

5th



Nurturing Future Leaders through Research and Innovation
APSURS
SABARAGAMUWA UNIVERSITY OF SRI LANKA

APPLIED SCIENCES UNDERGRADUATE RESEARCH SYMPOSIUM

*"Nurturing Future Leaders through
Research and Innovation"*



20th August 2026



Faculty of Applied Sciences
Sabaragamuwa University of
Sri Lanka

ABSTRACTS





APSURS 2026

APPLIED SCIENCES UNDERGRADUATE RESEARCH SYMPOSIUM
SABARAGAMUWA UNIVERSITY OF SRI LANKA



20TH AUGUST 2026

FACULTY OF APPLIED SCIENCES
SABARAGAMUWA UNIVERSITY OF SRI LANKA

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APSURS 2026 provides a platform for researchers, academics, professionals, and students to share the findings of their research with an extensive research and scholarly community, thereby exposing them to broad academic and industrial opportunities and research collaborations with leading industries.

It encourages participants to examine local and global trends in their fields of research and to share developments in applied sciences, technology, innovation, skills, knowledge, and investment.

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Message from the Actg. Vice Chancellor, Sabaragamuwa University of Sri Lanka

It is with immense pride and pleasure that I extend my warmest greetings on the publication of the Proceedings Book of the 5th Applied Sciences Undergraduate Research Symposium (APSURS 2026), organized by the Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka. Held under the theme “Nurturing Future Leaders through Research and Innovation,” APSURS 2026 reflects our University’s commitment to fostering intellectual curiosity, critical inquiry, research skills, innovation, and leadership among the next generation of scholars. Research is not merely an academic requirement; it is a journey of questioning what we know, challenging assumptions, discovering new knowledge, and seeking solutions to the problems faced by society. As Albert Einstein observed, “The important thing is not to stop questioning.” This spirit of curiosity is fundamental to undergraduate research and to the development of students as independent thinkers and future leaders. The 5th APSURS marks an important milestone as the symposium expands its participation to undergraduates from across Sri Lanka. This national platform provides young researchers with valuable opportunities to present their findings, exchange ideas, receive constructive feedback, develop their communication and analytical skills, and build relationships with fellow researchers from different institutions and disciplines. I am particularly pleased that the symposium seeks to strengthen the connection between academia and industry. Such engagement enables students to appreciate how knowledge, science, technology, and innovation can be translated into practical applications. It can also open pathways towards employment, entrepreneurship, postgraduate education, internships, and collaborative research. The value of APSURS therefore extends beyond the presentation of research. It is a platform where ideas are shared, questions are encouraged, skills are developed, networks are created, and aspirations are nurtured. I hope that the experience gained through this symposium will inspire our young researchers to pursue further studies, engage in meaningful research, and become leaders who contribute responsibly to the advancement of science and society. I wish to place on record my sincere appreciation to Microsoft for generously providing the Microsoft CMT service free of charge to support the peer-review process, including Azure cloud services, software development, and technical support. I also commend the Faculty of Applied Sciences, the Organizing Committee, reviewers, session chairs, academic and administrative staff, and all others who have contributed to the successful organization of APSURS 2026. To all undergraduate researchers, both from Sabaragamuwa University and from other institutions across Sri Lanka, I extend my warmest congratulations. Make full use of this opportunity to listen, question, engage, collaborate, and learn. Your present research may be only the beginning of your journey, but the qualities developed through it—curiosity, integrity, perseverance, critical thinking, creativity, and commitment to evidence—will serve you throughout your lives. May APSURS 2026 inspire you to dream boldly, investigate deeply, innovate responsibly, and contribute meaningfully to the future of our nation and the wider world. I wish APSURS 2026 every success and all participants a stimulating, rewarding, and memorable symposium.



Professor S. A. Ariadurai

Actg. Vice-Chancellor

Sabaragamuwa University of Sri Lanka

Message from the Dean, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka

The Faculty of Applied Sciences is committed to nurturing resourceful, innovative, and lifelong learners equipped with the knowledge, competencies, and professional skills required in their respective disciplines. With a strong emphasis on fostering a growth mindset, critical thinking, innovation, and continuous learning, the Faculty empowers students to make meaningful and sustainable contributions to academia, industry, and society.

The 5th Applied Sciences Undergraduate Research Symposium 2026, held under the theme “Nurturing Future Leaders through Research and Innovation,” marks a significant milestone in the academic journey of our undergraduates, providing them with a valuable platform to showcase their independent research, inventions, and innovative ideas. The symposium also reflects the academic diversity and research potential of the Faculty of Applied Sciences, bringing together a broad range of disciplines, including Natural Sciences, Food Science, Computer Science, Sport Science, and Physical Education. Designed to provide an enriching and inspiring experience for emerging researchers, the symposium incorporates the key elements of a distinguished scientific conference, fostering research excellence, interdisciplinary collaboration, innovation, and the development of future scientific leaders.

As the Dean of the Faculty, it is a great pleasure and privilege to witness the enthusiasm, commitment, and dedication demonstrated by our undergraduates and academic staff in making APSURS 2026 a success. I extend my sincere and heartfelt appreciation to all the students who have presented their valuable research, to their supervisors for their invaluable guidance, encouragement, and mentorship, and to the dedicated members of the APSURS 2026 Organizing Committee, under the able leadership of the Symposium Chair, for their outstanding efforts and commitment.

Beyond serving as a platform for presenting and exchanging research findings, I envision APSURS evolving into a flagship academic event for the Faculty, fostering a strong culture of research, innovation, critical inquiry, and interdisciplinary collaboration. I believe that the symposium will continue to inspire and empower a new generation of researchers to address contemporary challenges through creativity, scientific thinking, and innovation.

As APSURS continues to expand in scope, quality, and impact in the years ahead, I am confident that it will gain increasing national and international recognition and establish itself as a prestigious platform for undergraduate research, innovation, and academic excellence.

Professor R. M. Kapila Tharanga Rathnayaka

Dean, Faculty of Applied Sciences

Sabaragamuwa University of Sri Lanka



Message from the Chair, 5th Applied Sciences Undergraduate Research Symposium, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka

It is my great pleasure to welcome you to the 5th Applied Sciences Research Symposium (APSURS 2026), held under the theme “Nurturing Future Leaders Through Research and Innovations.” Research and innovation are essential for advancing knowledge, addressing emerging challenges, and creating a sustainable future. APSURS 2026 provides a valuable platform for researchers, academics, professionals, and students to present their work, exchange ideas, and build meaningful collaborations. This year’s symposium brings together research across four major tracks: Food Sciences and Technology; Earth and Natural Sciences; Physical Sciences and Computer Science; and Sports Sciences and Physical Education. The diversity of these fields reflects the importance of interdisciplinary research in developing innovative solutions to contemporary challenges. The theme of APSURS 2026 emphasizes our commitment to nurturing the next generation of researchers and leaders. By providing young researchers with opportunities to share their findings, receive expert feedback, and engage with the wider research community, we aim to strengthen their confidence, creativity, critical thinking, and leadership capabilities. I sincerely appreciate the dedication of the organizing committee, reviewers, academic staff, researchers, students, and all other contributors who have worked together to make this symposium a success. I also warmly thank all authors and participants for sharing their valuable research and expertise. As we celebrate the fifth edition of APSURS, let us continue to foster a culture of research excellence, innovation, collaboration, and leadership. May this symposium inspire new ideas, strengthen research partnerships, and empower our young researchers to become future leaders who contribute meaningfully to science and society. I warmly welcome you all to APSURS 2026 and wish you an inspiring, productive, and memorable symposium.



Dr. L.M.M. De Silva

Chair, 5th Applied Sciences Undergraduate Research Symposium

Sabaragamuwa University of Sri Lanka

Message from the Keynote Speaker

It is a great privilege and honour to deliver the keynote address at the 5th Applied Sciences Undergraduate Research Symposium 2026, organised by the Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka. I warmly congratulate the organisers, academic staff, researchers, supervisors, and, most importantly, the undergraduate researchers whose curiosity, dedication, and perseverance have made this symposium possible. The theme, “Nurturing Future Leaders Through Research and Innovation,” is both timely and inspiring. The challenges confronting our world—from climate change and food security to sustainable resource management, digital transformation, health, and human wellbeing—cannot be addressed through knowledge alone. They require curiosity, creativity, scientific thinking, collaboration, and the courage to transform ideas into meaningful solutions. This is precisely why undergraduate research matters. Research is not simply an academic requirement or a pathway to a publication. It is a process of learning how to ask important questions, distinguish evidence from assumption, embrace uncertainty, learn from failure, and develop solutions based on systematic investigation. Through research, students become not merely consumers of knowledge but producers and innovators of knowledge. The four tracks of this symposium—Food Science and Chemical Technology; Earth and Natural Sciences; Physical Sciences and Computing; and Sports Sciences and Physical Education—demonstrate the remarkable breadth of applied sciences. The emphasis on frontier technologies for sustainable development further reminds us that scientific progress must ultimately serve society and protect the future of our planet. To the undergraduate researchers, I encourage you to think beyond the immediate findings of your projects. Ask yourselves: What problem does my research address? Who can benefit from it? Can it be developed further? Can I collaborate with another discipline? Can this idea contribute to a more sustainable Sri Lanka and a better world? These questions can transform a student project into the beginning of a lifelong research journey. Equally important is collaboration. The most significant scientific and technological advances increasingly occur at the boundaries between disciplines. I therefore commend the symposium for creating opportunities for young scientists to share their findings, strengthen their research skills, and establish collaborations. Let this gathering become a space where ideas meet, disciplines connect, and partnerships emerge. Finally, I congratulate the Faculty of Applied Sciences of Sabaragamuwa University of Sri Lanka for sustaining this important platform for undergraduate research. I wish the 5th Applied Sciences Undergraduate Research Symposium 2026 every success and extend my very best wishes to all the young researchers embarking on their journey of discovery and innovation. Thank you, and may your research illuminate new possibilities for our nation and our world.



Professor K. P. S. Chandana Jayaratne

Chairman, Arthur C Clarke Institute for Modern Technologies

Chairman, Indu-Lanka Research Projects Evaluation Committee of the Ministry of Science and Technology
(Government of Sri Lanka counterpart)

Former Head of the Department of Physics, University of Colombo Editor in Chief, Journal of the Sri Lanka Association for the Advancement of Science

SYMPOSIUM TRACK

Earth and Natural Sciences



Applied Sciences Undergraduate Research Symposium 2026

5th Applied Sciences Undergraduate Research Symposium

20th August 2026

Sabaragamuwa University of Sri Lanka

Assessment of Pesticide Usage and Related Environmental & Health Impacts in Thanamalwila Region

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Pesticide usage plays a pivotal role in terms of enhancing agricultural yield and productivity in rural regions in Sri Lanka. The Thanamalwila region is one of the significant agricultural hubs in Uva Province, which involves intensive usage of agrochemicals. However, improper and excessive usage of pesticides poses risks to the environment and human health. This study assesses pesticide usage patterns, safety practices, and associated environmental and health impacts in the Thanamalwila region, focusing on Ranawarnawa and Balaharuwa villages. Data were collected through structured surveys by interviewing farmers and analyzed using descriptive statistical methods. The findings reveal a notable dependency on synthetic pesticides, with 90% of farmers relying on chemical inputs and 78% using pesticides for over 20 years. A considerable proportion of farmers (48%) exceeded the recommended dosage level, while 58% of farmers applied pesticides on a weekly basis. Safety practices were inadequate, with 12% of farmers reporting no precautionary measures and 87% lacking formal guidance on safe pesticide handling. Farmers primarily depend on personal experience and pesticide vendors for recommendations, with a lack of reliance on agricultural extension services. Improper disposal practices, including burning and burying of containers, were commonly observed, contributing to environmental contamination. Furthermore, 20% of farmers reported long-term health issues, including respiratory and skin-related conditions. Comparative analysis indicated that farming experience and knowledge significantly influenced the awareness of pesticide-related impacts and safety behaviors, with more experienced and knowledgeable farmers demonstrating better compliance. Despite the challenges, most farmers expressed their willingness to adopt eco-friendly and effective alternatives. The study highlights critical gaps in knowledge, safety practices, and regulatory compliance, emphasizing the need for targeted training programs, strengthened extension services, and promotion of sustainable pest management strategies, ensuring the long-term well-being of the farming communities in the region.

Keywords: Environmental Impacts, Farmer Awareness, Health Impacts, Pesticide Usage, Safety Practices

Assessing Household Willingness to Pay for Improved Solid Waste Collection in the Tourist-Attracted Belihuloya Region, Sri Lanka

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In the tourist-attracted rural Belihuloya region, limited waste infrastructure has forced residents to rely on harmful disposal practices such as burning and open dumping. Understanding households' (HHs') financial capacity and willingness to pay (WTP) for improved collection is vital for developing sustainable waste management solutions. This study aimed to assess the total annual household WTP for improved solid waste collection services in the area. A HH survey was conducted across six villages in the Belihuloya area: Assaddumwela, Bogaha Kumburuwela, Medahinnewela, Walakadawela, Galarawa, and Pahala Galagama. The study employed a stratified random sampling method, and the sample size was calculated using the Yamane's equation for a target population of 197 HHs. This calculation yielded a final sample size of 91 HHs with a margin of error of 7.6%. Data was collected using 10 focus group discussions (FGDs) and the contingent valuation method (CVM) during April 2026. The results showed that 36 HHs (39.6%) agreed to pay for enhanced services. The mean monthly WTP was 513.89 LKR, and the annual WTP per HH was 6,166.68 LKR. According to that the estimated total annual WTP among the 197 target HHs in the study area was 480,594.45 LKR. This low WTP may be attributed to limited awareness of the health and environmental hazards associated with improper waste disposal. Many HHs were reluctant to pay for the service due to reasons including having sufficient space to burn non-biodegradable solid waste, limited access to main roads for collection services, and minimal waste generation. HHs may prioritized short-time costs over long-term consequences. Continued burning of non-biodegradable solid waste poses significant risks that are not adequately considered by residents. Therefore, increasing public awareness and emphasizing the hidden future costs of improper solid waste management are essential.

