solutions. This baseline data provides essential evidence for incorporating mangrove ecosystems into Sri Lanka's climate change mitigation frameworks and highlights their underappreciated role in global carbon sequestration efforts.

Keywords: Blue carbon, Carbon sequestration, Koggala Lagoon, Mangrove sediments, Soil organic carbon



Optimization of Coagulation Performance Using Bio-Coagulants from Banana and Pineapple Waste as an Alternative to Aluminium Alum

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Access to clean water is essential for human health, agriculture, and industry; however, freshwater resources are increasingly threatened by pollution from industrial effluents, agricultural runoff, and other human activities. Raw water sources such as rivers, lakes, and groundwater often contain suspended solids, organic matter, heavy metals, and microorganisms that must be removed before use. Although conventional coagulants like Aluminium Sulfate (Aluminium Alum) are effective in removing turbidity and impurities, they have notable drawbacks, including the production of non-biodegradable sludge, potential health risks from residual Aluminium, and environmental impacts associated with their manufacture and disposal. Therefore, our study evaluated eco-friendly substitutes derived from banana peels, banana pseudo-stem, and pineapple peels with Aluminium Alum ($\text{Al}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$) for treating turbid raw water. The raw ingredients were collected, washed, depectinated, oven-dried, ground, and sieved into fine powders. Coagulation experiments compared their performance with Aluminium Alum to identify the effectiveness. After determining the most efficient bio-coagulant, we aimed to replace 25%, 50%, 75%, and 100% of the Alum with the selected bio-coagulant to evaluate its potential as a partial or complete substitute. This would help determine the optimum percentage at which Alum can be effectively replaced by the bio-coagulant without compromising treatment efficiency. The results demonstrated that banana pseudo-stem powder was the most effective replacement compared to banana peel and pineapple peel powder. The 50% Banana Trunk + 50% Alum had a 94.5% turbidity removal efficiency, while 100% Alum remained at 91% ($p < 0.01$). Further, the 75% Banana Trunk + 25% Alum demonstrated 93.1% turbidity removal efficiency, and it was significant compared to the control ($p < 0.01$). COD of raw water (223.2 ± 0.3) was reduced to 87.3 ± 0.7 by 100% Alum, while 50% Banana Trunk + 50% Alum reduced the COD to 61.8 ± 0.7 , and it was significant. COD of 75% banana + 25% Alum treatment was 92.8 ± 0.6 , and it was significantly higher than both. pH was not significant among all treatments while the TSS followed the same trend of turbidity. These findings highlighted the potential of replacing 50% of the Alum dose by banana pseudo-stem powder as an alternative to conventional coagulants without disturbing the efficiency of the conventional chemical coagulation process.

Keywords: Bio-coagulant, Coagulation-flocculation, Raw water treatment, Sustainable water purification, Turbidity removal



Formulation and Quality Evaluation of a Value-Added Hot Sauce Incorporating Scotch Bonnet (*Capsicum chinense*) and Traditional Lime Pickle (*Citrus aurantifolia*)

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Scotch Bonnet (*Capsicum chinense*) and lime (*Citrus aurantifolia*) are locally available ingredients in Sri Lanka that remain underutilized in high-value food products. Scotch Bonnet is rich in capsaicinoids, carotenoids, vitamins, and antioxidants, while traditional lime pickle provides strong acidic and aromatic characteristics. However, no scientifically validated formulation has combined these ingredients into a single value-added condiment. This study aimed to develop a hot sauce using ripened Scotch Bonnet and lime pickle and to evaluate its sensory quality, physicochemical properties, microbial safety, and storage stability. Eight formulations (T1–T8) were prepared by varying Scotch Bonnet (5–26%) and lime pickle (10–26%) proportions. Sensory evaluation was conducted using a five-point hedonic scale, and physicochemical and microbial analyses were performed in triplicate. Sensory results revealed that the formulation with 20% Scotch Bonnet and 15% lime pickle (T8) received the highest overall acceptability score (4.52 ± 0.18), which was higher than that of commercial chili sauces. Proximate analysis showed $77.14 \pm 0.63\%$ moisture content, $2.84 \pm 0.12\%$ protein, $3.19 \pm 0.19\%$ fat, $1.99 \pm 0.05\%$ crude fiber, $2.76 \pm 0.41\%$ ash, $12.07 \pm 1.10\%$ carbohydrates, and an energy value of 83.38 ± 2.72 kcal/100 g. pH increased slightly from 3.39 to 3.86 and Brix rose from 25.03° to 27.40° over 12 weeks, while titratable acidity gradually decreased from 0.82 to 0.69%. Microbial counts after 6 weeks remained within acceptable limits for sauces, with an aerobic plate count below 1×10^4 cfu/g and yeast and mold below 1×10^2 cfu/g; observed values were 1.5×10^1 cfu/g and 1.0×10^1 cfu/g, respectively, and no *Escherichia coli* was detected. In conclusion, combining Scotch Bonnet and lime pickle produced a stable, nutritionally acceptable, and highly preferred hot sauce. The optimized T8 formulation, containing 20% Scotch Bonnet, 15% traditional lime pickle, and 65% other ingredients, shows strong potential for commercial production, value addition, and reduction of postharvest losses using locally available ingredients.

Keywords: Food preservation, Hot sauce, Lime pickle, Sensory, Scotch Bonnet



Fish Waste Valorization for Sustainable Animal Feed Production: A Comprehensive Review

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Globally, fish production reached 223.2 million tons in 2022, with Sri Lanka contributing approximately 530,000 metric tons of production annually. However, the fisheries sector faces inefficiencies across the value chain, with postharvest losses estimated at 40–60%, corresponding to 200,000–300,000 metric tons of wasted fish biomass annually, causing both economic losses and environmental burdens. Concurrently, livestock producers face high feed costs, accounting for 60–70% of total production expenses. Sri Lanka imported USD 51.6 million worth of feed ingredients in 2023 due to domestic shortages. Converting underutilized fish waste into nutrient-rich animal feed offers a dual opportunity to reduce waste and lower feed costs. Using 25% of the monthly fish waste could potentially yield approximately 118–120 tons of animal feed per month. Processed fish-waste-based feed has been shown to achieve crude protein levels of 54–57%, lipids 12–17%, calcium 6–9%, and phosphorus 3–5%, depending on composition and processing method, demonstrating the feasibility of converting waste into high-quality feed. This review synthesizes peer-reviewed literature (2000–2025) retrieved from major academic databases to evaluate the potential of converting fish waste into animal feed. Technologies including traditional fishmeal and oil production, chemical and biological silage, novel physiochemical and enzymatic hydrolysis, and advanced ensiling methods have been reported for their efficacy and nutritional outcomes. Fish-waste-based animal feeds have been shown to enhance livestock performance, providing high-quality protein and omega-3 fatty acids. Key challenges include production limitations, product safety, and scalability feasibility. This review highlights future research directions for the circular economy and emphasizes the development of fish waste-based animal feed under the “waste-to-wealth” concept. Overall, valorizing fish waste represents a viable and sustainable pathway to reduce environmental pollution, reduce feed import dependency, and improve resource efficiency in the animal feed sector.

Keywords: Animal feed, Circular bioeconomy, Fish waste, Sustainability, Waste valorization



Uncovering Six New Rice MYB Orthologs Involved in Anthocyanin Pathways and Abiotic Stress-Responsive Regulatory Networks

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R2R3-MYB transcription factors (TFs) are key regulators of secondary metabolism and abiotic stress responses across plant species. However, limited information is available on the functional roles of R2R3-MYB TFs in rice in the context of sustainable agriculture. This study aimed to identify and functionally predict rice MYB transcription factors associated with anthocyanin biosynthesis and stress resilience using a comprehensive in-silico approach. Thirty-one MYB gene sequences linked to pigmentation and stress responses were retrieved from the Plant Transcription Factor Database. Conserved motif analysis confirmed the presence of the R2R3 domain and identified potential repressors. Phylogenetic analysis distinguished MYBs involved in anthocyanin biosynthesis, while the detection of EAR motifs in StMYB44 and PhMYB4 suggested repressor activity. Gene interaction network analysis revealed associations with stress-related pathways, including lignin biosynthesis, reactive oxygen species scavenging, stomatal regulation, and hormone signaling. Six novel rice orthologs, OsMYB52, OsMYB14, OsMYB26, OsMYB56, OsMYB64, and OsMYB80 were identified, showing close evolutionary relationships with functionally characterized MYBs from *Arabidopsis thaliana*, *Capsicum annuum*, *Zea mays*, *Triticum aestivum*, and *Vitis vinifera*. Cis-regulatory analysis revealed key promoter elements such as CAAT-box, TATA-box, ABRE, ARE, and G-box motifs, indicating responsiveness to environmental and hormonal cues. Experimental validation will be necessary to confirm the functional roles of the identified MYB candidates in stress resilience and anthocyanin accumulation.

Keywords: Abiotic stress resilience, Anthocyanin biosynthesis, MYB transcription factors, Phylogenetic analysis, Regulatory mechanisms



Variation of Leaf Morphology of Selected Cinnamon Accessions in Two Agroecological Regions of Sri Lanka

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Breeding stable, high quality and high yielding cinnamon varieties is useful for commercial cultivation. The objective of this study was to evaluate the variation of leaf morphology of selected cinnamon accessions in two locations. Twenty vegetatively propagated (VP) high yielding cinnamon accessions collected from Mid Country Research Station (MRS), Dalpitiya in Mid Country Wet Zone (WM2) were established in the Galle district (GD), for assessment in a randomized complete block design with three replicates. Quantitative traits of leaf length (LL), leaf width (LW), and petiole length (PL), and qualitative traits of leaf arrangement (LA), venation (LV), base (LB), margin (LM), apex (LAP), and shape (LS) were recorded. Accession 20 produced the longest PL (1.93 ± 0.67 cm) and LL (14.2 ± 0.6 cm), while accession 12 recorded the shortest PL (0.92 ± 0.10 cm) and LL (9.0 ± 0.5 cm). LW varied from 4.43 ± 0.12 cm (accession 26) to 6.00 ± 0.058 cm (accession 18). LA and LV exhibited the least environmental influence. LA types of opposite to sub-opposite on different branches and opposite to sub-opposite within the same branch were recorded, with the latter dominating (75%). LV of most accessions (70%) expressed the three- or five-veined pattern. LM showed the strongest environmental response, with 95% of accessions shifting from undulate (MRS) to entire (GD). Leaf shape varied markedly between sites: MRS was dominated by narrowly elliptic and oval types, whereas GD exhibited greater diversity, including several shapes absent at MRS. LAP morphology differed, with MRS showing broader variation, while GD was strongly dominated by the acute type. LB morphology remained relatively uniform, with obtuse, 'contracted into petiole, then shortly cuneate' form most common at both sites. These findings provide a basis for confirming morphological uniformity and developing stable, high performing cinnamon varieties.

Keywords: Agroecological regions, *Cinnamomum verum*, Leaf morphological traits



Eugenol and Benzyl Benzoate Chemotypes of Cinnamon (*Cinnamomum verum*) in Sri Lanka

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The chemical composition of seed-propagated cinnamon is variable. Varieties with distinct chemical compositions for specific purposes are lacking in Sri Lanka. This study aimed to determine the diversity of leaf essential oil composition in selected cinnamon accessions from an established collection at the University of Ruhuna. Eighteen accessions were evaluated in 2018 and 2021 using GC-MS analysis. Eugenol (EU) was the major compound in fifteen accessions, while benzyl benzoate (BB) was the major compound in three accessions. Eucalyptol, linalool, α -caryophyllene, caryophyllene, caryophyllene oxide, α -phellandrene, and cinnamaldehyde were variable in both periods. EU, α -phellandrene, and cinnamaldehyde compositions in 2021 were significantly different ($p < 0.05$) when compared to 2018. A dendrogram was constructed based on 33 chemical variables of eighteen *Cinnamomum verum* accessions in 2021, which produced two clusters at a rescaled distance of 20. Benzyl benzoate-rich accessions KA11 and GB17 were classified into a distinct cluster. Our results confirm that Sri Lankan cinnamon has two distinct chemotypes: one rich in eugenol (EU) and another rich in benzyl benzoate (BB). This finding enables farmers to cultivate specific chemotypes and allows industries to select material suited to their particular needs.

Keywords: *Cinnamomum verum*, Benzyl benzoate chemotype, Eugenol chemotype, GC-MS analysis, Leaf essential oil



Effects of Water Repellent Levels of Different Organic Amendments on Water Retaining Ability and Floating of Model Soil Aggregates

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Organic matter amended soil aggregates are widely used as potting media in modern agriculture, which induces soil water repellency (SWR) that may impact water retention and floating behavior. However, the impact of SWR on the water retaining ability (WRA) and floating time (FT) of organic amendment (OA) treated aggregates is still unknown. This research aims to assess the effects of different levels of SWR induced by OA-treated aggregates on the WRA and FT of artificially prepared model soil aggregates. Manure from cattle and goats, compost, and leaf litter from *Casuarina equisetifolia* and *Swietenia mahogani* were used as OA. Soil aggregates with uniform dimensions (1 cm × 1 cm × 0.5 cm) were prepared by incorporating OA at 15% on a weight basis. SWR was measured using the water drop penetration time (WDPT) test and the sessile drop contact angle method. The WRA and FT of the aggregates were measured using a mesh cup and surface floating tests, respectively. Results were analyzed statistically using descriptive statistics, analysis of variance (ANOVA), and regression models at a 5% significance level ($p < 0.05$). Aggregates prepared with *C. equisetifolia* and 100% soil (control) showed the highest and lowest water repellencies, respectively, based on their average WDPT (168 s, <1 s) and contact angle (80.5°, 54.77°) values throughout the study period. The water repellency of aggregates decreased gradually throughout the study period due to the decomposition of organic matter and the reduced availability of hydrophobic compounds. Aggregates treated with *C. equisetifolia* recorded the highest water retaining ability (20–35%) among all treatments, and the water retaining ability decreased gradually during the experimental period. However, none of the treatments showed any relationship between water retaining ability and WDPT ($R^2 < 1$) during the entire study period. *C. equisetifolia*-treated aggregates showed the highest average floating times (>1300 s), and floating time decreased over the experimental period. During the entire study period, floating time showed moderate to strong positive correlations with WDPT ($R^2 = 0.63\text{--}0.84$).

Keywords: *Casuarina equisetifolia*, Sessile drop contact angle, Soil water repellency, Water drop penetration time, Water retention



Assessing the Export Competitiveness and Market Potential of Coconut Kernel-Based Products in Sri Lanka

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Sri Lanka's coconut industry plays a vital role in its national exports, with coconut kernel-based products accounting for a significant share of agricultural exports. However, maintaining and enhancing the global competitiveness of these products remains a persistent challenge. This study aims to address this issue by examining the export competitiveness and market potential of nine coconut kernel-based products in Sri Lanka, using both primary and secondary data. The export competitiveness of each product was calculated using annual secondary data from 2005 to 2024 through the Revealed Symmetric Comparative Advantage index, while future trends were forecasted using the Autoregressive Integrated Moving Average model. Primary data were collected through a structured questionnaire distributed among coconut exporters to identify key constraints affecting export performance and market potential. The results indicate that desiccated coconut and coconut oil are highly competitive, although their competitiveness is projected to decline. Conversely, exports of virgin coconut oil, coconut milk powder, liquid coconut milk, coconut flour, and coconut cream demonstrate competitive performance with upward projections. These products are increasingly capturing attention in global health-conscious and plant-based food markets due to their nutritional and functional benefits. However, coconut butter and coconut water are not competitive in the international market. Survey responses highlighted key challenges limiting market potential, including high export costs, supply chain instability, exchange rate fluctuations, regulatory barriers, and limited capacity for market and product diversification. These findings provide valuable insights into future trends in export competitiveness and key challenges in enhancing market potential. They also offer a strategic direction for policymakers and industry stakeholders to enhance export competitiveness through cost reduction, innovation, infrastructure development, and market diversification strategies, thereby strengthening the long-term performance of Sri Lanka's coconut kernel-based export sector.

Keywords: Autoregressive Integrated Moving Average model, Coconut kernel-based exports, Export competitiveness, Revealed Symmetric Comparative Advantage



Assessing Entrepreneurial Skills of Small-Scale Agro-Entrepreneurs: A Case Study in Galle District, Sri Lanka

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The development of small and medium-scale entrepreneurship is essential for strengthening Sri Lanka's agricultural economy. However, entrepreneur survival remains a major concern, as nearly 79.8% of Small and Medium Enterprises (SMEs) operate for only about three years after establishment. Low productivity, outdated production techniques, and limited innovation are the major factors contributing to this short lifespan. Therefore, enhancing entrepreneurial skills is essential for improving the sustainability and performance of small-scale agro-entrepreneurs. This study focuses on assessing the entrepreneurial skills of small-scale agro-entrepreneurs in Galle District to propose strategies for upgrading these skills within the agricultural sector. The study employed a pretested structured questionnaire to collect data from 60 randomly selected small-scale agro-entrepreneurs drawn from a list of 110 registered agro-entrepreneurs in the Galle District at the Department of Agriculture, Southern Province. Entrepreneurial skills were evaluated using an Entrepreneurship Skills Index (ESI) developed across seven dimensions: risk-taking ability, decision-making ability, self-confidence, innovativeness, communication, management, and leadership. Each dimension was measured using a five-point Likert scale and converted into sub-indices for analysis. Descriptive statistical methods were used, and the reliability of the data was confirmed with a Cronbach's alpha of 0.96. Results show that 58.2% of respondents rely on their enterprise as their main income source. Floriculture was the most common enterprise (40.3%), followed by organic farming and mushroom cultivation. Only 34% engage in value addition, primarily due to lack of knowledge. Promotions are limited, with 85% depending on word-of-mouth, and only 14% and 3% using social media and internet marketing, respectively. The ESI indicated that 63% of entrepreneurs have a medium level of entrepreneurial skills, with communication scoring the highest average (0.77) and innovativeness the lowest average (0.53). The study emphasizes the need to strengthen value-addition knowledge, innovation capacity, and modern agribusiness practices. Training on digital marketing, product diversification, financial literacy, and innovation-driven problem solving are recommended to enhance entrepreneurial skills.

Keywords: Agro-enterprises, Entrepreneurial skills, Entrepreneurship Skills Index, Small-scale



Prevalence of Haemoparasites and Their Impact on Haematological Parameters of Dogs in Selected Sites in Matara District, Sri Lanka

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Canine vector-borne diseases are a significant health concern in tropical regions, with domestic dogs serving as both hosts and reservoirs for various haemoparasitic infections. This study aimed to evaluate the prevalence of haemoparasites and assess their impact on hematological parameters of dogs. A total of 117 dogs presented to veterinary clinics in Matara town, Dickwella, Hakmana, and Akuressa were included in the study. Peripheral blood samples were collected and analyzed for red blood cell (RBC), white blood cell (WBC), and platelet counts using standard hemocytometer methods. Blood smears and buffy coat preparations were stained with Giemsa for microscopic detection of haemoparasites, while microfilariae were identified using a modified Knott's test. Results showed a marked decrease in RBC counts ($2.85 \times 10^6/\mu\text{L}$) and significant elevations in WBC ($72.33 \times 10^3/\mu\text{L}$, $p > 0.05$) and platelet counts ($9114.11 \times 10^3/\mu\text{L}$), indicating strong inflammatory and immune responses. Haemoparasite analysis revealed that nematode parasites, *Dirofilaria* spp. (38.72%; $n=3095$) and unidentified microfilariae (21.03%; $n=1681$), were the most prevalent and cause dirofilariasis in dogs. Protozoan parasites such as *Babesia* spp. (36.93%; $n=2954$) and *Hepatozoon* spp. (2.24%; $n=179$) that cause destruction of RBC were moderately common. Among the dogs examined, 81 were infected with at least one haemoparasite, with single infections predominating (42.24%) and multiple infections being rare.

Keywords: Babesia, Dirofilaria, Hepatozoon, Vector-borne diseases

Computer Science and Information Technology



Adaptive Prompting for Clinical Text Summarization: A Few-Shot Learning Approach Using Generative Large Language Models

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Clinical text summarization is a critical yet challenging task due to the unstructured and heterogeneous nature of electronic health records (EHRs). Discharge summaries, in particular, often contain lengthy and complex narratives, making it difficult to efficiently extract key clinical insights. Recent advancements in generative large language models (LLMs) have shown great promise in automating summarization tasks; however, their optimal application in clinical contexts remains underexplored, representing a significant research gap. To address this gap, the present study investigates an adaptive prompting approach for discharge summary summarization using different few-shot learning settings, ranging from one-shot to six-shot, with several state-of-the-art generative LLMs, including GPT-5, LLaMA, Mistral, Gemini, and T5. The performance of these models was evaluated using multiple metrics—such as F1 score, ROUGE, and BERTScore—alongside complementary measures like BLEU, BLEURT, and METEOR, to ensure a comprehensive assessment. The experimental results revealed that GPT-5 achieved superior performance across all evaluation metrics in the five-shot configuration, reaching an average score of 99%. This outcome underscores the strong effectiveness of five-shot learning for clinical summarization tasks. These findings provide valuable insights for healthcare researchers, informatics practitioners, and policymakers aiming to integrate LLMs into clinical workflows to support efficient information retrieval and informed clinical decision-making.

Keywords: Large language models, Clinical text summarization, Electronic health records



Classification of pCR and non-pCR in HR+/HER2+ Breast Cancer Subtype Using ADC Maps and Machine Learning Models

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Pathological complete response (pCR) following neoadjuvant chemotherapy is a key prognostic indicator in HR+/HER2+ (triple-positive) breast cancer. Early non-invasive prediction of treatment response could help optimize therapeutic strategies and minimize exposure to toxic treatments. This study aimed to predict pCR using radiomics features extracted from apparent diffusion coefficient (ADC) maps derived from diffusion-weighted MRI (DWI) trace images acquired at the early treatment stage (T0) from The Cancer Imaging Archive (TCIA). The dataset included 215 ADC maps from 53 HR+/HER2+ patients, comprising 78 pCR and 137 non-pCR cases. ADC maps were generated by combining DWI trace images with b-values of 0 and 800 s/mm². The dataset was split into 70% training and 30% testing sets. Tumor regions of interest were manually delineated, and first-order statistical, textural, and morphological radiomics features were extracted. Correlation-based feature selection was applied to the training set, removing highly correlated features with correlation >0.9. Class imbalance was addressed using the SMOTE technique to upsample the minority class while minimizing overfitting. Several supervised machine learning classifiers were evaluated. Random Forest achieved the highest test accuracy (67.69%), followed by Decision Tree (61.54%), LightGBM (61.54%), Logistic Regression (56.92%), Support Vector Machine (56.92%), XGBoost (58.46%), and Gradient Boosting (47.69%). Five-fold cross-validation of Random Forest yielded 64.65% accuracy, with an area under the ROC curve of 0.54. The optimal Random Forest parameters were: n_estimators = 800, criterion = 'entropy', max_depth = 5, min_samples_split = 10, min_samples_leaf = 8, max_features = 0.05, bootstrap = True, random_state = 42. Limitations of this study include its retrospective multicenter design and small sample size. These findings should be validated in larger cohorts. Nevertheless, this study provides useful insights for predicting pCR in clinical practice, offering potential to guide personalized treatment decisions in HR+/HER2+ breast cancer.

Keywords: Magnetic resonance imaging, Apparent diffusion coefficient, Diffusion-weighted imaging, pCR and non-pCR, HR+/HER2+ (triple-positive breast cancer subtype), Random Forest

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Deep Learning-Based Tumor Grade Classification Using ADC Maps in Breast MRI

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Breast cancer is the most prevalent cancer worldwide, and its early diagnosis is essential for effective treatment strategies and improved patient survival. Cancer grading is critical when assessing tumor aggressiveness and guiding targeted therapeutic intervention. Breast tumors are generally classified as benign or malignant. Malignant tumors are cancerous, while benign tumors are non-cancerous, with additional grading required to assess clinical risk. The research aim is to develop and evaluate a convolutional neural network for automated classification of low-risk and high-risk breast tumor grades using ADC (Apparent Diffusion Coefficient) maps derived from breast MRI (Magnetic Resonance Imaging) data obtained from The Cancer Imaging Archive. ADC maps were generated in MATLAB by merging two different diffusion-weighted (DW) images acquired with two different diffusion sensitization levels. Tumor Regions of Interest (ROIs) were manually outlined under the supervision of a radiologist using the drawpolygon function in MATLAB for each patient separately. Furthermore, 590 tumor masks were extracted from the dataset and used to train and evaluate the Convolutional Neural Network (CNN) model implemented in Python on Google Colab. The proposed design includes supervised learning and quantitative performance evaluation using classification and segmentation metrics. The model achieved a test accuracy of 82.73% with a final test loss of 0.3811. Sensitivity was 87.27% and 78.18% for high-risk and low-risk grades, respectively, with specificity values of 78.18% and 87.27%. Precision scores were 80.00% and 86.00%, and F1-scores were 83.48% and 81.90%. The model demonstrated excellent segmentation performance with Dice Similarity Coefficient (DSC) values of 83.48% and 81.90% and Intersection over Union (IoU) values of 71.64% and 69.35% for each stage. The model achieved AUC-ROC values of 0.9173 and 0.9173. These findings demonstrate reliable tumor grade classification, supporting clinical decision-making. Limited dataset size remains a constraint, and future work could focus on expanding the dataset.

