

**JASPER 2025**  
RESEARCH SYMPOSIUM

# **BOOK OF ABSTRACTS**

**“Transforming Knowledge into Action:  
A Japan–Sri Lanka Development Perspective”**

**Japan - Sri Lanka  
Partnership in  
Education  
and Research**

26 September 2025  
[www.lnbt.lk](http://www.lnbt.lk)

**JASPER 2025**  
**Research Symposium**  
“Transforming Knowledge into Action: A Japan–Sri  
Lanka Development Perspective”

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**26<sup>TH</sup> SEPTEMBER 2025**

**LNBTI - LANKA NIPPON BIZTECH INSTITUTE**  
Sri Lanka

LANKA NIPPON BIZTECH INSTITUTE (LNBTI)

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## MESSAGE FROM THE CHAIRMAN

It is my great pleasure to welcome all participants to the JASPER 2025 Research Symposium. This gathering represents a landmark occasion for our institute, reflecting our commitment to creating meaningful academic platforms that connect Sri Lanka with Japan and the wider world.

Since its establishment, LNBTI has carried a distinctive mission: to bridge the knowledge, values, and professional excellence of Japan with the aspirations and talents of Sri Lankan youth. As the only Japanese university-level higher education institute in South Asia, we have endeavored to cultivate a truly international academic culture, grounded in quality, discipline, and innovation.



The launch of JASPER provides an important opportunity to strengthen academic and research collaboration with leading Japanese universities. It also reflects our determination to extend the benefits of these partnerships to our students and staff, opening new avenues for intellectual exchange and global exposure.

I would like to acknowledge with gratitude the contributions of our distinguished keynote and invited speakers, and all faculty members whose dedication has made this symposium possible. Their participation underscores the strong academic bonds we continue to build between Japan and Sri Lanka.

I sincerely hope that JASPER 2025 will not only promote the advancement of knowledge but also lay the groundwork for lasting partnerships in education and research. May this event inspire all of us to work together toward a future of shared growth and innovation.

**Mr. Kazuyuki Ikura**

*Chairman, LNBTI*

## MESSAGE FROM THE VICE CHANCELLOR & SYMPOSIUM CHAIR

It gives me great pleasure to welcome you all to the JASPER 2025 Research Symposium, held under the theme “Transforming Knowledge into Action: A Japan–Sri Lanka Development Perspective.” The launch of this research symposium marks another important step for LNBTI to guide students to become “Japan-Ready”, an initiative held for the first time.



In a country like Sri Lanka, higher education has traditionally been more focused on the theoretical aspects of learning, while the practical applications of subject specializations have often received less attention. In contrast, Japan emphasizes a balanced approach—giving equal importance to theory and practice—ensuring that learners not only understand the academic foundations of their disciplines but also gain the ability to apply them effectively in society.

As the only Japanese university-level higher education institute in Sri Lanka, and indeed in the whole of South Asia, Lanka Nippon BizTech Institute (LNBTI) has introduced a unique education model. Through this model, our graduates not only receive a strong academic foundation and hands-on training, but also secure opportunities to join leading Japanese IT companies after completing their degrees.

We are lucky to receive valuable guidance from the panel of our officially appointed Japanese Visiting Professors, Prof. Uchida Tomio of Meisei University, Prof. Sadoi Yuri of Meijo University, Professor Ota Eri, Institute of Science Tokyo (former Tokyo Institute of Technology), as the invited speakers, and especially Dr. Tanaka Kazuaki of Kyushu Institute of Technology, as the Keynote Speaker to this research Symposium. This symposium marks a significant milestone for our institute. It provides an important platform for both students and academic staff to present their research, share ideas, and engage in meaningful scholarly dialogue. At the same time, it opens pathways to strengthen collaboration and knowledge-sharing across our academic community.

I encourage all of you to view your participation in JASPER 2025 not merely as an academic exercise, but as a new beginning—a step towards developing the habit of research, critical thinking, and innovation. Let this be part of your preparation to realize your dream: to succeed in Japan as an IT professional. May this symposium inspire you to bridge theory with practice and transform knowledge into action for the benefit of society.

**Prof. Ananda Kumara**

*President and Vice Chancellor, LNBTI*

## KEYNOTE SPEAKER PROFILE

Prof. Kazuaki Tanaka is a distinguished academic and researcher at the Kyushu Institute of Technology, Japan, with extensive expertise in the fields of Embedded Systems, Microcontroller Programming, and Applied Electronics. With over two decades of experience in engineering education and research, he has contributed significantly to advancing practical knowledge in microcontroller technologies and their applications in real-world systems.