Keywords: Contingent valuation, Environmental health, Rural tourism, Solid waste management, Willingness To Pay

Potable Water Quality Assessment to Ensure Water Safety in Muththettuwagama GN Division, Balangoda, Sri Lanka

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Groundwater serves as the primary source of drinking and agricultural water for many rural communities in Sri Lanka. The quality of water is a critical factor for public health and sustainability. This study evaluates the physicochemical characteristics of potable water in the Muththettuwagama Grama Niladari Division in Balangoda, Sri Lanka, and compares the results with the Sri Lanka Standards (SLS 614:2013) and drinking water guidelines of World Health Organization. 28 water samples were collected from various sources, including dug wells, tube wells, springs, and National Water Supply and Drainage Board systems, representing different land-use settings. Key parameters such as pH, electrical conductivity (EC), turbidity, salinity, dissolved oxygen (DO), and temperature were measured using standard field and laboratory methods. The results indicated that most physicochemical parameters, including EC, salinity, turbidity, and dissolved oxygen, remained within acceptable limits. However, pH values in the majority of samples ranged from 4.81 to 6.18, falling below the recommended range of 6.5 to 8.5. That indicates slightly to moderately acidic conditions. This acidity may be influenced by local geological characteristics and agricultural runoff. Temperature variations were observed depending on well depth and sunlight exposure, while DO levels (~ 6 mg/L) suggested generally good water quality with minor localized impacts. Overall, the findings reveal that groundwater in the study area is largely suitable for consumption, although the acidic nature of some sources raises concerns regarding long-term usage and infrastructure corrosion. The study highlights the importance of continuous monitoring, improved groundwater management, and community awareness to maintain water safety. These measures are important for protecting public health and ensuring sustainable water resource management in rural areas.

Keywords: Physiochemical Parameters, Sri Lanka Standards, Water Quality, Water Safety

Developing a Conservation Plan for Pangolin for Belihuloya Region Through Community Survey

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The Indian pangolin (*Manis crassicaudata*), Sri Lanka's sole pangolin species and classified as Endangered by the IUCN, faces severe threats from habitat loss, poaching for meat and scales, and limited community awareness in regions like Belihuloya, where human activities exacerbate population declines. This study aimed to develop a conservation plan through community outreach, with specific objectives to document pangolin presence and threats, implement educational programs in schools and communities to promote coexistence, and reduce negative perceptions by highlighting the species' ecological role in insect control and soil aeration. The methods included selecting pangolin habitats across Belihuloya villages (such as Galagama and Pambahinna) and conducting a structured questionnaire survey with 97 community members to assess their knowledge of pangolin identification, diet, behavior, threats, and legal protections. Additionally, an awareness program was carried out at Galagama Dhammaloka Vidyalaya for 99 students through interactive sessions, leaflets, and social media, with its effectiveness evaluated using pre- and post-assessments analyzed by Wilcoxon signed-rank tests. Key results revealed high community awareness (81% familiar with pangolins), peaking among 40-50-year-olds (36 respondents) and farmers (64 participants), with frequent sightings in Galagama (23) and Pambahinna (22). Students knowledge improved significantly after the awareness programme, with median scores doubling, including 50% gains in identification, 36% in ecological understanding, 48% in threat recognition, and 68% in legal awareness. These findings underscore the efficacy of targeted education in bridging knowledge gaps and fostering positive attitudes, concluding that integrating wildlife conservation into local curricula and community monitoring can enhance sustainable human-pangolin coexistence, providing a replicable model for other Sri Lankan regions.

Keywords: Community Engagement, Conservation Education, Ecological Awareness, Endangered Species, Human-Wildlife Coexistence

Understanding and Improving Knowledge, Attitudes, and Practices (KAP) Regarding Snakes and Snakebite Responses in Belihuloya Area

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Snakes play important ecological roles as predators and prey, but fear and misunderstanding often lead to unnecessary killing. Snakebite is also a major health concern in Sri Lanka, particularly in rural areas where human–snake encounters are frequent. This study assessed community knowledge, attitudes, and practices regarding snakes and snakebite responses in the Belihuloya area, particularly Pambahinna and the Sabaragamuwa University premises. Data were collected from 124 students, staff members, and villagers using a structured questionnaire, interviews, and a visual snake-identification activity conducted through physical and virtual methods. Among the 92 participants with valid identification scores, the mean percentage of snake images correctly identified was 42.8% for participants aged 15–30 years, 29.7% for those aged 31–50 years, and 31.7% for those aged 51 years or older. Mean identification was 41.5% among males and 33.8% among females. Correct first-aid awareness was reported by 71.8%, 54.2%, and 31.8% of the three age groups, respectively, and by 67.4% of males and 58.0% of females. A positive attitude towards snake conservation was reported by 92.8%, 75.0%, and 72.7% of the age groups and by 92.5% of males and 81.3% of females. Belief in snake-related myths was reported by 15.4%, 20.8%, and 27.3% of the age groups and by 18.6% of males and 18.5% of females. First-aid awareness differed significantly among age groups, while the other comparisons were not significant after adjustment for multiple testing. Unsafe handling practices and inappropriate first-aid responses were also identified. Based on these findings, community outreach initiatives were conducted, including awareness sessions, and the distribution of an informative leaflet, while a newspaper article was published to promote appropriate snakebite responses and snake conservation.

Keywords: Attitudes and Practices (KAP) , Conservation ,First Aid,Knowledge,Snakebite,Snakes

Formulation and Assessment of Nitrogen-Enriched Granular Carbon Fertilizer Using Bagasse Boiler Ash from Sugar Industry

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The sugarcane-based sugar and alcohol industry generates several by-products, among which bagasse boiler ash (BBA) is produced during the cogeneration process. BBA is a carbon-rich by-product with limited nutrients that remains underutilized as a soil amendment. This study evaluated the feasibility of producing nitrogen-enriched granular carbon fertilizers from BBA using urea as the nitrogen source and either vinasse or methyl cellulose as binders at three nitrogen enrichment levels (2.5%, 5%, and 10%) in a completely randomized design with three replications. Granule quality was assessed via compressive strength, pH, electrical conductivity (EC), total nitrogen (N), available phosphorus (P), and exchangeable potassium (K). Subsequently, a pot experiment was conducted under shade-house conditions using reddish brown earth soil in a randomized complete block design to assess the effects of the developed granules on soil chemical properties, including pH, EC, N, P, K, organic carbon (OC), zinc, copper, and iron. Results showed that vinasse-based granules exhibited higher pH, strength and K than cellulose-based granules. The 2.5% vinasse formulation showed optimal strength and nitrogen retention, while the 10% enrichment yielded the highest N content in both binders. One-way ANOVA revealed significant differences ($p < 0.05$) among granule types for pH, EC, strength, N, and K. Pot experiment results demonstrated significant soil property improvements over controls, with the vinasse + 2.5% nitrogen treatment yielding the highest OC ($2.11 \pm 0.21\%$) and K (500.46 ± 40.02 ppm), and the vinasse + 10% nitrogen treatment recording the maximum total N (1410.88 ± 80.58 ppm). Collectively, these findings indicate that BBA-based granular fertilizers have potential for soil fertility enhancement, though field-scale trials remain necessary to confirm agronomic performance under practical cropping conditions.

Keywords: Bagasse boiler ash, Granular fertilizer, Sugarcane, Sugar-industry by-products

Assessing the Impact of Wildfire on Soil, Plants, and Community Indicators in Imbulpe DSD, Balangoda, Sri Lanka

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Wildfires are a recurring environmental disturbance in the Imbulpe Divisional Secretariat Division (DSD) of the Ratnapura District, Sri Lanka, significantly affecting soil properties, vegetation dynamics, and community livelihoods. This study aimed to assess and compare the impacts of wildfire on soil, plant, and community indicators in burnt and non-burnt areas of Nonperiell, Ihala Galagama, and Seelagama. A comparative field-based methodology was applied, where soil samples from burnt and adjacent non-burnt sites were analyzed for pH, electrical conductivity (EC), color, and texture, while vegetation conditions were assessed using Normalized Difference Vegetation Index (NDVI) and field observations; additionally, community data were collected through structured surveys. The results revealed significant differences between burnt and non-burnt areas. Burnt soils recorded higher pH values (6.83, 5.64, and 6.05) compared to non-burnt soils (5.82, 5.33, and 5.65), indicating increased alkalinity due to ash deposition. EC was also elevated in burnt soils (15.38, 10.27, and 10.69 $\mu\text{S}/\text{cm}$) relative to non-burnt soils (7.49, 5.87, and 8.10 $\mu\text{S}/\text{cm}$), reflecting increased soluble ion concentrations. Sieve analysis of soil showed a higher proportion of coarse particles in burnt soils, while non-burnt soils retained finer particles and higher organic matter, supported by darker soil coloration. NDVI analysis indicated a clear decline in vegetation health in burnt areas between 2023 and 2024, whereas non-burnt areas maintained relatively stable vegetation cover. Field observations further confirmed reduced species diversity and poor regeneration in burnt sites, with the absence of key undergrowth species such as *Osbeckia oclandra* and *Megathyrsus maximus*, which were present in non-burnt areas. Community survey findings showed that over 70% of wildfire incidents were caused by human activities, particularly intentional burning during the July–August dry season. Overall, wildfire significantly degrades soil quality, reduces vegetation recovery, and impacts livelihoods, highlighting the urgent need to establish sustainable land management and community-based wildfire prevention strategies in the region.

Keywords: Community livelihoods , NDVI, Soil properties, Vegetation recovery, Wildfire

Quantification of the Carbon Footprint: A Case Study in the Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka

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Carbon footprint is the measurement of the total amount of greenhouse gases released directly or indirectly by an activity, product or organization. Carbon footprint assessment is essential for reducing greenhouse gas emissions. However, studies on the carbon footprint of Sri Lankan universities are limited, highlighting the need for this study. Carbon Footprint of the Faculty of Applied Sciences of Sabaragamuwa University of Sri Lanka for the year 2023 was quantified based on the ISO 14064:2018 Guidelines and GHG Protocol. Emission Sources were identified under three scopes: first scope – direct emissions, second scope – indirect emissions, third scope – other indirect emissions. First scope includes direct emissions from LP gas usage, generator fuel consumption and faculty-owned vehicle fuel combustion. Second scope includes indirect emissions by purchased electricity. Third scope accounts the indirect emissions from commuting of students and staff to the faculty. Activity data for the calculations were gathered using university records and questionnaires. Emission factors were obtained from IPCC guidelines for GHG inventories and the Sri Lanka Sustainable Energy Authority reports. The total annual Carbon Footprint of the Faculty of Applied Sciences was calculated as 86.85 tCO₂-e for the year 2023. Scope one emissions, from direct emissions, contributed 12.08 tCO₂-e. Indirect emissions from purchased electricity under scope two contributed the highest proportion of the carbon footprint, which is 61.33 tCO₂-e. Scope three, emissions from staff and student commuting, contributed 13.44 tCO₂-e. According to the results of the study, it is recommended that the faculty can reduce or offset these emissions by promoting public transportation and carpooling, using energy-efficient appliances, raising awareness, using renewable energy for electricity generation, and regular evaluation and monitoring of carbon emissions.

Keywords: Carbon Footprint, Carbon offsetting, Greenhouse Gas Emissions, Renewable Energy

Integrated Assessment of Microplastic Pollution and Water Quality in Kandy Lake and Mid Canal: Effects of Cyclone Ditwah

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This study integrates microplastic (MP) abundance, morphology, polymer composition, water quality, and trace metals in Kandy Lake and the Mid Canal, which underlines the impacts of Cyclone Ditwah (November 2025, Sri Lanka). Water samples were collected from seven lake and eight canal sites before and after the cyclone. At each site, 5L of bulk water samples were used for microplastic extraction, with Nile Red fluorescence for detection. Water quality followed APHA standards. MP abundance in Kandy Lake increased significantly from 5.77 ± 2.21 particles/L to 16.17 ± 4.87 particles/L, whereas Mid Canal decreased from 15.11 ± 4.28 particles/L to 8.94 ± 4.90 particles/L, and the Mahaweli River exhibited elevated post-cyclone levels (15.6 particles/L). MPs were predominantly between 100 μ m and 1mm. Fibers were the dominant form ($n = 1081$). FTIR and Raman spectroscopy confirmed polyethylene and nylon as the most abundant polymers, with fibers showing 75% spectroscopic verification. Pollution Load Index (PLI) values before the cyclone ranged from 0.65 to 1.5. Post-cyclone, lake PLI and Nemerow Pollution Index (NPI) values increased due to stormwater input and sediment resuspension, while the canal showed a decreased PLI, indicating flushing and downstream transport. Spearman correlation showed statistically significant differences ($p < 0.05$) in MP abundance across sites and times, and in trace metal concentrations in water and on MPs. Strong positive correlations were observed with Mn^{2+} (aq) ($r = 0.867$) and Cu^{2+} (aq) ($r = 0.760$), indicating that MPs may act as vectors for specific trace metals, thereby enhancing mobilization and bioavailability. Cyclone-driven hydrodynamics caused site-specific water quality changes. Kandy Lake acts as both a sink and a source of microplastics, while the Mid Canal facilitates their transport. These findings highlight the need for mitigation.