Keywords: ADC map, Breast MRI, Convolutional neural network, Tumor grade



Machine Learning-Based Tumor Grade Classification Using ADC Maps in Breast MRI

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Breast cancer grading plays a critical role in treatment planning and prognosis, yet manual histopathological assessment is invasive, time-consuming, and subject to inter-observer variability. Diffusion-Weighted Imaging (DWI) and Apparent Diffusion Coefficient (ADC) maps provide quantitative information on tissue microstructure and offer potential for non-invasive tumor characterization. This study focused on developing and evaluating a machine learning (ML)-based radiomic framework for classifying low-intermediate grade (Grade 1–2) and high-grade (Grade 3) breast tumors from ADC-derived features. This study was carried out using 846 labeled ADC maps from breast cancer patients who were radiologically confirmed using the SBR (Scarff-Bloom-Richardson) grading system. Tumor regions of interest were manually segmented, and first-order, textural, and wavelet radiomic features were extracted. Feature redundancy and selection were performed using Pearson/Spearman correlation and ANOVA F-test. Dataset imbalance due to fewer low-intermediate-grade tumors was addressed using weighted class learning, SMOTE, SMOTE-Tomek, and SMOTE-ENN. Logistic Regression, Support Vector Machine (SVM), Random Forest, CatBoost, and XGBoost models were trained using patient-wise splitting and cross-validation to prevent data leakage. Performance was evaluated using accuracy, F1-score, and area under the ROC curve (AUC). SVM combined with SMOTE-Tomek achieved the best performance, yielding 68% accuracy and an AUC of 0.71, with improved sensitivity for detecting high-grade tumors. These findings show that ADC-based radiomic features capture clinically relevant markers for tumor aggressiveness. This proposed framework provides a reproducible, non-invasive decision support tool that may improve the diagnostic decision-making process. However, manual segmentation may limit generalizability. Future studies should incorporate automated segmentation and multimodal MRI features to enhance the robustness of the framework.

Keywords: Magnetic resonance imaging, Apparent diffusion coefficient, Diffusion-weighted imaging, Support vector machine, Machine learning



A Global Bibliometric Mapping of Plagiarism Detection Research (1990–2024)

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Plagiarism detection has gained increasing scholarly attention due to the rapid expansion of digital content and the widespread availability of online academic resources. Despite the growing body of literature, a comprehensive and up-to-date bibliometric overview that maps the intellectual structure and research evolution of plagiarism detection remains limited. To address this gap, this study conducts a global bibliometric analysis of plagiarism detection research published between 1990 and 2024. The objectives of the study were (1) to perform a descriptive analysis of the field of plagiarism detection, and (2) to identify areas of study that necessitate further investigation in order to advance plagiarism detection. Bibliometric analysis was performed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to analyze the data. The study considered 305 articles from 182 journals in the Scopus database, which demonstrate the topic's dynamic growth over the selected period. The study utilized Biblioshiny and VOSviewer to visualize data. The study identifies the most relevant sources, the distribution of publications across countries (both single-country and multi-country publications), and the most distinguished scholars whose contributions have been the most fruitful over time. Worldwide scholarly interest has focused on different types of technologies such as machine learning, deep learning, natural language processing, and text processing to detect plagiarism. Additionally, the study identified four clusters representing plagiarism detection techniques related to artificial intelligence, text processing techniques, plagiarism types, and underlying computer programming theories. Furthermore, additional research is necessary in the areas of computational linguistics, feature extraction, text processing, classification of information, semantics, syntactic analysis, and source code plagiarism detection. Overall, the insights derived from this bibliometric analysis provide a structured research agenda that supports the development of more effective, scalable, and theoretically grounded plagiarism detection methodologies.

Keywords: Bibliometric analysis, Plagiarism detection, PRISMA model



AutoGradePro: An Automated Grading System for Short-Answer Assessments Using Rule-Based Methods and Large Language Models

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AutoGradePro is an automated grading platform developed to reduce educator's workload in short-answer assessment evaluation in educational institutions. This full-stack web application addresses the limitations in manual grading, particularly excessive time consumption and scalability issues, by leveraging large language models and grading algorithms. The platform is built using Django for the backend, Next.js for the frontend, PostgreSQL database, and Ollama LLM for semantic evaluation. It supports four grading types: exact matching for single-word answers, semantic similarity assessment for short-phrase answers using Ollama's qwen2.5:1.5b model, comparison algorithms for ordered and unordered list-type answers, and predefined range validation for numerical answers. The system processes multiple document formats (TXT, PDF, DOCX, XLSX) through a five-stage pipeline consisting of file upload, format detection, text extraction, answer parsing, and automated grading with report generation. The system can process multiple student answer files simultaneously, which decreases the manual evaluation time and increases efficiency when grading large batches of assessments. Performance evaluation shows high accuracy across objective types: 100% for single-word answers, 92.9% for list-type answers, 84.6% for numerical responses, and 73.3% for short-phrase responses. When grading 20 student files containing 400 questions, average backend processing time was 307.82ms for single-word questions, 601.75ms for list-type questions, and 840.88ms for numerical questions. Compared to manual grading, the system provides a substantial reduction in evaluation time for objective questions and delivers an approximately fourfold increase in processing speed for short-phrase responses. Key features include automated marking scheme parsing, analytics dashboards and spreadsheet results export capabilities. AutoGradePro can reduce repetitive grading tasks while allowing educators to focus on high-value instructional activities.

Keywords: Automated Grading, Full-Stack Web Application, Large Language Models, Semantic Similarity, Short-Answer Assessment



LinkShield: Integrating Blockchain, Cryptography, and Reinforcement Learning to Prevent Link Discovery Attacks in SDVN

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A global network view-driven controller optimization can enhance the performance of vehicular networks in a Software-Defined Vehicular Network (SDVN). However, if Link Discovery (LD) Attacks (LDAs) contaminate the network architecture, such performance may be significantly impacted. Dynamic SDVN LD is less suitable for recent LDA mitigation techniques in the SDN realm. To address this research gap, we first show that five LDAs may be implemented in a typical SDVN architecture by taking advantage of flaws in the LD service and position tracking. Our main contribution, however, is to propose a novel framework to detect LDA by using a location-driven adaptive LD technique with Q-learning to derive link states. To mitigate the attacks, we use Diffie-Hellman (DH) symmetric key issuing, time-limited session-based Hash Message Authentication Codes (HMACs), Zero-Knowledge Proofs (ZKPs) of HMACs stored in the blockchain, packet limiting with signature matching, location verification, and cycle- and non-cycle-based digital signatures with a combination of post-quantum and classical cryptography. Additionally, a permissioned blockchain is used by employing a challenge-response mechanism for node registration with DH, global, and public key exchange and subsequent node authentication through established encrypted communication using signatures, ZKPs, attributes, and HMACs. A second smart contract is used to maintain non-tamperable node reputation and location scores by tracking node behavior and maintaining endorser trust scores for weighted reputation updates for consensus-based node blacklisting. We evaluate all five attack scenarios through simulations, and the findings indicate that the proposed technique is exceptionally effective in countering the five link discovery attacks outlined in this study, outperforming existing methodologies for SDN and Vehicular Ad hoc Networks. It achieved the second-best channel utilization during location-triggered flooding attack, the best link discovery latency during traditional flooding attack, and optimal packet delivery ratio and Matthews correlation coefficient, and zero packet interception ratios during fabrication, replay, and link vanishing attacks, in spite of its increased computational complexity.

Keywords: Blockchain, Link discovery attack, Reinforcement learning, SDVN, Vehicular networks



A Multi-Modal Emotion-Aware System for Workplace Wellness Using Emotion Recognition and an Empathetic Robot

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Prolonged engagement with digital workstations is increasingly associated with stress, fatigue, and adverse health outcomes. To address these challenges, an intelligent application combined with an empathetic robot is proposed for real-time Facial Emotion Recognition (FER) and wellness monitoring to enhance Human-Computer Interactions (HCI) in work environments. To determine a user's emotional and physical state, the system uses deep learning and sophisticated computer vision techniques. The primary contributions of this work are established through three major contributions. The research introduces a uniquely curated, balanced, multi-modal dataset manually validated across nine distinct emotion classes including angry, bored, disgust, fear, happy, neutral, sad, stress, and surprise to ensure demographic diversity and mitigate bias. Second, to process this data, the system utilizes the state-of-the-art You Only Look Once (YOLO) v11n-cls model, representing a significant advancement in emotion-aware computing. Comparative evaluations demonstrate that the YOLOv11n-cls model achieves 94.5% accuracy in FER, decisively outperforming optimized Convolutional Neural Network (CNN) (57.3%) and hybrid CNN-Long Short-Term Memory (78.2%) architectures. Furthermore, the YOLOv11n-cls model achieves 98.7% accuracy in posture-based emotion detection, surpassing transfer learning approaches using MobileNetV2 (85.31%). Third, the AI workflow processes these emotional states through Large Language Models, utilizing Reinforcement Learning to provide highly personalized and contextually relevant wellness interventions. In addition to the application-based HCI, the robot functions as a physical interface capable of conversational engagement, gestural interaction, and proactive interventions, such as promoting ergonomic adjustments and breaks during prolonged static periods. This dual approach, combining a software application with a physical robot, facilitates a holistic enhancement of user well-being. The proposed system offers a practical solution for sustaining productivity while promoting digital wellness, representing a significant advancement in the field of emotion-aware computing.

Keywords: Artificial intelligence, Emotion recognition, Human-computer interaction, Human-robot interaction, Large language model



Artificial Intelligence Framework for Automated Creation of Customized Business Agents for Small Enterprises

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Small and Medium Enterprises (SMEs) are important in the local as well as global economy. However, they face challenges in managing customer communication, sales operations, and inventory due to limited resources and the high cost of advanced technologies like Artificial Intelligence (AI). Most large-scale entrepreneurs use AI-driven solutions such as chatbots and virtual assistants to automate their business operations. However, these systems are too generic and too expensive, and they require technical expertise to manage. Therefore, such expensive methods are unaffordable for small business owners. This research proposes an AI framework for automated creation of customized business agents for small enterprises using Large Language Models (LLMs) and Natural Language Processing (NLP), enabling small business entrepreneurs and solo digital entrepreneurs to create AI agents that meet their specific requirements without any programming knowledge. The system offers a dual-agent architecture consisting of a business owner agent and a customer agent. Together, these agents support tasks such as responding to customer inquiries, handling business updates, retrieving business-specific knowledge, and generating operational insights. Unlike existing solutions that require technical expertise or lack customization, this framework uniquely combines zero-code deployment, dual-agent role specialization, and automated Retrieval-Augmented Generation (RAG) synchronization. The proposed methods involved dataset preparation, business-specific knowledge extraction, prompt-engineering pipelines, agent design, and RAG integration. Several LLMs and different vector databases were compared to select Llama 3.2 as the most suitable LLM and Qdrant as the vector database. The system was evaluated against n8n, a widely adopted workflow automation platform commonly used by SMEs for chatbot deployment, using an e-commerce dataset. Experimental results show the proposed framework achieved a normalized average score of 0.70 across evaluation metrics (BLEU: 0.590, ROUGE-L: 0.664, BERTScore: 0.854) compared to 0.076 for the n8n baseline (BLEU: 0.0105, ROUGE-L: 0.139, BERTScore: 0.078). Overall, the proposed AI framework enhances SME productivity by automating repetitive communication tasks and enabling real-time decision-making, with potential to reduce operational costs by 20–30% while providing 24/7 customer support.

Keywords: AI agents, LLMs, NLP, RAG architecture, SMEs



AI-Assisted Autonomous Trading System for Volatile Cryptocurrency Tokens

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Artificial cryptocurrency tokens are highly volatile and risky to trade, particularly due to fake tokens, pump-and-dump schemes, and coordinated trading activities that can create short-lived momentum and abrupt collapses. This project presents an AI-assisted autonomous trading system designed to reduce decision noise and emotional bias by fusing three complementary signal sources into a single, auditable pipeline for Solana DEX tokens: (i) on-chain wallet activity and DEX OHLCV behavior, (ii) persona-based trader selection based on historical wallet performance, and (iii) off-chain social sentiment used as a gating mechanism. In this work, a signal is a candidate token entry alert represented as a structured record (token address/symbol, timestamp, evidence features). Signals are promoted to trades only when multiple independent validations agree, including wallet/persona credibility via a Trader Selection Framework (TSF), coordinated accumulation patterns from tracked wallets, sentiment strength and evidence count, and rule-based technical confirmation based on EMA, RSI, ATR, and volume conditions. Key contributions include an end-to-end integrated architecture covering stream ingestion, analytics, gating, execution, and audit logging; a TSF for statistically ranking wallets and assigning personas using risk-adjusted behavior; a coordination detector for near-real-time burst detection on wallet traces; and a multi-model NLP sentiment gate using X (formerly Twitter) posts combined with consistency validation (RAG) to reduce spurious triggers. A 7-day replay evaluation over 420 tokens and 1,250 candidate signals produced 312 paper trades under fixed stop-loss and tiered take-profit rules, achieving a 54.2% win rate, +0.42% mean return per trade, -7.8% maximum drawdown, and 18.6 min average holding time, while maintaining near-real-time latency (coordination event median ≈ 320 ms; P95 < 1 s). This demonstrates that multi-source validation and explicit risk constraints can operationalize safer, more systematic automation for high-risk token markets.

Keywords: Artificial intelligence, Autonomous trading, Blockchain, Cryptocurrency, Natural language processing



LLM-Based Banking System for Microfinance Companies in Rural Areas Using Blockchain and Artificial Intelligence

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Microfinance institutions (MFIs) in rural areas play a vital role in financial inclusion but continue to face operational inefficiencies, limited transparency, and security vulnerabilities due to heavy reliance on manual workflows. Particularly in developing countries such as Sri Lanka, these challenges are further exacerbated by unreliable network connectivity and weak digital infrastructure. Therefore, to address these difficulties, this study investigates whether integrating a fine-tuned Large Language Model (LLM) with a permissioned blockchain can deliver a secure, scalable, and accurate digital banking platform tailored for rural microfinance environments. The proposed system introduces a novel five-stage methodology of an AI-driven framework that integrates LLM-based loan assessment with Hyperledger Fabric blockchain, enabling secure transactions, blockchain-enforced role-based access control, and full auditability. The methodology comprises dataset preparation using real-world microfinance records from a Sri Lankan MFI, natural-language prompt transformation, parameter-efficient fine-tuning of a Llama-based model using LoRA adapters, baseline model development using traditional machine learning and transformer-based encoders, and multi-dimensional evaluation across classification, regression, and text-generation tasks. To address rural connectivity limitations, the system adopts a hybrid networking architecture that supports offline transaction processing with later blockchain synchronization. Experimental results demonstrate that the fine-tuned Llama model consistently outperforms baseline models in loan eligibility, repayment capacity, and fraud risk classification, achieving macro-averaged F1 scores of 88%, representing an improvement of 11% over traditional approaches. For regression-based predictions of optimal loan amount and tenure, the proposed model achieves MAE and RMSE values of LKR 25,000 and LKR 50,000, respectively. Unlike existing blockchain-based microfinance systems, the proposed approach uniquely incorporates LLM-driven structured JSON output generation for explainable loan decisions, validated using BLEU (61.9), ROUGE-L (62.5), and BERTScore (83.0) metrics. Security evaluation under three attack scenarios—credential theft, token theft, and private key compromise—shows that blockchain-based authentication maintains a maximum successful attack rate of only 10%, even under full private key compromise, compared to 21% for MFA-only systems and 90% for non-MFA systems. Load testing with 100–500 concurrent users confirms stable system performance, achieving a throughput of 0.79 transactions per second with error rates below 60%.

Keywords: AI — Artificial Intelligence, LLM — Large Language Model, MF — Microfinance, MFA — Multi-Factor Authentication

Economics, Finance, and Management



The Impact of Digital Financial Literacy on Performance of Small and Medium-Scale Enterprises in Matara District, Sri Lanka

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Digital financial literacy comprises the knowledge, attitudes, and skills required to use digital technologies safely and effectively for financial tasks. This study examines the impact of digital financial literacy on entrepreneurial performance among small and medium enterprises (SMEs) in Matara District, Sri Lanka. As digital transformation reshapes the entrepreneurial landscape, understanding how digital financial competencies influence business performance becomes critical for developing economies undergoing rapid technological change. The study adopted a deductive, quantitative research approach with a cross-sectional survey design. Snowball sampling was used because there was no comprehensive list of SMEs that use digital financial tools. Primary data were collected from 114 SMEs through a structured questionnaire adapted from validated instruments with contextual modifications for Sri Lanka. All questions were constructed as five-point Likert-scale items. The results of the multiple regression model indicate that 59.7% of the variance in entrepreneurial performance ($R^2 = 0.597$, $F = 32.026$, $p < 0.000$) is predicted by digital financial literacy. Among the five dimensions of digital financial literacy, four dimensions significantly predicted performance, including Digital Financial Risk Control ($\beta = 0.285$, $p = 0.000$), Awareness of Digital Financial Risk ($\beta = 0.289$, $p = 0.005$), Financial Knowledge ($\beta = 0.193$, $p = 0.031$), and Digital Knowledge ($\beta = 0.171$, $p = 0.044$). Notably, Knowledge of Digital Financial Services ($\beta = 0.001$, $p = 0.986$) did not show a significant effect, suggesting that mere awareness of available tools is insufficient without reliable infrastructure, user-friendly platforms, and supportive regulatory environments. Results emphasize the need for comprehensive digital financial literacy programs that focus on risk management and practical application rather than basic awareness. Policymakers, financial institutions, and educational institutions should prioritize interventions that bridge the gap between knowledge and effective implementation. This study contributes to the literature on digital financial literacy in developing economic contexts, providing empirical evidence from a regional district perspective and identifying critical competencies for SME success in digitalized markets.

Keywords: Digital financial literacy, Entrepreneurial performance, Matara District, SMEs, Sri Lanka



Impact of Perceived Risk on Online Food Purchase Intention: Evidence from Food Ordering App Users in Sri Lanka

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With the change in consumer behavior, consumers in Sri Lanka have started to use food ordering apps more than before. This is because these apps make buying food easy and convenient. However, consumers' intention to use these food ordering apps has often been affected by different types of perceived risks, including product risk, financial risk, psychological risk, and social risk. Therefore, this study examines how perceived risks affect online purchase intention when using food ordering apps. A quantitative method with a descriptive research design was employed, focusing on consumers who use food ordering apps in Sri Lanka. Perceived risk in food ordering apps was conceptualized based on key risk dimensions: financial risk, product risk, social risk, and psychological risk. A structured questionnaire was used to collect data from a sample of 120 consumers who use food ordering apps, using a convenience sampling method. Cronbach's alpha was used to ensure reliability, and multiple regression analysis was used to test the study hypotheses. The results revealed that only social risk ($\beta = -0.14$, $p = 0.02$) has a significant negative impact on online purchase intention. Financial risk ($\beta = -0.16$, $p = 0.05$) was marginally insignificant, while product risk ($\beta = 0.09$, $p = 0.29$) and psychological risk ($\beta = -0.03$, $p = 0.64$) showed no significant impact. Overall, only social risk significantly impacts users' intention to use food-ordering apps. This highlights the importance of social understanding and its risk in influencing consumers. Businesses should try to reduce social concerns by improving their brand image using positive feedback and social proof, as our findings indicate that social risk significantly influences online purchase intention. App developers can increase user trust by being transparent and adding features that make the app more reliable. Future research could explore diverse demographic groups and additional perceived risks that may impact the use of food ordering apps.

Keywords: Food-ordering apps, Food-ordering app usage, Online purchase intention, Perceived risk



The Impact of Social Media on SMEs Growth in Rathnapura District

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This study examines the impact of social media on the growth of small and medium-sized enterprises (SMEs) in Rathnapura District that operate in the manufacturing, retail, service, and other sectors. Accordingly, this research focuses on three key dimensions: mindful adoption, community building, and absorptive capacity. Adopting a deductive, quantitative research approach with a cross-sectional survey design, this study employed snowball sampling to identify 110 SMEs actively using social media for business activities in Rathnapura District. Primary data were collected using a structured questionnaire to ensure consistent responses. Social media measurement used five-point Likert-scale questions, and the target population comprised small and medium-sized enterprises operating in the Rathnapura District. Multiple regression analysis was conducted using SPSS to test four hypotheses examining the relationships between social media and SMEs' growth. The regression model accounted for 85.26% of the variance in SMEs' growth ($R^2 = 0.8526$, $F = 204.482$, $p < 0.000$), indicating a significant relationship between social media and SME growth. Three dimensions significantly predicted growth: Mindful Adoption ($\beta = 0.368$, $p = 0.000$), Community Building ($\beta = 0.262$, $p = 0.003$), and Absorption Capacity ($\beta = 0.326$, $p = 0.000$). Notably, this research emphasizes that the data and dimensions provide valuable empirical evidence of the critical role of social media in influencing the development and success of SMEs in this region. Moreover, this research confirms that effective use of social media can significantly improve the growth prospects of small and medium-sized businesses in Rathnapura. It is also essential for SMEs to increase their competitiveness in the digital economy by strategically engaging with customers, investing in targeted advertising, and maintaining high-quality content. The findings of this study are expected to provide valuable insights into how SMEs can effectively use social media to accelerate growth, enhance customer engagement, and improve business performance. The study also offers practical implications for policymakers and business owners in developing strategies to maximize the benefits of social media use.

Keywords: Absorptive capacity, Community building, Mindful adoption, Rathnapura District, SMEs growth, Social media

Education, Humanities, and Social Sciences



Impact of Sleep Patterns on Attention Focus during Lectures: A Perception-Based Study of Undergraduate Students

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Sleep quality and regularity are critical for maintaining attention, learning capacity, and academic success. However, inadequate and irregular sleep remains a prevalent concern among university students. This study examines the relationship between sleep patterns and attention focus during lectures among Sri Lankan undergraduates, addressing a gap in regional empirical research on student well-being and learning performance. Data were collected from 161 respondents representing both state and private universities through a structured questionnaire based on the Pittsburgh Sleep Quality Index (PSQI) and related validated scales. Descriptive and inferential statistical methods, including Pearson correlation and regression analysis, were employed to assess associations between sleep duration, quality, and perceived attentiveness. Findings revealed that nearly half of the participants (49%) slept fewer than six hours per night, below the recommended 7–9 hours, while 54% self-rated their sleep as “good.” However, regression results indicated no significant relationship between total sleep duration and attention ($R^2 = .001$, $p = .632$). These results suggest that sleep quality and consistency exert a greater influence on cognitive focus than sleep quantity alone. Environmental and behavioral factors such as irregular routines, digital device use, and late-night study sessions also emerged as potential contributors to poor attentiveness. The study underscores the importance of promoting sleep hygiene awareness, stress management programs, and flexible academic scheduling in higher education institutions. By integrating behavioral health interventions into university support systems, educators can enhance students’ cognitive alertness, emotional well-being, and academic engagement. These findings contribute to the growing global understanding of how lifestyle factors impact learning outcomes, particularly within the South Asian higher education context.

Keywords: Sleep Quality, Attention, Cognitive Performance, Undergraduates, Sri Lanka, Academic Engagement



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මහජන පුස්තකාලය රටක පුළුල් සහ නොමිලේ සේවා සපයන ආයතනයක්වන අතර එහි එක් සේවාවක් වන ළමා පුස්තකාල සේවාව ළමා මනෝවිද්‍යාත්මක මූලධර්ම හා සමාජ විද්‍යාත්මක කරුණු පදනම් කරගනිමින් සැලසුම් කෙරේ. ශ්‍රී ලංකාවේ මහජන පුස්තකාල පද්ධතිය පළාත් පාලන ආයතන යටතේ ක්‍රියාත්මක වන අතර ඒවා අතර ආර්ථික මට්ටම, තාක්ෂණික පහසුකම් ආදිය සම්බන්ධ විචල්‍යතා පැවතියද බොහෝ මහජන පුස්තකාලයන්හි ළමා පාඨකයින් ඉලක්ක කරගත් පුස්තකාල සේවාවන් පවත්වාගෙන යනු ලැබේ. සමහර පුස්තකාලයන්හි ළමා පුස්තකාල සේවාවන් නොපවතින අතර ඒ සඳහා විවිධ කරුණු බලපා ඇත. මෙම අධ්‍යයනය මගින් ශ්‍රී ලංකාවේ දකුණු පළාතේ මහජන පුස්තකාල පද්ධතිය තුළ පවත්නා ළමා පුස්තකාල සේවාව විමර්ශනය කරන අතර ළමා පුස්තකාල සේවාව පිළිබඳ පුස්තකාලාධිපති වරුන්ගේ ආකල්ප හා ඒවා පවත්වාගෙන යාමේදී මුහුණපාන ගැටළු පිළිබඳ විමසා බලන ලදී. නියැදි සමීක්ෂණ ක්‍රමවේදය භාවිතයට ගනිමින් ශ්‍රී ලංකාවේ දකුණු පළාතේ මහජන පුස්තකාල 154ක් අතුරින් ගාල්ල, මාතර හා හම්බන්තොට දිස්ත්‍රික්කයන්හි හඳුනාගත් මහජන පුස්තකාල 30ක් ඇසුරින් පුස්තකාලපතිවරුන් 30 (46%) දෙනෙකු හා අහඹු පාඨකයින් 450 දෙනෙකුගෙන් ප්‍රශ්නාවලි, සම්මුඛ සාකච්ඡා ආශ්රයෙන් ලබාගත් ප්‍රමාණාත්මක හා ගුණාත්මක දත්ත හා පර්යේෂකයා විසින් නිරීක්ෂණ ක්‍රමවේදය මගින් ලබාගත් දත්ත විස්තරාත්මක විග්‍රහයට ලක් කරමින් නිගමන වලට එළඹෙන ලදී. සොයාගැනීම් වලට අනුව ශ්‍රී ලංකාවේ දකුණු පළාතේ මහජන පුස්තකාල අතරින් 97% ක් වෙනම ළමා පුස්තකාල අංශයක් පවත්වාගෙන යන අතර 3% පුස්තකාල කිසිදු සුවිශේෂී ළමා පුස්තකාල සේවාවක් පවත්වාගෙන නොයයි. පුස්තකාලාධිපතිවරුන් අතරින් 34% පවත්නා ළමා පුස්තකාල සේවය පිළිබඳ තෘප්තිමත්වන අතර 13% ක් අතෘප්තිමත් වෙති. ඉතිරි අය මේ පිළිබඳ අදහසක් නොමැත. සියළුම පුස්තකාල සඳහා රාජ්‍ය මුදල් ප්‍රතිපාදන ප්‍රමාණවත් නොවූ අතර 93% පුස්තකාල බාහිර පරිත්‍යාගශීලීන්ගේ ප්‍රතිපාදන මත ළමා පුස්තකාල සේවය පවත්වාගෙන යති. මේ අතරින් 6% මුදල් පරිත්‍යාගද, 46% මුදල් හා ද්‍රව්‍ය පරිත්‍යාගද , 48% ද්‍රව්‍ය පමණක් ද ලබාගෙන ඇත. පාඨකයින් අතුරින් 43% ළමා පුස්තකාල සේවය පිළිබඳ තෘප්තිමත් වුවද 57% අතෘප්තිමත් වී ඇත. අධ්‍යයනයට අනුව පොදුවේ ශ්‍රී ලංකාවේ දකුණු පළාතේ මහජන පුස්තකාලයන්හි ළමා පුස්තකාල සේවය පවත්වාගෙන යාමේදී විවිධ ගැටළුවලට මුහුණ දියයුතු අතර ප්‍රමාණවත් යටිතල පහසුකම් නොමැතිවීම, ප්‍රමාණවත් මූල්‍ය ප්‍රතිපාදන නොමැතිවීම, පුස්තකාල කාර්යමණ්ඩලයේ ළමා අංශ පවත්වාගෙන යාම පිළිබඳ පුහුණුවක් නොමැතිකම හා නවීන තාක්ෂණය නොමැතිකම ආදිය කෙරෙහි විශේෂ අවධානයක් යොමු කළ යුතුවේ.