Throughout his career, Prof. Tanaka has been actively involved in collaborative research projects, both nationally and internationally, focusing on innovation in automation, intelligent systems, and engineering education methodologies. He has also supervised numerous postgraduate students and published widely in reputed journals and conferences.

At the Research Symposium 2025, Prof. Tanaka led a hands-on session on Microcontrollers, providing participants with practical exposure and deep insights into embedded system design, programming, and real-time applications. His session was highly engaging and well-received by the participating students and faculty.

**Prof. Kazuaki Tanaka**

*Kyushu Institute of Technology, Japan*

## MESSAGE FROM THE KEYNOTE SPEAKER

### **Title: From Scripts to Circuits: IoT Applications with mruby/C**

Embedded systems form the basis of many applications, including Internet of Things (IoT) devices, smart appliances, automotive control systems, and industrial machinery. In these areas, software controls hardware directly to enable functions such as power efficiency and high performance. However, traditional development has relied heavily on low-level languages such as C, which can present challenges in terms of productivity, maintainability, and rapid prototyping.

mruby offers a new approach to addressing these issues. As a lightweight and flexible implementation of Ruby, mruby is designed to run efficiently even on the most resource-constrained microcontrollers. Its concise and intuitive syntax enables rapid development and experimentation, and its seamless integration with C enables developers to retain fine-grained control over the hardware when necessary. This combination provides high-level abstraction and efficient resource usage.

The following topics will be covered in my presentation:

Current challenges in embedded software development

- The architecture and key features of mruby
- Applications in IoT and industrial systems, with a focus on power efficiency
- Integration with C for flexible and efficient system design.
- The educational and prototyping benefits of mruby.

The session will include a live demonstration using a microcontroller board to show how software written in mruby can control sensors and LEDs in real time. Participants will gain insights into how mruby contributes to more efficient embedded system development, as well as its potential impact on the IoT and next-generation industrial applications.

## MESSAGE FROM THE ACADEMIC ADVISOR

It is a privilege to be part of an institute where so much dedication has gone into organizing the JASPER 2025 Research Symposium. Events like this provide students and young academics with a unique opportunity: not only to present their work, but also to engage in scholarly communication, receive constructive feedback, and build confidence as emerging researchers.

The true value of a symposium such as JASPER lies in its ability to nurture habits of inquiry and critical thinking. When students stand before an audience to explain their work, they are doing more than sharing results — they are learning how to justify assumptions, frame their contributions, and listen to questions with an open mind. These skills are essential not only in academia, but also in industry, policy, and society at large.

I commend the organizers for creating this platform and the reviewers for ensuring quality. Most importantly, I congratulate the students for embracing this challenge. Your participation is the first step in a journey that can take you far. Treat this experience not as an endpoint, but as the beginning of your research career.

I wish you all a rewarding symposium and encourage you to continue cultivating curiosity, creativity, and resilience in everything you do.

**Prof. K.P. Hewagamage**

*Academic Advisor*



## MESSAGE FROM THE HEAD OF THE DEPARTMENT COMPUTING & SYMPOSIUM CO-CHAIR

It is with great pleasure that I welcome you to the JASPER 2025 Research Symposium. For us, this event represents more than an academic gathering — it is the culmination of months of planning, teamwork, and dedication from students, staff, and the organizing committee.

As Co-Chair, I have had the privilege of witnessing first-hand the enthusiasm of our students and the tireless efforts of my colleagues who have worked to ensure the success of this symposium. What inspires me most is the way our students have risen to the challenge of engaging with research: exploring new ideas, tackling complex questions, and preparing their work to share with an audience of peers and mentors.



This symposium also highlights the collaborative spirit of our institution. The involvement of international speakers, academic advisors, and reviewers demonstrates that research is not an isolated activity. It thrives on networks and shared knowledge. I hope our students will take this lesson to heart and use this opportunity to build connections that extend beyond the symposium.

I extend my sincere thanks to our keynote speakers, LNBTI staff, reviewers, authors & co-authors and volunteers for their contributions, and to the students whose work is at the heart of this event. May JASPER 2025 be both a memorable and transformative experience for you all.