Keywords: Cyclone Ditwah, Microplastics, Nemerow Pollution Index, Pollution Load Index, Trace Metals

Assessing Soil pH Buffering Capacity for Paddy Growing Low Humic Gley Soil in Sri Lanka for the Application of Dolomite

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Soil acidity mainly affects nutrient availability and plant growth in rice cultivation. Determination of site-specific dolomite requirement is essential to optimize soil pH. This study was conducted to determine accurate dolomite requirement for low humic gley soils using pH buffering capacity. Buffer curve was developed by treating the soils with calcium hydroxide solution. A pretest was conducted to determine the best equilibrium time required for neutralizing of soil acidity with the addition of series of $\text{Ca}(\text{OH})_2$ solutions and equilibrium time was identified as 4 hours. Based on this buffering capacity, the calculated dolomite amount was 0.382 t/ha. A pot experiment was carried out to test the different dolomite rates including no dolomite (T1), Department of Agriculture recommended blanket dolomite rate (2t/ha) (T2) and dolomite application based on the buffering capacity (0.382 t/ha) (T3) in a greenhouse using completely randomized design with five replicates using Bw 312 rice variety. Soil pH was determined in weekly. The plant height, number of tillers and leaves per plant was recorded after the completion of fertilizing. Results indicated a gradual increase in soil pH after dolomite application. The T3 treatment increased the soil pH to the suitable range for crop growth (5.85- 6.06). Plant height differed significantly among treatments ($p < 0.05$) and the highest was in treatment 3 (64.54cm). There was no significant difference in number of tillers and the root dry weight. Number of leaves, shoot dry weight and 1000 grains weight were not significantly different in T2 and T3. Yield per plant differed significantly among treatments and the highest was in treatment 3 (3.18 g per plant). Determination of dolomite requirement considering buffering capacity of the soil gives the site-specific dolomite requirement which is more beneficial rather than using blanket application.

Keywords: Dolomite, Soil Acidity, Soil pH Buffering Capacity

SYMPOSIUM TRACK

Food Science and Chemical Technology



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Sabaragamuwa University of Sri Lanka

Development and Evaluation of a Plant-based Creamy Spread from Cocoyam (*Xanthosoma sagittifolium*)

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The increasing demand for plant-based and clean-label foods has encouraged the development of alternative spread products using locally available crops. However, the utilization of cocoyam (*Xanthosoma sagittifolium*) as a plant-based spread remains largely unexplored. Therefore, this study developed and optimized a creamy plant-based spread formulated from cocoyam with vinegar, garlic, black pepper, and coconut oil, and evaluated its physicochemical, microbiological, nutritional, textural, color, and sensory properties. Three formulations containing (0%), (1%), and (2%) vinegar were prepared, thermally processed, packaged in airtight food-grade containers, and stored under refrigerated conditions ($4\pm 2^{\circ}\text{C}$). Formulation optimization was based on physicochemical, microbiological, textural, and sensory properties. Sensory evaluation using 30 semi-trained panelists revealed significant differences ($p < 0.05$) in appearance, aroma, flavor, color, and overall acceptability, whereas texture showed no significant variation ($p > 0.05$). The formulation containing 1% vinegar (F1) achieved the highest overall acceptability 6.30 ± 0.88 . Physicochemical analysis showed that vinegar reduced the pH from 6.11 ± 0.01 to 5.46 ± 0.04 , improving product stability. Moisture content ranged from 46.68–56.07%, while texture profile analysis confirmed desirable spreadability with a hardness of 83.9 ± 18.3 g and cohesiveness of 0.937 ± 0.210 . The optimized formulation contained 16.96% fat, 1.71% fiber, and 0.48% ash. Total plate counts remained below 10^4 CFU/g throughout four weeks of refrigerated storage. These findings demonstrate that cocoyam has strong potential as an underutilized raw material for developing a safe, nutritious, and consumer-acceptable plant-based spread, supporting value addition and innovation in the plant-based food sector.

Keywords: Microbial safety, Optimization, Plant-based spread, Sensory analysis, Texture

Development of a Wood Apple (*Limonia acidissima* L.) Spread Incorporated with Value-Added Shrimp Processing By-Products.

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Fruit spreads are popular and widely accepted, but generally contain limited protein and other essential nutrients. Meanwhile, shrimp processing generates substantial quantities of by-products that causing environmental pollution. This study aimed to develop a wood apple spread incorporated with shrimp processing by-product powder. This powder was incorporated into wood apple pulp at four concentrations: 0 g (Control), 9 g (F1), 12 g (F2; approximately 15% of the pulp weight), and 15 g (F3) per 80 g of wood apple pulp. Sensory evaluation using a five-point hedonic scale with 30 untrained panelists identified F2 as the most preferred formulation, receiving significantly higher scores ($p < 0.05$) scores for appearance (4.57 ± 0.62), color (4.33 ± 0.84), aftertaste (4.37 ± 0.67), mouthfeel (4.17 ± 0.58), and overall acceptability (4.27 ± 0.57). Texture Profile Analysis showed that F2 had significantly lower hardness (95.93 ± 7.94 g). Spreadability values ranged from 1.19 ± 0.03 to 1.33 ± 0.10 g·cm·s⁻¹, with F2 showing the highest numerical value (1.33 ± 0.10 g·cm·s⁻¹); however, differences among formulations were not statistically significant ($p > 0.05$). Proximate analysis showed significantly higher crude protein (3.8%), crude fat (0.13%), and ash (7.71%) contents in F2 compared with the control (0.07%, 0.07%, and 6.64%, respectively). The selected formulation exhibited a pH of 3.70 ± 0.05 and total soluble solids of 69.47 ± 0.41 °Brix. Color analysis showed that F2 possessed significantly higher lightness ($L^* = 24.05 \pm 6.08$) and redness ($a^* = 5.34 \pm 2.15$) values. During 14 days of storage at 30°C in sterilized glass jars, a_w remained approximately 0.70, with a peroxide value of 3.20 ± 0.30 meq O₂/kg. Microbiological evaluation confirmed the absence of *Escherichia coli* (< 3 MPN/g) and *Salmonella* spp. FTIR identified characteristic functional groups associated with proteins and chitin derived from shrimp by-products. These findings demonstrate that incorporating approximately 15% shrimp processing by-products powder into wood apple spread can enhance its protein and mineral contents while maintaining acceptable sensory quality, spreadability and microbiological safety.

Keywords: FTIR, Nutrient incorporation, Shrimp by-products, Waste valorization, Wood apple spread.

Development of Plant-Based Seasoning Cube

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Commercially available seasoning cubes contain high salt, monosodium glutamate, and hydrogenated fats to enhance flavor. There is huge consumer demand for nutritional, plant-based, reduced-additive products in ready-to-use form. This research aimed to develop a ready-to-use, plant-based seasoning cube by using locally available spices and herbs and to evaluate its physicochemical, sensory, and nutritional properties. Three formulations (F1, F2, F3) were prepared by changing the amount of broken rice flour and grated coconut. A commercially available seasoning cube was used as the control sample. Sensory evaluation (50 untrained panelists) showed significant differences among samples ($p < 0.05$) and F1 (25% broken rice flour, 15% grated coconut) recorded the highest mean scores for appearance (5.540 ± 0.885), aroma (5.540 ± 0.762), flavor (4.200 ± 0.881), consistency (4.260 ± 0.944), aftertaste (4.120 ± 0.689), and overall acceptability (4.520 ± 0.839). In most attributes, F1 performed better than the commercial control sample. Compared with the control sample, F1 showed a dissolution time of 50.0 ± 5.0 s (the control sample showed 60.7 ± 51.1 s), lower bulk density (0.75 ± 0.05 g/cm³), and comparable water activity (0.67 ± 0.02), indicating good dispersibility and moisture stability. F1 contained 6.37% moisture, 50.3% fat, 7.9% protein, 8.4% fiber, 3.96% ash, and 23.07% carbohydrate, while yeast and mold counts remained below detectable limits over 7 days of storage. These results show that F1 showed better results than the commercial product, and it could be a good plant-based alternative for household and food service use.

Keywords: Consumer acceptability, convenience food, functional food, plant-based ingredients seasoning cube

Development and Characterization of a Probiotic Ready-to-Drink Fermented Beverage Using Okra (*Abelmoschus esculentus*) Mucilage and Beetroot (*Beta vulgaris*)

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Plant-based probiotic beverages are promising dairy alternatives for individuals with lactose intolerance, milk allergies, and plant-based diets. This study developed and characterized a ready-to-drink probiotic fermented beverage using okra (*Abelmoschus esculentus*) mucilage as a natural prebiotic stabilizer and beetroot (*Beta vulgaris*) juice as a functional ingredient. Four formulations were prepared: F1 (100% okra mucilage; control), F2 (25% okra mucilage:75% beetroot juice), F3 (50% okra mucilage:50% beetroot juice), and F4 (75% okra mucilage:25% beetroot juice). Beetroot juice was pasteurized (72°C, 15 s), blended with okra mucilage, inoculated with 1% (v/v) ABY-3 culture (*Lactobacillus acidophilus*, *Lactobacillus delbrueckii subsp. bulgaricus*, *Streptococcus thermophilus*, and *Bifidobacterium bifidum*), and fermented at 43°C for 7 h. Sensory evaluation using a 5-point hedonic scale with 50 untrained panelists identified F4 as the most acceptable formulation (4.280 ± 0.904 ; $p < 0.05$). In F4, fermentation reduced pH from 5.41 ± 0.02 to 4.05 ± 0.01 and increased titratable acidity from $0.800 \pm 0.100\%$ to $0.933 \pm 0.06\%$ lactic acid. F4 exhibited greater redness ($a^* = 0.51 \pm 0.49$) than the control ($a^* = -1.82 \pm 0.16$), higher total phenolic content (16.313 ± 1.309 vs. 2.173 ± 1.367 mg GAE mL⁻¹), and greater in vitro glucose uptake ($65.45 \pm 0.60\%$ vs. $20.49 \pm 2.74\%$). Optical density (OD_{600}) measurements indicated active microbial growth, with the highest absorbance recorded for F4 (1.033 ± 0.418) after 21 h of incubation. Total plate count analysis indicated acceptable microbiological quality throughout 14 days of refrigerated storage. Overall, F4 demonstrated superior sensory quality, physicochemical characteristics, and functional properties, indicating its potential as a plant-based probiotic fermented beverage.

Keywords: Beetroot, Fermentation, Functional beverage, Okra mucilage, Plant-based probiotic beverage

Development and Quality Evaluation of Composite Flour Cookies Using Underutilized Plant By-Products

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The utilization of agro-processing by-products for the development of nutrient-enriched foods has emerged as a sustainable strategy to address both food waste and nutritional inadequacy. Banana peel flour (*Musa* spp.), watermelon seed flour (*Citrullus lanatus*), and jackfruit seed flour (*Artocarpus heterophyllus*) are nutrient-dense yet underutilized materials with significant potential to enhance the nutritional quality of bakery products. This study aimed to develop a functional cookie enriched with these by-product flours and to evaluate its physicochemical, nutritional, antioxidant, sensory, and microbiological properties. Cookies were formulated using a composite flour blend comprising 70% wheat flour and 30% alternative flours (10% each of banana peel, watermelon seed, and jackfruit seed flours). Chocolate-flavoured, nut-enriched, and plain cookie variants were subjected to sensory evaluation by 30 untrained panellists using a five-point hedonic scale, while microbial quality was monitored over a ten-week storage period (26.5±0.5°C). Physicochemical and proximate composition analyses were conducted using standard SLS and ISO methods. Antioxidant activity was assessed using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay, with ascorbic acid used as the reference standard, and results were expressed as IC_{50} values. Among the formulations, chocolate-flavoured cookies achieved the highest sensory scores for taste, texture, and overall acceptability. Physicochemical analysis indicated desirable structural attributes, with a mean diameter of 5.7 cm, a mean thickness of 1.2 cm, a spread ratio of 4.75, and a pH of 6.7 at 26.5±0.5°C. Nutritional analysis revealed an improved nutritional composition, including 8.3% moisture, 7.6% protein, 64.1% carbohydrates, and 1.3% dietary fibre. The cookies exhibited moderate antioxidant activity ($IC_{50} = 87.12 \mu\text{g/mL}$), indicating the presence of bioactive compounds derived from the incorporated plant by-product flours. No detectable microbial growth was observed throughout the ten-week storage period, demonstrating satisfactory microbiological stability. The findings demonstrate that the developed functional cookie exhibits enhanced nutritional quality, acceptable sensory characteristics, moderate antioxidant activity, and satisfactory microbiological stability, supporting the potential of underutilized food by-products for the development of sustainable, value-added bakery products.

Keywords: Agro-processing by-products, Functional cookies, Physicochemical properties, Sensory evaluation, Sustainable food systems

Development of Frozen Fruit Cubes as a Value-Added Functional Food and Beverage Ingredient

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Rising health concerns associated with artificially formulated bottled beverages have increased consumer demand for natural fruit juice-based products. The present study aimed to develop and evaluate the sensory, physicochemical, functional and microbial properties of frozen fruit cubes. Two formulations were prepared: a watermelon (*Citrullus lanatus*) and pineapple (*Ananas comosus*) combination, and a mango (*Mangifera indica*) and pineapple (*Ananas comosus*) combination. To enhance stability and extend shelf life, both natural and chemical preservatives, including lemon (*Citrus limon*) juice and sodium metabisulfite, were incorporated into the formulations. A consumer panel of thirty-five untrained panelists evaluated sensory quality using taste, aroma, color and overall acceptability on a 5-point hedonic scale, and the most preferred formulation was selected for further physicochemical, functional and microbiological analyses based on its overall sensory acceptability and consumer preference. The pH was recorded as 3.8 ± 0.1 (27.5°C), indicating an acidic nature favorable for preservation. Total phenolic content, determined via the Folin–Ciocalteu assay, was 12.69 ± 0.20 mg GAE/g, indicating a considerable phenolic content. Antioxidant activity, assessed using the DPPH radical scavenging assay, showed an IC_{50} of 49.03 ± 6.8 μ g/mL, indicating significant free radical scavenging activity and antioxidant potential. Microbiological evaluation revealed no detectable microbial growth, with microbial load below the ISO detection threshold (< 10 CFU/mL), confirming the microbiological safety of the formulation. The developed frozen fruit cubes represent a consumer-oriented, natural, convenient and value-added alternative to conventional bottled beverages, contributing to the advancement of healthier product options within the food and beverage industry.