මූල්‍ය පද - ළමා පුස්තකාල සේවා, ශ්‍රී ලංකාවේ මහජන පුස්තකාල, ළමා පුස්තකාල ගැටළු, ළමා පුස්තකාල පාඨක ආකල්ප



ශ්‍රී ලාංකික කිතුනු සාහිත්‍ය කලාවේ අභිවර්ධනය වෙනුවෙන් ජාතෝමේ
ගොන්සාල්වෙස් පියතුමාගේ දායකත්වය පිළිබඳව ඓතිහාසික අධ්‍යයනයක්

එල්.එල්.එල්.මධුවන්ති¹, එල්. ගමගේ^{1*}

¹ ඉතිහාසය හා පුරාවිද්‍යා අධ්‍යයනාංශය, රුහුණ විශ්වවිද්‍යාලය, මාතර, ශ්‍රී ලංකාව

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ක්‍රි.ව. 1505 දී ශ්‍රී ලංකාවේ සමහර ප්‍රදේශ පෘතුගීසීන් විසින් යටත් කර ගනු ලැබී ය. පෘතුගීසී පාලන සමයෙහි ප්‍රධාන වශයෙන් ශ්‍රී ලංකාවේ මුහුදුබඩ පළාත්වල ක්‍රිස්තියානි දහර්තය සහ ඒ හා බැඳී ගිය සාහිත්‍ය හා කලාවේ අභිවර්ධනයක් දැහැමාන විය. පෘතුගීසීන්ගෙන් අනතුරු ව ලංකාවේ මුහුදුබඩ ප්‍රදේශය පාලනය කරනු ලැබුවේ ලන්දේසීන් විසින් ය. ලන්දේසි පාලන සමයෙහි ක්‍රිස්තියානි දහර්තය විසින් පෝෂණය කරනු ලැබූ සාහිත්‍ය හා කලා කටයුතුවලට විවිධ තාඩන පීඩන එල්ල වූ අතර ඒ වෙනුවට ලන්දේසීන් අදහනු ලබන රෙපරමාදු ආගම සහ ඒ හා බැඳී ගිය සංස්කෘතිය ව්‍යාප්ත විය. මෙම අවස්ථාවේ කිතුනු දහම හා බැඳුණු කලාවේ සංස්කෘතිය ආරක්‍ෂා කර ගැනීමට ක්‍රිස්තියානි පූජකයින් ලංකාවට පැමිණි අතර ඒ අතරින් ජාතෝමේ ගොන්සාල්වෙස් පියතුමාට හිමිවනුයේ සුවිශේෂී ස්ථානයකි. ඒ අනුව මෙම අධ්‍යයනය ගොන්සාල්වෙස් පියතුමාගෙන් මෙරට කලාවට හා සාහිත්‍යයට සිදු වූ සේවාව පිළිබඳ ව අධ්‍යයනය කිරීමේ අරමුණින් සිදු වූවකි. මෙම අධ්‍යයනය ගුණාත්මක දත්ත විශ්ලේෂණයකි. ප්‍රාථමික හා ද්විතීයික යන මූලාශ්‍රය දෙවර්ගය ම මෙහි ලා පරිශීලනය කරනු ලැබීණි. ද්විතීයික මූලාශ්‍රය අතර විවිධ පොත්පත් හා ග්‍රන්ථ වැදගත් වන අතර ප්‍රාථමික මූලාශ්‍රය අතර සමකාලීන ලේඛන වැදගත් වේ. ඊට අමතර ව ක්ෂේත්‍රය පිළිබඳ ව දැනීමක් ඇති ක්‍රිස්තියානි පියවරුන්/පූජකවරුන් සමග ගැඹුරු සාකච්ඡා (In-depth Interviews) පවත්වනු ලැබී ය. තේමාත්මක විශ්ලේෂණ ක්‍රමය (Thematic Analysis Method) යටතේ දත්ත විශ්ලේෂණය කෙරිණි. මෙම ප්‍රයෝජ්‍යයට අනුව ජාතෝමේ ගොන්සාල්වෙස් පියතුමා මෙරට කිතුනු සාහිත්‍ය හා කලාවේ අභිවර්ධනය වෙනුවෙන් කටයුතු කළ බවත්, දේශීය සංස්කෘතීන් සමඟ ඒකී අංගයන් සම්මිශ්‍රණය කර ගැනීමට දායකත්වයන් දැක්වූ බවත් ගම්‍යමාන වේ.

මුඛ්‍ය පද -කලාව, කිතුනු, ජාතෝමේ ගොන්සාල්වෙස්, පෘතුගීසී, රෙපරමාදු ආගම



Assessing the Feasibility of WhatsApp-Based Digital Extension Services for Paddy Farmers in Sri Lanka: Evidence from Ampara District

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Agricultural extension services crucially enhance agricultural productivity and food security. Traditional extension systems constantly face serious drawbacks: inadequate communication between farmers and extension officers, limited extension staff capacity, and the slow delivery of timely information. These constraints are particularly evident in Ampara, a leading paddy-producing region in Sri Lanka. This study explored the potential of introducing a WhatsApp-based e-extension service system as an innovative, low-cost, and interactive communication tool. Primary data were collected through a pretested structured questionnaire from a sample of 150 paddy farmers in the Akkaraipattu East, Akkaraipattu West, and Sammanthurai agrarian service areas. Descriptive statistics, confirmatory factor analysis, and a Smart PLS structural model were adopted to assess relationships between key variables: perceived ease of use, perceived usefulness, attitude toward use, and behavioral intention. Findings showed that existing e-extension platforms (Govi Nena, Govi Mithuru, and Krushi Advisor) face several challenges: ineffective communication (mean = 4.50, $p = 0.001$), lack of tailored solutions (mean = 3.79, $p = 0.004$), and information gaps (mean = 3.75, $p = 0.003$). Strong relationships were observed among perceived ease of use, perceived usefulness, and behavioral intention (path coefficients $\beta = 0.83$ and 0.91), suggesting that farmers find WhatsApp more accessible than existing e-sources, and ease of use becomes more effective for obtaining timely information in a trusted way (attitude toward using WhatsApp, $\beta = 0.89$). The study concludes that a WhatsApp-based extension system could significantly improve the accessibility of relevant agricultural information in a timely manner, which can strengthen real-time communication, deliver personalized guidance, and make extension services more accessible. This study offers meaningful insights for policymakers and extension agencies to modernize their approaches by embracing simple, farmer-friendly digital tools to boost agricultural productivity.

Keywords: Digital extension, Farmer readiness, Paddy sector, WhatsApp-based communication



Interconnected Academic, Personal, Social, and Administrative Challenges: An Anonymous Digital Help Desk for Undergraduates at the Faculty of Agriculture, University of Ruhuna

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Undergraduates may face difficulties throughout their university life due to various root causes. Students navigate a complex blend of academic, personal, social, and administrative challenges that directly affect their well-being and performance. Many state universities in Sri Lanka, including the University of Ruhuna, offer support mechanisms such as mentoring and counseling, but undergraduates are often hesitant to seek help due to inner struggles such as fear of judgment, lack of anonymity, and limited awareness about available services. This study addresses the necessity of an anonymous, technology-based Student Help Desk (SHD) by identifying the types and severity of challenges faced by undergraduates at the Faculty of Agriculture, University of Ruhuna. The total sample consisted of 150 students representing all four academic years, including 1st, 2nd, 3rd, and final year students. A semi-structured questionnaire was distributed via Google Forms using a convenience sampling technique. Both descriptive and inferential analyses were adopted to identify the relationships between variables. Smart PLS Structural Equation Modeling (SEM) clearly explored the relationships among student performance and Academic Challenges (AC), Personal Consequences (PC), Social Issues (SI), and Administrative Issues (AI). The findings revealed that PC strongly influences both administrative ($\beta = 0.662$) and social challenges ($\beta = 0.545$). This highlights how stress, financial struggles, and emotional difficulties spill over into academic performance. Administrative problems ($\beta = 0.558$) and social issues ($\beta = 0.351$) contribute significantly to individual academic performance. Personal Consequences (PC) showed the strongest influence across all domains ($f^2 = 0.548$). Collectively, the model explains 44.9% of academic, 43.8% of administrative, and 29.7% of social challenges, demonstrating interconnected structural barriers affecting student performance. In conclusion, there is an urgent need for an anonymous SHD to provide timely academic, administrative, technical, and psychological support as a transparent platform to foster a more inclusive and supportive learning environment.

Keywords: Academic performance, Challenges, Student Help Desk, Undergraduate, University experience



Assessing the Need for a Digital, Anonymous Students' Help Desk (SHD) at the Faculty of Agriculture, University of Ruhuna

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University students face numerous academic, social, and personal challenges that can negatively impact their academic performance and overall well-being. Although support mechanisms such as counseling and mentoring are available, many students hesitate to use them due to fear of judgment or social pressures. This study assessed the need for a digital, anonymous Students' Help Desk (SHD) at the Faculty of Agriculture, University of Ruhuna, Sri Lanka, to provide timely academic, administrative, and mental health support. A cross-sectional survey was conducted among 155 undergraduates across three degree programs: BSc in Agricultural Resource Management and Technology, BSc in Agribusiness Management, and BSc in Green Technology. Data on socio-demographics, academic performance, digital access, and preferences for anonymous reporting were collected using structured questionnaires and analyzed descriptively. Results indicated that 48% of students preferred anonymity when sharing personal or social concerns, 60% agreed that technology-based anonymous platforms would allow all students to raise concerns fairly, 69% perceived the SHD as improving communication with administration, and 75% believed it could positively impact mental health. High digital readiness (97% owning smartphones or laptops) further supports the feasibility. Chi-square and Spearman correlation analyses revealed no significant differences across gender ($p = 0.204$), age, GPA, or scholarship status, indicating a universally high demand for the platform among both male and female students. Findings indicate that mental health and personal concerns represent the highest priority, followed by administrative and academic support. Overall, the results highlight a strong preference for an anonymous, digital, student-centered help desk to address academic, administrative, and social challenges. Implementation of such a system is expected to enhance accessibility, inclusiveness, early detection of student issues, and overall well-being, while reducing faculty workload and improving institutional responsiveness.

Keywords: Academic support, Anonymity, Digital platform, Mental health, Students' Help Desk, University of Ruhuna



Collective War Memory and Ethnic Reconciliation in Contemporary Sri Lanka: Voices from the Eastern Province

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More than a decade after the formal end of Sri Lanka's civil war in 2009, reconciliation remains fragile and contested. While post-war state initiatives have prioritized infrastructure development and economic reconstruction, less attention has been given to the enduring role of war memory in shaping interethnic relations and community trust. This study examines how war memory influences ethnic reconciliation in post-conflict Sri Lanka, focusing on the Eastern Province—one of the regions most severely affected by the conflict. The research was conducted between 2022 and 2024 in Karadiyanaru village, Batticaloa District, using a mixed-methods ethnographic design. Qualitative data were collected through 30 semi-structured interviews with war-affected civilians, including war widows, ex-combatants, elders, and community leaders, along with 10 key informant interviews. Quantitative data were obtained from a simple random sample household survey of 110 respondents selected from 130 distributed questionnaires. Thematic and narrative analysis techniques were applied to qualitative data, while descriptive statistical analysis was used for survey findings. The findings reveal that collective memories of fear, displacement, insecurity, and loss remain deeply embedded in everyday life, shaping interpersonal trust and interethnic engagement. Participants emphasized that state-led memorialization practices often privilege narratives of military victory while marginalizing Tamil suffering, producing emotional distress and a sense of exclusion from national reconciliation frameworks. Material development initiatives such as road construction, housing schemes, and livelihood programs were perceived as insufficient in addressing unresolved trauma, demands for recognition, and structural grievances. Respondents prioritized dignified memorialization, access to death certificates, proper burials, psychosocial support, compensation, and equitable power-sharing arrangements as essential components of reconciliation. The study argues that sustainable reconciliation in Sri Lanka requires integrating memory-sensitive, trauma-informed, and justice-oriented approaches into national peacebuilding strategies. By foregrounding survivor testimony and community narratives, this research contributes to sociological debates on memory politics and transitional justice in post-conflict societies.

Keywords: Ethnic reconciliation, Post-conflict Sri Lanka, Psychological trauma, Transitional justice, War memory



Systemic Dissonance in Higher Education: The Collapse of Cadre Norms Amidst Expansion and Austerity — Insights through the University of Ruhuna

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Staff-to-student ratios serve as one of the fundamental indicators of institutional quality in higher education. In Sri Lanka, the University Grants Commission (UGC) formalized these standards via Circular No. 04/2019, mandating specific staffing ratios for academic, temporary academic, administrative, and support staff categories. Ideally, this policy framework requires that student intake expansion be synchronized with proportional workforce growth. However, this study identifies a systemic breakdown in this mechanism, precipitating a “tri-partite divergence” between regulatory standards (Normative De Jure), administrative authorizations (Static De Jure), and operational realities (De Facto). Using the University of Ruhuna (UoR) as a case study, this research investigates the “quality gap” driven by uncoordinated increase in student enrollment and severe post-2022 economic austerity measures. A critical disruption occurred between the 2017/2018 and 2023/2024 academic years, where annual student intake increased by 30% to 160% across different faculties, while the workforce simultaneously contracted due to “brain drain” and the strict 2022 treasury recruitment freeze. Quantitative analysis exposes a two-tiered crisis: a “policy gap” where approved cadres failed to match intake, and a “vacancy gap” where even approved posts remain unfilled. Currently, UoR faces an academic shortage of 221 against the approved cadre and 894 cadre positions against the regulatory norm. Consequently, student-to-teacher ratios have deteriorated drastically compared to UGC standards: Medicine (1:12 vs. 1:7), Science (reaching 1:38 vs. 1:10), Humanities (1:26 vs. 1:15), and Management (1:51 vs. 1:18). Furthermore, the administrative and executive staff ratio has plummeted to 1:0.02 (norm: 1:0.1), while the support staff ratio stands at 1:1.3, failing to meet the 1:2 standard for science-based programs. The institution’s records show absolute shortfalls of 369 temporary instructors, 113 administrative/executive staff, and 1,454 support staff. To prevent an irreversible collapse in educational quality, the higher education sector must be exempted from the 2022 recruitment restrictions to urgently fill approved vacancies and align staffing with established norms.

Keywords: Brain drain, Higher education quality, Quality assurance, Recruitment freeze, Staff-to-student ratio



Pedagogical Versus Andragogical Learning Patterns Reflected in Artificial Intelligence Use Among Allied Health Undergraduates at the University of Ruhuna, Sri Lanka

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Artificial intelligence (AI) is increasingly influencing health professions education, yet the extent to which positive student perceptions translate into routine educational use remains unclear, particularly within a pedagogy and andragogy framework in low- and middle-income settings. To identify independent predictors of high-frequency educational AI use among allied health undergraduates at the University of Ruhuna, Sri Lanka. A descriptive cross-sectional online survey was conducted among 278 undergraduates from the Departments of Nursing, Pharmacy, and Medical Laboratory Science. A pretested questionnaire assessed demographics, knowledge, attitudes, practices, barriers, and ethical concerns related to AI. Binary logistic regression determined independent predictors of high-frequency educational AI use, adjusting for gender, formal AI education, knowledge level, academic year, and department. Learning orientation was not measured separately but inferred from patterns of autonomous AI use versus non-use, consistent with adult learning theory. Although 51.4% of students reported adequate AI knowledge and 86.7% perceived AI as beneficial, educational AI use remained limited. Nearly half (48.6%) reported no academic AI use, and only 5.4% used AI daily. The most common barriers were lack of skill (79.3%) and limited resources (61.1%). In the adjusted model, gender was the only significant independent predictor. Male students had approximately two-fold higher odds of frequent educational AI use than females (OR = 2.05; 95% CI:1.12 to 3.75; $p = 0.020$). Other variables were not significant. Positive perceptions and perceived knowledge of AI did not translate into autonomous educational practice, revealing an attitude-practice gap. Frequent self-initiated AI use was interpreted as a proxy for andragogical learning, whereas low or absent use reflected reliance on pedagogically structured learning. Skill-focused, autonomy-supportive, and gender-sensitive strategies are essential to promote equitable and effective AI integration in allied health education.

Keywords: Artificial intelligence, Allied health education, Pedagogy, Andragogy, Educational technology, Sri Lanka



Green Innovation Intention among Engineering Undergraduates in Sri Lanka

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Green innovation has emerged as a crucial approach to finding solutions for global environmental problems while supporting sustainable economic development. As nations increasingly embrace greener technologies and practices, the role of future engineers has become vitally important. Developing countries are increasingly facing challenges posed by the negative consequences of environmental degradation. Therefore, it is important to examine the tendency of engineering undergraduates toward developing green innovations in a developing country like Sri Lanka. Since existing literature on students' intention toward green innovation is limited, this research was designed to assess the factors affecting the green innovation intention of engineering undergraduates in Sri Lanka. Factors were determined mainly based on the theory of planned behavior (TPB). This research examined the effects of attitudes, social norms, and perceived behavioral control on green innovation intention of engineering students. In addition, effects of environmental awareness and living in a resource-constrained environment on green innovation intention were also considered. Survey responses were collected from engineering undergraduates in Sri Lanka using the snowball sampling method, and 515 responses were analyzed using PLS-SEM with SMARTPLS4 software. The results revealed that environmental awareness ($\beta = 0.137, p < 0.05$) and living in a resource-constrained environment ($\beta = 0.231, p < 0.001$) have significant positive effects on students' green innovation intention. While perceived behavioral control and social norms significantly influenced green innovation intention, attitudes toward green innovation did not show a statistically significant effect. Overall, the findings suggest that contextual and environmental factors play a more prominent role than personal attitudes in shaping green innovation intention. This study contributes to the literature by exploring an extended version of the TPB in relation to engineering students' green innovation intention and highlights the need for universities to enhance environmental awareness, social support mechanisms, and exposure to resource-constrained innovations to foster environmentally sustainable engineering practices.

Keywords: Green innovation intention, Resource-constrained environment, Sri Lanka, Theory of planned behavior



Can AI Boost the 3Rs? Exploring the Influence of AI-Based Learning Applications on Students' Information Processing Skills

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Artificial intelligence (AI) is rapidly revolutionizing the higher education sector and transforming how students learn, understand, and interact with information via AI-based learning tools. As there are no previous studies comparing AI-based and traditional learning within the 3Rs framework, a research gap is evident. Therefore, the current exploratory study investigates the effects of AI-based learning applications on students' information processing skills and draws special attention to the 3Rs: review, retention, and retrieval. Six hundred fifty (650) undergraduates were purposefully divided into two groups. All students were provided an information-search assignment, for which they had to collect, analyze, and use information on course-specific topics covered during the first three months of the semester. One group was instructed to use AI-based learning tools, while the other group was not. One week was given to each group to complete the task. Immediately after completion, 121 students in each group (242 total) were randomly selected using the Morgan table. The selected two groups responded to a self-reported questionnaire, which measured their information review skills, ability to store information in long-term memory, and capacity to retrieve relevant knowledge. A comparison of retrieval fluency, retention, and review skills was conducted through quantitative analysis. Statistical differences between observational groups were found. Students who practiced AI-based learning had greater retrieval fluency, while those who followed regular studies had much stronger information review and long-term retention. These results indicate that although AI-based tools can assist in quick access to information, traditional learning methods are proven to be better for deep cognitive processing and long-term memory encoding. The study highlights the necessity of a blended and pedagogically oriented combination between AI-based and traditional learning technologies in higher education.

Keywords: Artificial intelligence in education, Information processing skills, Review, Retention, and Retrieval (3Rs)



AI Readiness in Academic Libraries: Usage Patterns, Barriers, and Training Needs at the University of Ruhuna

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Within the dynamic global scenario, though library operations are being revolutionized through Artificial Intelligence (AI), its acceptance by library staff remains varied. This study aimed to evaluate the awareness, usage patterns, barriers to adoption, and training interests among library staff at the University of Ruhuna. An online survey was administered to 50 staff members, including academic, non-academic, and administrative staff, representing multiple levels of experience. According to the survey results, 66% of staff reported being familiar with AI tools, but only 10% had received formal training, revealing an 86% training gap. Despite this limited training, 60% currently use AI tools, mainly for translation services (68% of users), ChatGPT (52%), and grammar checkers (34%). Additionally, 64% of users reported using them regularly (daily or weekly). The benefits reported by staff included increased productivity, work accuracy, and significant time savings. The main barriers to using and adopting AI tools were lack of formal training on AI, limited awareness of available AI tools, and insufficient technical skills. Moreover, results indicated that interest in training is high, with 86% showing strong interest in receiving training and 90% preferring hands-on workshops. Regarding future library services, staff rated AI as very important (78%) or important (18%). However, self-assessed understanding of AI remained low, with 68% rating themselves at or below moderate proficiency. The results indicated a negative relationship between experience and AI understanding, showing that senior staff, particularly those with over 20 years of experience, had the lowest comprehension score of 1.9 out of 5. Therefore, it is recommended that structured training sessions be offered, including peer learning sessions, development of customized AI tools for library applications, and clear timelines for addressing skills gaps.

Keywords: Academic libraries, Artificial intelligence, Library services, Staff training, Technology adoption, Professional development



Approaches to Measuring and Modelling School Education Quality: A Systematic Review

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A clear definition of 'quality of education' remains a challenge for researchers. Education quality encompasses multiple factors that must satisfy stakeholders, and it has been established that students, teachers, administrative staff, physical facilities and infrastructure, teaching, learning outcomes, and curricular and extracurricular activities are critical factors that guide students toward excellence. Educational quality can be considered in terms of efficiency, effectiveness, and equity. This study aimed to conduct a systematic review of quality education-related research. The research question examined the existing conditions for quality education as illustrated by previous studies, with special reference to quantitative studies. It is debatable whether prevailing indicators and modelling techniques are adaptable for multifaceted quantitative and qualitative approaches to measuring quality in education. In this study, a systematic review (SR) was carried out based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, considering 22 research articles published between 2000 and 2025 about composite index estimation for quality education, excluding non-English papers. As a composite indicator that evaluates multidimensional concepts into a single measure, the systematic literature review produced research trends, indicators, methods, and challenges for measuring educational quality in empirical estimations locally and internationally. Based on the results, Principal Component Analysis (PCA), multiplicative aggregation, Data Envelopment Analysis model, arithmetic averaging, normalization, weighted arithmetic mean, and correlation analysis through multi-criteria measurement and assessment of quality are popular in this field. Principal Component Analysis (PCA) is one leading method used to design a composite index and was later extended into Weighted Principal Component (WPC) analysis based on the dimensions of variables. The literature analysis highlights the importance of leveraging both quantitative and qualitative approaches in one measuring tool. Therefore, the Benefit of the Doubt (BoD) and virtual weighting, inter-transmission comparisons, and considering a quantitative approach would be ideal for designing a moderated composite index for quality education estimation.