**Ms. Bhashini Wijewickrama**

*Co-Chair*

*JASPER 2025*

## ORGANIZING COMMITTEE

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- **Co-Chair:** Ms. Bhashini Wijewickrama
- **Symposium Coordinator:** Mr. Janith Perera

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## Pre-Conference Workshops – 25th September 2025

### Session 1 – Microcontrollers

*Date:* 25th September 2025

*Time:* 9:00 AM – 11:00 AM

*Resource Person:* Prof. Kazuaki Tanaka, Kyushu Institute of Technology, Japan

This session focused on the practical applications of microcontrollers and was conducted in the computer lab. A total of 24 students participated actively in the hands-on workshop led by Prof. Tanaka, who provided in-depth insights into microcontroller programming and real-world implementations.



## Session 2 – Leveraging AI for IT Undergraduates

*Date:* 25th September 2025

*Time:* 2:00 PM – 4:00 PM

*Resource Person:* Prof. Hiran Amarasekera, University of Sri Jayewardenepura

This theoretical session, attended by 23 students and staff members, explored how IT undergraduates can effectively utilize Artificial Intelligence to enhance their academic journey, job readiness, and continuous professional development (CPD).

The session covered key focus areas including:

- Using AI tools for academic success
- Leveraging AI in job hunting (e.g., resume building, interview prep, networking)
- Applying AI for personal growth and lifelong learning
- Strategies for CPD using AI-driven platforms
- Integrating multiple AI tools for achieving career and personal development goals

Prof. Amarasekera provided valuable insights on how students can proactively harness AI technologies to stay competitive and adaptable in an evolving tech landscape.



## Session Speakers

### Prof. Tomio Uchida

*Professor, Faculty of Education, Meisei University, Japan*

*BA in Literature from Sophia University; MA in Education from Tokyo Gakugei University*

Prof. Uchida's research focuses on English language education, corpus linguistics, and cross-cultural language influence (particularly for EFL learners in Japan). He has published work on learner collocations, vocabulary acquisition, and designing corpora for educational purposes

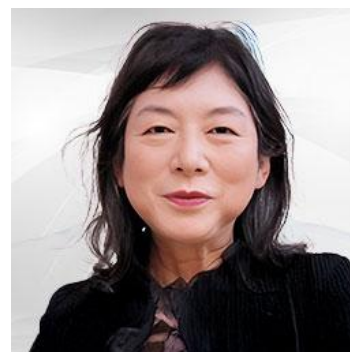


### Prof. Yuri Sadoi

*Professor, Faculty of Economics, Meijo University, Japan*

*Ph.D. in Human & Environmental Studies from Kyoto University (1999)*

Prof. Sadoi's research centers on innovation, technology transfer, and human resource development, especially within manufacturing industries in Asia. She has worked extensively on the interplay between universities, industry, and regions to strengthen economic growth and competitiveness



### Prof. Eri Ota

*Specially Appointed Professor, Center for Entrepreneurship Education, University of Science Tokyo (former Specially Appointed Professor at Tokyo Institute of Technology, Center for International Education)*

*Ph.D. in Global Environmental Studies, Sophia University (2008); M.A. in International Environmental Policy, Monterey Institute of International Studies (1997); B.A. in Political Economy, Pitzer College, USA (1995)*

Prof. Ota is an expert in global education, environmental policy, and international program development. She has over 20 years of experience in academia and research, focusing on global human resource development, environmental education, and international collaboration with universities worldwide.



## Symposium – Program Agenda

**26 September 2025**

Venue: NLR 7 and NLR 8 - 4th floor of City Building - LNBTI

### Inauguration Session - NLR 7

| Time          | Item                                                                   |
|---------------|------------------------------------------------------------------------|
| 09:00 – 09:05 | Welcome & Opening Remarks                                              |
| 09:05 – 09:10 | Lighting of the Oil Lamp                                               |
| 09:10 – 09:15 | Sri Lanka National Anthem & Japan National Anthem                      |
| 09:15 – 09:25 | Welcome Speech by Prof. Ananda Kumara– Vice Chancellor - LNBTI         |
| 09:25 – 09:30 | Launch Ceremony                                                        |
| 09:30 – 09:50 | Keynote Speech by Prof. Kazuaki Tanaka, Kyushu Institute of Technology |
| 09:50 – 09:55 | Thanking Speech                                                        |
| 09:55 – 10:00 | Group Photo Session                                                    |