Keywords: Consumer Acceptability, Frozen Fruit Cubes, Functional Food, Natural beverage alternative

Chemical and Physical Characterization of Cement Grinding Aids for Quality Inspection

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Consistency and stability in cement grinding aids are critical for optimizing grinding efficiency and ensuring product quality. This study evaluated the chemical and physical stability of SikaGrind®-870 LK and SikaGrind®-770 LK using Fourier Transform Infra-Red (FT-IR) spectroscopy and Total Solid Content (TSC) analysis. Samples were collected from both IBC tanks and dosing points at cement mill #01 to determine if quality is maintained during storage and transportation. The physical stability of SikaGrind®-870 LK was assessed via sedimentation behavior under non-agitated plant conditions over 14 days. Results indicated that while manual mixing yields uniform TSC values, prolonged static storage leads to significant TSC variation and visible phase separation. This confirms that sedimentation occurs during storage, potentially compromising the physical uniformity of the additive if not agitated. Chemical fingerprinting was conducted using FT-IR spectra in the range of 4000–400 cm⁻¹. The analysis revealed that the chemical profile of SikaGrind®-870 LK remained consistent between the IBC tank and the dosing point, suggesting no chemical degradation during the delivery process. However, SikaGrind®-770 LK exhibited a distinct spectrum, confirming a different formulation. Functional group analysis of SikaGrind®-870 LK identified carboxylate/polycarboxylate (–COO⁻), amine (–NH/–NR), hydroxyl (–OH), and ether (C–O–C) groups. These groups are essential for reducing particle agglomeration and enhancing dispersion during grinding. In conclusion, while SikaGrind®-870 LK is chemically robust and contains the functional groups necessary for high-efficiency cement grinding, its physical stability is sensitive to static storage. To ensure consistent performance, mechanical agitation is recommended to prevent sedimentation before dosing.

Keywords: Cement grinding, FT-IR spectroscopy, Grinding Aid, SikaGrind®-870 LK & SikaGrind®-770 LK, Total Solid Content.

Chemical & Pharmacological Properties Of *Abelmoschus Esculentus*

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Abelmoschus esculentus, a widely cultivated vegetable in tropical and subtropical regions, has gained increasing scientific interest due to its diverse medicinal properties. Some parts including pods, seeds, and leaves, which are traditionally used in folk medicine, contain bioactive compounds like flavonoids, polyphenols, polysaccharides, and vitamins. These compounds exert numerous pharmacological effects, including, but not limited to antioxidant, anti-inflammatory, antidiabetic, antimicrobial and hepatoprotective activity. This review aims to comprehensively evaluate the current evidence regarding the chemical and pharmacological properties of the *Abelmoschus esculentus*. According to PRISMA guidelines, a comprehensive review was conducted in the following databases: PubMed (22%), Google Scholar (71%), and PubChem (7%) for articles published between 2016 and 2023, using the keywords “medical properties”, “*Abelmoschus esculentus*” and “chemical properties”. After removing duplicates, the total number of articles was 104. The articles were manually screened for the following exclusion criteria, not full text articles, review articles, inadequate data for analysis, low methodological quality and unclear data. Finally, 30 articles were included for the review. Among the selected articles, 80% of studies have emphasized its antidiabetic activity whereas, 75% of articles have emphasized its’ antioxidant properties consistent with strong free radical scavenging activity of *Abelmoschus esculentus* phytoconstituents. Antimicrobial activity was found in 55% while anti-inflammatory effects were described in 60% of studies. Further, hypolipidemic and cardioprotective effects were addressed in 40of this literature. Less frequently (25%) of studies. Further, hypolipidemic and cardioprotective effects were addressed in 40of this literature. Less frequently Mucilage of *Abelmoschus esculentus* and seed extracts show strong potential as natural therapeutic agents, especially for managing diabetics, due to their antioxidant, antibacterial and antidiabetic properties.

Keywords: Chemical Properties, pharmacological properties, *Abelmoschus esculentus*

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AI Powered Ethical Recruitment and Retention Framework HR Management in the Sri Lankan Apparel Industry

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Sri Lankan Apparel Industry has a high employee turnover rate and an inefficient and subjective recruitment process. While there is a potential data-driven approach in the form of Artificial Intelligence (AI), most AI-based HR solutions are geared towards recruitment and retention as separate concerns and do not deliver the same level of accuracy, accountability, explainability, fairness auditing, and local validation. This is what this study aims to answer. The principal objective is to develop and pilot an AI-based ethical framework for an ethical decision-making process for the Sri Lankan apparel sector which combines recruitment and retention within a single governance framework. A max accuracy model of 85.4% has been built to predict employee attrition using Logistic Regression, Random Forest, and XGBoost. The most important features, identified by SHAP, are: job satisfaction, overtime, income, and work-life balance. A recruitment model based on cosine-similarity-based candidate-job matching for real job description and resume datasets to rank candidates objectively based on skills and experience was audited for demographic bias by making changes in attributes where gender was coded, and only a small difference (0.53) was found between counterfactual scores. The outputs of the model were converted to HR friendly risk levels and then ranked; reasons, along with the key findings of fairness, were correlated with a survey of HR practitioners in the Sri Lankan apparel industry, which has a high level of congruence with the reality on the ground. This self-developed framework combines data pre-processing, predictive modeling, an explainability layer, a bias-detection layer, and human validation, offering a new, ethically regulated, and easily implementable AI-HR system for the industry.

Keywords: Artificial Intelligence, Employee Retention, Explainable AI, Recruitment, Sri Lankan Apparel Industry

A Real-Time Preschool Management System for Integrated Monitoring and Parent- Teacher Communication

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In many preschools, particularly in Sri Lanka, reliance on manual record-keeping systems and fragmented communication channels reduces operational efficiency, compromises data accuracy, and limits transparency in administrative processes. This study presents a centralized web-based preschool management system that integrates administrative operations, child development monitoring, parent–teacher communication, and Artificial Intelligence-assisted learning support within a single platform to enhance preschool management. The system was developed using the Waterfall software development methodology, encompassing requirements analysis, system design, implementation, integration, and testing. Laravel was used for back-end development, React for front-end development, MySQL for relational database management, and the Gemini API for Artificial Intelligence integration. The completed system was evaluated through usability testing involving preschool administrators, teachers, and parents. The assessment framework examined usability, functionality, reliability, accessibility, and overall user satisfaction using structured questionnaires and role-based testing scenarios. The findings indicated that the system effectively streamlined administrative tasks, improved communication between parents and teachers, enhanced monitoring of children’s learning and behavioural progress, and provided a reliable platform for secure data management and Artificial Intelligence-assisted educational support. The study demonstrates that integrating modern web technologies with Artificial Intelligence can improve operational efficiency, strengthen stakeholder engagement, and provide a more transparent, child-centred approach to preschool management.

Keywords: Artificial intelligence, Information system, Parent–teacher communication, Preschool management system, Usability evaluation,

Evaluation of Couch Attenuation Effects on Target and Organ-at-Risk Doses in IMRT Treatment Planning

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Intensity Modulated Radiotherapy (IMRT) is widely used in cancer treatment to deliver a high radiation dose to the tumor while limiting exposure to the surrounding healthy tissues. Patients are positioned on a carbon fiber couch during radiotherapy and accurate dose calculation is essential. Although carbon fiber is designed to reduce beam absorption, some attenuation may occur, particularly for posterior beam angles. In some treatment centers, the couch model is not included in dose calculation. The objective of the study is to quantify the dosimetric effect of the couch by comparing dose distributions with and without the couch in IMRT plans. In this study thirty-two prostate cancer IMRT plans were analyzed. For each patient, two treatment plans were generated: one without the couch model and one with the couch included. Target coverage was assessed using D95, defined as the dose received by 95% of the planning target volume. Bladder and rectum dose constraints (V40.8 Gy, V48.6 Gy, V52.8 Gy, V57 Gy, V60 Gy) were also evaluated. Statistical analysis was performed using the Shapiro-Wilk test and Wilcoxon signed-rank test. The mean absolute D95 difference was obtained as 0.9755 Gy (SD 0.1111 Gy). Relative to the 60 Gy prescription dose, the mean percentage difference was 1.63%. The data were not normally distributed ($p = 0.0415$). The Wilcoxon test showed a statistically significant difference between plans ($p < 0.0500$). For bladder constraints, two additional patients remained within acceptable dose limits when the couch was included. For rectum constraints, one additional patient met V40.8 Gy and V60 Gy limits, while other levels showed no difference. Couch attenuation resulted in a small but measurable reduction in target dose and produced minor changes in organ dose compliance in prostate IMRT planning.

Keywords: Couch attenuation, D95, IMRT, Prostate cancer, Wilcoxon test

Machine Learning-Based IT Career Role Prediction for Undergraduate Students in Sri Lanka

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Sri Lanka's rapidly expanding ICT sector continues to face a significant challenge as many IT undergraduates end up in jobs misaligned with their academic background and skills, largely due to reliance on informal peer networks and generalized career guidance. This study proposes a machine learning-based career prediction system that recommends suitable IT job roles for Sri Lankan undergraduate students based on their academic profiles, technical skills, and professional experience. Data were collected through a structured survey of 5,000 IT undergraduate profiles across 19 distinct IT job roles, with ground-truth labels derived from students' self-reported preferred career paths rather than current employment. Approximately 729 input features were engineered using multi-hot skill encoding, TF-IDF bigrams, Word2Vec, and FastText embeddings to capture explicit and semantic skill relationships. Class imbalance was addressed using SMOTE, followed by feature importance analysis to identify the most predictive attributes. Six classification algorithms were evaluated using a leakage-free train/test protocol, with the tuned LightGBM model achieving the best performance at 81.10% accuracy, 81.10% weighted F1-score, a Matthews Correlation Coefficient of 0.8007, 99.00% One-vs-One ROC-AUC, and 88.78% PR-AUC, substantially outperforming the most-frequent baseline. SHAP and LIME were employed for global and instance-level explanations, enabling ranked top-three career recommendations with model-derived confidence scores. Feature-importance analysis indicated that internship domain, role-specific technical skill indicators, semantic skill embeddings, and professional certifications contributed most strongly to career-role prediction. The Top-1 recommendation was compared against the actual preferred career path label for held-out test profiles to assess prediction reliability. The results show that an explainable machine learning pipeline can effectively support personalized career guidance for IT undergraduates in Sri Lankan higher education.

Keywords: Career Prediction, Explainable Artificial Intelligence, Machine Learning, Sri Lankan ICT, Undergraduate Career Guidance

A Hybrid AI and Kansei Engineering Framework for Post-Release Requirement Prioritization in Banking Applications: Balancing Customer Emotions and Developer Constraints

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Traditional software requirement prioritization in digital banking suffers from a systematic "frequency bias," where high-volume minor complaints overshadow low frequency but severe events such as security breaches, and existing approaches like frequency ranking and AHP lack a mechanism to weight requirements by emotional severity rather than mention count. This research addresses that gap by introducing a Hybrid Artificial Intelligence and Kansei Engineering (KE) framework that fuses affective computing with transformer-based Natural Language Processing (NLP) for post-release requirement prioritization. The framework processes 715 multilingual app store reviews from five major commercial banks through a trilingual normalization pipeline capable of interpreting native scripts and emoji-encoded sentiment, feeding a three-layer hybrid classifier, a Kano-model security rule engine, a negation-aware keyword matcher built on a domain-specific Kansei lexicon, and zero-shot BART-MNLI inference, that categorizes emotions and assigns numerical intensity weights. AT5 model translates these classified insights into IEEE 830-compliant specifications, which are then ranked using a novel Hybrid Priority Score (HPS) that mathematically balances Kansei emotional intensity against Fibonacci-scaled developer effort constraints. Across 31 ranked requirements, the framework elevated security-related needs to Rank 7 despite a substantially lower mention frequency than performance complaints ($n = 82$ vs. $n = 234$), resisting the frequency bias inherent to conventional ranking, with inter-rater validation of $\kappa = 0.64$ (substantial agreement) and a structured comparison against frequency-ranking and AHP baselines confirming materially different, emotion-sensitive outcomes. By producing ready-to-implement, IEEE 830-compliant specifications ranked by combined emotional urgency and engineering feasibility, the framework gives banking software teams a concrete tool for surfacing high-severity, low-frequency risks that conventional triage overlooks. To our knowledge, this is the first framework to operationalize Kansei Engineering alongside transformer-based NLP for multilingual, post-release requirement prioritization in banking, offering a reliable, emotionally intelligent roadmap for the next generation of banking application development.

Keywords: Affective Computing, Kansei Engineering, Mobile Banking Applications, Requirements Prioritization, Transformer-based NLP,

Adaptive Hybrid GraphRAG: Integrating Knowledge Graphs and Large Language Models for Repository-Aware Developer Assistance

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Modern software repositories contain interconnected artifacts such as source code, documentation, issue reports, pull requests, and commits, making repository exploration and maintenance increasingly complex. Although Large Language Models (LLMs) support software engineering tasks, existing repository-aware retrieval methods often lack sufficient contextual grounding, perform poorly on multi-hop queries, and may generate unsupported or hallucinated responses. This study proposes an adaptive Graph Retrieval-Augmented Generation (GraphRAG) framework that combines repository Knowledge Graphs with graph and vector retrieval to improve repository-specific reasoning. Unlike conventional GraphRAG approaches that primarily depend on fixed graph retrieval strategies, the proposed framework adaptively selects and combines structured graph traversal and semantic retrieval according to the query type. The framework was evaluated using a programmatically generated synthetic software engineering dataset and five open-source repositories: Spring PetClinic, OpenMRS, eShopOnContainers, Apache Airflow, and MLflow. The synthetic dataset models realistic development workflows through interconnected developers, repositories, source files, components, dependencies, commits, issues, pull requests, and documentation, while providing complete predefined relationships and ground truth for controlled evaluation. Repository artifacts were extracted using static code analysis and repository metadata mining and transformed into a Neo4j Knowledge Graph. A benchmark question-answering dataset containing 300 questions was developed across six task categories: entity retrieval, dependency analysis, issue reasoning, documentation retrieval, pull request analysis, and multi-hop repository reasoning. Ground-truth answers were generated using validated Cypher queries and manually verified against repository evidence. Using identical questions, the framework was compared with Plain LLM, Vector RAG, and conventional GraphRAG baselines. It achieved an Exact Match score of 0.842, F1-score of 0.883, BERTScore of 0.928, hallucination rate of 0.071, and multi-hop reasoning accuracy of 0.864. These findings demonstrate that adaptive graph-grounded retrieval improves reliable, evidence-based repository reasoning and provides a reproducible benchmark for intelligent software engineering assistants.