Keywords: Quality of education, Systematic review, School education, Quantitative study, PRISMA method



‘ත්‍රිමද ගලිත හස්ති’ යන්න භාෂා-සාහිත්‍ය සංකල්පයන්හි ලා විශද වන ආකාරය

පූජ්‍ය ආචාර්ය මොරකන්දේගොඩ අරියවංස හිමි^{1*}

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සිංහල භාෂා-සාහිත්‍ය සම්ප්‍රදායයෙහි ලා විවිධාචර් ජනනය හා කථනය කෙරෙන යෙදුමක් සේ ‘ත්‍රිමද ගලිත හස්ති’ යන්න හඳුනා ගත හැකි ය. භාෂා තත්ත්වයන්ට අනුව ත්‍රිවිධ ස්ථානයකින් මද වැගිරීම හා ත්‍රිවිධාකාරයකින් මද වැගිරීම යනුවෙන් මෙහි අථර් ද්වයයක් පවතියි. ‘ත්‍රිමද ගලිත හස්ති’ යන්න භාෂා-සාහිත්‍ය සම්ප්‍රදායයෙහි විග්‍රහ වන්නේ කෙසේ ද? යන්න පිළිබඳ විමර්ශනය කිරීම මෙහි ප්‍රධාන අරමුණ වේ. ‘ත්‍රිමද ගලිත’ යන පදය සම්බන්ධයෙන් සිංහල භාෂා සම්ප්‍රදායයෙහි අන්තර්ගත ද්විතීයික ස්වරූපය නිරාකරණය කිරීම, සංස්කෘත-පාලි ආදී භාෂාවන්හි මෙකී සංකල්පය විශද වී ඇති ආකාරය විමර්ශනය කිරීම, මෙකී පදයෙහි අථර් විග්‍රහය ස්ථාන වාචිත්වයෙන් ගත යුතු ද නැතහොත් ආකාර වාචිත්වයෙන් ගත යුතු ද යන්න නිර්ණය කිරීම මේ පර්යේෂණයෙහි අරමුණු ය. මෙහි ලා ගුණාත්මක පර්යේෂණ ක්‍රමවේදය භාවිත අතර මෙකී සංකල්පය ඇතුළත් සම්භාව්‍ය සිංහල ගද්‍ය-පද්‍ය කෘති ප්‍රාථමික මූලාශ්‍රයන් ලෙසත් සිංහල භාෂා-සාහිත්‍යය සම්බන්ධයෙන් සම්පාදිත ශබ්දකෝෂ, ශාස්ත්‍රීය ග්‍රන්ථ හා ප්‍රායෝගික ලිපි යනාදිය ද්වේනික මූලාශ්‍රයන් ලෙසත් යොදා ගැනිණි. ඉහතින් සඳහන් කරන්නට යෙදුණු කරුණු අනුව පෙනී යනුයේ ‘ත්‍රිමද ගලිත’ යන්නට අථර් කථන දෙකක් ඇති බවත් ඒවා තත් තත් ප්‍රකරණයට ගැළපෙන සේ භාවිත වන බවත් ය. ‘ත්‍රිමද ගලිත හස්ති’ යන්න හුදකලා හස්තියකු ගැන කීමේදී මද වැගිරෙන ආකාර ත්‍රයයෙන් කුමන හෝ ආකාරයකට සීමා වන බවත් හස්ති සමූහයක් සම්බන්ධයෙන් භාවිත කිරීමේ දී උක්ත ආකාර ත්‍රයයෙන් ඕනෑම අවස්ථාවකට පැමිණ සිටින හස්තීන් ඇති හෙයින් ඒ ඒ හස්තියාට අනුව භාවිත කළ හැකි බවත් ප්‍රකට විය. කෙසේ නමුත් හුදකලා හස්තියකු සම්බන්ධයෙන් ‘ත්‍රිමද’ ‘සජතමද’ හා ‘දශමද’ යන මේවා ආකාර වාචිත්වයෙන් ගෙන පොදුවේ භාවිත කළ නොහැකි බවත් අවශ්‍ය නම් ‘ත්‍රිමද’ අවස්ථාවේ පටන් ‘දශමද’ අවස්ථාව තෙක් ඕනෑම එක් අවස්ථාවක් ගත හැකි බවත් විශද විය.

මුඛ්‍ය පද --- ආකාර වාචිත්වය, ත්‍රිමද ගලිත, දශමද, සජතමද, ස්ථාන වාචිත්වය

Engineering, Technology, and Applied Sciences



Design of Hoisting System for Six Vertical Sliding Gates in Oliyamulla Stormwater Pumping Station

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Urban flooding in low-lying areas of Colombo has intensified due to increased monsoonal rainfall and inadequate gravity drainage capacity, necessitating reliable stormwater control infrastructure. The Oliyamulla Stormwater Pumping Station was developed as a flood mitigation measure within the Peliyagoda-Kelaniya drainage basin and incorporates six vertical sliding gates to regulate pumped and gravity-driven discharges to the Kelani River. Accordingly, an electrically hoisted sluice gates or vertical gates were designed that overcame significant engineering challenges to ensure safe and reliable gate operation. This paper presents the design and implementation of a mechanically robust and cost-effective hoisting system for vertical sliding gates with significantly different sizes, weights, and operating heads. The design methodology involved analytical evaluation of hydrostatic thrust, buoyancy, friction at guides and seals, and dynamic lifting forces. Maximum operating loads of approximately 76 kN per spindle for pump outlet gates and 178 kN per spindle for gravity-flow gates were derived using standard hydraulic load formulations with appropriate safety factors. The spindles are 90 mm in diameter and manufactured from stainless steel Grade 304. Power requirements were calculated from the lifting forces and target spindle speed, resulting in the selection of 7.5 kW and 11 kW geared motor systems operating at lifting speeds of approximately 0.34 m/min. Structural integrity of the screw spindles was verified against Euler buckling, thread wear, and combined stress criteria, while the hoisting platform was validated using SAP2000 finite element analysis. The finalized systems achieved reliable dual-mode operation with overload protection and adequate safety margins. The novelty of this work lies in the unified design approach that standardizes spindle size and transmission components across heterogeneous gate configurations while complying with American Water Works Association (AWWA) and Indian Standards (IS), thereby providing a practical solution for urban flood control infrastructure.

Keywords: flood control, gate hoisting mechanism, screw jack design, stormwater pumping station, mechanical design, sluice gates



Performance Evaluation of a Newly Invented Vertical Axis Wind Turbine with Deflectable Blades

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The proposed mechanism is made more efficient by minimizing the friction and the force required to tilt the blades and by ensuring perfect blade orientation. A workable prototype design features rotatable blades on horizontal shafts connected to a vertical axis, with a wheel-and-track system linked to a yawing mechanism that turns the blades with wind direction. The turbine was fabricated using readily available materials such as PVC pipes, fittings, cardboard, metal sheets, etc.

The wind speed just before (V_1) and after (V_2) both sides of the turbine were measured at several wind speeds generated by a wind source. The $V_1:V_2$ (m s^{-1}) results are: 2.1:0.6, 2.4:0.8, 2.5:0.9, 2.7:1.0, 3.0:1.3, 3.2:1.5, 3.5:1.7, 3.9:1.9. Then the energy available in the blowing wind before and after passing the side of the turbine that captures the wind was calculated. The difference is the energy captured by the wind turbine. A part of this absorbed energy is consumed for the operation of the tilting mechanism. Since both sides of the tilting blades are well balanced, there is minimum or no energy consumed for lifting a blade. The only factor that consumes energy is friction. If friction is minimized, the captured energy can be assumed to approach the mechanical energy generated by the turbine.

The calculated power coefficient values for each incoming wind speed are: 0.98, 0.96, 0.96, 0.95, 0.95, 0.93, 0.92, 0.90, 0.89, 0.88. These results show that the Betz limit of 0.59—defined as the maximum efficiency that can be achieved by any Horizontal Axis Wind Turbine (HAWT)—is exceeded by this VAWT. From the results, it can be concluded that the efficiency of capturing wind energy of this new VAWT is higher than that of conventional Horizontal Axis Wind Turbines (HAWT), which are the most common in commercial use.

Keywords: Vertical axis wind turbines, Deflectable blades, Betz limit, Wind energy



Design and Development of an Automated Bead Laying System Using a Three-Axis Gantry Platform

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In the manufacture of electrical meters, junction boxes, and control panels, soft rubber sealing beads are widely used to prevent the ingress of dust, moisture, and environmental contaminants. In the studied production line, bead laying is performed manually by four operators working eight-hour shifts, limiting output to about 1200 components per day, while upstream injection molding produces 1500 units. This imbalance creates a throughput bottleneck and increases labor costs, while fatigue-related errors cause bead misalignment and inconsistent seating, leading to quality variations. Although automated dispensing systems exist, most are designed for liquid adhesives and are unsuitable for handling solid, deformable rubber beads, especially within narrow grooves and curved paths. The absence of dedicated solutions capable of managing bead deformation, orientation, and seating force highlights a significant gap in current manufacturing practice. This study aims to design and experimentally validate a compact automated bead-laying system that improves consistency, reduces operator dependency, and aligns production rates with upstream processes. The system employs a three-axis Cartesian gantry to provide precise and programmable motion for bead placement along straight and curved grooves in plastic and metal enclosures. The key contribution is a custom multifunctional end-tool specifically developed for deformable bead handling. It integrates continuous bead feeding through an extruder-type mechanism, uniform seating with a spring-loaded roller, tangential alignment using a servo-driven rotary module, and clean termination via an integrated gripper-cutter. This compliance-aware design enables one-pass placement while controlling deformation, contact force, and orientation. The system is optimized for 1.4 mm diameter beads in 1.2 mm grooves. Developed using 3D CAD modeling, finite element analysis, and stepper motor drives, the prototype achieved an 80% success rate during testing on 50 samples. Compared with manual operation, the system reached 1500 units per day with a 45-second cycle time, requiring only one operator. The solution provides a scalable and retrofit-friendly approach for high-mix, low-volume sealing applications.

Keywords: Automated bead laying system, Cartesian gantry system, End-tool design, Sealing bead, Rubber sealing bead, Rubber bead dispensing system



Development of an Air Quality Monitoring and Treatment System for Biomass Heat Generators

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Biomass is widely regarded as a renewable alternative to fossil fuels; however, its combustion can generate harmful emissions such as carbon monoxide (CO), nitrogen oxides (NO_x), and particulate matter (PM), which contribute to global warming, acid rain, and adverse health effects. The Intergovernmental Panel on Climate Change (IPCC) has reported that continued reliance on fossil fuel-based energy systems could increase global average temperatures by 1.4°C to 5.8°C by 2100. This research developed an integrated IoT-based air quality monitoring and treatment system for biomass heat generators, capable of real-time measurement and analysis of combustion characteristics, including CO, NO₂, and particulate matter (PM_{1.0}, PM_{2.5}, PM₁₀). The multistage treatment system consists of a reagent spray reactor (180°C–400°C) using AdBlue for ammonia generation, a selective catalytic reduction reactor (300°C–700°C) for NO_x reduction, and a TiO₂-coated photocatalytic reactor (150°C–250°C) illuminated by UV-A light. The exhaust gas monitoring system was implemented using an ESP32 microcontroller integrated with MiCS-4514, PMS7003, and DHT11 sensors, with data transmitted to cloud-based platforms for remote monitoring and an automated email alert system. The experiment was conducted using rubber, cinnamon, and Gliricidia wood at five mass increments (0.25 kg–1.25 kg), each across 20–40 minute combustion cycles. The results demonstrated significant emission reductions across all biomass types. Rubber wood achieved reductions of 48.75% in NO₂, 32.06% in CO, 40.83% in PM_{1.0}, 76.53% in PM_{2.5}, and 76.21% in PM₁₀. Cinnamon wood showed reductions of 32.38% in NO₂, 28.84% in CO, 44.10% in PM_{1.0}, 72.40% in PM_{2.5}, and 72.17% in PM₁₀. Gliricidia wood exhibited reductions of 41.71% in NO₂, 30.81% in CO, 42.31% in PM_{1.0}, 73.97% in PM_{2.5}, and 74.74% in PM₁₀. The proposed integrated system offers a cost-effective and scalable solution for small to medium-scale industries, enabling compliance with emission regulations while supporting sustainable biomass-based energy utilization.

Keywords: Biomass combustion, Emission reduction, Gas monitoring system, Gas treatment system, Selective catalytic reduction



Design and Development of a Low-Cost Multifunctional Medical Device with Integrated Syringe Pump and Remote Access

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Contemporary healthcare technologies for patient monitoring and precision drug delivery have proliferated globally, yet their elevated costs render them inaccessible in resource-constrained settings. This research introduces a low-cost, multifunctional IoT-enabled medical device that seamlessly integrates an automated syringe pump with real-time monitoring of vital parameters—body temperature, heart rate, and blood oxygen saturation (SpO₂)—alongside remote control capabilities. By unifying these functions into a single platform, the device eliminates equipment multiplicity, streamlines clinical workflows, and facilitates efficient management during routine care and emergencies. The system leverages a microcontroller-driven motor with a lead screw mechanism for syringe actuation, coupled with cost-effective off-the-shelf sensors, ensuring high precision and affordability. Rigorous validation against international standards confirmed superior performance: the syringe pump delivered $\pm 1.67\%$ volumetric accuracy and $\pm 3.94\%$ temporal accuracy (IEC 60601-2-24 compliant), while monitoring achieved heart rate precision of ± 1.82 bpm, SpO₂ accuracy of ± 0.85 – 0.92% , and temperature accuracy of ± 0.56 – 0.85°C (ISO 80601-2-61 compliant). All safety protocols, including occlusion detection and emergency stops, demonstrated 100% reliability. This innovation provides a scalable, accurate solution to enhance patient safety and care accessibility in low-resource healthcare environments.

Keywords: IoT-enabled syringe pump, Patient vital monitoring, Low-cost medical device, Remote healthcare, Resource-limited settings



Investigating Barriers to Sustainable Waste Material Adoption in Concrete Production: A Study in the Sri Lankan Construction Industry

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Despite extensive research demonstrating the technical feasibility of incorporating waste materials as partial replacements in concrete production, real-world implementation remains significantly limited. Studies have identified successful applications of tire rubber as coarse and fine aggregate replacement up to 10%, crushed glass particles as sand and cement replacement up to 10–15%, and concrete demolition waste as coarse aggregate replacement up to 30%. This study addresses the critical research-to-practice gap by exploring multifaceted barriers preventing engineers and clients from adopting these sustainable alternatives—a novel contribution that systematically investigates implementation barriers within the construction industry in Sri Lanka. Key barrier categories were identified through a comprehensive literature review and stakeholder consultations specific to the construction industry. Economic feasibility concerns, supply chain infrastructure deficiencies, technical performance uncertainties, awareness gaps, and reluctance to adopt new technologies were recognized as primary barriers. Experts identified the following main concerns: direct costs and initial processing expenses often outweigh indirect benefits like carbon footprint reduction; maintaining reliable supplies of recycled materials for large-scale projects presents significant supply chain challenges; lack of building code compliance, insufficient technical knowledge, and inadequate guidelines hinder adoption among professionals; and cultural resistance may prevent acceptance beyond technical considerations. These findings are context-specific to the construction industry in Sri Lanka, with limited generalizability to other regions without comparable conditions. These concerns must be studied thoroughly within the legal, economic, environmental, and social conditions of the country to motivate adoption. This requires quantitative data collection and analysis, outlining clear pathways for developing practical strategies: regulatory framework development, financial incentive mechanisms, quality-controlled supply chains, and professional training programs tailored to the construction landscape. These evidence-based efforts facilitate sustainable construction practices and ensure valuable research transitions from academic inquiry to practical implementation, benefiting future generations.

Keywords: Sustainable construction, Recycled materials, Implementation barriers, Research-practice gap, Construction industry



Real-Time Traffic Violation Detection and Analysis Using YOLO-Based Computer Vision Models

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This study presents an advanced automated multi-violation traffic monitoring system developed using state-of-the-art computer vision and deep learning techniques to address modern traffic enforcement challenges. The system detects and analyzes critical violations, including triple riding, helmet violations, illegal parking, red-light violations, speed limit violations, and vehicle number plate recognition using optical character recognition (OCR). A unified pipeline integrates YOLOv8 (You Only Look Once version 8) object detection models with region-specific rule modeling and OCR, enabling real-time, end-to-end violation detection. The novelty of this work lies in combining multiple specialized detection modules with automated evidence generation, region-adaptive rule logic, and robustness under varying traffic conditions. Each module is optimized for specific tasks: the helmet detection module identifies riders without helmets, the triple-riding module counts multiple riders on a single motorcycle, illegal parking is detected using predefined Regions of Interest (ROIs) and temporal occupancy analysis, red-light violations are flagged by combining traffic signal state recognition with vehicle movement tracking, and speed violations are estimated using pixel-distance calibration. Number plates are localized using YOLOv8 and recognized through OCR to link violations directly to vehicle records. Experimental evaluation used six hours of video footage from Sri Lankan roads under both bright and gloomy weather conditions. The system achieved detection accuracies of 92% for helmet violations, 89% for triple riding, 94% for red-light violations, 96% for illegal parking, and 93% for number plate recognition. These results demonstrate improved precision and recall compared to traditional rule-based and earlier CNN-based approaches, particularly under occlusion, variable lighting, and dynamic traffic scenarios. Overall, this AI-driven traffic monitoring framework provides a scalable, reliable, and efficient solution for intelligent traffic management, enhanced law enforcement, and improved road safety, with potential for future expansion to additional violation types and analytical modules.

Keywords: Computer vision, Deep learning, Intelligent traffic monitoring, Optical character recognition (OCR), Traffic violation detection, YOLOv8



Development of Virtual Environment for Swing-Up of Rotary Double Inverted Pendulum for Engineering Education

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The swing-up control of a Rotary Double Inverted Pendulum (RDIP) is considered one of the benchmark problems in teaching advanced control systems engineering. The RDIP is a 4th-order nonlinear underactuated system that involves many coupled forces affecting the system's stability. Fabrication of a reliable RDIP system requires precision machining and high-quality electronic sensors, and the few readily available products on the market are prohibitively expensive. With the current number of student enrollments in engineering faculties at state universities in Sri Lanka, multiple units of such systems are required to improve student interaction and hands-on experience. Therefore, a virtual environment for simulating and testing such systems could improve the current status of engineering education in Sri Lanka. In this study, a virtual environment has been developed for studying the swing-up behavior of the rotary double inverted pendulum. The developed virtual system is based on commonly available software in engineering education. The state-space mathematical model of the system was built using the Lagrangian method. Computer-Aided Design was used to demonstrate the dynamic system behavior visually, which was integrated with real-world conditions such as gravity, friction, and joint damping. The swing-up is achieved using multi-stage energy control. Energy is pumped into the system sequentially, considering the energy levels of the two links separately until the target energy level is achieved. Overall, this virtual environment allows multiple users to engage in individual learning of control systems engineering at once, even without depending on an internet connection. Furthermore, deploying a virtual RDIP will completely eliminate expensive hardware failures due to student mistakes.

Keywords: RDIP, Remote learning, Energy control, Engineering education, Swing-up control



A Scalable IoT-Driven Framework for Predictive Maintenance Using Big Data Analytics and Machine Learning

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The reliance on conventional industrial maintenance strategies like reactive and preventive maintenance leads to unexpected production halts, unnecessary costs, and reduced equipment efficiency. This proposed work addresses these inefficiencies by developing a scalable predictive maintenance (PdM) system for industrial machines, specifically lathe machines. It leverages real-time data from low-cost sensors and advanced deep learning models to monitor parameters such as vibration, temperature, and current using an ESP32 microcontroller. The primary contribution is the implementation of a fault-tolerant architecture utilizing Message Queuing Telemetry Transport (MQTT), Apache Kafka for high-volume message buffering, and Apache Spark for real-time data pre-processing. Another identified gap is the development of an effective AI-based model for predicting machine condition. To address this, a Patch Time-Series Transformer (PatchTST) model is employed rather than a traditional Long-Short-Term-Memory (LSTM) model, which processes 30 days of historical readings (720 past hourly timesteps as the lookback which is the context used by the model) to forecast the next 5 days (120 future hourly timesteps as the horizon which is the forecast prediction time period by the model). Experimental results demonstrate high predictive accuracy, with the 'current' feature achieving 91.89%, 'vibration' at 81.46%, 'body temperature' at 70.51%, and 'shaft temperature' at 86.49%. The goal of implementing this framework is to potentially reduce equipment downtime by approximately 25% based on forecasting-led proactive interventions. This integrated approach provides a robust, cost-effective solution for real-time industrial condition monitoring.

Keywords: Deep learning, Artificial Intelligence, Predictive Maintenance, Transformers, Timeseries Forecasting, Big Data Scalability



IMU Sensor-Based Gait Analysis System for Stroke Risk Identification in Older Adults

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Stroke is a leading cause of deaths and long-term disability among the older adults worldwide. For each successive 10 years after age 55, the stroke rate more than doubles in both men and women. The walking pattern of a person reflects his neurological health status of the body. Patients with neurological diseases, such as stroke, show deviations in walking parameters from normal values. These walking parameters include step length, stride length, number of steps per minute, stance and swing duration, double support time and walking velocity. The availability of an early stroke identification tool can help reduce disability and mortality among older adults through timely clinical intervention and preventive care. Therefore, a wearable inertial measurement unit (IMU) sensor-based gait analysis system was developed to detect stroke-related gait abnormalities and support rehabilitation monitoring in older adults. The IMU sensor-integrated sock band was developed using elastic material and attached to the shank (the part of the leg below the knee and above the ankle) to measure angular velocity and acceleration in the sagittal plane during walking. These measurements were combined using a gravity-based complementary filter to detect heel strike and toe-off, which were then used to calculate gait parameters. A linear regression machine learning model was developed using Python and Scikit-learn to classify people as healthy or stroke patients based on gait parameters. This model used a publicly available dataset and aims to support automatic gait analysis and stroke risk identification. The system supports single-session gait screening and longitudinal monitoring, comparing sessions to baselines for classifying status and tracking stroke recovery. The system could assist doctors in monitoring rehabilitation outcomes and making informed healthcare decisions. The system has the potential to support clinical decision-making by assisting physicians in identifying patients with abnormal gait patterns who may require further clinical assessment.

Keywords: Gait analysis, Inertial measurements units, Stroke risk identification, Wearable sensors, Machine learning



Tuition Class and Student Management System

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Private educational institutions face significant challenges in managing multiple aspects of their operations, including student enrollment, attendance tracking, payment processing, cashier operations, and managing both online and physical classes. Traditional manual systems and fragmented software solutions often lead to inefficiencies, data inconsistencies, and poor accountability. This study presents the design, development, and implementation of a comprehensive web-based class management system utilizing microservices architecture to streamline administrative operations in private educational institutions. The system was developed using React.js for the frontend and PHP 8.0 with MySQL 8.0 for the backend, deployed using Docker containerization. The architecture comprises seven independent microservices: authentication, student management, teacher management, class management, payment processing, cashier operations, and attendance tracking. RESTful APIs enable inter-service communication, while JWT-based authentication ensures security. The system integrates third-party services including PayHere for online payments, a custom WhatsApp API service for notifications, and barcode scanning for attendance. The system successfully manages multi-role access (students, teachers, cashiers, and admins), payment tracking with real-time KPI monitoring, cashier session management, and WhatsApp notifications for payment confirmations. The cashier module successfully handled more than 50 payment transactions per session while maintaining accurate financial tracking and audit trails. The WhatsApp notification system achieved a 98% delivery success rate with an average delivery time of 3–5 seconds. The barcode-based attendance system reduced student check-in time from approximately 30 seconds to under 5 seconds per student. The system maintained 100% uptime during testing. The microservices architecture ensures scalability, maintainability, and fault isolation.

Keywords: Microservices architecture, Educational management system, Web application, Payment processing, Cashier management, Attendance automation



Development of a Low-Cost Smart Medical Bed with mmWave Radar-Based Non-Contact Monitoring and Bilingual Voice Control System

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The growing global elderly population and rising incidence of mobility-limiting injuries have significantly increased the number of bedridden patients requiring long-term care. Caring for these individuals in hospitals and home settings imposes substantial physical and emotional burdens on caregivers, while commercially available smart medical beds remain prohibitively expensive and inaccessible in resource-limited environments. This study presents a low-cost smart medical bed that integrates millimeter-wave (mmWave) radar-based non-contact vital signs monitoring with bilingual (Sinhala and English) voice-activated bed control to enhance patient autonomy and safety.

The system employs a 60 GHz mmWave radar sensor for continuous, non-invasive monitoring of heart rate and respiratory rate, eliminating the need for attached physiological sensors. An ESP32-based voice control unit, connected to a cloud speech recognition service, enables patients to adjust bed positions via Sinhala and English voice commands, while a Raspberry Pi manages radar signal processing, data logging, and communication with a mobile application that displays real-time and historical vital signs. Experimental validation under controlled conditions demonstrated 95% accuracy in heart rate and respiratory rate compared with a medical-grade pulse oximeter at a 1.5 m sensing distance, with minimal body movement. Voice command recognition achieved 95% accuracy for English (38/40 successful commands) and 80% accuracy for Sinhala (32/40 successful commands). The complete system was implemented at a cost below LKR 70,000, offering over 90% cost reduction compared with typical smart medical beds. The proposed solution, therefore, provides a cost-effective, technically robust assistive bed platform suitable for home care and rural healthcare settings, with the potential to reduce caregiver workload and improve continuous monitoring of bedridden patients.

Keywords: mmWave radar sensing, Non-contact vital signs monitoring, Bilingual voice recognition, Smart medical bed, Low-cost healthcare technology



Hydrodynamic Dam Breach Modelling of Ancient Earthen Embankment Dams in Sri Lanka: A Case Study

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Dams, reservoirs, and downstream communities are identified as major components of the irrigated agriculture system in Sri Lanka. However, the aging and deterioration of ancient earthen embankment dams and their vulnerability to extreme rainfall events have raised serious concerns regarding dam safety. Despite the low likelihood, a dam breach could result in catastrophic consequences including loss of life and severe damage to infrastructure and the environment. Thus, hypothetical dam breach modeling has become an effective tool in dam safety management to forecast breach flood exposure downstream. The objective of the present study is to model a hypothetical dam breach scenario at Giritale Dam in Polonnaruwa, triggered by seepage-induced piping. Breach analysis is carried out using HEC-RAS. The initial condition is set as the reservoir at a 10 m head-water stage being subjected to a Probable Maximum Flood (PMF) inflow, and a two-dimensional unsteady flow analysis is simulated to assess dam breach flood behavior downstream. Simulation results estimate a maximum breach discharge of 893.45 m³/s occurring 3.5 hours after breach initiation. An inundation map for the dam breach outflow flood was developed, revealing a total inundation area of over 17.25 km² spanning 12 Grama Niladari (GN) divisions downstream. According to Land Use/Land Cover (LULC) overlay on the inundation map, a 15.08 km² area of paddy cultivation is completely inundated (87% of the total inundation area). Given that irrigated agriculture is the key source of livelihood in the Giritale downstream area, a significant socio-economic impact would result from dam failure. With a great number of aging earthen embankment dams in Sri Lanka currently suffering from alarming seepage issues, insights from this hypothetical dam breach modeling effort are timely for proactive dam safety management in the country.