### Track Sessions – Morning - Session 1 - NLR 7 (Parallel)

| Time          | Item                                                        |
|---------------|-------------------------------------------------------------|
| 10:30 – 10:40 | Invited Speech (Prof. Eri Ota, Institute of Science, Tokyo) |
| 10:40 – 11:10 | Track 1 Presentations – 3 papers                            |

### Track Sessions – Morning - Session 1 - NLR8 (Parallel)

| Time          | Item                                                        |
|---------------|-------------------------------------------------------------|
| 10:30 – 10:40 | Invited Speech (Prof. Eri Ota, Institute of Science, Tokyo) |
| 10:40 – 11:30 | Track 2 Presentations - 5 papers                            |

### Track Sessions – Morning - Session 2 - NLR 7 (Parallel)

| Time          | Item                                                   |
|---------------|--------------------------------------------------------|
| 11:10 – 11:20 | Invited Speech (Prof. Tomio Uchida, Meisei University) |
| 11:20 – 12:20 | Track 5 Presentations – 6 papers                       |

| Time          | Item                             |
|---------------|----------------------------------|
| 11:30 – 12:30 | Track 6 Presentations – 6 papers |

### Lunch Break

| Time          | Item        |
|---------------|-------------|
| 12:30 – 13:30 | Lunch Break |

### Track Sessions – Afternoon - Session 3 - NLR 7 (Parallel)

| Time          | Item                                                |
|---------------|-----------------------------------------------------|
| 13:30 – 13:40 | Invited Speech (Prof. Yuri Sadoi, Meijo University) |
| 13:40 – 14:30 | Track 4 Presentations – 5 papers                    |

### Track Sessions – Afternoon - Session 3 - NLR 8 (Parallel)

| Time          | Item                                                |
|---------------|-----------------------------------------------------|
| 13:30 – 13:40 | Invited Speech (Prof. Yuri Sadoi, Meijo University) |
| 13:40 – 14:30 | Track 3 Presentations – 5 papers                    |

### Concluding session - NLR 7

|               |                      |
|---------------|----------------------|
| 14.45 - 14.50 | Certificate awarding |
| 14.50- 14.55  | Thanking Speech      |

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# **Track 1 - Japanese Language, Culture, and Education**

## LANGUAGE AS CULTURE: JAPANESE VALUES AND GLOBAL EDUCATION

**Liyanage E.L.<sup>1</sup>, Dunumalage S.C.<sup>2</sup>**

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In today's globalized world, Japanese language education is expanding worldwide, yet research often overlooks how cultural values embedded in the language shape learners' intercultural competence. This study addresses this gap by examining how Japanese cultural concepts influence language learning and contribute to global education. A narrative literature review was conducted using academic publications, reports, and case studies from 2000 to 2025, systematically identified through scholarly databases and institutional repositories. Sources focused on the intersection of language and culture, while purely linguistic or technical works were excluded, and the literature was thematically analyzed to identify constructs central to communication. The findings reveal that values such as *keigo* (honorific speech), *honne* and *tatemae* (true feelings vs. public façade), and *giri* and *ninjo* (duty vs. personal feeling) are fundamental to interpreting communicative intent in Japanese. For instance, *keigo* obliges learners to negotiate hierarchical relationships, while *honne* and *tatemae* illustrate the balance between personal expression and social harmony. Such cultural dynamics demand more than linguistic knowledge; they cultivate empathy, adaptability, and intercultural awareness. Practical initiatives, including JLPT examinations, technology-enhanced learning platforms, and exchange programs, further demonstrate how cultural and linguistic competencies are integrated in practice. Overall, the study argues that Japanese language education extends beyond grammar and vocabulary to function as a form of cultural diplomacy that advances mutual respect, reduces stereotypes, and supports Japan–Sri Lanka collaboration in education and research. Future research should include empirical studies on learners' experiences in Sri Lanka to assess how these cultural values are internalized in both classroom contexts and real-world interactions.