Keywords: Developer Assistance, GraphRAG, Knowledge Graph, Large Language Models, Software Engineering

Comparing AI Chatbots and Human Technical Support in Sri Lanka: A Non-Parametric Analysis of Service Performance and Task–Technology Fit in a Local Context

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Sri Lankan firms across e-commerce, telecommunications, banking, and ride-hailing have moved a large share of customer support from human agents to AI chatbots, yet whether local users accept the shift has not been tested directly. Although prior studies have compared chatbot and human service performance, limited evidence explains how task complexity, local language use, and culturally specific communication patterns influence user preferences in Sri Lanka. This study compared the two support modes on perceived speed, accuracy, and convenience, mapped task type to preferred mode, and examined how language and demographic context relate to satisfaction and frustration. An online survey of Sri Lankan consumers produced 317 valid responses. Wilcoxon Signed-Rank tests found no significant difference in perceived speed ($p = 0.384$) or convenience ($p = 0.106$), but human agents were rated significantly more accurate than AI chatbots ($p < .001$). Chi-square tests on five task categories produced an ordered pattern: respondents preferred AI for routine inquiries (64.4%) and simple troubleshooting (52.7%), and preferred human agents for complex troubleshooting (77.8%), advisory tasks (62.0%), and financial disputes (84.2%). The financial dispute preference held across every satisfaction level ($p = 0.544$), so the preference does not depend on prior AI experience. Kruskal-Wallis tests showed that AI satisfaction was significantly lower among younger respondents, undergraduates, and users who frequently encountered Singlish-related chatbot failures ($p < .001$), while frustration tracked most strongly with low self-rated technical skill. Pairwise comparisons further showed that respondents who preferred a handoff after two failed bot attempts reported higher satisfaction than those preferring immediate handoff ($p < .001$). The results support a tiered hybrid model in which chatbots handle routine and simple tasks and hand off to human agents on clear triggers for complex, advisory, and financial cases. However, the findings are limited by convenience sampling, self-reported data, and restricted generalisability beyond Sri Lanka.

Keywords: AI chatbots, customer satisfaction, non-parametric analysis, Sri Lanka, task technology fit.

Predictors of Customer Satisfaction with AI Chatbots in Sri Lanka: A Multiple Linear Regression Approach

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Sri Lankan firms increasingly rely on AI chatbots for customer support, yet the factors driving user satisfaction with these systems have not been quantified for the local market. This study identified the strongest predictors of overall satisfaction with AI chatbots among Sri Lankan consumers, with attention to trust, reliability, language coverage, and demographic context. An online survey produced 317 valid responses across users of e-commerce, telecommunications, banking, and ride-hailing services. Correlation analysis identified AI Reliability ($r = 0.640$), AI Accuracy ($r = 0.603$), AI Convenience ($r = 0.569$), and AI Trust ($r = 0.541$) as the variables significantly associated with overall satisfaction. A multiple linear regression explained 59.5% of the variance in AI satisfaction. AI Reliability ($p < .001$) and AI Trust ($p < .001$) were the strongest positive predictors, followed by AI Accuracy ($p = 0.006$) and AI Convenience ($p = 0.004$). These findings suggest that Sri Lankan users are more satisfied when chatbots provide dependable, accurate, convenient, and trustworthy support. Two predictors carried significant negative weight: AI Language Failure linked to Singlish ($B = -0.161$, $p = 0.005$) and a Human Cultural Preference for politeness ($p = 0.009$). This highlights where users may expect chatbots to understand mixed-language expressions and respond in a polite and socially appropriate manner. Within the categorical predictors, basic technical skill ($p = 0.011$) and a preference for human agents on advisory tasks ($p = 0.009$) also reached significance. This indicates that users with basic technical skills may interact more confidently with chatbots, while users may still prefer human assistance for complex, sensitive, or advice-based services. The findings indicate that trust and reliability are the leading predictors of AI satisfaction in Sri Lanka, and improving local language coverage, including Singlish recognition, and culturally appropriate interaction may be more important than introducing new chatbot features.

Keywords: AI chatbots, customer satisfaction, multiple regression, Sri Lanka, trust calibration.

Benchmarking Open-Source LLMs for Mockery, Extremism, Sarcasm, and Hatespeech (MESH) Jailbreak Vulnerabilities

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The rapid deployment of open-weight Large Language Models (LLMs) has intensified concerns regarding their susceptibility to adversarial jailbreak attacks, where carefully crafted prompts circumvent built-in safety alignment mechanisms. Existing jailbreak benchmarks rely predominantly on static, first-generation attack templates that contemporary models increasingly recognise and refuse, resulting in artificially low attack success rates and limited assessment of real-world safety vulnerabilities. To address this gap, this study proposes MESH, a novel adaptive jailbreak benchmarking framework that combines a two-generation attack taxonomy with an automated, human-validated evaluation pipeline. The framework systematically generates a combinatorial benchmark comprising 864 adversarial prompts across four harm categories, three semantic targets, and twelve attack templates, together with 22 benign control prompts for over-refusal assessment. Responses are evaluated using a dual-model ensemble judge consisting of Mistral-7B and Gemma-7B, enhanced by rule-based harm detection, conflict resolution, and heuristic confidence scoring to improve evaluation reliability. The framework was evaluated on LLaMA 3.2-3B using a total of 886 prompts, achieving an overall automated attack success rate (ASR) of 41.44%. Chain-of-Thought Leakage (68.06%) and Translation Attack (61.11%) emerged as the most effective jailbreak strategies, while Hate Speech prompts recorded the highest category-level ASR (46.30%). The ensemble judges achieved 77.65% agreement, and human validation on a stratified 40% subsample produced a Fleiss' kappa of 0.7232, with the human-validated ASR differing from the automated ASR by only 0.74 percentage points, supporting the reliability of the proposed evaluation methodology. Furthermore, a multi-criteria curation pipeline generated a reproducible benchmark of 297 high-quality prompts suitable for Supervised Fine-Tuning (SFT) and Reinforcement Learning from Human Feedback (RLHF). The findings demonstrate that adaptive, multi-generation jailbreak benchmarking exposes safety weaknesses overlooked by conventional static benchmarks and provides a scalable, reproducible framework for evaluating and strengthening the safety alignment of open-weight LLMs.

Keywords: Adversarial Benchmarking, AI Safety, Ensemble Judging, Jailbreak Attacks, Large Language Models.

Structural and Elemental Characterization of ZnO Nanoparticles Synthesized via a Controlled Sol-Gel Route

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Zinc oxide (ZnO) is a technologically significant material for energy harvesting, sensors, and micro-electromechanical systems due to its intrinsic piezoelectricity originating from its non-centrosymmetric wurtzite crystal structure. However, achieving precise control over stoichiometry, phase purity, and grain morphology through cost-effective chemical routes remains a key challenge. To address this gap, this study presents a refined sol-gel strategy employing strict pH regulation to synthesize high-purity, structurally uniform ZnO nanoparticles. Zinc acetate dihydrate was dissolved in ethanol, with the solution pH precisely maintained at 12.0 using sodium hydroxide to optimize gelation kinetics. The resulting gel underwent 12 hours of aging, centrifugal washing at 3000 RPM, and calcination at 500 °C for four hours to ensure high crystallinity. Comprehensive structural and elemental characterizations were conducted using Fourier Transform Infrared (FTIR) spectroscopy, Energy Dispersive X-ray Spectroscopy (EDS), and Scanning Electron Microscopy (SEM). FTIR spectroscopy confirmed the successful formation of the metal-oxide framework, exhibiting a prominent Zn–O stretching absorption peak at 430–450 cm⁻¹. EDS measurements verified high elemental purity with clear Zinc (1.01 keV) and Oxygen (0.52 keV) peaks, revealing a near-stoichiometric Zinc concentration of 84 wt%. SEM imaging demonstrated quasi-spherical nanostructures residing strictly within the nanometer regime with grain sizes ranging from 200 nm to 700 nm. Overall, these findings validate that precise pH-controlled sol-gel synthesis offers a reliable, low-cost route for producing pure, crystalline ZnO nanoparticles tailored for piezoelectric and sensing applications.

Keywords: Metal-oxide framework, Piezoelectricity, Sol-gel synthesis, ZnO nanoparticles

Voice Command Calculator based on Sinhala Language: A Systematic Literature Review

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Voice command calculators enable mathematical calculations through natural language, yet no such system has been developed for Sinhala, the low-resource language spoken by the majority of Sri Lankans, leaving a crucial gap in accessible computing. Previous work on voice-based calculators and speech recognition has focused on high-resource languages including English and Mandarin, mainly addressing restricted vocabularies, Interactive Voice Response (IVR) systems or isolated command classification rather than complete mathematical processing. For Sinhala, further challenges arise from the lack of annotated datasets, dialectal variation and inherently low-resource language characteristics, all resulting in significant accuracy limitations and a clear research gap. To address this, a systematic literature review was conducted across four databases, namely Google Scholar, ResearchGate, IEEE Xplore, and ScienceDirect following an identification-screening-eligibility-inclusion process informed by PRISMA guidelines. Keyword-based searches yielded records screened by title and abstract relevance to the review scope, yielding 67 candidate papers which were then assessed against defined exclusion criteria, namely duplicate entries and studies outside the 2018-2026 timeframe, narrowing the corpus to 11 papers for in-depth analysis. Among the reviewed works, the identified technologies include Automatic Speech Recognition (ASR) frameworks based on Hidden Markov Models (HMM), Natural Language Processing (NLP) pipelines for commands interpretation, and Deep Neural Networks (DNN) for acoustic and language modelling. Existing voice calculator systems offer only basic arithmetic operations (addition, subtraction, multiplication and division) with moderate accuracy rates typically ranging between 52% and 87% due to limited training data and the structural complexity of the language. HMM- based models remain interpretable, whereas deep learning methods achieve higher accuracy on large corpora but perform poorly for low-resource languages where data is limited. Further integration of NLP, ML and ASR techniques can enable the development of a Sinhala language voice command calculator with potential extensions to support scientific computations and Tamil language integration.

Keywords: Human-Computer Interaction, Natural Language Processing, Voice Calculator, Voice Command in Sinhala, Voice Recognition

Mixed-Method Evaluation of the Impact of Micro-Interactions on User Engagement and Cognitive Flow Among Gen Z In E-Commerce Interfaces

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In Modern e-commerce interfaces, small animations called micro-interactions are essential for keeping users focused and engaged. However, current e-commerce websites use these micro interactions poorly, causing frustration for Generation Z users instead of interacting with them. This study uses a mixed-method approach. The research targeted a population of Generation Z digital natives, utilizing a sample size of 90 participants (N=90) recruited through a combination of convenience and chain referral sampling to ensure a technically fluent and relevant data pool. This research evaluates how micro-interactions affect both user engagement and cognitive flow for Gen Z consumers. Findings confirm an overwhelming demand for interactivity, as 95.5% of participants (86 out of 90) favored interactive websites over static designs. Statistical analysis indicates that optimized elements achieve high user satisfaction ($\mu = 4.4000$, $\sigma = 0.8183$) and successfully enhance states of deep cognitive flow, particularly time distortion or immersion ($\mu = 4.3333$, $\sigma = 0.7932$). Despite this, a significant 'Reality Gap' exists, participants rated current e-commerce sites at a lower mean of ($\mu = 3.6333$, $\sigma = 1.1461$), identifying intrusive pop-ups and slow-loading effects as primary flow disruptors. Based on these findings, the study concludes that developers must prioritize functional speed over aesthetic movement, as a Gen Z heavily favored visual-only effects (69 users) over motion- based animations (21 users). Consequently, the study recommends that e-commerce interfaces adopt the 150-300ms execution threshold as a core technical requirement within the 10 proposed UX guidelines. The guidelines are categorized into Timing & Latency, Feedback & Clarity, and Simplicity & Autonomy.

Keywords: Cognitive Flow, E-Commerce, Generation Z, Micro-interactions, User Engagement

Agentic AI for Multimodal Bone Fracture Detection

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Bone fracture detection from medical images is essential for clinical diagnosis however, manual interpretation of X-ray and Magnetic Resonance Imaging (MRI) scans is time consuming, prone to human error, and often lacks effective clinical decision support mechanisms. Existing automated approaches are commonly limited to single imaging modalities, insufficient handling of data imbalance, limited interpretability, and a lack of intelligent reasoning. To address these challenges, this research proposes a multimodal bone fracture detection framework integrating YOLOv8n, modality-aware late fusion, Grad-CAM explainability, and a lightweight rule-based Agentic AI reasoning layer for clinically interpretable decision support. The proposed framework utilizes the Human Bone Fractures Multi-modal Image Dataset (HBFMID), comprising 1,539 X-ray and MRI images, which were stratified into training, validation, and testing sets using an 80:10:10 split. Three YOLOv8n models were developed, including a multimodal model and modality-specific X-ray and MRI models, whose predictions were combined through a modality-aware late fusion strategy to leverage complementary diagnostic information. To address class imbalance, a class-conditional Deep Convolutional Generative Adversarial Network (DCGAN) with DiffAugment was investigated and evaluated using the Fréchet Inception Distance (FID). Since the generated images did not satisfy the predefined quality criteria, the final training pipeline employed a validated augmentation strategy based on real-image transformations. Grad-CAM was integrated to visualize fracture regions influencing model predictions, thereby improving transparency and interpretability. Furthermore, a lightweight rule-based Agentic AI reasoning layer was introduced as a post-detection decision-support module that interprets fracture class, prediction confidence, imaging modality, and Grad-CAM evidence using predefined reasoning rules to generate structured explanations and clinical recommendations. Experimental evaluation achieved a Precision of 93.63%, Recall of 92.14%, F1-score of 92.88%, mAP@0.5 of 96.98%, and mAP@0.5:0.95 of 59.77%. The Agentic AI reasoning layer further achieved a mean Reasoning Coherence of 86.88%, Evidence Consistency of 100.00%, and an overall Agentic AI score of 93.44%. These findings demonstrate that integrating multimodal deep learning, explainable AI, modality-aware late fusion, and lightweight agent-based reasoning provides an accurate, transparent, and clinically interpretable framework for automated bone fracture detection and intelligent clinical decision support.