Keywords: Dam breach, Earthen embankment dams, HEC-RAS, Inundation mapping, Seepage-induced piping



Integrated Health Monitoring System for Preventive Care and Doctor-Patient Interaction

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Diabetes, hypertension, and cholesterol disorders are some of the major chronic diseases globally. Early diagnosis, continuous monitoring, and strong doctor-patient communication are essential for controlling these diseases. While existing digital health systems focus on either medical data or lifestyle monitoring, they lack an integrated approach for preventive care. This system proposes a personalized health monitoring system combining medical data tracking, nutritional monitoring, and interactive doctor-patient communication. The system is built using Node.js, React/React Native, and Firebase, enabling real-time data management. The system has two types of users: patient and doctor. Patients can enter or upload their medical records into the system, including details related to blood pressure, blood sugar, lipid profile, and full blood count. They can monitor their dietary intake manually or by uploading pictures of consumed food. A convolutional neural network trained on 5,000 labeled food images across five food classes was used to recognize food items and estimate nutritional parameters such as calories, sugar, and cholesterol, achieving a validation accuracy of approximately 90%. The estimated values are compared with recommended daily intake limits, and warning messages are generated when thresholds are exceeded, providing actionable insights to support healthier dietary choices. A dedicated dashboard enables doctors to view patient medical histories and provide feedback. The system supports active patient engagement through continuous self-monitoring and timely remote medical feedback. By enabling early identification of potential health issues and remote consultations, the system reduces unnecessary hospital visits, while the integrated real-time chat platform facilitates efficient doctor-patient communication. Overall, the system supports personalized health monitoring and preventive healthcare through integrated data tracking and interactive digital communication.

Keywords: Doctor-Patient Communication, Health Monitoring, Convolutional Neural Network, Preventive Healthcare, Nutrition Analysis



Mitigation of Atmospheric Duct Interference (ADI) in LTE-TDD Networks: A Machine Learning-Based Approach

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Atmospheric Duct Interference (ADI) causes abnormal long-range radio propagation due to refractivity inversions in the lower atmosphere, resulting in severe uplink degradation in LTE-TDD cellular deployments. This research proposes a data-driven framework to automatically detect, predict, and mitigate ADI while preserving network coverage and uplink quality. The proposed framework was developed using two heterogeneous data sources. Network-side measurement data were obtained from Dialog Axiata PLC, collected from LTE-TDD deployments in the Jaffna Peninsula, with approximately 100,000 time-indexed records from over 580 cells across 111 base stations, including uplink interference statistics, symbol-wise uplink power measurements (UL0-UL13), antenna configuration parameters, and geographical coordinates. Environmental and atmospheric parameters were obtained from the Copernicus Climate Data Store, including temperature, pressure, and humidity profiles used to characterize ducting conditions. After preprocessing and labeling, numerical and categorical features were standardized and encoded using a Python-based pipeline. Class imbalance was addressed using random undersampling, and the data were split into 70% training, 15% validation, and 15% testing sets. Three supervised classifiers—Random Forest, Support Vector Machine, and k-Nearest Neighbors—were trained and evaluated using accuracy, confusion matrices, and cross-validation. Among the evaluated models, the Random Forest classifier demonstrated the most stable performance, achieving the highest test accuracy of 97.8% in distinguishing normal and interference-affected conditions. Feature analysis confirmed that uplink interference levels, symbol-wise power ramping behavior, and spatial indicators are dominant predictors. Upon ADI detection, a coordinated mitigation strategy involving adaptive antenna down-tilting, transmit power adjustments, and coverage compensation from neighboring cells was applied using radio propagation modeling. Simulation results demonstrate that over 70% of ADI-induced coverage loss can be recovered without introducing additional spectrum usage. This research presents an original, scalable solution for intelligent ADI management in LTE-TDD networks and provides a practical foundation for future ADI-aware optimization.

Keywords: Atmospheric ducting interference, LTE-TDD, Machine learning, Network optimization, Uplink interference



AI-Based Real-Time Multi-Agent Depression Detection and Therapy System

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Depression is a prevalent mental health disorder in the world, but diagnosis is constrained by stigma, cost and lack of clinical services. This study describes an AI-Based Real-Time Multi-Agent Depression Detection and Therapy System which aims at early detection and provides therapy suggestions. NLP and speech emotion analysis are incorporated to assess the user input and calculate the level of depression using the Patient Health Questionnaire-9 (PHQ-9). Five specialized agents work collaboratively to process text and voice data, retrieve linguistic and emotional features, and categorize mental states from minimal to severe. A fusion model of PHQ-9 scores, classifier confidence, and speech-based emotion indicators produces a factor-calibrated depression index for precise severity differentiation. Depending on the identified level, the system can offer AI-assisted therapeutic care for minimal or moderate cases, while severe cases are referred to professional care. For voice-based emotion detection, wav2vec 2.0 was trained and reached 81% testing accuracy when classifying emotions into happy, sad, fearful, angry, and neutral categories. Among the 10 participants diagnosed with depression, the system correctly matched the actual severity level for 9 individuals, resulting in an accuracy of 90%. Among these matched cases, a comparison based only on PHQ-9 severity revealed one mismatch: PHQ-9 indicated minimal severity, while both the actual diagnosis and the system identified a moderate level. This demonstrates that the proposed system provides a more accurate severity classification than reliance on PHQ-9 scores alone. A comparison of Large Language Models showed that GPT-3.5 and Mistral produced the most fluent outputs, with BERTScores of 71% and 69.2% respectively, outperforming Gemini at 61% and Claude at 59.8%. Among them, GPT-3.5 was identified as the most suitable model to integrate into the system due to its overall performance.

Keywords: Artificial Intelligence, Depression Detection, Mental Health, Multi-Agent System, Natural Language Processing



High-Volume Automated MCQ Marking: An Image Processing Approach for Enhanced Efficiency and Accuracy

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This study proposes the development of an AI-powered optical mark recognition (OMR) system that aims to automate and enhance the grading of multiple-choice question (MCQ) answer sheets. Traditional OMR systems rely on shaded bubbles or pencil marks, which can cause recognition errors, especially when students use different marking styles, such as crosses instead of shading. The manual marking process can take a considerable amount of time for large numbers of students. To overcome these limitations, the proposed system combines advanced image processing techniques with a Convolutional Neural Network (CNN) to accurately classify bubbles as crossed, shaded, or empty. A mathematically calculated and defined A5 bubble-sheet with a 50-question layout was designed to support two paper structures, enabling shuffled question papers for enhanced exam security. These structures make the system more practical, user-friendly, and suitable for large-scale academic and institutional assessments.

The system was implemented using Python with PySide6 for the graphical user interface. In addition, OpenCV, TensorFlow, NumPy, and Pandas were used for processing and model training. A custom dataset was developed using real student-marked papers representing different marking behaviors and image conditions. The final CNN model achieved a validation accuracy of 98.87%. The model demonstrated strong generalization and consistent performance across different lighting and image quality conditions. Furthermore, the Gemini Pro API was incorporated to automatically extract student registration numbers from scanned answer sheets, ensuring accurate mapping between responses and student identities.

The desktop application provides features for automated scoring, manual verification by examiners, and exporting results in Excel format. It also supports evaluating shuffled MCQ papers, enabling examiners to mark answer sheets that belong to different paper versions with different question orders. Additionally, the system includes registration number detection. The system substantially reduces grading time while maintaining human-verified reliability through dual examiner review features. The solution provides a practical, scalable, and cost-efficient alternative to commercial OMR systems for large-scale assessments in universities.

Keywords: MCQ marking, Image processing, Enhancing efficiency, Accuracy



AI-Aided Abnormal Events Detection in Multi-Camera Surveillance Systems

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This paper proposes an abnormal event detection system designed for real-world multi-camera CCTV surveillance applications. Current state-of-the-art systems suffer from limitations imposed by single-camera and computationally predefined or infeasible approaches. Traditional surveillance relies on manual monitoring processes, whereas state-of-the-art systems cannot circumvent problems related to low sensitivity, poor scalability, and inability to generalize to unseen anomaly cases. The proposed solution incorporates deep learning, multi-modal analysis, contextual reasoning, and adaptive learning to deliver a lightweight yet robust anomaly detection framework. It is based on a Multi-Task Temporal Anomaly Detection Network (MT-TADN) that encompasses three key components: the spatial feature extractor EfficientNet-B0, the short-term temporal pattern learner BiLSTM, and the global sequence modeling Transformer encoder. This network was trained on weakly labeled videos for fourteen kinds of anomalies, covering violent, property, and situational events, from the UCF Crime dataset. This work complements the deep model using a multi-modal fusion engine that integrates object, pose, motion, and object tracking information using weighted decision fusion to address ambiguous scenarios and reduce false positives. Reinforcement learning has been used with human operator feedback to adaptively adjust decision thresholds continuously during deployment. Empirical evaluation yields high accuracy with improved class sensitivity, especially for rare events, and strong real-world robustness across varying lighting, motion, and camera angle conditions. The system reliably processes multiple synchronized camera streams with low latency and provides contextualized alerts suitable for practical security applications. Overall, the results demonstrate that hybrid deep learning combined with multi-modal fusion and adaptive thresholding significantly enhances anomaly detection reliability, making this approach suitable for smart surveillance, public safety monitoring, and real-time operational environments.

Keywords: Abnormal events detection, CCTV surveillance, Deep learning, Multi-camera systems, Online AI



Analysis of Suitability of Composite Materials under Marine Conditions

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Marine vessels operate under highly demanding environmental conditions, where exposure to saltwater, humidity, and continuous mechanical loading accelerates material degradation. Traditional construction and repair materials such as wood, steel, aluminium, and conventional fiberglass often suffer from corrosion, rot, and fatigue, resulting in high maintenance requirements and reduced service life. To address these limitations, this study investigates the development and evaluation of composite materials specifically designed for marine applications, aiming to enhance the durability, strength, and long-term performance of structures. Two synthetic reinforcements, Chopped Strand Mat (CSM) and Woven Roving Mat (WRM), and two natural fibers, Coir and Pineapple Leaf Fibre (PALF), were mixed with epoxy resin as the matrix phase to fabricate composite panels. Four composite structures were prepared: CSM, WRM, CSM and Coir (1:1), and WRM and PALF (3:1), using the hand lay-up method. Mechanical properties of developed composites, including tensile strength, flexural strength, impact resistance, hardness, and water absorption, were evaluated according to ASTM standards before and after immersion in seawater for one month. Results show that WRM-based composites exhibited the best performance, achieving tensile strength of 133.98 MPa, flexural strength of 484.72 MPa, and impact resistance of 134 kJ/m², attributed to their continuous fibre structure and reduced void formation. In comparison, natural fibre hybrids showed poor mechanical properties, while the CSM-Coir composite demonstrated the highest water absorption (up to 4.22%), indicating reduced suitability for prolonged exposure to wet environments. Seawater immersion resulted in approximately 30% reduction in tensile strength and around 10% reduction in flexural strength across all samples due to moisture diffusion and fibre-matrix debonding. Overall, the study confirms that glass-fibre-reinforced composites are highly suitable for structural marine applications due to their strength, durability, and low water absorption. Natural fibre hybrid composites, while less mechanically robust, demonstrate potential for non-structural marine components where sustainability and cost-efficiency are priorities.

Keywords: Composite materials, Marine conditions, Synthetic fibers, Natural fibers, Hybrid composite

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Implementation of a GPS Guided Remote Controlled Surveillance Rescue Boat

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Drowning remains a critical socio-technical challenge in Sri Lanka, intensified by monsoon-driven flooding, hazardous currents in inland reservoirs, and a lack of lifeguard infrastructure in rural coastal regions. This research presents the engineering design, fabrication, and experimental validation of a low-cost, GPS-assisted Unmanned Surface Rescue Vehicle (USRV) integrated with a preventative geofencing wireless signaling system. The vessel utilizes a catamaran architecture for enhanced lateral stability, locally fabricated using a fiberglass-reinforced plastic (FRP) matrix over a medium-density fiberboard (MDF) core to ensure both affordability and watertight integrity. Propulsion is achieved via dual water-jet thrusters powered by two nickel-metal hydride (NiMH) battery modules, strategically placed to optimize stabilizing mass and vessel balance. Experimental validation confirmed a vessel mass of 16.50 kg and a static draft of 6.60 cm, aligning with theoretical hydrostatic predictions within a 10.00% margin. Hydrodynamic analysis demonstrated efficient hull-water interaction, overcoming a calculated drag force of 2.41 N at operational speeds. A core innovation is the integration of a swimmer-worn GPS wristband featuring geofencing logic. Unlike reactive vision-based systems, this preventative trigger transmits an SMS alert with real-time coordinates via a Global System for Mobile Communications (GSM) link upon boundary violation. Field testing confirmed a notification latency of less than 5.00 seconds, effectively mitigating manual detection delays. This study provides a scalable, locally manufacturable solution for improving search-and-rescue (SAR) efficiency in diverse aquatic environments.

Keywords: Emergency response system, Geofencing technology, GPS-assisted rescue, Twin-hull design, Unmanned surface vehicle



Nm Index: A Percentile-Based Metric Accounting for Author Contribution, Sequence, Influential Self-Citations, Career Stage, and Field Norms for Assessing Global Scholarly Impact

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Even though author position is taken into account by some scores, they ignore actual contributions, particularly for middle authors or for alphabetical ordering. Furthermore, position-based scores frequently contain over-rewards and redundancies, like the single-author factor being repeated across sub-scores. Citations differ by domain and year of publication as well, but the existing scores do not account for multi-domain involvement or outlier effects, such as a few papers with a lot of citations or a few with very few. Likewise, h, g, Hf, and Hm indices vary according to article domains and career stage, which disadvantages early-career academics in sectors with few citations. Lastly, while Hm and Hf assume equal author contributions, the m-index penalizes seniors. To solve these inadequacies, this work introduces the Nilmantha (Nm) index, a novel percentile-based metric designed to address these limitations through comprehensive normalization and weighting strategies that produce a percentile score showing academic significance directly comparable internationally. Alphabetical/Random (A/R), Relative Contribution (RC) with multiple/single First Authors (FAs) or Last Authors (LAs), and Explicit Contribution (EC) with multiple/single FAs/LAs are considered. In particular, it employs a harmonic model for RC, uniform weights for A/R, proportionate uniform weights for multiple FAs/LAs per RC/EC, and AHP-driven CRediT or ACI. First, self-influence and overlapping core-author influence are taken into account when adjusting citations for influential self-citations. Second, we calculate the weighted average hf (productive cited output with fractional credit), hm (productive cited output for multi-authorship), and g (highly cited works) indices, all of which are adjusted for career factor (preserving senior academics' collective achievements) and multiple fields. We also calculate the outlier-uncontrolled weighted field- and year-normalized (WFYN) total cites (overall impact), outlier-controlled WFYN citations per paper (average paper impact), and outlier-controlled WFYN citation rate (impact rate). Fictitious author profile use cases are used to validate the model, and the numerical results show that the model captures 36% more impact than traditional C-scores in multi-field contexts, provides 118% more accurate per-paper assessments through contribution weighting, and avoids the over-penalization of senior researchers while appropriately boosting early-career scholars.

Keywords: Author contribution, Author ordering, Self-citation, Career



compensation, Nm-index



ShieldBlackhole: A Blockchain and Cryptography-based Credible Scheme to Mitigate Blackhole Attacks in SDVN

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Blackhole attacks are a major threat to Software-Defined Vehicular Networks (SDVNs) since they enable malicious nodes to drop packets rather than forward them, resulting in loss of information and decreased network efficiency. Existing research has concentrated very poorly on blackhole attacks in the SDVN domain, and existing methods depend mainly on a centralized authority, while current blackhole mitigation techniques in SDN and MANET domains suffer from limited reliability under high-mobility and poor resistance to coordinated attacks. Although blockchain has been proposed for security in SDN, its usage in high-mobility SDVN environments, tailored for blackhole attack mitigation, has not been fully analyzed in current studies. This study introduces a hybrid mitigation framework that combines log-based verification and blockchain-based overhearing for secure end-to-end packet forwarding. Within this framework, the controller collects and processes transmission and reception logs of vehicular nodes to detect instances of receiving-side forwarding failure, while neighboring vehicular nodes observe and report packet forwarding behavior by placing votes onto the blockchain. To improve security, the control plane communication is encrypted with integrity protection using HMAC, while authenticity is improved by signing. A smart contract aggregates votes to dynamically update each node's trust value by imposing penalties on nodes that exhibit blackhole behavior. As a reliability measure for the controller, a group of trusted nodes periodically validates the controller function and triggers an automatic failover if any malfunction is detected. The proposed ShieldBlackhole method was implemented using NS-3 for network simulation and Hyperledger Fabric for blockchain functionality. It has been compared with existing blackhole mitigation techniques using key performance evaluation metrics including packet delivery ratio, average latency, Matthews correlation coefficient, precision, and recall. This research shows that the proposed ShieldBlackhole method sustains over 80% packet delivery ratio with 40% attacks, maintains MCC above 0.7, and achieves approximately 0.9 precision and 0.75 recall, outperforming existing solutions.

Keywords: Blackhole attack mitigation, SDVN, Blockchain, NS-3 simulation, Hyperledger Fabric, Smart contracts



IoT-Enabled Multi-Modal AI System for Detecting and Predicting the Freshness and Ripeness of Produce

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Accurate evaluation of the quality of produce is essential for food safety, consumer acceptance, and reduction of post-harvest losses. Manual inspection and chemical tests, which are considered traditional methods, are subjective, tedious, and destructive. The proposed approach is a Multi-Modal AI System that detects and predicts the freshness and ripeness of produce through a non-destructive intelligent system, helping to overcome these limitations. The methodology employs a two-stage hierarchical pipeline that integrates visual information from a camera module with data from a sensor array comprising MQ4 (methane), MQ135 (CO₂/ammonia), TGS2602 (Volatile Organic Compounds), and an AS7263 Near-Infrared (NIR) spectrometer. In Stage 1, an object detection model identifies the type of produce. In Stage 2, visual features extracted by a Convolutional Neural Network (CNN) are combined with normalized sensor-array readings in a novel early fusion model to determine freshness and ripeness. The findings clearly demonstrate the strength of data fusion, with the multi-modal framework achieving an overall prediction accuracy of 95%. This approach outperformed the unimodal methods, which achieved accuracies of 93% for image-only and 88% for sensor-only data, respectively. Additionally, the Vision Transformer (ViT) model, designed specifically to detect artificially ripened fruit, achieved accuracies of 94% for bananas and 92% for mangoes. The system is deployed through three applications, including a “GreenMate” physical device, an “AI Food Assistant” mobile application, and a standalone portable device specifically designed for the classification of artificial ripening in mangoes and bananas. Together, these solutions provide a low-cost, real-time, and practical approach to enhancing supply chain transparency, protecting consumers, and reducing food waste.

Keywords: Multi-Modal AI System, Freshness and Ripeness Prediction, Data Fusion, Computer Vision



IoT Network Traffic Analysis for User Behavior Mapping and Adaptive Privacy Risk Mitigation

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The recent rise of Internet of Things (IoT) devices has raised significant concerns about user privacy, as these devices may unknowingly expose sensitive information to third parties. Since smart devices continuously communicate over a network, they generate unique traffic patterns that can be passively captured by an attacker without the user's knowledge. Although this traffic is encrypted, it can still reveal device identities and user behaviors within the environment. This study investigates how network traffic can be analyzed to identify specific IoT devices and how detected device triggers can be mapped to meaningful user actions under realistic deployment conditions. Accordingly, we propose a novel four-stage methodology to address this challenge. First, we introduce a Retrieval-Augmented Generation (RAG) based device fingerprinting approach that supports open-set recognition and enables identification of previously unseen devices. Second, we implement a hybrid device trigger detection method that combines a rule-based system with a Long Short-Term Memory (LSTM) approach to improve reliability under practical constraints. Third, sequences of detected triggers are mapped to user behaviors using a prompt-engineered Large Language Model (LLM) framework capable of inferring complex activities without reliance on fixed training datasets. Furthermore, we evaluate and propose privacy-preserving mitigation techniques that conceal genuine user behavior within realistic fake behaviors through adaptive traffic obfuscation, increasing attacker uncertainty rather than attempting to fully block inference. To support experimentation and evaluation, two practical testbeds are deployed for data collection and validation, and a user-friendly web application integrates the full pipeline into an accessible interface. Overall, this work provides practical insights into privacy risks in smart environments and demonstrates effective, deployable strategies for mitigating behavior inference from encrypted IoT traffic.

Keywords: Behavior inference, Device fingerprinting, Encrypted traffic analysis, IoT privacy, Passive sniffing

An Optimization-Driven Energy and Throughput-Aware Stable Multipath Flow Routing Scheme Considering Flow Interactions for Software-Defined Vehicular Networks

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Uncertain link states and the presence of dynamic vehicular topologies pose significant challenges in Software-Defined Vehicular Networks (SDVNs) when considering the reliability of data delivery. Current methods fail to model uncertainty and estimate link lifetime accurately; therefore, the risk of packet loss is greater. In addition, they do not compute optimal flow fractions based on sub-flow throughput, energy consumption, latency, and packet delivery ratio, nor do they consider the effect of flow interactions. In this study, an original link lifetime estimation model is proposed along with an optimization-based multipath flow routing framework. The optimization model is formulated as a nonlinear optimization problem with the aim of optimizing flow delivery with the objectives of maximizing throughput and packet delivery ratio while minimizing latency and packet transmission energy. The proposed framework aims to model the effect of flow interactions in the optimization model to capture the effects of congestion and interference among different flows. Through the introduction of constraints for heterogeneous channel utilization, the proposed framework aims to avoid network congestion, while Quality of Service (QoS) threshold constraints guarantee a QoS-aware routing solution, ensuring data integrity and reliability. Prediction of link lifetime uses probability-based methods incorporating vehicle mobility scenarios, such as approaching/leaving junctions or other nearby vehicles, with corresponding sensor data like relative velocity and acceleration. The link lifetime modeling includes the effects of vehicular density and propagation path loss on link stability and is derived using the Cost-231 path loss model for line-of-sight and non-line-of-sight scenarios with urban building obstructions. Our study evaluates the proposed routing framework against existing approaches in terms of delivery ratio, latency, energy consumption, and throughput for different speeds and flow sizes. The results demonstrate the superiority of the proposed framework with a consistent packet delivery ratio of 98–100% and much lower latency (10–15 ms) compared to benchmark schemes (e.g., QRSDN at 60% delivery and 80 ms latency), while maintaining stable throughput.

Keywords: SDVN, Link lifetime estimation, Multipath flow routing, Nonlinear optimization, Energy efficiency



A Multimodal AI Framework for Automated Grading of Digital and Text-Based Handwritten Exams

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Manual examination grading is time-consuming, inconsistent, and difficult to scale. This study presents a multimodal Intelligent Exam Evaluation System for automated grading of digital and handwritten scripts across various question types, including short answers, lists, essays, equations, diagrams, graphs, and multiple-choice questions (MCQs). The framework integrates Transformer-based OCR (TrOCR), Retrieval-Augmented Generation, and multiple large language models in a context-grounded evaluation pipeline. Handwritten text is extracted using TrOCR, achieving 93.24% character-level and 76.59% word-level accuracy. Grading is based on rubric-aligned semantic evaluation, grounded in lecture materials and model answers stored as vector embeddings rather than exact word matching. Text-based grading was evaluated using OpenAI GPT, Google Gemini, Anthropic Claude, DeepSeek, and a fine-tuned DeepSeek-R1 model. Zero-shot and few-shot prompting were applied strictly as inference-time strategies to guide rubric-aligned evaluation. Fine-tuning was performed through continued pre-training on domain-specific academic text in structured JSON format to enhance subject-domain understanding. Evaluation included 500 text answers, 350 equation responses, 250 diagram answers, 250 graph answers, and 200 handwritten responses. Temperature sensitivity analysis at 0.0 and 0.2 showed that few-shot prompting at 0.0 provided the most stable and reproducible grading, suitable for high-stakes academic assessment. At this setting, the system achieved the highest matching accuracy of 72% for short answers using Gemini, 80% for list-type using OpenAI, 60% for essays using Claude, and 63.43% for equations using OpenAI. Multimodal evaluation achieved a strong correlation with human scores, with Pearson's correlation coefficient of 0.784 for diagrams using Claude and 0.787 for graphs using Gemini. Compared to prior automated grading systems focused primarily on MCQs or text-only responses, the proposed framework supports handwritten text, equations, and visual content within a single scalable pipeline.

Keywords: Automated Grading, Handwritten Text Recognition, Large Language Models, Multimodal Evaluation, Retrieval-Augmented Generation



Agentic AI-Powered Workflow Automation System

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The majority of organizations and universities in Sri Lanka still use traditional manual workflows, which cause scheduling problems, inefficiencies, and difficulties in retrieving important information in a timely manner. To overcome these problems, this research introduces a conversational agent-based Agentic AI-Powered Workflow Automation System (APWAS), a Multi-Agent System implemented at the Faculty of Engineering, University of Ruhuna. APWAS integrates three specialized agents: a Guidance-Agent (GA) using a privacy-preserving Retrieval-Augmented Generation (RAG) pipeline with locally-hosted LLMs. The GA offers instant and accurate access to the institution's policies through its two specialized sub-agents: the University-Agent, which retrieves information from internal resources such as university documents and websites; and the Governance-Agent, which deals specifically with regulatory materials by accessing UGC circulars, procurement guidelines, and establishment codes. A Hall-Booking-Agent (HBA) features a novel hybrid recommendation engine backed by a dual-database architecture, and a Planner-Agent (PA) employs a unified constraint optimization model for integrated academic and examination timetabling. APWAS ensures data sovereignty. Evaluation shows the GA achieved 0.95 context recall and 100% autonomous tool accuracy. The HBA demonstrated perfect intent recognition, and the PA generated conflict-free schedules. User Acceptance Testing yielded a 4.9/5 satisfaction score. Agents are integrated into a single interface, and role-based access control is implemented for students, staff, and administrators. The system is deployed in a VPS environment with 2GB RAM, 2 CPU cores, and 25GB of storage space. Only free open-source models and tools are used, which are cost-effective and provide data sovereignty, thereby addressing institutional privacy concerns. Central authentication is used for agent coordination, while plans are in place for direct negotiation protocols. This integrated, agentic architecture provides a scalable blueprint for modernizing administrative workflows, demonstrating a practical, secure model for universities and public and private sector institutions where data privacy and operational autonomy are critical.