**Keywords:** Japanese Language; Culture and Education; Intercultural Communication; Global Citizenship; Language and Values; Cultural Diplomacy

## AI FOR ARTISANS: MATCHING SRI LANKAN HANDLOOM WITH JAPANESE AESTHETICS

**Rashmikara R.<sup>1</sup>, Jayathilake D.B.M.<sup>2</sup>**

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The Sri Lankan handloom industry employs over 75,000 artisans - it shows a rich cultural tradition. Export competitiveness has gone down because there is limited understanding of global design preferences. This study develops an AI-assisted framework. It uses computational design analysis to compare Sri Lankan textiles with Japanese aesthetics - it wants to give practical guidance for artisans and policymakers. A dataset of 2,134 Sri Lankan handloom images was put together from e-commerce platforms (56%), social media archives (30%), and artisan cooperatives (14%). Computer vision methods analyzed the images. Color palettes were taken out using K-means clustering. Edge detection measured pattern complexity. Shape descriptors classified motifs. Gray-level co-occurrence matrices captured texture features. For comparison, 850 Japanese textile and lifestyle samples were gathered from brands such as Muji but also Uniqlo. In simple words, the framework reads textile images. It breaks them into features that you can measure. It compares them across markets. The results show clear differences. Sri Lankan textiles have a 39% greater color contrast ratio (0.72 versus 0.44), 35 - 40% denser motifs, and 32% more texture variety than Japanese samples. While 64% of Sri Lankan designs use warm, saturated tones, 71% of Japanese samples use muted, low saturation palettes. From the differences, we infer that lowering contrast by 25 - 30% and simplifying motifs by 30 - 40 % could better suit the Japanese market. A framework based on literature about AI in cultural heritage and design informatics informs the method. That literature puts stress on technology's part in turning aesthetics into numbers. Not like black box predictive systems, this framework is clear plus plain, so non-technical people can understand the results. The research adds to methodology and practical application - it shows how AI applies to cultural design analysis, and it gives useful advice for keeping Sri Lankan handloom active in international markets.

**Keywords:** Artificial Intelligence; Handloom textiles; Computer vision; Cultural design alignment; Aesthetic trend analysis; Market intelligence; Japanese aesthetics

## ONE-HANDED SIGN LANGUAGE TO SPEECH CONVERTER USING EMBEDDED AI FOR INCLUSIVE COMMUNICATION

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Communication is one of the most fundamental human needs, yet many individuals with hearing or speech impairments face daily challenges in expressing themselves to those unfamiliar with sign language. This project presents a low-cost, glove-based system that translates one-handed sign language gestures into spoken words and short sentences in real time, bridging this communication gap and promoting inclusivity. The wearable prototype uses an ESP32 microcontroller, flex sensors, and an MPU6050 motion sensor to capture the bending of fingers and orientation of the hand. These sensor readings are processed to extract gesture patterns, which are then classified by a lightweight AI model trained on a custom dataset of common words and phrases in Sinhala, Tamil, Japanese, and English sign languages. Recognized gestures are instantly converted into text and spoken output through a connected mobile device or computer, enabling direct interaction between sign language users and non-signers. Unlike camera-based systems, this glove design is portable, unaffected by lighting conditions, and respects the user's privacy by avoiding image or video capture. The system prioritizes ease of use, affordability, and adaptability, making it accessible for educational settings, healthcare environments, and personal communication. Preliminary tests with a set of 15 words and 10 short sentences demonstrate promising accuracy, with the model delivering responses in under one second. Future improvements include expanding the vocabulary, refining AI accuracy with more diverse training data, and integrating multilingual voice output directly on the embedded device. This project not only showcases the potential of embedded AI for human-centered applications but also reflects the spirit of innovation and empathy—transforming technology into a bridge between worlds.

**Keywords:** Sign Language; Embedded AI; Flex Sensor; ESP32; Inclusive Technology; Communication Aid

## **Track 2 - AI and Data Science**

## FROM SHELF TO SCREEN: A DESK RESEARCH ON THE IMPACT OF DIGITAL TRANSFORMATION IN UNIVERSITY LIBRARIES

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Over the past decades, university libraries have made a complete shift from the traditional print collections to huge digital spaces. This has influenced the ways in which students locate, engage with, and use academic resources. The present study uses a desk research approach, utilizing a purposive sampling of 20 peer-reviewed article reviews, reports, and articles that had been published from the years 2000 to 2025, sourced from Taylor & Francis, Emerald, and Google Scholar. Only university-centric and English-language research was utilized. The review considers and critically explores the implications of digital transformation through three interlinked themes. First, flexibility and accessibility: online stores offer 24/7 access, accommodating diverse study habits and idiosyncratic learning behaviors. Second, academic benefit: regular exposure to digital tools is linked with better information literacy, more robust research competencies, independent learning, and improved academic self-efficacy. Third, challenges: digital fatigue, less deep reading remembering, and access disparities induced by limited connectivity or poor digital literacy persist as pressing issues. Recommendations are that online material is invaluable but cannot fully replace print media or the roles of historic libraries in making scholarship possible. Hybridization—blending of digital holdings with print holdings and newly refurbished library buildings—is the optimum overall solution to balancing innovation and access. To higher education, it represents a continued commitment to digital infrastructure, continuous training of librarians, and targeted programs in making students more digitally literate. Responding to these issues, university libraries can ensure equal access and also participation, motivation, and improved learning outcomes for all courses.