Keywords: Agentic AI, Bone Fracture Detection, GAN Augmentation, Multimodal Learning, YOLOv8n

Enhancing Usability and Security in Digital Banking for Elderly in the Kegalle District of Sri Lanka Through Inclusive User Experience (UX) Design

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The rapid growth of digital banking in Sri Lanka has enhanced access to financial services; however, elderly users (aged 60 and above) continue to face significant challenges in adopting these technologies. This study aims to investigate the usability and security barriers experienced by elderly Sri Lankans and to explore how inclusive User Experience (UX) design can improve their interaction with digital banking systems. A qualitative research approach was employed with 25 elderly participants from the Kegalle District (13 digital-banking users and 12 non-users), recruited through community contacts and local senior citizens' associations. Data were collected using in-depth interviews and structured questionnaires and analysed together using thematic analysis. The analysis generated 93 initial codes, which were consolidated into eight key themes based on recurring patterns. The findings reveal that elderly users face multiple interconnected challenges, including low digital literacy, high levels of error anxiety, limited trust in digital platforms, and strong dependence on family or external support. Usability issues such as complex interfaces, unclear navigation, and poor feedback mechanisms further hinder effective interaction. Additionally, security concerns are largely driven by fear and lack of understanding rather than actual system vulnerabilities. Based on these insights, the study proposes a set of inclusive UX design recommendations focused on simplifying interfaces, providing guided interactions, enhancing trust through transparent security communication, and integrating support systems. These solutions aim to reduce cognitive load, improve user confidence, and promote independent usage of digital banking services. This research contributes to the development of user centered and inclusive digital banking solutions, supporting financial institutions in improving accessibility and fostering digital inclusion among the elderly population in Sri Lanka.

Keywords: Digital Banking, Elderly Users, Security, Usability, User Experience

Hybrid Models for Time Series Forecasting: A Comparative Study Across Heterogeneous Domains

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Time series forecasting plays an important role in data-driven decision-making across domains such as tourism, environmental monitoring, public health, and energy management. However, selecting a forecasting model that performs consistently across different time series remains challenging because datasets differ in seasonality, volatility, and nonlinear behaviour. This study compares three classical statistical models, AutoRegressive Integrated Moving Average (ARIMA), Seasonal AutoRegressive Integrated Moving Average (SARIMA), and Error, Trend, and Seasonal (ETS), with two deep learning models, Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU), selected to represent complementary forecasting paradigms. Four heterogeneous datasets covering tourism demand, Beijing PM2.5 air quality, DengAI weekly dengue incidence, and appliances energy consumption were selected to represent diverse temporal characteristics, including seasonal, noisy, and nonlinear behaviour. Following consistent preprocessing, chronological train-validation-test splitting, forecasting performance was evaluated using Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and Symmetric Mean Absolute Percentage Error (sMAPE). Results showed that no single model consistently outperformed the others across all datasets. Statistical models achieved superior performance on strongly seasonal tourism series, whereas deep learning models performed better on irregular datasets. Residual hybrid experiments showed that the ETS + GRU hybrid improved Tourism T1 forecasting by approximately 9.86% in RMSE, while most other hybrid configurations did not outperform the best standalone models. Overall, the findings demonstrate that forecasting performance depends strongly on dataset characteristics and highlight the importance of data-aware hybrid model design for developing more reliable and generalizable forecasting frameworks.

Keywords: ETS, Hybrid Models, LSTM, SARIMA, Time Series Forecasting .

An ARIMA-Machine Learning Model for Predicting Volatile Prices and Market Opportunities in Agricultural Supply Chains

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Agriculture remains central to Sri Lanka's economy, employing nearly 27% of the workforce and providing the primary livelihood for rural smallholder farmers. In the principal wholesale markets of Dambulla and Peliyagoda, prices of key up-country vegetables (carrots, leeks, and beans) exhibit pronounced volatility driven by weather shocks, festival demand, transport costs, and intermediary margins. Although hybrid ARIMA-LSTM architectures are widely applied to agricultural time series, most existing studies stop at improved forecast accuracy and do not couple multi-variable prediction with a downstream spatial allocation mechanism tailored to perishable supply chains. To address this research gap, this paper presents a decision-support hybrid framework that integrates Seasonal ARIMA (SARIMA), Long Short-Term Memory (LSTM) residual modelling, and linear-programming market allocation. A weekly panel of 260 observations (2021 - 2025) comprising market prices, meteorological variables, fuel prices, and festival indicators was pre-processed and chronologically partitioned (80:20 train-test split). SARIMA extracted linear and seasonal structures, while an LSTM network subsequently modelled non-linear residuals conditional on exogenous drivers. The hybrid was benchmarked against standalone SARIMA, LSTM, Random Forest, and XGBoost. Forecasts then fed a PuLP-based linear programme that maximises expected net revenue subject to supply balance, market capacity, and transport-cost constraints. On the held-out test set, the hybrid reduced forecast error by 18.4% relative to SARIMA and by 12.7% relative to standalone LSTM. Spatial optimization raised simulated farmer revenue by 14.2% and narrowed inter-market price disparity by 21%. The principal novelty lies in the closed-loop linkage of multi-variable volatile-price forecasting with operational market-allocation decisions, yielding an actionable prototype decision-support system for smallholders. Limitations include the five-year series length, constraining long-horizon seasonality capture. Future work will enlarge the temporal window and conduct field validation with farmer cooperatives.

Keywords: Decision Support System, Hybrid ARIMA-LSTM, Market allocation, Multi- market optimisation, Vegetable price forecasting

A Deep Learning Approach for Student Emotion Recognition in Online Educational Environments

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Online learning limits instructors' access to nonverbal cues used to determine whether students are engaged, bored, confused, or frustrated. Although deep learning has advanced facial emotion recognition, many educational studies focus on basic emotions, rely mainly on overall accuracy, and provide limited class-level analysis for imbalanced learning-centred datasets. Addressing this gap, this study evaluates an explainable ResNet-50 model for recognizing four student affective states in online learning. DAiSEE, containing 9,068 video clips annotated for Engagement, Boredom, Confusion, and Frustration, was used. Emotion-intensity annotations were converted into dominant-emotion labels, followed by frame extraction, resizing to 224×224 pixels, normalization, targeted augmentation, and oversampling. An ImageNet-pretrained ResNet-50 was selected because its residual connections support stable optimization, while its convolutional structure captures localized patterns around the eyes, eyebrows, mouth, and facial contours. The model was fine-tuned using Focal Loss with inverse-frequency class weighting to reduce class-imbalance effects. Evaluation on a 5,248-frame test set achieved 91.44% overall accuracy and a Macro-F1 score of 0.276. Performance was strongest for Engagement and Boredom, while Confusion and Frustration remained difficult to detect reliably, showing that overall accuracy can overestimate multiclass performance when Engagement dominates the test data. Explainable AI (XAI) was implemented using Grad-CAM to identify facial regions influencing predictions, helping verify whether the model uses meaningful cues and supporting transparent error analysis for educators and developers. This study contributes an imbalance-aware and explainable evaluation of ResNet-50, demonstrating strong overall accuracy while revealing limitations in recognizing underrepresented student emotions.

Keywords: Explainable AI, Online Learning, ResNet-50, Student Emotion Recognition

A Workflow for LLM-Assisted High-Level Software Architecture Generation

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High-level software architecture design is a knowledge-intensive, iterative process requiring domain expertise, reasoning, and consistent architectural decisions. Although Large Language Models (LLMs) show potential in software engineering, their effectiveness for high-level architecture is limited by context loss, element omissions, and insufficient domain knowledge. This research proposes a structured end-to-end workflow for LLM-assisted high-level software architecture generation. The workflow integrates Retrieval-Augmented Generation (RAG), persistent architectural context storage, a domain-aware “Architect LLM,” Explainable AI (XAI), structured Human-in-the-Loop checkpoints, and rationale tracing to validate outputs, improve transparency, and reinforce contextual memory. A Design Science Research methodology is adopted, covering workflow design, prototype development, and comparative case-study evaluation. The workflow is evaluated using Pet Clinic, Learning Management System, and E-Commerce tasks against Vanilla LLM and RAG-Only baselines with Gemini 2.5 Flash, Groq Llama 3.3 70B, and Claude 3.5 Sonnet. Quantitative evaluation considers architectural completeness, cross-view consistency, omissions, and token usage, supported by qualitative expert assessments. The Full System increased average architectural completeness from 0.042 to 0.745 for Gemini, from 0.100 to 0.872 for Groq, and from 0.345 to 0.965 for Claude. It reduced average omissions from 16.0 to 9.8, 16.0 to 10.0, and 8.8 to 1.2, respectively. Claude achieved the strongest performance, including a cross-view consistency score of 0.885, while Groq provided strong performance with lower token usage. These results provide empirical support that the proposed workflow improves the completeness, consistency, and practical usability of LLM-generated high-level software architectures.

Keywords: Human-in-the-Loop, Large Language Models, Memory Retention, Retrieval- Augmented Generation, Software Architecture

Explainable Defect Root Cause Analysis Using Commit History and Developer Activity Metrics

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Just-In-Time (JIT) defect prediction identifies risky commits before defects propagate, but prediction-only systems provide little guidance about why a change is flagged. This study developed and evaluated an explainable defect-risk framework using commit history and developer activity metrics from ApacheJIT commits dated 2015 onward. The training set contained 14,616 commits, while a separate pool of 39,925 commits provided a balanced test benchmark of 11,636 commits. Twelve original metrics were expanded to 32 predictive features, including a leakage-controlled past-only project defect prior. Logistic regression with Bonferroni correction, variance inflation factors, and bootstrap stability identified significant metrics. Random Forest, XGBoost, LightGBM, and CatBoost were tuned through temporal cross-validation and evaluated with calibrated logistic stacking. LightGBM achieved the best balanced-test F1-score of 80.90%, with 80.72% accuracy, 80.12% precision, 81.69% recall, 89.06% ROC-AUC, and 87.72% PR-AUC. CatBoost was selected for SHAP-based explanation and single-model deployment, while a stacking bundle supported ensemble deployment. SHAP was more stable and faithful than LIME, and its contributions were converted into natural-language risk and action reports. Leave-one-project-out evaluation achieved macro ROC-AUC of 0.8079 and macro PR-AUC of 0.7936. A paired developer evaluation with 25 participants and 125 scenario assessments showed significantly higher understanding, trust, usefulness, and actionability for explanation-supported outputs (Wilcoxon $p < 0.001$). The Python package supports metric extraction, single and batch scoring, command-line and HTTP interfaces, and CI/CD integration. The framework provides practical predictive evidence without making causal claims about defect root causes.

Keywords: Calibrated Stacking, Developer Evaluation, Explainable Artificial Intelligence, Just-In-Time defect prediction, Software Quality.

A Comparative Study of CNN and Transfer Learning for Real-Time Face Liveness Detection in Unconstrained Lighting Environments

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Face recognition systems are widely used in biometric authentication but remain vulnerable to presentation attacks such as printed photos, replay videos, silicone masks, and 3D mannequin attacks. This research develops and evaluates a robust face liveness detection system capable of distinguishing between real and spoofed faces under unconstrained environmental conditions. The study compares the performance of a Convolutional Neural Network (CNN) trained from scratch with a Transfer Learning model based on the MobileNetV2 architecture. The research follows an experimental deep learning approach using multiple anti-spoofing datasets, including the Anti-Spoofing Live Dataset, Silicone Mask Dataset, 3D Mannequin Dataset, and Low Webcam Attack Dataset. Data preparation involved video frame extraction, image resizing, cleaning, and augmentation techniques such as rotation, horizontal flipping, brightness adjustment, cropping, and noise injection to simulate real-world conditions. Two models were developed for binary classification (real vs. fake) and multiclass spoof detection. Performance was evaluated using accuracy, precision, recall, F1-score, confusion matrices, and ROC-AUC analysis. The CNN model achieved 95% accuracy, while the Transfer Learning model achieved 97% accuracy with better precision, recall, and overall robustness against spoof attacks. ROC-AUC results further confirmed the superior performance of the Transfer Learning approach. The best-performing model was integrated into a real-time web application using FastAPI and Next.js, demonstrating its suitability for practical biometric authentication systems. The proposed system can support applications such as mobile authentication, banking security, and digital identity verification. The findings confirm that Transfer Learning using MobileNetV2 provides a more accurate, scalable, and efficient solution for real-time face liveness detection compared to CNN models trained from scratch.

Keywords: Face Liveness Detection, Transfer Learning, MobileNetV2, Spoofing Attacks, Biometric Authentication

AI and IoT Based Smart Emergency Braking System for Railway Safety

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Railway transportation is one of the mostly used methods for passenger and goods transport. However, human error, signal failures, and delayed emergency braking during critical situations remain major railway safety concerns. Conventional emergency braking systems mainly rely on driver intervention or fixed threshold values, which may not respond effectively under dynamically changing speed and obstacle distance conditions. To overcome these limitations, this study proposes an AI and IoT based smart emergency braking system for railway safety. The system is built using two ESP32 microcontroller boards. These boards handle real-time data from the train. An ultrasonic sensor is used to measure how far obstacles are and while a wheel speed sensor measures the rotational speed of the train wheel. These values are sent to a Flask server hosted on Replit, where a trained model predicts the chance of a possible collision. During testing, the model reached an accuracy of 95.99%. If a dangerous situation is detected, the system issues a braking command within 1.8 s and sends a stop signal to the ESP32 NodeMCU. This signal is then passed through UART communication to the ESP32 DevKit V1, which activates the braking system using an L298N motor driver. In addition, a Blynk IoT dashboard was developed to monitor the important system parameters in real time, including obstacle distance, wheel speed, collision risk percentage, and brake status. Experimental results showed that the proposed system provides more reliable and intelligent braking decisions compared to the traditional threshold-based methods. The study demonstrates that the integrating artificial intelligence, IoT, and embedded systems can support the development of a low-cost, scalable, and efficient railway safety solution for future smart transportation systems.