Keywords: Agentic AI, Workflow automation, Privacy-preserving RAG, Hall booking, Dual database



Enhancing Autonomous Vehicle Safety and Efficiency: Implementation of ANN Models on an Existing Scaled Testbed

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Autonomous vehicles (AVs) have transformed the transportation sector by enhancing safety, efficiency, and reliability through reduced human intervention. This research presents the development and evaluation of Artificial Neural Network (ANN)-based autonomous driving models on a scaled testbed, focusing on safety and efficiency. The primary contribution of this research is the development of an autonomous vehicle that achieves reliable autonomy using minimal sensor inputs and low computational resources. The testbed relies solely on a web camera for environmental perception and obstacle detection and uses an NVIDIA Jetson Nano board as the computing unit. ANN-based models are developed and integrated for lane detection, steering control, and object detection to simulate real-world driving conditions. We evaluate two autonomous driving approaches: a modular approach and an end-to-end learning approach. For the modular pipeline, a U-Net model is employed for lane segmentation along with YOLOv8 (You Only Look Once version 8) for object detection. In this approach, steering control is based on explicit lane boundaries and detected obstacles produced by the perception modules. In the end-to-end approach, a CNN (Convolutional Neural Network) directly predicts the steering command from raw images, with a YOLOv8 model running in parallel to provide obstacle awareness. Both approaches are evaluated under different scenarios to measure their performance. To evaluate safety, testing was conducted at three selected speeds for lane-keeping, object avoidance, and pedestrian avoidance accuracies. Experimental results show that the U-Net-based modular pipeline achieves a lane-keeping accuracy of 97% of lap time, while the end-to-end CNN approach demonstrates improved obstacle and pedestrian avoidance, achieving zero collisions in both tasks at low speeds (0.7 km/h), up to 50% obstacle safe-zone operation, 90% pedestrian safe-zone performance, and a reduced inference time of approximately 28 ms.

Keywords: Artificial neural networks, Autonomous vehicles, Computer vision, Vehicle safety



Design and Development of a Semi-Automated Machine for Foaming Biodegradable Grow Cups from Banana Pseudostems

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The increasing demand for sustainable alternatives to plastic containers in agriculture has highlighted the potential of biodegradable materials. In this study, a machine capable of producing biodegradable grow cups from banana pseudo-stem pulp is designed and developed. This machine demonstrates that banana pulp is a viable eco-friendly raw material for scalable agricultural applications and offers a sustainable substitute for plastic containers and traditional grow bags used in agriculture. Due to the lack of large-scale automated machinery, this study focuses on addressing the shortcomings of current machinery. First, compression force testing was conducted. From this test, we confirmed that 500 N compression force was needed to form the cup. After the pre-made pulp is fed into the hopper, it is molded into the required shape using a compression mechanism and subjected to required temperatures in the dryer chamber. The machine consists of an extruder with hopper, mold and rotating mold carousel, compressing mechanism, and dryer chamber. The machine uses a sequential four-stage molding cycle where the rotating carousel rotates 90 degrees following each compression to achieve maximum production efficiency, producing four cups per cycle. Arduino-controlled relay systems combined with thermocouples regulate temperature-stable heating conditions in both the drying chamber and mold. Four heating elements in the dryer with exhaust ventilation, monitored by temperature and humidity sensors, provide ideal drying conditions. Timed extrusion cycles achieve precise pulp volume control, maintaining uniform cup dimensions. This project is primarily concerned with the utilization of pulp derived from banana pseudostems for the fabrication of biodegradable pots intended for nursery applications. The study aims to identify and evaluate optimal pulp composition parameters, as well as corresponding machine operating conditions, to establish an automated production process.

Keywords: Biodegradable grow cups, Bio-pot, Banana pseudostem pulp, Foaming machine, Sustainable agriculture



Design and Development of an Electrolysis Stack to Generate Green Hydrogen Using Solar Power

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The transition toward renewable energy systems has intensified interest in green hydrogen as a clean and sustainable energy carrier. Conventional hydrogen production methods contribute approximately 830 million tons of CO₂ emissions annually, necessitating alternative zero-emission solutions. Sri Lanka's national target of achieving 70% renewable energy by 2030, supported by 1,358 MW of planned solar capacity, highlights a critical need for effective energy storage to mitigate solar intermittency. This study presents the design, fabrication, and experimental validation of a cost-effective solar-powered alkaline electrolysis stack, with the primary technical contribution being the development of an optimized bipolar stack configuration with improved sealing and system integration suitable for decentralized hydrogen production. An iterative design methodology was adopted, progressing from single-cell prototype testing to a six-cell bipolar stack configuration. Design-driven safety enhancements and material optimization significantly improved system reliability and performance. The final electrolysis stack achieved a hydrogen production rate of 85.856 cm³/min at 12 V, with a total power consumption of 36 W. The system demonstrated an electrolysis efficiency of 51%, defined as the effectiveness with which electrical energy supplied to the electrolyzer is converted into chemical energy stored in the form of hydrogen, and an energy efficiency of 59%. Successful integration with a photovoltaic power supply, battery storage, and real-time monitoring validated stable operation under variable solar conditions. The developed electrolysis stack demonstrates strong potential for off-grid energy storage and decentralized renewable energy applications in regions with high solar availability.

Keywords: Alkaline electrolysis, Green hydrogen production, Solar-powered electrolyzer, Bipolar electrolysis stack, Renewable energy storage



Smart Home Energy Management System with Integrated PV and Battery Storage

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A smart residential renewable energy system integrated with a solar photovoltaic (PV) system, a battery energy storage system (BESS), web-based monitoring system, and an advanced home energy management system (HEMS) is presented in this research. The objective of the system is to optimize energy usage, enhance supply reliability, and ensure efficient operation under varying on-grid and off-grid conditions. The existing off-grid PV arrangement was upgraded by developing a structured load integration mechanism and an automated load bank that enabled realistic testing of domestic energy patterns. A key component of this work is the development of a real-time energy management strategy that prioritizes power allocation, protects the battery from deep discharge, and ensures uninterrupted supply to critical loads. Direct communication between the PV inverter, BESS, and microcontroller was established using Modbus TCP and RTU protocols by bypassing the manufacturer-provided apps. Real-time inverter parameter retrieval, real-time measurements, and data transmission to a backend server for storage and visualization were accomplished through an ESP32 microcontroller. The developed HEMS algorithm uses these retrieved battery state of charge, inverter status, and load demand to determine load shedding levels and reconnection thresholds. Real-time visualization of PV output, battery behavior, load currents, and system operating modes is provided through a web interface, enabling remote supervision and improved user awareness. To achieve advanced home energy management, simulation studies were conducted to compare baseline operation with the proposed rule-based HEMS algorithm. The proposed algorithm uses the time-of-use tariff in Sri Lanka. Hence, it is relevant as residential solar PV owners are required to transition from flat tariffs to TOU-based pricing structures. Improved battery utilization, reduced grid dependency, and efficient PV energy distribution among household loads are the results of the study. Therefore, the proposed system provides a smart, sustainable, reliable, and efficient solution for powering a home while improving energy efficiency.

Keywords: Battery Energy Storage System (BESS), Building integrated photovoltaics, Energy management system, Load management, Rule-based systems, Smart homes



Design and Prototyping of a Grid-Forming Inverter for a Microgrid

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The penetration of renewable energy resources in power systems is steadily increasing, leading to a transition from traditional centralized power systems to decentralized architectures incorporating microgrids. In microgrids, maintaining voltage and frequency stability is particularly challenging during off-grid operation, commonly referred to as islanded mode. To address this challenge, grid-forming inverters—inverters equipped with advanced control strategies that emulate grid characteristics—are required. This paper presents the design and laboratory prototyping of a grid-forming inverter capable of regulating voltage and frequency in an islanded microgrid. The proposed solution is achieved through a comprehensive control architecture consisting of outer-loop active and reactive power droop controllers and an inner-loop voltage regulation scheme. The system has been modeled and validated through extensive computer simulations. The system's dynamic performance, stability, and disturbance ride-through capability are evaluated under various operating conditions, including load variations, secondary control operation, and fault scenarios. The simulation results demonstrate that the proposed grid-forming inverter can significantly enhance the stability and reliability of renewable energy-based microgrids. A hardware prototype has been developed using a microcontroller, isolated sensing circuits, an intelligent power module, and an LC output filter. The laboratory prototyping procedure is presented, followed by preliminary experimental results required to validate the signal processing and pulse width modulation of the grid-forming inverter.

Keywords: Grid-forming inverter, Microgrid, Islanded operation, Voltage and frequency control



Maximum Wind Power Harvesting Using Interior Type Permanent-Magnet Synchronous Generator

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Wind energy is a renewable and highly efficient power source, capable of converting approximately 40–50% of the wind's kinetic energy into electrical energy. Wind energy extraction is primarily governed by two control stages: turbine control and generator control. In the turbine control stage, extraction efficiency depends on accurate Maximum Power Point Tracking (MPPT) under varying wind conditions. Conventional MPPT techniques rely heavily on precise turbine characteristics, which can lead to time delays and reduced dynamic responsiveness. This work proposes an artificial intelligence (AI)-based MPPT scheme that eliminates dependence on empirical equations and extensive simulations. The proposed approach directly predicts the optimal rotor shaft speed using an Artificial Neural Network (ANN). Furthermore, an AI-based wind forecasting model is incorporated to enhance predictive control and improve MPPT accuracy. In the generator control stage, an Interior Permanent Magnet Synchronous Generator (IPMSG) is employed to achieve high efficiency. The absence of rotor windings in the IPMSG eliminates rotor copper losses, thereby improving overall efficiency. Efficiency is further enhanced using a Maximum Torque Per Ampere (MTPA) control strategy, which minimizes stator current for a given torque demand and reduces stator copper losses. Field-Oriented Control (FOC) is implemented to achieve precise regulation of the stator current components in the d-q reference frame. Clarke and Park transformations are used to convert three-phase stator currents into d-q components and vice versa, enabling independent proportional-integral (PI) controllers for the d-axis and q-axis currents. A slower PI speed controller, operating at a bandwidth ten times lower than the current control loop, determines the required torque for speed regulation. The performance of the complete system is validated through computer simulations. In addition, a laboratory-scale prototype incorporating an IPMSG and a power electronic converter is developed to experimentally verify the power conversion in the system.

Keywords: Wind energy conversion system, Maximum power point tracking (MPPT), Interior permanent magnet synchronous generator (IPMSG), Maximum torque per ampere (MTPA) control



Balancing an Inverted Pendulum on a Two-Wheeled Cart Under Low Sensor Sample Rate

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Balancing an inverted pendulum mounted on a two-wheeled cart presents a challenging nonlinear control problem due to its inherent open-loop instability and the coupled dynamics of the cart and pendulum. Furthermore, the system is underactuated and includes nonlinearities in both mechanical and electrical domains. The system investigated in this work is a two-degree-of-freedom platform where both the cart and the pendulum are free to rotate, each contributing to the instability. The cart itself cannot balance without continuous wheel actuation, while the pendulum adds an additional unstable mode, making the configuration similar to a simplified double-pendulum system, but in a more uncontrolled environment as it must operate on ground that is not perfectly smooth and flat, experiencing wheel slip and mechanical dead zones. This study examines whether effective stabilization can be achieved under a low sensor sampling rate and control rate of 200 Hz, which is intentionally selected to allow implementation on a low-cost microcontroller (STM32F103). Such constraints limit the bandwidth of the controller and increase sensitivity to measurement noise. Furthermore, they introduce processing limitations due to limited CPU power. Similar work presented in the literature uses sample rates beyond 500 Hz for simple control and over 1 kHz for advanced optimal or robust controller implementation. Advanced optimal control strategies were implemented with a 200 Hz sample and control rate, including a Linear Quadratic Regulator (LQR) combined with a Kalman state estimator, and incremental PI motor controllers are utilized to maintain stability. Despite low sampling rates and the use of the cheapest available IMU (\$1.50 USD), the proposed approach achieves reliable balancing and smooth recovery from disturbances. In this study, velocity estimation near the operating point of the implemented system is challenging due to the zero responses at the operating point, particularly under low sample rates. The Kalman estimator compensates for these limitations by fusing encoder, accelerometer, and gyro data.

Keywords: 2 DOF inverted pendulum, Pendulum on cart, Low sample rate control, Underactuated control



Modelling Temperature Distribution Analysis in a Data Center Using CFD-Transient Analysis for Cooling Layout Optimization

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A data center is a specialized facility that houses computer systems, servers, storage devices, and associated networking equipment, where energy efficiency is crucial due to high overall energy consumption. The improvement of cooling system efficiency represents a great opportunity for energy and cost savings in a data center. Computational Fluid Dynamics (CFD) is an effective tool that provides a platform for analyzing airflow patterns and thermal behavior in data centers, for both existing and proposed configurations, before they are built. This study presents a computational fluid dynamics (CFD)-transient analysis aimed at identifying an efficient and optimized cooling layout for an air-cooled data center using ANSYS Fluent software. A three-dimensional (3D) model of a raised-floor data center is developed, and eight cooling layout configurations are investigated: four configurations with a single air-conditioning unit (ACU) and the same four configurations with dual ACUs. For each layout, airflow patterns and temperature distributions are analyzed in terms of rack inlet temperature, hot-spot formation, and ACU net cooling power. The simulation results provide detailed three-dimensional temperature and velocity fields and demonstrate how ACU number, positioning, and airflow organization influence the thermal performance of the data center. By comparing the eight cases, the study identifies the layout configurations that most effectively reduce hot spots and maintain inlet and outlet temperatures within the allowable ranges recommended by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) standards. The results indicate that the most efficient configuration for a data center equipped with a single ACU is achieved with the ACU located on the front wall side, yielding a temperature of 20.12°C under the cold aisle arrangement. For the dual-ACU configuration, the most efficient layout is obtained with ACUs placed on adjacent walls, resulting in a temperature of 19.09°C under the hot aisle arrangement.

Keywords: Air-conditioning unit (ACU) layout, Inlet outlet air temperature optimization, Raised-floor air distribution



Aero Sense Phase II — AI-Enhanced ELF Radio Receiver for Unmanned Aerial System Detection and Localization

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The increased use of Unmanned Aerial Systems (UAS), or drones, requires the development of effective detection and localization methods to mitigate escalating privacy and security risks. Traditional active sensing techniques (visual, acoustic, radar, RF) are susceptible to discovery or evasion. Aero Sense Phase 02 addresses this gap by proposing an AI-enhanced passive sensing system that capitalizes on the Extremely Low Frequency (ELF) magnetic signatures emitted by Brushless DC (BLDC) motors. Building on the foundation of Phase I, this study extends the detection range (beyond 10 m) and introduces a crucial localization functionality within a predefined target area. The methodology involves designing and testing optimized receiver antennas to capture these weak ELF signals, despite challenges posed by high ambient noise. Multiple circular and octagonal loop antennas were designed and experimentally characterized indoors and outdoors. The analog front end, including a 1.65 V bias and passive 3:1 attenuation network, reliably conditioned bipolar signals up to 10 Vpp into the 0–3.3 V ADC window without clipping across 1–7 kHz. Drone signatures were analyzed using the Spectral Correlation Function (SCF) computed via the FFT Accumulation Method, which clearly separated drone-present and environment-only cases and revealed distinct spectral patterns for different drone models. These SCF images formed the input to CNN models, which were used to localize the drone in a real-world 5 m × 5 m grid, where a customized EfficientNetB0 reached approximately 85–98% cell-level accuracy. The results confirm that ELF-based passive sensing combined with SCF and deep learning is a viable alternative for short-range UAV detection and coarse 2D localization.

Keywords: Analog circuits, Antenna theory, Cyclostationary process, Fast Fourier transforms, Noise cancellation



AI-Driven Driver Assistance for Electric Vehicles

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Level-1 driver-assistance systems aim to enhance driving safety and comfort while keeping the human driver responsible for supervision and control. Camera-centric Advanced Driver Assistance System prototypes are attractive due to low cost and rich semantic information, but practical deployment is limited by illumination variability, obstruction, domain shifts, and real-time constraints, especially when multiple perception tasks run concurrently. This paper presents a modular ROS 2-based Level-1 driver-assistance prototype for Electric Vehicle (EV) platforms that integrates (i) real-time camera perception for road-object detection, traffic sign/light detection, and lane detection, (ii) a multi-agent decision fusion node (“Brain”) that stabilizes probabilistic outputs using temporal voting, confidence hysteresis, and rule-based arbitration, and (iii) advisory command publishing through a Controller Area Network (CAN) interface. A hybrid lane subsystem combines semantic segmentation (YOLOv8n-seg) with classical geometry (BEV transform, polynomial fitting, smoothing) to produce interpretable lane curvature and lateral offset suitable for lane-keeping assistance. Experiments in a webcam bench mode and a simulation-ready mode evaluate speed-accuracy trade-offs, end-to-end latency, jitter, and decision stability under varying scene complexity and lighting. Bench tests on an Intel Core i9 (32 GB RAM, RTX 4090) sustained 1280×720 at 30 FPS in a modular ROS 2 pipeline, with YOLOv11 traffic light detection achieving $mAP@0.5 = 0.95$ and $mAP@0.5:0.95 = 0.69$. Lane perception using a ResNet backbone (CULane subset) achieved $F1 = 60.84\%$ (Precision 70.60%, Recall 53.45%, Mask $mAP@0.5 = 52.66\%$). The findings highlight engineering considerations for Sri Lankan road contexts and motivate future work on domain expansion and repeatable scenario replay using simulation.

Keywords: Level-1 ADAS, Camera-only perception, ROS 2, Lane segmentation, CAN bus interface



Factors Influencing Thermal Comfort and Occupant Well-Being in Naturally Ventilated Buildings and Their Level of Impact

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Thermal comfort in naturally ventilated buildings plays a crucial role in determining indoor environmental quality. It directly affects occupant health, productivity, and overall well-being, especially in warm-humid climates such as Sri Lanka where buildings rely substantially on natural ventilation. This study investigates the relative influence of environmental, building design, and occupant-related factors on thermal comfort in naturally ventilated office buildings. Furthermore, it examines associated Sick Building Syndrome (SBS) symptoms and perceived productivity impacts. A mixed-methods approach was adopted. First, a large-scale questionnaire survey of the general public ($n = 375$) was conducted to prioritize thermal comfort factors using Relative Importance Index analysis. This was followed by detailed occupant surveys in two naturally ventilated office buildings in Galle, Sri Lanka: the Department of Buildings ($n = 25$) and the Road Development Authority ($n = 20$), to assess actual indoor comfort conditions, health symptoms, and perceived productivity. Thermal comfort was evaluated using the Predicted Mean Vote (PMV) model, supported by statistical analysis of occupant responses. Results of the first survey show that air temperature is the most influential environmental factor for thermal comfort, followed by radiant temperature, air velocity, and relative humidity. Key building design factors include room size, building materials, and window size with their placement. Moreover, occupant density, clothing level, and activity level are occupant-related factors that significantly affect perceived comfort. Results of the second survey show both buildings exhibited warmer-than-neutral conditions ($PMV \approx 1.1-1.2$), comfort levels between uncomfortable and neutral, and a high prevalence of SBS symptoms (DoB = 72%, RDA = 50%). Occupants also reported notable impacts of indoor environmental conditions on work performance, indicating an association between thermal comfort and productivity, although causality cannot be conclusively established. The findings highlight the need for targeted thermal comfort improvements through optimized natural ventilation, improved building envelope design, and occupant-centered control strategies to enhance health, comfort, and productivity in naturally ventilated buildings in Sri Lanka and similar climatic regions.

Keywords: Naturally ventilated buildings, Occupant well-being, Sick Building Syndrome (SBS), Thermal comfort, Workplace productivity



Effect of Particle Size and Shape on the Breakage Characteristics of Ballast Aggregates Used in Sri Lankan Railway Tracks

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Ballast breakage is one of the most critical factors affecting the long-term performance, stability, and maintenance needs of Sri Lankan railway tracks. The durability of ballast is strongly governed by its individual particle properties, particularly size and shape, which control how particles resist compressive stresses and fracture under loading. However, the influence of these two parameters on breakage behavior has not been comprehensively studied for ballast aggregates used in Sri Lankan railway tracks. Consequently, this research presents an experimental and numerical investigation aimed at quantifying the effects of particle size and particle shape on the breakage characteristics of railway ballast used in Sri Lanka. Ballast samples were collected from the Department of Railways, Sri Lanka, and categorized into four size ranges between 20 and 63 mm. Shape categorization was carried out using flakiness and sphericity values derived from 3D-scanned particle geometries. Representative particles from each size and shape group were tested through single-particle crushing tests under displacement-controlled conditions to determine peak load capacity, force-displacement response, and tensile strength. Discrete Element Method (DEM) models of the single-particle crushing test were developed using 3D-scanned ballast particles and calibrated against laboratory results to numerically simulate particle breakage. The findings highlight significant effects of both particle size and shape. Larger particles recorded higher peak loads but lower tensile strength due to internal flaws and stress concentration, reflecting a significant impact from particle size. Flaky-shaped particles exhibited substantially weaker mechanical resistance and more brittle failure modes compared to cubical-shaped particles of the same size. DEM simulations accurately reproduced these trends, confirming the dominant influence of size and shape on particle breakage. Overall, the results emphasize the importance of controlling both size distribution and shape quality to minimize breakage and improve the long-term performance of ballast aggregates.

Keywords: Ballast breakage, DEM modelling, Particle shape, Particle size, Single-particle crushing test



AI-Based Code Generator and Code Reviewer

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Integrating artificial intelligence into large and legacy codebases remains challenging due to fragmented structure, outdated technologies, limited documentation, and frequent code changes. Existing AI-based code generators and reviewers rely mainly on surface-level context and treat files independently, resulting in a weak understanding of project structure and restricted input length constraints. This work presents a hybrid AI-based Code Generator and Code Reviewer that combines Retrieval-Augmented Generation, Abstract Syntax Tree (AST)-based semantic chunking, and a coordinated multi-agent framework. Large codebases are managed using AST-based chunking, which extracts functions and classes as structurally meaningful units for indexing and retrieval. File-level indexing and hashing are employed to detect modified files and incrementally update embeddings, enabling efficient adaptation to evolving repositories. Conversation history is selectively retained and pruned so that agents share only relevant context, preventing context overflow. The code generator operates in an agentic RAG mode for context-aware querying and in an autonomous agent mode capable of navigating files, applying edits, and executing commands. The code reviewer integrates static analysis tools with specialized AI agents for security, code quality, and code smell detection. Through an iterative refinement process supported by short-term and long-term memory, the system identifies high-impact issues and prioritizes fixes aligned with company coding standards and best practices. Experimental evaluation on the SWE-Bench Verified benchmark (500 real-world issues) demonstrates a pass@1 accuracy of 40.4% using Gemini 2.5 Flash, exceeding the official baseline of 28.73%. The reviewer's fine-tuned agents reached 98.1% (security), 99.8% (code smell), and 99.7% (quality) validation accuracy, and detected 33% more total issues than leading commercial tools. The results confirm that the proposed RAG-AST-multi-agent architecture provides an effective and scalable solution for AI-assisted development in large and legacy codebases.

Keywords: AI agents, AST, Code generator, Code reviewer, Large and legacy codebases



Mixed Reality Based Immersive Communication Platform for Enabling Telepresence

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Traditional video conferencing systems offer limited telepresence due to restricted spatial awareness, reduced non-verbal communication, and minimal interaction capabilities. The primary research objective of this study is to design and implement a Mixed Reality (MR)-based immersive communication platform that enhances situational awareness and co-presence through a unified Augmented Reality (AR) and Virtual Reality (VR) ecosystem, compared to conventional video-based communication tools. The proposed platform supports real-time audio-visual communication and immersive spatial interaction through synchronized facial expressions and gestures. Unlike existing communication systems that rely primarily on 2D video or focus on either AR or VR in isolation, the platform offers a novel approach to remote communication through spatially grounded interaction within an MR environment. The system architecture is developed using a Unity-based framework on the Meta Quest 3, integrating WebRTC for low-latency streaming and AI-driven animation for real-time avatar synchronization. This enables more natural interaction through shared spatial anchors and expressive humanoid avatars. A human-computer interaction (HCI)-oriented usability evaluation conducted with 20 participants reported a System Usability Scale (SUS) score of 78.5, indicating good usability, while participants also reported high perceived immersion (76%) and moderate to high avatar-mediated social presence (72%). Compared to traditional video conferencing systems, users experienced improved engagement, more natural interaction, and a stronger sense of shared presence. The current implementation targets MR-capable head-mounted devices and requires stable network connectivity, which may limit accessibility in resource-constrained environments. Nevertheless, the platform demonstrates strong potential for applications in collaborative virtual environments, remote communication, education, and social interaction, highlighting the effectiveness of Mixed Reality technologies in advancing immersive telepresence.