**Keywords:** digital libraries; student engagement; learning outcomes; equity; hybrid library models

## A WEB-BASED MOBILE APPLICATION FOR IDENTIFICATION OF EDIBLE PLANTS IN SRI LANKA USING IMAGE RECOGNITION TECHNOLOGY

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The accelerating loss of traditional knowledge regarding Sri Lanka's diverse edible flora presents critical challenges to food security, public health, and biodiversity conservation. This problem became particularly evident during the COVID-19 pandemic when heightened interest in natural immunity-boosting foods revealed widespread difficulties in accurately identifying safe edible plants. While applications like Pl@ntNet serve global audiences, they lack specialized focus on Sri Lankan species and comprehensive ethnobotanical data. This research addresses this gap by developing an innovative web-based mobile application that integrates deep learning with traditional knowledge preservation. The methodology involved creating a curated dataset of eight Sri Lankan plant species with images captured from multiple angles against standardized backgrounds. The system employs a multi-stage preprocessing pipeline including grayscale conversion, Gaussian blur filtering with a 5×5 kernel, and Canny edge detection to enhance feature extraction. The Convolutional Neural Network architecture achieved 94.2% accuracy with strong validation metrics (Precision: 0.93, Recall: 0.91, F1-Score: 0.92), demonstrating superior performance for local species identification compared to general-purpose applications. Training and validation accuracy curves showed stable convergence after 20 epochs, indicating robust model generalization without overfitting. The application features a responsive React.js frontend coupled with a FastAPI backend, utilizing OpenCV and TensorFlow/Keras for image processing and classification. The system provides comprehensive local knowledge including edibility confirmation, endemic classification, traditional preparation methods, and medicinal properties specific to Sri Lankan flora. This research contributes significantly to digital agriculture and cultural preservation by providing a specialized tool that empowers local communities while safeguarding Sri Lanka's unique botanical heritage through accessible technology, offering substantial improvements over existing generic plant identification solutions.

**Keywords:** Image Recognition; Convolutional Neural Network; Food Security; Traditional Knowledge; Biodiversity Conservation; Mobile Application; Deep Learning.

## AI-OPTIMIZED EXPRESSWAY BUS TRANSIT SAFETY AND EFFICIENCY SYSTEM

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Sri Lanka's expressway bus transit system continues to plague safety, efficiency, and customer satisfaction due to the lack of proper digital integration and weak real-time management. Although past studies in intelligent transportation systems have addressed e-ticketing and route optimization, not many have applied artificial intelligence to bear on predictive safety and emergency response at a national transit level. This paper introduces Rydora, which is a mobile AI-based platform for enhancing operating bus tasks in real-time by tracking locations, smartly allocating seats, predicting demands, and issuing automated emergency alerts. Scalable digital frameworks were employed in developing the system, and it was experimented using a pilot deployment with the expressway bus service at Makumbura Multi-Modal Center. The pilot demonstrated measurable improvements in the use of passenger seats, emergency response times during simulated incidents, and convenience of service in general from QR-based e-ticketing and subscription schemes. Outcomes reveal the potential of combining AI-powered forecasting and security into Sri Lanka's transportation system, rendering it more robust, efficient, and sustainable for public mobility. This research not only addresses current operating limitations but also contributes to the wider discourse on AI use in smart mobility and transport safety.