Keywords: Artificial Intelligence, Emergency Braking System, ESP32, Internet of Things, Railway Safety

Catalogue Development and Analysis of Cataclysmic Variable Stars

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Cataclysmic variable (CV) stars represent interacting binary systems that provide valuable insights into stellar evolution and accretion processes. This study presents the development of a comprehensive catalogue of CV stars by integrating data from various astronomical databases and literature sources, including the SIMBAD database, American Association of Variable Star Observers (AAVSO), and the Ritter and Kolb catalogue. The CV catalogue serves as a valuable resource for investigating the properties, evolutionary characteristics, and outburst behavior of cataclysmic variable stars. Data preprocessing procedures were performed, including the removal of duplicate records, exclusion of incomplete entries, and the standardization of parameters to improve the quality and consistency of the dataset. The resulting catalogue was systematically arranged, and contains key parameters such as celestial coordinates, orbital period, and classification types. Statistical analysis of the catalogue shows that dwarf novae are the most prevalent category, comprising 2303 systems, followed by nova-like variables (411), classical novae (117), and recurrent novae (5). To investigate the evolutionary characteristics of CV systems, the distribution of orbital periods was analyzed using Python. The findings reveal a significant decrease of systems between orbital periods of 2 and 3 hours, corresponding to the well known orbital period gap observed in cataclysmic variables. This feature is consistent with current theoretical models of CV evolution.

Keywords: Cataclysmic variable (CV) stars, Catalogue, Period gap, Stellar evolution

A Spectroscopic Analysis of Accretion Properties and Temperature in Cataclysmic Variable Stars

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Cataclysmic Variable (CV) stars are interacting binary systems in which a white dwarf accretes matter from a low-mass donor star through Roche lobe overflow, forming an accretion disk. The thermal properties of the accretion disk provide important insight into accretion activity and energy transfer processes in close binary systems. Therefore, investigating the relationship between accretion properties and disk temperature is important for understanding the physical behavior and evolution of CV systems. The objective of this study is to investigate the relationship between the mean temperature of the accretion disks (T_m) and mass transfer rate ($\dot{M}$), and orbital period in CV stars using spectroscopic analysis. A sample of 75 CV systems was analyzed using calibrated spectroscopic data obtained from the Sloan Digital Sky Survey (SDSS). Standard data reduction techniques, including flux calibration, dereddening, continuum fitting, and Gaussian fitting of emission lines, were applied to extract spectral parameters. Flux ratios of Balmer emission lines, $H\gamma/H\beta$ and $H\delta/H\beta$, were used to estimate T_m and $\dot{M}$. The results show no clear relationship between T_m and orbital period, indicating that disk temperature is not primarily governed by orbital evolution. In contrast, a strong positive correlation is observed between T_m and $\dot{M}$, where higher temperatures correspond to higher mass transfer rates. Linear fits for systems above, below, and within the orbital period gap show similar slopes ranging from approximately 3.8 to 4.1, demonstrating a consistent relationship between temperature and accretion activity across all systems. In addition, systems above the period gap exhibit comparatively higher T_m and $\dot{M}$ values, while systems below the gap show lower values. Results obtained from both Balmer line ratios are in good agreement, confirming the reliability of the spectroscopic analysis. These findings suggest that the thermal behavior of CV systems is primarily controlled by accretion processes rather than orbital evolution and highlight a strong coupling between temperature and mass transfer activity in accretion disks.

Keywords: Cataclysmic Variable Stars, Mass Transfer Rate, Orbital Period, Period gap, Spectroscopy

Impact of Different Carbon-Supported Materials on TiO_2 Cathode Performance in Mg^{2+} Ion Batteries

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Rechargeable batteries offer promising way for energy storage. Among them Li^+ ion batteries attract significant attention due to their high charge capacity and long cycle life. However, they suffer from several drawbacks such as safety and environmental concerns. This leads to search for alternative systems. Mg^{2+} ion batteries offer a promising alternative system for Li^+ ion batteries. This study focuses on investigating the impact of different carbon supported TiO_2 cathodes on the electrochemical performance of Mg^{2+} ion batteries. Activated carbon (C), reduced graphene oxide (rGO), and graphitic carbon nitride (g-C₃N₄) were separately incorporated into TiO_2 while maintaining the 3:2 mass ratio. A homogeneous paste of each sample was coated on fluorine-doped tin oxide (FTO) glass using a doctor blade method. The battery cell was assembled by utilizing a magnesium plate as an anode and a quasi-solid Mg ion electrolyte, which was prepared by magnesium borohydride ($\text{Mg}(\text{BH}_4)_2$), ethylene glycol (EG) and fumed silica (SiO_2). The electrochemical performance of the fabricated batteries was evaluated through open-circuit voltage (OCV), discharge current analysis, and cyclic voltammetry. The OCV measurements revealed voltages of 1.6618 V, 1.3607 V, and 1.5929 V for C/ TiO_2 , g-C₃N₄/ TiO_2 and rGO/ TiO_2 cathodes contained batteries, respectively. The discharge capacity of each batteries was evaluated through a discharge analysis. The C/ TiO_2 composite exhibits the highest discharge capacity 10.2500 mAhg⁻¹ compared with rGO/ TiO_2 (9.5438 mAhg⁻¹), and g-C₃N₄/ TiO_2 (7.3010 mAhg⁻¹). These results highlight that activated carbon incorporated TiO_2 composites are promising cathode materials for Mg^{2+} ion batteries. This study shows a comparative evaluation of different carbon-supported TiO_2 cathodes for Mg^{2+} ion batteries.

Keywords: Activated carbon, Discharge capacity, Graphitic carbon nitride, Open circuit voltage, Reduced graphene oxide.

Dosimetric Impact of Patient Setup Errors in Prostate Cancer IMRT Treatment Plans

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Radiotherapy is technique that used in the treatment of prostate cancer. Advanced techniques such as Intensity-Modulated Radiation Therapy (IMRT) can deliver a highly conformal radiation dose to the target and reducing the dose to surrounding normal tissues. However, patient setup errors during treatment may change the planned dose and affect both target coverage and organs at risk (OARs). This study evaluated the dosimetric effect of translational setup errors on prostate cancer IMRT treatment plans. Twenty patient plans were analysed using a Treatment Planning System (TPS). Setup shifts of ± 1 , ± 2 , ± 3 , ± 4 , and ± 5 mm were introduced separately in the left–right (LR), superior–inferior (SI), and anterior–posterior (AP) directions. PTV V95 was used to evaluate target coverage, while dose-volume parameters of the rectum and bladder were used to evaluate OAR dose changes. Repeated-measures ANOVA and Holm-adjusted post-hoc tests were used for statistical analysis. PTV V95 showed no statistically significant difference between the original plans and the ± 1 mm shifts. However, as the magnitude of the setup error increased towards ± 5 mm, the mean PTV V95 gradually decreased, indicating a gradual reduction in target coverage. Significant changes in PTV V95 were observed at larger shifts. For the rectum, the evaluated dose-volume parameters V60, V57, V52.8, V48.8, and V40.8 showed the greatest changes in the AP direction ($p < 0.001$). Bladder V60, V48.6, and V40.8 showed significant changes in both the SI and AP directions ($p < 0.001$), while no significant overall changes were observed in the LR direction. The results show that the dosimetric effect of setup errors depends on both the size and direction of the displacement. Accurate patient positioning and image-guided verification are therefore important for maintaining target coverage and reducing unnecessary dose changes to nearby normal tissues during prostate IMRT.

Keywords: Dosimetric Analysis, IMRT, Patient Setup Errors, Prostate Cancer, Radiotherapy.

Dosimetric Comparison of 3-Beam and 4-Beam 3D-CRT Techniques in Oesophageal Cancer

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Oesophageal cancer is a malignancy arising from abnormal cellular growth in the oesophagus. Radiotherapy aims to deliver an adequate tumour dose while minimising radiation exposure to surrounding organs at risk (OARs). This study aimed to compare the dosimetric characteristics of 3-beam and 4-beam Three-Dimensional Conformal Radiotherapy (3D-CRT) techniques in patients with mid-oesophageal cancer. A retrospective dosimetric evaluation was performed using treatment plans from 38 patients with mid-oesophageal cancer. For each patient, 3-beam and 4-beam 3D-CRT plans were generated using identical planning parameters. The plans were evaluated using Conformity Index (CI), Homogeneity Index (HI), spinal cord maximum dose, heart V30, heart V40, and lung V20. A paired t-test showed no statistically significant difference in the Conformity Index (CI) between the 3-beam and 4-beam plans ($p = 0.092$). 3-beam plan demonstrated a significantly better (lower) Homogeneity Index than the 4-beam plan (0.1631 ± 0.0302 vs. 0.1746 ± 0.0567 , Wilcoxon signed-rank test, $p < 0.001$). The 3-beam technique showed higher heart and lung doses compared with the 4-beam technique, with heart V30 values of $53.02 \pm 19.73\%$ vs $35.45 \pm 16.19\%$, heart V40 values of $25.95 \pm 14.06\%$ vs $18.33 \pm 10.52\%$, and lung V20 values of $28.91 \pm 12.42\%$ vs $21.64 \pm 10.03\%$, respectively. However, the spinal cord maximum dose was significantly lower in the 3-beam technique compared with the 4-beam technique (3607.53 ± 513.84 cGy vs. 4371.04 ± 336.76 cGy, $p < 0.001$), demonstrating better spinal cord protection with the 3-beam arrangement. The 4-beam 3D-CRT technique demonstrated favourable overall dosimetric performance by achieving significant reductions in heart and lung doses. Although the 3-beam technique provided better, homogeneity, and spinal cord protection, the improved OAR sparing achieved with the 4-beam arrangement provides a more balanced approach for mid-oesophageal cancer radiotherapy. Despite the slightly higher spinal cord dose observed with the 4-beam technique, the overall reduction in doses to critical organs at risk supports. Therefore, the 4-beam technique may be considered a preferable beam arrangement when prioritising overall organ-at-risk protection in oesophageal cancer 3D-CRT planning.

Keywords: 3-Beam and 4-Beam Techniques , 3D Conformal Radiotherapy (3D-CRT) , Dosimetric Evaluation , Mid-oesophageal Cancer

SYMPOSIUM TRACK

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The Effects of Regular Walking on Cardiovascular Health Outcomes: A Systematic Review

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Cardiovascular disease (CVD) is a leading cause of mortality and morbidity worldwide, and physical inactivity remains an important modifiable risk factor. Walking is an accessible, low-cost, and sustainable form of physical activity widely recommended to enhance cardiovascular health. However, available evidence is mixed, varying by population, intervention features and study design, and uncertainty remains regarding how walking dose, intensity, bout duration, and population characteristics influence cardiovascular outcomes, with evidence across randomized and observational studies not yet consistently synthesized. This systematic review therefore aimed to systematically synthesis existing evidence on the effects of regular walking on cardiovascular health outcomes in adults. A systematic search of PubMed and Google Scholar was conducted to identify peer-reviewed studies published from 1979 to 2026. Studies were included if they examined walking as the primary physical activity intervention/exposure and assessed cardiovascular-related outcomes in adults. Eligible studies were identified using specific inclusion and exclusion criteria, and risk of bias was assessed using design-appropriate appraisal tools. Following screening, 30 studies were included, comprising randomized controlled trials (RCTs), prospective cohort studies, and quasi-experimental studies. Most intervention studies reported improvements in blood pressure, lipid profiles, cardiac function, cardiorespiratory fitness, and metabolic regulation, while prospective cohort evidence consistently associated greater walking exposure with lower cardiovascular disease, hospitalization, and all-cause mortality risk. Greater walking volume and/or intensity were generally associated with larger cardiovascular benefits, and accumulated short bouts of walking appeared to provide benefits comparable to continuous walking for several outcomes. Regular walking was consistently associated with favorable cardiovascular outcomes across intervention and observational evidence; however, heterogeneity in walking prescriptions, populations, outcome measures, and study quality limits identification of an optimal walking dose. These findings have implications for public health policy and highlight the need for standardized, high-quality trials to determine optimal walking prescriptions for long- term cardiovascular benefit.

Keywords: Blood pressure, Cardiovascular disease , Cardiovascular health, Physical activity, Walking.

Effects of a Structured Training Programme on Agility, Speed, and Drive Shot Performance Among Badminton Players in Ratnapura District, Sri Lanka

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Successful badminton performance, particularly drive shot execution, depends heavily on agility and speed related physical capacities. Although agility and speed training are widely used in badminton, limited research has examined their combined effects on drive shot performance among badminton players in Sri Lanka. this study aimed to examine the effects of a structured training programme on agility, speed and drive shot performance among badminton players in Ratnapura District, Sri Lanka. A one group pre test, post test experimental design was employed using purposive sampling to recruit 24 competitive badminton players ($n = 24$). Participants completed a six week structured training programme consisting of agility ladder drills, cone drills, sprint training, and badminton-specific movement exercises for one hour sessions, three times per week. Agility was assessed using the Agility T-Test, speed was measured using the 10 meter sprint test, and drive shot performance was evaluated through an accuracy based skill test. Agility performance improved, with mean times decreasing from 15.35 ± 1.0 s to 14.19 ± 0.9 s, indicating enhanced change of direction ability. Similarly, 10 meter sprint performance improved, with times decreasing from 2.06 ± 0.15 s to 1.88 ± 0.12 s, suggesting improved acceleration. Drive shot accuracy increased from $62.48 \pm 5.2\%$ to $72.21 \pm 4.8\%$, indicating improved technical proficiency. Paired samples t-tests revealed statistically significant improvements in all measured variables ($p < .001$). The findings suggest that a structured training programme may effectively enhance agility, speed, and drive shot performance among badminton players in Ratnapura District, Sri Lanka.