Keywords: Avatar-mediated communication, Collaborative virtual environments, Human-computer interaction, Immersive telepresence, Mixed reality



Doctracer: Intelligent Document Information Extraction and Processing Toolkit for Sri Lankan Extraordinary Gazettes

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Sri Lankan Extraordinary Gazettes serve as the primary legal mechanism for publishing government structures, including ministries, their allocated departments, and the Acts and functions assigned to each ministry. Following national elections and subsequent administrative revisions, these structures are frequently amended through complex legal documents involving transfers of departments, reassignment of laws, and structural reorganizations. Due to the unstructured nature, dense layouts, and heavy numerical formatting of gazette documents, manual analysis and automated extraction remain highly challenging. This research introduces Doctracer, an intelligent document information extraction and processing toolkit designed specifically for Sri Lankan Extraordinary Gazettes. This system contains customized layout aware parsing pipeline specially optimized for these gazette-specific multi column and tabular structures. This pipeline is closely aligned with controlled, few shot learning optimized Large Language Model (LLM) prompting for accurate information extraction. Extracted content is converted into structured format and modeled using a domain-specific graph schema consisting of key entities such as Gazette, Minister, Department, Law, and Function, along with their semantic relationships. Then this structured data is stored in Neo4j Graph Database to preserve temporal dependencies and enable interactive visualization. Doctracer also introduces an automated amendment comparison module that accurately detects insertions, updates, deletions, and renumbering operations between base and amendment gazettes. Comparative experimental evaluation against widely used LLMs demonstrates that Doctracer achieves significantly higher accuracy in both base gazette extraction and amendment change detection tasks. For base gazette processing, Doctracer achieved 95% extraction accuracy, outperforming ChatGPT (79%), DeepSeek (87%), and Gemini (56%), particularly in handling complex multi-column layouts and maintaining structural consistency. In amendment change detection, Doctracer achieved 100% accuracy in identifying all modification operations, matching the performance of Gemini and DeepSeek while ChatGPT showed no successful detections in this task.

Keywords: Information extraction, Knowledge graph, Layout-aware parsing, Legal document analysis, Natural language processing



Stormwater Quality Assessment of Urban and Rural Road: A Comparative Analysis of Runoff and Dust Sampling Methods

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Road dust significantly impacts stormwater quality from roads, acting as a temporary pollutant sink that varies between urban and rural environments. Urban roads, with high traffic and impervious surfaces, accumulate finer particles with higher concentrations of metals and hydrocarbons. This study investigates pollutant profiles from urban and rural road runoff and dust samples in Galle, Sri Lanka. It evaluates the applicability of using tap water as an alternative testing medium through artificial rainfall simulation. Four sites representing diverse pollution levels were selected: two low-traffic rural sites and two high-traffic urban sites adjacent to a busy bus terminal. Using a developed experimental laboratory apparatus, rainfall events were simulated under controlled conditions. Runoff samples were collected using both natural rainwater and tap water. Dust samples were manually collected from road surfaces adjacent to runoff sampling locations. Key water quality parameters assessed included pH, EC, turbidity, TSS, TDS, VSS, COD, oil and grease, BOD₅, and heavy metals (Pb, Cu). Runoff samples were analyzed directly, while dust samples were mixed with water using a magnetic stirrer for 48 hours before analysis. Results indicate significant pollution differences, with urban areas showing high levels of TSS (59.4–78.9 mg/L), COD (478–603 mg/L), oil and grease (144–198 mg/L), and Pb (2.9–3.3 mg/L), all surpassing aquatic life standards. Rural areas showed TSS (52–65 mg/L), COD (56–122 mg/L), oil and grease (2–4 mg/L), and Pb (0.1–0.15 mg/L), with only COD and TSS exceeding standards. Sieve analysis confirmed that 85% of collected particles were smaller than 1.622 mm and 2.261 mm in low and high traffic conditions, respectively. Correlation analysis revealed that urban road runoff was the major pollution source ($R^2 > 0.8673$), while rural road dust was the primary contributor ($R^2 > 0.9791$). Stormwater runoff provided the most realistic pollution assessment, tap water runoff proved suitable for controlled experimental evaluations, and dust sampling supported understanding of particle-associated pollutant accumulation, necessitating targeted stormwater management strategies for varying traffic conditions.

Keywords: Stormwater quality, Rural roads, Road dust, Road runoff, Urban roads

Human Health, Pharmaceuticals, and Medicine



Factors Associated with Electrolyte Disturbances among Diabetic Nephropathy Patients Attending the Diabetes Clinics at National Hospital Galle

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Diabetic Nephropathy (DN), a severe complication of Diabetes Mellitus, often leads to electrolyte imbalances due to altered renal function, insulin insufficiency, and disrupted hormonal regulation. This cross-sectional study was conducted at the National Hospital Galle to investigate the prevalence and associated factors of serum electrolyte disturbances specifically sodium, potassium, and chloride among 259 patients with DN. Data was collected through pre-tested questionnaire, medical records, and laboratory tests, focusing demographic details, clinical features, lifestyle, and dietary habits. Chi-square test was used to check whether there was a significant difference in the frequency of electrolyte disturbances between the groups. The study found a high prevalence of hyponatremia (54.8%), hyperkalemia (45.2%), and hyperchloremia (64.5%) among DN patients. Despite assessing various demographic (age, sex, marital status, residence), clinical (diabetes duration, BMI, diabetic complications), and lifestyle (smoking, alcohol use) factors, no statistically significant associations were observed with serum electrolyte levels, except a weak association between BMI and chloride levels (Pearson Chi-Square = 5881.477, $p < 0.05$). Notably, dietary patterns emerged as potential influencers, as white rice (Chi-Square = 43.7, $p < 0.05$) and fruits (Chi-Square = 151.325, $p < 0.05$) with chloride level and bakery food consumption with potassium levels (Pearson Chi-Square = 47.6, $p < 0.05$) showed notable associations. These results highlighted that while demographic and most clinical or lifestyle factors may not significantly affect electrolyte balance in DN patients, dietary habits could contribute to electrolyte disturbances in DN patients, especially in potassium and chloride regulation. The findings emphasize the importance of comprehensive clinical monitoring and dietary guidance in the management of DN patients to prevent complications arising from unrecognized or untreated electrolyte disturbances.

Keywords: Associated factors, Diabetic Nephropathy, Electrolyte disturbances



Knowledge and Awareness on Long-Acting Reversible Contraceptive Methods among Women in Childbearing Age: A Cross-sectional Study in Ampara District, Sri Lanka

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Long-acting reversible contraceptive (LARC) methods, such as intra-uterine contraceptive devices (IUCDs) and implants, are safe and effective in preventing unplanned pregnancies. However, they are not widely accepted by women due to lack of awareness. This study explored knowledge and awareness about LARC methods among women of childbearing age in Ampara District, Sri Lanka. A descriptive cross-sectional study was conducted with 423 women aged 18–49 years from selected MOH clinics in Ampara District. Data collection was done using a structured questionnaire consisting of 18 questions to assess knowledge and awareness of LARC methods. Six questions on a scale of True, False, and No idea were used to assess knowledge score. It was categorized as No knowledge (score 0), Low (score 1–3), and High (score 4–6) according to the score. Among 423 respondents, 43.7% were between 29–39 years of age. The majority were Muslims (76.6%), married (100%), and housewives (70.2%). Around 46% had been educated up to G.C.E. O/L. Of the participants, 68.6% (n=290) were aware of the general term “Loop,” which is used for IUCD. Awareness about the terms Copper IUCD, Mirena, and Jadelle were 13.0% (n=55), 6.4% (n=27), and 70.7% (n=299), respectively. Among participants who were aware of each LARC method, the women who had high knowledge about Copper IUCD, Mirena, and Jadelle were 39 (70.9%), 13 (48.1%), and 209 (69.9%), respectively. They were aware of the correct insertion/removal method of Copper IUCD (98.2%), Mirena (96.3%), and Jadelle (83.6%). Comparatively, fewer had knowledge about the maximum effective duration of LARC: Copper IUCD 41.8%, Mirena 7.4%, Loop 14.5%, and Jadelle 51.5%. Less than one-third knew that IUCDs do not protect against sexually transmitted diseases (STDs) (Copper 30.9%, Mirena 25.9%, Loop 26.6%), while 65.6% had the misconception that Jadelle protects against STDs. Women of childbearing age in Ampara District had poor knowledge and awareness about different LARC methods. A comprehensive knowledge assessment and educational interventions are recommended in the future to prevent unplanned pregnancies and to aid correct decision-making related to contraception.

Keywords: Ampara District, Cross-sectional study, Knowledge, LARC, Women



Ethnobotanical Survey of Medicinal Plants Used for the Management of Inflammatory Bowel Disease by Ayurveda and Traditional Medicine Practitioners in Matara District

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Inflammatory bowel disease (IBD) is characterized as a chronic inflammatory condition in the gastrointestinal tract, which includes two major types, Crohn's disease (CD) and ulcerative colitis (UC). In Sri Lanka, traditional management of IBD relies on undocumented medicinal plant knowledge passed through generations. This study aimed to document the plant species, preparation methods, and treatment practices used by Ayurvedic and traditional medicine practitioners in Matara District. Ethical approval was obtained from the Faculty of Allied Health Sciences, University of Ruhuna. Ethnobotanical data were collected by using an open-ended, semi-structured questionnaire from 139 registered Ayurveda and traditional medicine practitioners who were between 25 and 75 years old, had more than 1 year of clinical experience, and had more than 2 years of residency in the Matara district. Ethnobotanical data were analyzed using relative frequency of citation (RFC), use value (UV), fidelity level (FL), relative popularity level (RPL), rank order priority (ROP), and family importance value (FIV). A total of 95 medicinal plants belonging to 50 families were recorded. Leaves were the most frequently utilized plant part, and decoction was the most frequently utilized preparation method in IBD remedies. *Aegle marmelos* L. (common name: Bael fruit) (RFC = 0.59) was the most cited plant, followed by *Plectranthus zatarhendi* var. *tomentosa* (common name: Iriveriya) (RFC = 0.51). Rutaceae was the family with the highest FIV, followed by Apiaceae. *Azadirachta indica* A. Juss. (common name: Kohomba) had the highest UV (6.00) and the highest RPL (6.00) in IBD remedies. This is the first ethnobotanical survey conducted on medicinal plants used to treat IBD by Ayurveda and traditional medicine practitioners in the Matara district, Sri Lanka. The data obtained from this survey facilitate the preservation of the knowledge of Ayurveda and traditional medicine in managing IBD and also help in the development of novel drug entities for treating IBD.

Keywords: Ayurveda practitioners, Ethnobotany, Inflammatory bowel disease, Medicinal plants, Traditional healers



Synthesis of Chitosan/Alginate Nanoparticles from the Aqueous extract of *Asparagus falcatus* L. with enhanced anti-inflammatory activity

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Nanoparticle systems integrating alginate and chitosan emerge as a promising platform for anti-inflammatory therapeutics. *Asparagus falcatus* L. (Family: Asparagaceae) is a medicinal plant recognized for its potent anti-inflammatory activity based on previous scientific studies. This study aimed to synthesize, characterize, and assess the anti-inflammatory activity of aqueous extract of *A. falcatus*-loaded alginate/chitosan nanoparticles. Aqueous extract of *A. falcatus* (0.125 mg/mL) loaded alginate/chitosan nanoparticles were prepared by ionotropic pre-gelation of an alginate followed by chitosan polyelectrolyte complexation. Characterization of *A. falcatus*-loaded alginate/chitosan nanoparticles was performed in terms of particle size, zeta potential, polydispersity index, scanning electron microscopy (SEM), and Fourier transform Infrared spectroscopy (FTIR). Anti-inflammatory activity was evaluated in terms of xanthine oxidase, hyaluronidase inhibitory, and membrane stabilization assays. Allopurinol, tannic acid, and diclofenac were used as their positive controls, respectively. The *A. falcatus*-loaded alginate/chitosan nanoparticles had maximum encapsulation efficiency and loading capacity at 3 mg/mL concentration of 82.42% and 0.37%, respectively. The polydispersity index and zeta potential of *A. falcatus*-loaded alginate/chitosan nanoparticles were 0.44 and -19.4 mV, respectively indicating the broad size distribution of particles and a lesser tendency to aggregate. SEM and FTIR confirmed that particles were in an acceptable nano range and successful encapsulation of *A. falcatus* into the alginate/chitosan matrix. The *A. falcatus*-loaded alginate/chitosan nanoparticles were active against xanthine oxidase inhibition, with significant ($p < 0.05$) improvement of 53.74% compared to its crude extract and positive controls. The aqueous extract of *A. falcatus*-loaded alginate/chitosan nanoparticles was capable of inhibiting hyaluronidase enzyme and hypotonicity-induced hemolysis under membrane stabilization at 8.93% and 48.37%, significant improvement respectively. In conclusion, *A. falcatus*-loaded alginate/chitosan nanoparticles showed enhanced anti-inflammatory activity, highlighting their potential as promising nanotherapeutics.

Keywords: *Asparagus falcatus*, Chitosan, Alginate, Nanoparticles, Anti-inflammatory



An Exploratory Psychometric Assessment of the Clinical Learning Environment and Supervision Evaluation Scale (CLESES) for Nursing Undergraduates in Sri Lanka

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Clinical learning occupies a paramount point in nursing education. The quality of the clinical learning environment (CLE) significantly contributes to enhancing students' learning outcomes, career ambitions, and perceptions of the nursing profession. Ongoing evaluation of the CLE would help restructure the learning environment to ensure a reliable clinical learning experience for nursing undergraduates (NUGs). Different tools to evaluate the CLE have already been developed internationally, while Sri Lanka does not have a reliable and validated tool. This study aimed to validate the Clinical Learning Environment and Supervision Evaluation Scale (CLESES) in the Sri Lankan context. The CLESES, originally developed in India, consisted of 53 items and three main domains (A. The learning environment, B. Role of the clinical instructor, and C. Supervisory relationship). The adaptation procedure was done following the WHO guidelines after obtaining permission. Content and face validity were established through expert review without many changes; 353 NUGs in the second to eighth semesters of the BSc Nursing degree program, Department of Nursing, Faculty of Allied Health Sciences, University of Ruhuna, Sri Lanka included in the study. Reliability of the CLESES was assessed using Cronbach's alpha ($\alpha = 0.931$); sub-domains' α was also satisfactory, such as A: 0.866, B: 0.881, and C: 0.811 in the 1st administration. Test-retest reliability of the overall scale was 0.900, and A, B, and C sub-domains were 0.818, 0.873, and 0.836. Exploratory factor analysis was done using principal component analysis with varimax rotation; 12 domains extracted, explaining a cumulative variance of 63.54%. However, the final CLESES consisted of 11 domains (52 items), had good psychometric properties, making it a valid and reliable tool to assess the CLE of nursing undergraduates in Sri Lanka; further, it would provide reliable data on assessing the existing CLE and be helpful for positive changes in the clinical environment in the future.

Keywords: Clinical learning environment, CLESE scale, Nursing undergraduates, Reliability-Validity



Impact of Pre-Fracture Sarcopenia on Short-term Mortality of Hip Fracture Patients Admitted to a Tertiary Care Center in Southern Sri Lanka

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Sarcopenia is a progressive loss of skeletal muscle mass, strength and function, and a leading cause of falls and fractures. Sudden decline in mobility and acute inflammatory reaction following hip fracture (HF) leads to an acceleration of pre-existing muscle wasting resulting in poor health outcomes in this vulnerable population. This study was designed to determine the association between pre-fracture sarcopenia and short-term mortality among HF patients admitted to National Hospital Galle (NHG), Sri Lanka. A prospective cohort study was conducted among 370 consecutive patients with incident HF, aged 40 years or more, admitted to the NHG. Sarcopenia was assessed using the locally validated SARC-F tool soon after the admission with a score ≥ 4 indicating risk of sarcopenia. Patients were followed up for 30 days, post fracture to evaluate the mortality outcomes through telephone interviews with family members. Binary logistic regression analysis was used to examine the association between pre-fracture sarcopenia and short-term mortality. Ethical approval was obtained from Ethical Review Committee of Faculty of Medicine, University of Ruhuna. Among 370 subjects, 76% (n=281) were females, while 65.7% (250) were married. The mean ($\pm SD$) age of HF patients was 75.1 (10.8) years. Of the 370 patients, 31.9% (115) had a risk of sarcopenia at the time of admission (SARC-F >4) and 9.4% (34) patients died while in the hospital or within 30 days of HF. The short-term mortality rate was significantly associated with pre-fracture-sarcopenia of HF patients ($p=0.02$) and sarcopenia was a significant predictor of short-term mortality of HF patients. Sarcopenia remained a strong predictor after adjusting for several confounders such as age, gender and physical disability (OR= 4.14, 95% CI [1.65,10.38], $p=0.002$). Pre-fracture sarcopenia significantly increases the risk of mortality in HF patients, and it is a significant predictor of short-term mortality in patients with HF. Therefore, early detection and targeted interventions should be integrated with the HF management protocol specially in vulnerable population.

Keywords: Hip Fracture, Sarcopenia, Short-term Mortality



A Cost-Effective Capillary Tube Method for Gram Staining: A Comparative Study with Conventional Slide Technique

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Gram staining (GS) is widely used for rapid visualization and determination of bacteria based on cell wall characteristics, classifying them as Gram-positive or Gram-negative. The conventional slide-based technique requires multiple reagents, including ammonium oxalate-crystal violet, Lugol's iodine, acetone-iodine, and dilute carbol fuchsin, often in relatively high volumes. This study aimed to introduce a novel capillary tube-based GS method to significantly reduce reagent usage and offer a cost-effective alternative method while maintaining accuracy. The capillary tube method (CTM) and the conventional glass slide method (GSM) were performed on selected control strains and clinical isolates. A small volume of bacterial suspension was drawn into a capillary tube, heat-fixed, and Gram-stained after natural cooling. The crystal violet and Gram's iodine steps were extended to one minute to optimize staining. Stained capillary tubes were evaluated using eight scoring variables. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated. A chi-square test was applied for data analysis using SPSS. Cost and turnaround time per assay were also estimated. There was no statistically significant difference about uniformity of background staining between the two methods ($p=0.825$), with a sensitivity of 88.9%, specificity of 20%, PPV of 90.9%, and NPV of 16.7%. Similarly, the presence of staining artifacts was not statistically significant between methods ($p=0.064$), with a sensitivity of 70%, specificity of 62.5%, PPV of 31.8%, and NPV of 89%. Hence, no significant difference was observed between CTM and GSM. The CTM was the most cost-effective method while GS required less processing time. The CTM offers a cost-effective alternative to the conventional GSM without compromising staining quality or diagnostic reliability, making it suitable for resource-limited laboratory settings.

Keywords: Bacteria, Capillary tube method, Glass slide method, Gram staining



The Health-Related Quality of Life among the Informal Family Caregivers of Older Adults with Disabilities in Gampaha District

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Informal family caregivers play a vital role in providing long-term care for disabled older adults at home, yet the demands of caregiving can negatively affect their health-related quality of life (HRQOL). Reporting on caregivers' HRQOL is essential to improve care quality. This community-based, descriptive cross-sectional study assessed HRQOL among 270 informal family caregivers of older adults with disabilities in three selected Divisional Secretariat divisions in Gampaha District: Urban (Negombo DS), Semi-urban (Minuwangoda DS), and Rural (Dompe DS). Participants were selected using consecutive sampling and included caregivers of older adults with musculoskeletal problems, cognitive impairments, limitations in activities of daily living, and non-communicable diseases. A validated, interviewer-administered Short Form-36 (SF-36) health survey was used to measure HRQOL. Data were analyzed using descriptive statistics, including means, standard deviations, frequencies, and percentages in SPSS 25.0. Most caregivers were female (74.8%), 43.7% were aged 46–60 years, 58.9% were married, 40.7% had an ordinary level education, and 34.1% were unemployed. A gross monthly family income of Rs. 10,000–29,999 was reported by 39.6% of participants. Children of older adults comprised 68.5% of caregivers, and 86.7% lived in the same home as the care recipient. Mean $\pm$ (SD) scores for SF-36 domains were: physical functioning 77.24 $\pm$ (17.26), role physical 42.04 $\pm$ (41.65), role emotional 35.31 $\pm$ (38.62), vitality 65.02 $\pm$ (16.66), emotional well-being 59.17 $\pm$ (13.97), social functioning 40.97 $\pm$ (17.58), bodily pain 50.72 $\pm$ (20.98), and general health 40.93 $\pm$ (15.38). Based on HRQOL categorization, 45.9% had low, 43.7% moderate, and 10.4% high HRQOL. Significant associations were found between HRQOL and caregivers' age ($p < 0.001$), gender ($p < 0.001$), marital status ($p = 0.013$), education ($p < 0.001$), employment ($p < 0.001$), income ($p < 0.001$), and relationship to the older adult ($p < 0.001$). In conclusion, the majority of caregivers reported low HRQOL, highlighting substantial caregiving burden. The associations with socioeconomic and personal factors emphasize the need for support mechanisms to improve the well-being of caregivers and strengthen their capacity to provide sustained, high-quality care for older adults.

Keywords: Disabled, HRQOL, Informal caregiver, Older adult



Comparative Study of Cell Permeability and Cell Viability of Desferrioxamine Incorporated Chitosan/Polyethylene Oxide/Ethyl Cellulose Nanocomposite in Caco-2 and HeLa Cells

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Iron overload is a notable clinical concern, especially among patients who undergo regular blood transfusion, such as those with thalassemia major. Desferrioxamine (DFO) is the gold standard iron chelator, used in the treatment of this condition. However, the clinical utility of DFO is limited due to its lower cell permeability and low plasma half-life, rendering the drug non-absorbable orally requiring burdensome subcutaneous infusions. The main objective of this study is to compare the cell permeability of the synthesized DFO incorporated chitosan/polyethylene oxide/ethyl cellulose nanocomposite (DFO_PEO_EC_CTS_TPP) using two different cell lines including HeLa and Caco-2. The synthesized nanocomposites were characterized using x-ray photoelectron spectroscopy, scanning electron microscopy, particle size analyzer and Fourier-transform-infrared spectrometry. Welch's t-test revealed that Caco-2 cells exhibited significantly higher cell permeability values compared to HeLa cells ($t = 6.69$, $df \approx 2.1$, $p < 0.05$) indicating that the permeability of nanocomposite is cell-type dependent and suggesting a greater potential for intestinal absorption. Cell viability studies were performed on both Caco-2 and HeLa cell lines, confirming that the nanocomposite exhibited lower cytotoxicity compared to neat DFO. Further, the novel drug formulation showed lower cell viability in HeLa cells ($IC_{50} = 29.9 \mu M$) compared to Caco-2 cells ($IC_{50} = 185.3 \mu M$) indicating differential sensitivity between epithelial like cells and cancer cells. This can be due to variation in proliferation rate, drug uptake and intrinsically more resistant nature in Caco-2 cells. The pharmacokinetic profile of the nanocomposite confirmed that the sustained release nature of DFO at both physiological and intestinal pH values. In-vitro blood compatibility assay confirmed that this nanocomposite is hemocompatible. The cell permeability study showed that Caco-2 cells exhibited higher permeability than HeLa cells, and the present results suggest enhanced gastrointestinal tract uptake, showing high potential for the formation of a non-cytotoxic oral drug formulation.

Keywords: Desferrioxamine, HeLa cells, Iron overload, Caco-2 cells, Cell permeability



Evaluation of Selected Sri Lankan Medicinal Plants for Selective Anticandidal Properties: Implications for Herbal Oral Care Formulations

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Oral candidiasis is a common opportunistic fungal infection, particularly among immunocompromised individuals such as cancer patients. The emerging resistance of *Candida* species to conventional antifungals highlights the urgent need for effective and holistic alternatives. This study evaluated the in vitro anticandidal activity of aqueous extracts of *Aegle marmelos* (leaf and fruit), *Lawsonia inermis* (leaf), and *Cinnamomum zeylanicum* (leaf) and their effects on oral commensal microorganisms. The minimum inhibitory concentrations (MICs) and minimum fungicidal concentrations (MFCs) of the extracts were determined against eleven clinically isolated *Candida* species, including fluconazole-resistant isolates, using the broth microdilution method. The effect on oral commensals was assessed using the agar well diffusion method with mixed cultures from oral rinse samples from cancer patients and healthy individuals. All four plant extracts demonstrated notable anticandidal activity, with *C. zeylanicum* showing the most potent and consistent inhibition, followed by *A. marmelos* leaf extract, while *L. inermis* exhibited moderate activity. MIC values of the plant extracts ranged between 0.016–1.000 mg/mL, comparable in some cases to fluconazole, and all extracts effectively inhibited *Candida krusei* and *Candida glabrata*, known for intrinsic fluconazole resistance. Importantly, none of the aqueous extracts produced inhibitory zones against oral commensal bacteria, indicating selective antifungal activity without disturbing the beneficial oral microbiota. Phytochemical screening revealed the presence of alkaloids, glycosides, tannins, terpenoids, saponins, and flavonoids, which may contribute synergistically to the observed anticandidal activity. These findings highlight the significance of *A. marmelos*, *L. inermis*, and *C. zeylanicum* as promising plant-based alternatives, making them promising candidates for developing a safe, natural herbal mouthwash to manage oral candidiasis without disrupting the oral microbial balance.