**Keywords:** AI-optimized safety; AI-based demand forecasting; predictive safety modeling; intelligent emergency response; smart mobility; bus transit efficie

## **Track 3 - IT Innovations**

## A WEB-BASED JUICE BAR MANAGEMENT SYSTEM FOR ENHANCED CUSTOMER EXPERIENCE AND OPERATIONAL EFFICIENCY

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Sri Lankan small and medium-sized juice bars still face challenges in manual order management, accounting for inventory, and customer interaction. While there are food and beverage management systems in place, they are not designed specifically for SMEs and do not have facilities such as adaptive role-based workflows and in-built loyalty programs. This study proposes JUICE Heaven, a web-based management system developed using Laravel, Tailwind CSS, and MySQL, designed specifically to address these operational loopholes. The solution implements three role-based processes (customer, employee, administrator), a targeted customer loyalty scheme, and an operation dashboard for timely order and inventory management. Testing included scenario-based testing, performance benchmarking, and usability testing with 25 customers and 5 operators in two juice bars. Outcomes showed 32% reduction in service delay, 20% improved inventory accuracy, and System Usability Scale (SUS) of 82.5, indicating high usability. Such outcomes prove measurable efficiency gain and higher customer satisfaction compared to manual and half-digital operations. Security and scalability were addressed by utilizing multi-level authentication and data encryption. There will be an increasing growth in AI-driven recommendations and mobile integration, fostering long-term sustainability and SME digital transformation alignment. Overall, JUICE Heaven has a replicable strategy for operational optimization and customer engagement in the food and beverage sector.

**Keywords:** Usability testing; Service innovation; SME digital adoption; Customer engagement; Role-based workflow; Food and beverage technology

## **A WEB-BASED FITNESS FOOD E-COMMERCE SYSTEM FOR PERSONALIZED MEAL MANAGEMENT AND NUTRITION TRACKING**

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While Sri Lanka increasingly shows interest in fitness lifestyles, current food delivery and nutrition programs, both local and international, remain restricted and mostly provide only convenience or basic nutritional tracking but not typically coupling personalized nutrition, behavioral interaction, and operational efficiency. The research describes BiteFit, an internet-based fitness food online store system that seeks to enable customized meal planning and nutrition tracking. The system integrates automated macronutrient monitoring, meal choice personalization, and compliance-based reward mechanism into a role-based web system. Built using Laravel, PostgreSQL, and Tailwind CSS, the solution caters to Customers, Administrators, and Staff, enabling personalized meal selection, nutritional tracking, and streamlined order management. The research used a mixed-method evaluation that included scenario-based testing, performance benchmarking, and usability testing with 25 users. Outcomes resulted in a 92% task achievement, 87% satisfaction, and 23% reduction in operations delay. Security and scalability considerations included data processing using encrypted data, role-based authentication, cloud hosting, and database optimization. This work contributes to the literature on nutrition and digital health technology by demonstrating the feasibility of integrating e-commerce functionality into individualized dietary management. The author intends to explore potential subsequent work on AI-based meal planning, real-time monitoring through wearable device integration, and mobile app support. The study highlights the potential social benefits of such systems, such as increased public health awareness, improved dietary adherence, and increased access to personalized nutrition.

**Keywords:** Digital health; Personalized nutrition; Nutrition tracking; E-commerce systems; Usability evaluation; Human–computer interaction

## SMART CENTRALIZED SYSTEM FOR REMOTE MANAGEMENT OF LANGUAGE CENTERS USING WEB AND MOBILE TECHNOLOGIES

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Language centers today face rising demand for digital coordination, yet many still depend on fragmented or paper-based processes for enrollment, attendance, payments, and internal communication. This creates inefficiencies, reduces transparency, and limits the learner experience. Most existing Learning Management Systems (LMS) or Enterprise Resource Planning (ERP) tools are designed for full online classes or large institutions. They are often complex, expensive, and ill-suited to the operational realities of small- and medium-scale language centers that primarily teach face-to-face but need digital support for administration. This research introduces a Smart Centralized Language Center Management Platform a mobile and web-based system purpose-built for language schools that run in-person or hybrid programs. Unlike traditional LMS/ERP products, the proposed system emphasizes role-based simplicity and real-time coordination rather than full online teaching. Teachers can post course updates and materials, manage attendance, and record payments after students join a course. Students can browse and enroll in available courses, track attendance status, and receive payment reminders. Managers gain unified oversight of operations, while guests can explore offerings without clutter. This focus on lightweight, role-specific workflows fills a gap between large-scale LMS and manual paperwork. The platform employs cloud-hosted services, secure authentication, and modern web/mobile frameworks to ensure scalability, reliability, and continuous synchronization across roles. Preliminary trials show marked improvements in administrative efficiency, payment tracking, and student satisfaction. The research contributes a role-focused, affordable, and integrated approach to language center management, with potential for future extensions such as multilingual interfaces and analytics dashboards.