Keywords: Agility, Badminton, Drive shot, Speed, Training intervention

The Effect of a Six-Week Lower Body Explosive Strength Training on Backcourt Clear Stroke: A Case Study of an Intermediate Badminton Player at Sabaragamuwa University of Sri Lanka.

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Badminton performance is influenced by various factors, including technical skill and physical fitness. Lower body explosive strength may contribute to the effective execution of badminton strokes, particularly the backcourt clear stroke. This case study aimed to examine the effect of a six week lower body explosive strength training program on backcourt clear stroke performance in an intermediate badminton player at Sabaragamuwa University of Sri Lanka. A pre-test and post test design was used with one purposively selected 22 year old female intermediate player. The participant completed a six week training program consisting of five sessions per week, with each session lasting one hour. The program included squats, lunges, calf raises, and jump squats, with training load increasingly increased according to the principle of progressively overload. Performance was assessed before and after the intervention using straight jump height, standing substantial jump distance, backcourt clear shot distance, and backcourt clear shot accuracy. Following the intervention, straight jump height increased from 28 cm to 32 cm , standing big jump distance improved from 1.65 m to 1.78 m , backcourt clear shot distance increased from 8.2 m to 9.1 m , and accuracy improved from 6/10 to 8/10 productive shots. As the study involved only one participant, no constructive statistical analysis was performed, and the findings cannot be generalized to other badminton players. The results indicate that improvements in unstable strength and backcourt clear stroke performance were observed in this participant following the six week training program. Further studies with big samples and right statistical analyses recommended.

Keywords: Badminton performance, Backcourt clear stroke, Explosive strength

Sustainable Sports Equipment Management in Sri Lankan State Universities: Resource Utilization, Waste Management and Implications for Sport Management Education

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Sustainability has emerged as a critical concern within sport management, particularly regarding the responsible use and disposal of sports equipment. Despite growing global attention to sustainable practices in sport organizations, limited research has examined how sustainability principles are applied to the management of sports equipment within higher education institutions in developing countries. This review examines sustainable sports equipment management practices in Sri Lankan state universities, with particular attention to resource utilization, waste management and the role of sport management education in promoting sustainable practices. A systematic literature review was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta- Analyses) guidelines. Relevant studies were identified through Scopus, Web of Science, SPORTDiscus and Google Scholar using predefined search terms covering publications from 2010 to 2024. Studies were selected using predefined inclusion and exclusion criteria, and the methodological quality of the included studies was assessed using the Mixed Methods Appraisal Tool (MMAT). A total of 30 eligible studies were included in the final synthesis. The findings reveal significant gaps in policy implementation, limited institutional frameworks for sustainable equipment management, inadequate waste management systems and minimal integration of sustainability concepts into sport management curricula in Sri Lankan universities. For example, most institutions lacked a formal, written policy for equipment replacement or disposal, and only a small number reported any structured reuse, donation or recycling scheme for worn-out sports equipment. The review further indicates the absence of formal mechanisms for equipment lifecycle management, sustainable procurement practices and circular economy approaches within university sport departments. These findings highlight the urgent need for policy reform, institutional capacity development and curriculum integration to promote sustainable sports equipment management. Aligning university sport management practices with national sustainability policies and the United Nations Sustainable Development Goals (SDGs) could significantly enhance environmental responsibility and resource efficiency within Sri Lanka's higher education sport sector.

Keywords: Sustainability, Sports equipment management, University sport management, Waste management, Sustainable development goals, Sri Lanka

The Impact of a Six Week Agility Training Program on Zig - Zag Dribbling Performance Among Intermediate Female Midfield Hockey Players at Sabaragamuwa University of Sri Lanka

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This study investigated the impact of a six-week agility training program on zig-zag dribbling performance among intermediate female midfield hockey players at the Sabaragamuwa University of Sri Lanka. Agility is a critical physical component in field hockey, as it enables players to change direction rapidly while maintaining ball control. Zig-zag dribbling, in particular, is essential for midfielders to evade defenders and advance play. Employing a pre-experimental pre-test/post-test design, two intermediate female midfield players ($n = 2$) were selected from the university hockey team via purposive sampling. The intervention consisted of a structured agility program conducted three times per week. Data were collected using the Illinois Agility Run Test and a Zig-Zag Dribbling Test administered before and after the intervention. Results demonstrated performance improvements in both measures: the mean time for the Illinois Agility Test decreased by 1.35 seconds, while the Zig- Zag Dribbling Test time decreased by an average of 0.95 seconds. These findings indicate that structured agility training positively impacts both general agility and sport-specific dribbling proficiency. The study concludes that targeted agility interventions can effectively enhance technical skills in intermediate female field hockey players, offering practical insights for coaches and trainers in designing sport-specific conditioning programs.

Keywords: Agility training, Field hockey, Midfielders, Skill performance, Zig-zag dribbling.

Effect of a Rondo-Based Passing Training Program on Aerobic Endurance and Passing Skill Among School-Level Defending Soccer Players

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Football requires both aerobic endurance and technical skills, particularly for defenders who must cover large distances and complete accurate passes under pressure. In school football settings, coaches often have limited time and resources to develop these abilities simultaneously. Rondo-based training combines continuous movement with repeated passing actions and may provide a practical method for improving both physical and technical performance. However, there is limited evidence on its effects in young school-level defenders. Therefore, this pilot study investigated whether an eight-week Rondo-based training programme was associated with improvements in aerobic endurance and passing accuracy among Grade 8 (under-12) school football defenders. An experimental design was used with four participants. Two players were assigned to the intervention group and completed an eight-week Rondo-based training programme consisting of regular Rondo sessions in addition to football practice, while two players continued their regular football training as the control group. Aerobic endurance was measured using the Cooper 12-minute run test, and passing accuracy was assessed using McDonald's Passing Test. Pre-test and post-test assessments were conducted for both groups. The intervention group showed improvements in both aerobic endurance and passing accuracy from pre-test to post-test, whereas the control group demonstrated only small changes over the same period. These findings suggest that participation in the Rondo-based training programme was associated with improvements in the measured performance outcomes among the players included in this study. Because the sample size was very small, the results should be considered preliminary and interpreted with caution. This pilot study provides initial evidence that Rondo-based training may be a practical and time-efficient approach for developing aerobic endurance and passing accuracy in young school football defenders, and further research with a larger sample is recommended.

Keywords: Accuracy, Cooper 12-minute test, McDonald's Passing Test, Rondo-based training

An Investigation Into The Influence Of Upper Body Muscular Power On The Performance Level For Intermediate Female Shot Putter

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The study examined the effect of an eight week periodized – upper body strength training program on upper body muscular power in an intermediate level female shot put athletes. It used a periodized approach and included workouts that focused on the arms, back, shoulders, and chest. The program addressed physiological and technical needs specialized to female athletes. The single-athlete sample size ($n=1$) is used to collect the data, selecting by a pilot test. The chest medicine ball throw test was used to assess upper body power both before and after the training. According to the results, medicine ball throw distance improved by 80.8%. These findings suggested that improvements in upper – body muscular power may contribute to shot put performance enhancement. The study highlighted how important upper body strength is to shot put success and demonstrate the potential effectiveness of a structured periodized training program. The results provide trainers and coaches with useful recommendation on how to improve shot put performance using research-based techniques.

Keywords: Female athletic, Medicine ball throw, Periodized training, Strength training

The Effect of 08-Week Speed Training Program on the Acceleration Ability Of Beginner Male Athlete In Karagasthalawa Maha Vidyalaya

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Acceleration is a critical component of sprint performance, yet the need for targeted speed training among novice athletes requires more focus. Therefore, the aim of this case study was to examine the effect of 08-week speed training program on the acceleration ability of a beginner male athlete in Karagasthalawa Maha Vidyalaya. A single-subject pre-test–post-test intervention design was employed. The data was collected from one (n=1) healthy beginner male player to participate in this study. A 08-week speed training program including resisted sprints, plyometrics, and technique-focused drills was applied to the sample in 3 days per each week. The testing was conducted before and after 08 weeks of training. The acceleration ability and speed were evaluated for 30m sprint test and 100m test. The mean time for the 30m sprint test decrease by 1.02 seconds (improving from 11.98 s to 10.96 s, an 8.5% improvement) and the 100m time dropping by 1.36 seconds (improving from 21.31 s to 19.95 s, a 6.4% improvement) after training, the results indicated notable improvements. To validate these findings, more research with greater sample sizes is necessary according to the study's limitations, which include the use of a single participant. The improvements in sprint performance occurred in the initial acceleration and speed-maintained phase. The results suggest that an eight-week speed training programme may effectively improve acceleration and overall sprint performance in beginner athletes. Key words: - Speed Training, Acceleration, Sprint

Keywords: Speed Training, Acceleration, Sprint Performance, Beginner Athlete, Athletic Development

Effects of a Six-Week Coordination Training Programme on Hand-Eye Coordination Performance Among Volleyball Setters at Sabaragamuwa University of Sri Lanka

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Hand-eye coordination is a critical component of volleyball setting performance, influencing ball control, accuracy, and decision-making. This study examined the effects of a six-week coordination training programme on the hand-eye coordination performance of volleyball setters at Sabaragamuwa University of Sri Lanka. A one-group pre-test-post-test quasi-experimental design was employed. The study involved four female volleyball setters ($n=4$), Age range: 20-25 years old, Playing experience: Minimum of 3 years of competitive playing experience, Competitive level: Intermediate, Selection criteria: selected via purposive sampling. Hand-eye coordination performance was evaluated using the Wall Toss Test. The structured training programme consisted of wall toss drills, reaction ball exercises, target setting drills, and coordination-based games, conducted three times per week for two hours per day over a six-week period. Pre-test results indicated a mean score of 17 catches (fair level), which improved to 31.5 catches (good level) in the post-test. These practical improvements are substantial, showing a mean difference of 14.5 catches, representing an 85.29% performance increase. A paired sample t-test was conducted using Microsoft Excel (2019 version) for statistical analysis. The findings indicate a statistically significant improvement following the training intervention: $t(3) = 50.26$, $p < .001$, $d = 25.13$. The results demonstrate that structured coordination training significantly improves measured hand-eye coordination performance among volleyball setters. However, because of the very small sample size and the absence of a control group, performance improvements cannot be attributed solely to the intervention, limiting the generalizability of these findings. Therefore, future studies involving larger samples and control groups are highly recommended.

Keywords: Volleyball Setters, Hand-Eye Coordination, Coordination Training, Motor Performance, Skill Development

Happiness And Mental Health Of Adolescents (Age 15- 17) In Selected Schools In Vavuniya

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This study examined the relationship between mental health and happiness among 400 adolescents aged 15-17 years studying in selected Sinhala-medium schools within the Vavuniya Zonal Education Division, Sri Lanka. Using a quantitative descriptive-correlational research design, data were collected through the Oxford Happiness Questionnaire (OHQ) and the Mental Health Continuum-Short Form (MHC-SF). The findings revealed that the majority of participants (79%) reported average happiness levels, while 21% experienced low happiness. Regarding mental health, 23% were classified as flourishing, 59% as moderate, and 18% as languishing. A strong positive correlation ($r = .612$, $p < .001$) was found between happiness and overall mental health, with significant relationships observed across all three dimensions of mental health: emotional ($r = .584$), social ($r = .526$), and psychological well-being ($r = .548$). No significant gender differences were identified in either happiness or mental health measures. Both instruments demonstrated good reliability (OHQ: $\alpha = .842$; MHC-SF: $\alpha = .856$). These findings highlight the interconnected nature of happiness and mental health among adolescents and emphasize the need for school-based mental health promotion programs that address emotional, social, and psychological well-being dimensions. The study contributes valuable empirical evidence to the limited research on adolescent mental health in rural Sri Lankan educational contexts and provides implications for educators, counselors, and policymakers in developing culturally sensitive interventions.

Keywords: Adolescent mental health, Happiness, Positive psychology , Rural schools, Sri Lanka, Subjective well-being

An Assessment of Knowledge of Anti-Doping Regulations Among University Athletes at Sabaragamuwa University of Sri Lanka

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Anti-doping knowledge is a fundamental prerequisite for clean and ethical sport participation; however, university athletes in developing nations often lack structured education on the World Anti-Doping Agency (WADA) regulatory framework. This study assessed the extent of anti-doping knowledge among competitive university athletes at Sabaragamuwa University of Sri Lanka (SUSL) using a cross-sectional survey design. A total of 102 athletes ($n = 102$) across five sports responded to a structured questionnaire covering four domains: general anti-doping knowledge, prohibited substances and methods, doping control and testing procedures, and sanctions and education. Descriptive statistics were used to summarize anti-doping knowledge levels across all domains. Results indicated that most athletes demonstrated sound conceptual understanding of anti-doping principles, including defining doping, recognizing WADA's regulatory role, and understanding that regulations uphold fair play and athlete welfare. However, fewer than one quarter (23.5%) had received formal anti-doping training. Awareness of prohibited substances was moderate on a 1–5 Likert scale, with relatively high awareness of blood doping (mean = 3.61 ± 1.05) and moderate awareness of supplement contamination risks (mean = 3.52 ± 1.07). Notably, 23.5% of athletes believed all supplements were safe to use. Awareness of testing procedures was relatively high (79.4%); however, a critical procedural gap emerged, as 26.5% of athletes did not recognize that refusing a doping test constitutes an anti-doping rule violation a finding with direct implications for compliance risk. Regarding educational needs, 87.3% of athletes identified coaches, universities, and sports associations as their preferred sources of anti-doping education, while 84.3% regarded formal anti-doping education programmes as the most effective preventive measure. The findings highlight the need for comprehensive anti-doping education initiatives within university sports programmes to address procedural knowledge deficiencies and promote ethical sporting practices, particularly given the gap between athletes' conceptual understanding and their procedural compliance knowledge.

Keywords: Anti-Doping Knowledge, Doping Prevention, Sports Integrity, University Athletes, WADA Regulations



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