Keywords: Antifungal resistance, Ethnomedicine, Herbal mouthwash, Oral candidiasis



Synergistic Antioxidant Interactions Between *Solanum melongena* and *Solanum virginianum*: Implications for Ayurvedic Polyherbal Formulations

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Ayurvedic polyherbal formulations are widely recognized for their enhanced therapeutic efficacy, attributed in part to synergistic interactions among constituent plant materials. Eranda Sapthakaya is a traditional formulation commonly used to relieve arthritis-related discomfort. Two of its ingredients, *Solanum melongena* (SM) roots and *Solanum virginianum* (SV) dried aerial parts, are known to possess antioxidant phytoconstituents, but their potential interactive effects have not been scientifically evaluated. This study is designed to investigate the synergistic antioxidant interactions between SM and SV extracts using DPPH assay. Hydroalcoholic root extract of *S. melongena* and ethanolic extract of *S. virginianum* were prepared via simple maceration. The in vitro antioxidant activities of the individual plant extracts were assessed using the DPPH assay. The 30% inhibitory concentrations (IC₃₀) of SM and SV were 58.22 ± 8.66 and 30.39 ± 3.39 $\mu\text{g/mL}$ respectively, as derived from dose-response curves using linear regression analysis. The two plant extracts were subsequently combined in their IC₃₀ ratio (1:1.9) to evaluate the antioxidant potential of the mixture, which demonstrated an IC₃₀ value of 20.95 ± 0.93 $\mu\text{g/mL}$. The calculated combination index (CI) was 0.47, indicating a synergistic interaction between the two plant materials. Isobologram analysis further supported this finding, as the experimental IC₃₀ value fell below both the additive line and the theoretical IC₃₀ value (44.35 $\mu\text{g/mL}$). Additionally, the dose-response curve of the SM-SV combination exhibited a leftward shift compared to those of the individual plant extracts, indicating enhanced potency and further confirming the synergistic antioxidant effect of the combination. In conclusion, SM and SV exhibit significant synergistic antioxidant effects, supporting their combined use in traditional formulations such as Eranda Sapthakaya and highlighting their potential for therapeutic applications.

Keywords: Synergism, *Solanum melongena*, *Solanum virginianum*, Antioxidant, Isobologram



Knowledge, Attitudes and Practices towards Psychotropic Medications among Undergraduates: A Cross-sectional Study at University of Ruhuna, Sri Lanka

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University students are a vulnerable population for psychiatric disorders due to the increased mental health challenges they face. Psychotropic medications play a crucial role in managing psychiatric disorders among university students. The present study is a cross-sectional survey to assess knowledge, attitudes, and practices towards psychotropic medications among 959 undergraduates from the University of Ruhuna, Sri Lanka. Data were collected using a pre-validated self-administered questionnaire. The prevalence of current use of psychotropic medications among undergraduates was 3.8%, while 7.8% of participants had used them at some point in their lifetime. Male students showed significantly higher use of psychotropic medications (6.0%) compared to female students (2.6%) ($p = 0.010$). The mean knowledge score was 48.71 ± 18.77 out of 101 points, with 70% of students rating their knowledge as low or very low. The mean attitude score was 42.26 ± 3.93 out of 60 points; however, 54.2% of participants opposed the use of psychotropic medications as a therapeutic approach. The mean practice score was extremely low (1.99 ± 6.26 out of 36 points) due to the low number of users of psychotropic medications. However, the findings were alarming, with 7.3% of participants using psychotropic medications without prescriptions, 7.6% misusing them, and 45.7% showing abrupt discontinuation of medications. Multivariate analysis revealed that knowledge of psychotropic medications was significantly affected by gender ($p = 0.026$), faculty of enrollment ($p < 0.001$), academic year ($p = 0.003$), and parental profession ($p = 0.047$), while age ($p = 0.027$) and hometown ($p = 0.007$) affected practices. Gender was a significant factor affecting attitudes towards psychotropic medications ($p = 0.029$), with female students showing a more positive attitude than their male counterparts. Weak correlations were observed among knowledge, attitudes, and practices domains towards psychotropic medications, indicating that these domains function independently in this study population. University of Ruhuna undergraduates demonstrated moderate levels of knowledge, moderately positive but conflicted attitudes, and poor practices towards psychotropic medications. Significant knowledge gaps, conflicted attitudes, and unsafe medication practices highlight the need for health promotion initiatives regarding the use of psychotropic medications among Sri Lankan university students.

Keywords: Knowledge, Attitude, Practices, Psychotropic medications, Undergraduates, University of Ruhuna



Prescribing Patterns and Costs of Antihypertensive Medications in Secondary Care Hospitals of Galle District, Sri Lanka

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Hypertension is a major risk factor for the development and mortality of cardiovascular diseases, representing a significant public health issue both locally and globally. Its prevalence is increasing in Sri Lanka due to aging, urbanization, and lifestyle factors. To improve treatment outcomes and promote rational drug use, it is essential to evaluate prescribing patterns and the associated costs of antihypertensive medications in the public healthcare system. This study aimed to assess the prescribing patterns and treatment costs of antihypertensive medications in selected secondary healthcare facilities in Galle District. A hospital-based retrospective cross-sectional study was conducted in three randomly selected hospitals. Primary data were collected from patient interviews and records using structured data collection forms and analyzed using SPSS. Descriptive and inferential statistics, including the Chi-square test, were employed. A total of 349 hypertensive patients from Balapitiya (n=144), Elpitiya (n=148), and Unawatuna (n=57) hospitals were included. Antihypertensive medications were categorized into six classes, with Angiotensin II Receptor Blockers—mainly Losartan (72.20%)—being most frequently prescribed, followed by Beta Blockers (35.50%), Calcium Channel Blockers (33.20%), Diuretics (31.20%), Alpha Blockers (13.20%), and ACE inhibitors (11.50%). The mean monthly cost per patient was LKR 373.97, and affordability perceptions were positively correlated with income ($p < 0.05$). Drug availability varied (ARB/Diuretics: 100.0%, ACEi/BB:97.5%, CCB:84.5%, AB: 0.0%), occasionally requiring patients to purchase medications privately. Prescribing practices adhered 100% to national guidelines, with elderly patients (≥ 65 years) preferentially receiving ARBs. Monotherapy was prescribed in 53.3% of patients, dual therapy in 33.8%, and polytherapy in 12.6%, resulting in an overall polypharmacy prevalence of 53%. In conclusion, prescribing patterns in secondary care hospitals in Galle District largely aligned with national and international guidelines. Regular monitoring and the promotion of cost-effective medications may enhance rational drug use and reduce healthcare expenditures.

Keywords: Antihypertensive drugs, Drug cost, Galle district, Hypertension, Prescribing patterns



Pharmaceutical Pricing and Governance in Sri Lanka and LMICs: From Price Ceilings to Adaptive Accountability

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Medicine affordability in Sri Lanka and other low- and middle-income countries (LMICs), as classified by the World Bank, has long been pursued through price ceilings and procurement reforms. However, evidence on how governance conditions influence the success or failure of these measures remains fragmented. This study addresses that gap by synthesizing global practices in price-ceiling regulation and analyzing seven decades of pharmaceutical policy in Sri Lanka. The objective is to develop an adaptive multi-level governance framework that links political economy, institutional accountability, and actor behavior. A scoping review was conducted using JBI and PRISMA-ScR guidance. Searches across MEDLINE, Scopus, Web of Science, and major grey literature sources covering 2009 to 2025 identified 66 documents from 13 countries. Findings show that transparent pricing methodologies, predictable revision cycles, and structured stakeholder engagement are the strongest drivers of both affordability and supply sustainability. These governance conditions are more influential than the formulas used. Weak enforcement and opaque processes align with shortages and policy reversals. Sri Lanka's experience from 1949 to 2025 demonstrates this pattern, with shifts often propelled by leadership discretion and symbolic actions that generate short-term legitimacy while weakening institutional capacity. The framework highlights coherence across macro-level political legitimacy, meso-level accountability mechanisms built on transparency, answerability, and enforceability, and micro-level actor reasoning. Price ceilings should be understood as governance instruments rather than technical measures. Integrating them into adaptive systems that publish methodologies, institutionalize reviews, use health technology assessment and procurement data, and enable participatory oversight can reduce oscillation and support sustained access. Limitations include variability in reporting across countries. Future research could apply the framework in live regulatory environments to assess its practical value. Overall, this study shows that governance rather than pricing formulas underpins resilient pharmaceutical regulation and provides principles that can guide LMIC regulators seeking durable and transparent systems for medicine pricing.

Keywords: Accountability, Governance, Medicines pricing, Pharmaceutical policy, Price ceilings



Pharmaceutical Manufacturing in Sri Lanka: Production and Formulation Challenges

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Sri Lanka's pharmaceutical industry has been recognized as a key sector that can support national economic growth. However, 85% of the country's pharmaceutical needs are met through imports. Improving self-sufficiency requires a clear understanding of the challenges experienced within the industry. This study identifies the key factors that limit the production capacity of Sri Lankan pharmaceutical manufacturers, with a specific focus on production and formulation activities. Production and formulation managers from local pharmaceutical companies listed on the National Medicines Regulatory Authority website (as of January 2023) were invited to participate. Data were collected using a semi-structured, open-ended questionnaire, allowing participants to describe their experiences. Five participants representing five companies contributed to the study. Due to the limited number of participants, data saturation was not reached. The responses were analyzed using inductive thematic analysis. The first major theme identified was difficulties in meeting Good Manufacturing Practice (GMP) requirements, due to complex regulations, limited financial and technical resources, and the heavy burden of documentation. A second major theme focused on human resource constraints, encompassing challenges in recruiting skilled personnel, providing adequate training, and managing workplace attitudes. Product recall management emerged as another major theme, with subthemes such as difficulties in identifying root causes, coordinating with distributors, managing public reactions, and safeguarding company reputation. Ensuring consistent drug quality, particularly when using imported active pharmaceutical ingredients (APIs) and responding to quality failures, were identified as ongoing concerns. Participants also described strategies to improve production capacity, including process optimization, greater automation, better resource planning, workforce development, and stronger government support. The findings suggest that both industry-level initiatives and government-level investments are required to strengthen local pharmaceutical manufacturing and reduce Sri Lanka's reliance on imported medicines. These results offer exploratory insights and should be interpreted considering the limited participant representation.

Keywords: Challenges, Drug quality, Pharmaceutical industry, Production capacity, Self-sufficiency



Hepatic Steatosis and Its Associated Factors among Patients with Psoriasis Receiving Methotrexate

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Methotrexate (MTX) is an effective and affordable systemic therapy for psoriasis but requires continued biochemical and sonographic monitoring to detect liver damage early. This study evaluates liver functions and ultrasonographic findings among MTX-treated psoriasis patients, with emphasis on hepatic steatosis and associated factors. This cross-sectional study of 80 adults with chronic plaque psoriasis assessed demographic characteristics, disease severity using body surface area (BSA) and Psoriasis Area Severity Index (PASI), cumulative MTX dose, and liver biochemistry. Ultrasonography was performed by a radiologist blinded to clinical data. Comparisons between groups were assessed using the Mann-Whitney U test. Of the 80 patients assessed, 34 were males (42.5%), and the majority (45%) belonged to social class 3. The median (IQR) disease duration was 12 (5–19) years, with a median (IQR) cumulative MTX dose of 885 (90–2272) mg. Ultrasound assessment showed a normal liver in 45% of participants, grade I steatosis in 50%, and grade II in 5%. Mean values of total protein (7.05 ± 0.45 g/dL), albumin (4.54 ± 0.24 g/dL), total bilirubin (0.70 ± 0.33 mg/dL), ALP (60.9 ± 26.3 U/L), ALT (36.0 ± 28.7 U/L), AST (29.4 ± 13.2 U/L), and GGT (25.7 ± 16.5 U/L) were within normal limits. Patients with steatosis had higher BMI, waist circumference, diastolic blood pressure, fasting blood sugar, TG/HDL ratio, hs-CRP, and GGT, and lower HDL levels (all $p < 0.05$). No significant differences were found for age, gender, cumulative MTX dose, disease severity indices, other lipid parameters, or liver function markers. Overall, most methotrexate-treated patients demonstrated normal liver biochemistry. Metabolic risk factors, rather than exposure to higher cumulative doses of MTX, were more prevalent among patients with hepatic steatosis. Therefore, metabolic screening combined with ultrasound may aid in detecting liver abnormalities in MTX-treated psoriasis patients.

Keywords: Methotrexate, Psoriasis, Liver function, Hepatic steatosis, Ultrasound



Availability and Acceptability of Hormone Replacement Therapy for Menopause in Sri Lanka: Insights of Pharmacists

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Hormone Replacement Therapy (HRT) remains underutilized and insufficiently studied in many low- and middle-income countries (LMICs), despite its recognized potential to alleviate menopausal symptoms and improve quality of life. This study aimed to examine pharmacists' perspectives on the use, cost, and availability of HRT in Sri Lanka, a setting where structured menopause care services are still emerging. A cross-sectional survey was conducted from 1 January to 31 March 2025 as part of the Global Menopause Project. Pharmacists employed in community, hospital, and private-sector settings were invited to complete an anonymous online questionnaire. The instrument, piloted prior to dissemination, assessed the availability of HRT products, pricing patterns, and perceived barriers to access and use. A total of 58 pharmacists participated. Of these, 23.1% (n=32) worked in private community pharmacies, while 13.8% (n=15) were employed in government hospital pharmacies and 3.6% (n=2) in private hospitals. The remainder represented government community pharmacies and specialized areas such as clinical or regulatory pharmacy. The sample consisted of 37 females (63.8%) and 21 males (36.2%), with 66% practicing in urban areas. Participants held diverse professional qualifications, including Certificate of Proficiency or Efficiency (n=28), BPharm (n=20), Higher National Diploma (n=6), BSc Pharmacy (n=2), and postgraduate qualifications (n=2). Pharmacists reported that only Femoston (1 mg and 2 mg) were reliably available as HRT options in Sri Lanka. The Mirena coil was the most expensive HRT-related product (US\$101). Notably, 72.4% (n=42) of pharmacists incorrectly identified oral contraceptive pills or emergency contraceptive pills as HRT formulations. Major barriers included low public health literacy, financial constraints, and limited access to menopause-specific healthcare services. Findings highlight significant disparities in HRT availability, affordability, and awareness. Pharmacists' perspectives underscore the urgent need for integrated, equitable strategies to strengthen menopause care and women's health policy in resource-limited settings such as Sri Lanka.

Keywords: Availability, Acceptability, Hormone replacement therapy, Pharmacists, Sri Lanka



Self-Medication Practices and Awareness among Mothers of 3–5 Year Old Children in Matara Municipality Area

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Self-medication is globally practiced, and its prevalence is rising among mothers administering drugs to their young children. Though self-medication is convenient, it carries important risks of inappropriate medication, adverse drug reactions, and accidental overdose, especially in vulnerable pediatric populations. This study aimed to assess self-medication practices and awareness among mothers of 3–5-year-old children in the Matara Municipality area, Sri Lanka. A descriptive, cross-sectional study was conducted enrolling five randomly selected preschools in the Matara Municipality area. Data were collected from a total of 313 mothers through an interviewer-administered questionnaire that assessed socio-demographic characteristics, recent use of self-medication, history of illnesses, and awareness, attitudes, and practices of self-medication. Data were analyzed using SPSS version 25.0 with descriptive statistics and chi-square test to identify associations among selected variables. The prevalence of self-medication among mothers was 89.5%. Paracetamol (84%) and antihistamines were the common self-medications mothers used for their children; the antihistamines were Piriton (52.1%) and Cetirizine (35.1%). Most participants (67.1%) reported the internet as their main source of information. Most children had suffered from common cold (65.2%), cough (44.1%), and fever (39.9%) in the last 30 days. Only 15% of mothers showed high awareness about the risks of self-medication, and 72.8% had a moderate level of awareness. Self-medication awareness was significantly associated with maternal education ($p < 0.001$), occupation ($p \leq 0.001$), and family income ($p < 0.001$). In addition, socio-demographic factors were shown to affect attitudes and practices as well. This study further identified knowledge gaps in the areas of drug overdosing and adverse effects. Self-medication is a very common practice among a high majority of mothers in the Matara Municipality area, and there is a significant lack of awareness about the risks of medication and their proper use. Educational interventions for mothers are urgently needed.

Keywords: Self-medication, Mothers, Preschool children, Awareness, Pediatric medication safety



Polypharmacy among Patients with Diabetes Mellitus Attending the Diabetic Clinic, National Hospital, Galle

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Patients with diabetes mellitus are at a higher risk of exposure to polypharmacy due to the presence of multiple comorbid conditions, which heavily impact their overall health outcomes. This study aimed to assess the prevalence, appropriateness, associated factors, and impact of polypharmacy on diabetic patients. A cross-sectional study was conducted among 290 patients aged ≥ 18 years with type 1 or type 2 diabetes attending the diabetic clinic at the National Hospital, Galle. Data were extracted from clinic record books and from both self-administered and interview-administered questionnaires. Polypharmacy was defined as taking five or more medications per day. The appropriateness of polypharmacy was analyzed by two expert clinicians. Descriptive statistics, chi-square tests, odds ratios, and logistic regression were performed using SPSS version 25, with a significance level of $p < 0.05$. The mean age of the study population was 59.2 years (SD = 11.03), and patients were prescribed an average of 5.88 medications (SD = 2.43). The prevalence of polypharmacy was 69% (200/290). Inappropriate polypharmacy was observed in 12.4% of participants (36/290). Polypharmacy was significantly associated with multimorbidity ($p < 0.05$), including hypertension (OR = 4.49; 95% CI: 2.633–7.675), dyslipidaemia (OR = 3.60; 95% CI: 2.107–6.146), asthma (OR = 8.27; 95% CI: 1.083–63.117), and heart failure (OR = 11.00; 95% CI: 1.459–82.93). Lipid-modifying (86.3%) and antithrombotic drugs (63.1%) were the most frequently prescribed in combination with antidiabetic medications. The prevalence of polypharmacy showed a significant association with age ($p < 0.001$), duration of treatment ($p < 0.001$), and low knowledge about medications ($p = 0.002$). Polypharmacy had a significant impact on forgetfulness, difficulty in managing cost, adverse side effects, healthcare utilization barriers, medication adherence, and patient dissatisfaction with their treatments ($p < 0.001$). In conclusion, the study revealed a high prevalence of polypharmacy among patients with diabetes, and the findings indicate the importance of continuous medication review, improving prescribing practices, and enhancing patient education to minimize inappropriate polypharmacy and optimize therapeutic outcomes.

Keywords: Diabetes mellitus, Multimorbidity, Polypharmacy, Inappropriate polypharmacy



Optimization and Validation of a UV Spectrophotometric Assay for Empagliflozin: A Cost-Effective Approach for Pharmaceutical Quality Control

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Empagliflozin, a selective sodium-glucose co-transporter 2 (SGLT2) inhibitor, is widely used for the management of type 2 diabetes mellitus (T2DM). Ensuring the quality and consistency of empagliflozin-containing pharmaceutical products requires validated analytical methods that are simple, accurate, and cost-effective. This study aimed to develop and validate a UV spectrophotometric method for the quantitative estimation of empagliflozin in bulk drug and tablet formulations, following ICH Q2(R1) guidelines. A UV spectrophotometric method was developed using a 50:50 methanol-deionised water solvent system. The λ_{max} (223 nm) was identified from the absorption spectrum, and calibration curves were prepared within the 2–20 $\mu\text{g/mL}$ range. Validation parameters—including linearity, specificity, accuracy, precision, limits of detection and quantification (LOD/LOQ), and solution stability—were evaluated per ICH Q2(R1). Commercial empagliflozin 10 mg tablets were assayed using both the developed UV method (200–400 nm range) and a validated HPLC method to confirm method accuracy. Empagliflozin exhibited optimal solubility and spectral stability in the selected solvent system, with a prominent λ_{max} at 223 nm. Calibration data demonstrated excellent linearity ($R = 0.9994$). Method validation confirmed excellent specificity, with no interference from excipients. Accuracy studies demonstrated recovery values ranging from 97.1% to 99.8%, while intra-day and inter-day precision yielded %RSD values of 0.57% and 0.53%, respectively. The LOD and LOQ were 0.34 $\mu\text{g/mL}$ and 1.03 $\mu\text{g/mL}$, respectively. Analytical solutions remained stable for up to 24 hours at room temperature with less than 1% change in absorbance. API content obtained using UV spectrophotometry (97.8%) closely matched that obtained by HPLC (98.2%), supporting the reliability of the developed method. Overall, the developed UV spectrophotometric method is simple, rapid, environmentally friendly, and cost-effective, meeting all regulatory validation requirements. It is suitable for routine quality control of empagliflozin formulations and provides an accessible alternative to chromatographic techniques, particularly in laboratories with limited resources.

Keywords: Empagliflozin, UV spectrophotometry, Method validation, Quality control

Pure Sciences, Mathematics, and Statistics



Digital Image Security on Elliptic Curve using Visual Cryptography

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In the modern digital landscape, images are integral to daily communication and operations, making their security a critical concern. While no encryption method can guarantee absolute security, some approaches offer significantly stronger protection than others. This paper presents a novel hybrid image encryption scheme that combines the strengths of Visual Cryptography (VC) and Elliptic Curve Cryptography (ECC). The proposed method begins by using Visual Cryptography to split a secret image into two distinct shares. One share functions as an encryption key, while the other is encrypted using ECC 128 bits curve parameters to produce a cipher image. Subsequently, both shares are merged into a single secured image file. The effectiveness of the encryption and decryption processes is rigorously evaluated through standard security analyses. Performance metrics such as the Number of Pixel Change Rate (NPCR), Unified Average Changing Intensity (UACI), histogram analysis, and processing speed are used to assess the scheme's robustness and efficiency.

Keywords: Digital Image, Visual Cryptography, Elliptic Curve Cryptography



Modeling Conditional Value-at-Risk Using Tukey's g-and-h Family of Distributions with Maximum Approximated Likelihood Estimation

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The main purpose of this study was to model Conditional Value-at-Risk using Tukey's g-and-h distribution and employ the maximum approximated likelihood method for parameter estimation, subsequently contrasting Tukey's distribution with Cornish-Fisher and classical approaches. While the Cornish-Fisher method modifies the normal quantile to account for skewness and kurtosis, the classical methodology assumes that asset returns follow a normal distribution. Historical daily return data from January 1, 2003, to January 17, 2011, from Spain were used in the study. Conditional Value-at-Risk (CVaR), also known as Expected Shortfall (ES), is a risk indicator that shows the expected loss at a given confidence level when a loss exceeds the Value-at-Risk. The maximum approximated likelihood estimator is one approach used to estimate the parameters of Tukey's distribution. Because of its light-tailed assumption, the classical technique results in the least extreme losses. Due to its sensitivity to skewness and kurtosis modifications, the Cornish-Fisher approach produces noticeably larger tail losses; however, at very high confidence levels, this may introduce instability. Without the dramatic divergence observed in the Cornish-Fisher method, the MALE-based Tukey's model captures heavy-tailed traits with smoother and more stable tail behavior. These findings imply that MALE provides a more reliable paradigm for measuring high risk. These findings have applications in stress testing, regulatory calculation, and risk management, where precise extreme tail risk estimation is essential. Model errors, parameter uncertainty, data selection, and inadequate data may still impact the proposed strategy. Consequently, even while MALE enhances tail risk prediction, its efficacy depends on adequate data and trustworthy estimation techniques. As a recommendation, to further confirm the MALE model's resilience in measuring severe risk, additional research should examine its performance in various market scenarios and on larger datasets.

Keywords: Classical method, Conditional Value-at-Risk, Cornish-Fisher method, Maximum approximated likelihood method



Forecasting Green Tea Production in Sri Lanka: A Time Series Analysis

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Tea is the main agricultural value-added export product in Sri Lanka, providing a significant contribution to the national economy. Specifically, green tea has drawn worldwide attention in this sector due to its growing consumer demand. Therefore, the main objective of this study was to obtain a reliable forecasting model for green tea production using time series analysis, which is essential for strategic planning to maintain competitiveness in the international market. This study develops time series forecasting models for monthly green tea production using both traditional Seasonal Auto Regressive Integrated Moving Average (SARIMA) models and modern approaches such as Recurrent Neural Network (RNN) models, specifically Long Short-Term Memory (LSTM) models. Monthly production data from 2013 to 2024 were obtained from the Sri Lanka Tea Board for analysis. Model forecasts were evaluated against observed values using standard forecasting accuracy measures such as MAE, MAPE, and RMSE to identify the best-performing model. SARIMA (2,1,2) (1,1,1)₁₂ and LSTM models were developed to forecast monthly green tea production for the test data months. The dataset was split into training and testing data, focusing on capturing short-term production patterns. The results indicate that the LSTM model achieves the lowest prediction error, demonstrating superior forecasting performance. The results demonstrate that modern forecasting approaches, such as LSTM based on Recurrent Neural Networks (RNNs), can effectively capture the nonlinear dynamics of tea production and outperform traditional SARIMA models. These findings suggest that industry stakeholders and policymakers can use RNN-based forecasts to improve production planning, resource allocation, and market supply management, thereby supporting more informed decision-making in the green tea sector.

Keywords: LSTM, MAE, MAPE, RMSE, SARIMA



Deriving the Density Form Factor for the Strongly Interacting ($c \rightarrow \infty$) 1D-Bosons in Lieb-Liniger Model

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Interacting bosons in one dimension (1D) are described by the exactly solvable Lieb-Liniger (LL) model, which satisfies the Bethe Ansatz equations. The dynamical structure factor (DSF) is given by the Fourier transform of the time-dependent density-density correlation function. This study aims to obtain a simplified analytical expression for the density form factor (DFF), which is currently unavailable due to the complexity of the calculation related to the density-density correlation function. The DFF is a function that describes how energy eigenstates are distributed in space. As a first step, the excited momentum of the boson particle in the ground state was approximated up to $1/c$, where c is the coupling constant, based on the momentum of the ground state. The DFF was then expanded using the Lehmann representation, and each term in the expansion was simplified separately using mathematical techniques such as the Cauchy determinant, in terms of energy eigenstates. Finally, a simplified analytical expression was derived for the DFF, and the result was confirmed by numerical results and the dispersion relation. The dispersion relation for 1D strongly interacting bosons in the LL model was obtained considering a large system with constant density. Furthermore, this study helps to gain knowledge about the significant excitation of the system based on the sum rule.

Keywords: Dispersion relation, Dynamical form factor, Lieb-Liniger model

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