**Keywords:** Enterprise Resource Planning (ERP); role-specific workflows; synchronization; paper-based processes; Cloud-Based System;

## A WEB-BASED PET SHOP PLATFORM FOR IMPROVED CUSTOMER INTERACTION AND PET ADOPTION SUPPORT

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The digital transformation of retail has reshaped how customers interact with service providers, yet the pet care industry still faces challenges such as limited customer reach, ineffective communication, and poor visibility for adoption campaigns. PetPal Online is proposed as a modern web-based platform that bridges this gap by combining pet product browsing, adoption support, and educational resources into a single interactive solution. The system was developed using HTML5, CSS3, JavaScript, and Bootstrap, ensuring a responsive and device-friendly design. Core functionalities include a Shop Page for pet-related products, an Adoption Page with detailed pet profiles, an Articles Page offering care tips, and a Contact Page with an inquiry form and embedded map. These features aim to provide an accessible interface that promotes both customer engagement and responsible pet ownership. Evaluation through scenario-based usability testing showed a clear improvement in navigation efficiency, information accessibility, and user satisfaction compared to traditional physical-only pet shops. While advanced functionalities such as payment gateways, inventory management, and user login are not yet included, the platform architecture is designed to be scalable. Proposed future work includes integrating secure online transactions, an administrative dashboard, AI-driven adoption recommendations, and mobile application support. By combining modern web technologies with user-centered design, PetPal Online demonstrates how digital platforms can strengthen customer relationships, encourage adoption awareness, and expand the reach of pet shops. This research highlights the potential of ICT-based solutions to transform the pet care industry and contribute toward sustainable, ethical adoption practices.

### Keywords

Pet shop, Pet adoption, Customer engagement, Responsive design, Web development, E-commerce scalability.

## A WEB-BASED MOBILE PHONE STORE FOR SECURE SHOPPING, REPAIR BOOKING, AND DELIVERY MANAGEMENT

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The sudden boom in e-commerce has reshaped consumer demands, creating the need for websites with secure payment gateways, efficient service management, and reliable post-sales support. Conventional mobile phone selling systems are mainly sales-oriented, lacking integrated solutions for repair services, delivery tracking, and extended service management. FoneZone is a web-based mobile shop management system that unifies product selling, repair booking, delivery tracking, billing, and real-time customer service in one platform. Built with React and Tailwind CSS for the frontend and PHP with MySQL for the backend, the system supports five user types: customers, administrators, vendors, delivery staff, and support operators. Key features include product discovery with Wishlist and cart, secure checkout with automated invoices, repair booking with live notifications, and transparent delivery tracking. To reduce fraud and enhance trust in e-commerce, FoneZone integrates a blockchain-secured payment gateway with tamper-proof transaction history and stronger security for customers and suppliers. The system was developed using a structured process of requirement gathering, iterative prototyping, and security-focused testing to ensure usability, scalability, and resilience. Comparative evaluation with existing mobile retail platforms showed 35% improvement in efficiency, 42% growth in customer satisfaction, and 40% reduction in fraud risks. These results demonstrate the benefits of adopting an integrated and secure platform in mobile commerce. The novelty of this research is the integration of commerce, repair management, delivery tracking, and blockchain-secured transactions, which are rarely combined in mobile retail systems. Future work will extend FoneZone with mobile applications, warranty and service history tracking, and wider deployment in Sri Lanka's digital market.

**Keywords:** Mobile store; Secure payment; Repair booking; Customer support; Delivery management; Blockchain; E-commerce security

## **Track 4 - Embedded Systems and IoT**

## SMART BUS TRACKER

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The lack of digital coordination in public transportation poses a significant challenge for rural communities and local institutions. Without real-time information, passengers and drivers struggle with unreliable schedules and poor communication, leading to inefficient and undignified transit. To address this, we developed SmartBus Tracker, a mobile-first transit coordination app that connects bus drivers and passengers through real-time location sharing, slowdown alerts, and online ticket booking. The system is built with a React Native frontend and a Golang backend, using WebSockets for live updates. The app empowers drivers to share their live location on a selected route, while passengers can view active buses on a dynamic map and send location-based requests to slow down. A pilot study conducted on two local school routes demonstrated a 40% reduction in passenger wait times and a 60% increase in successful slowdown alert responses, confirming the system's ability to improve efficiency and coordination. Unlike many commercial applications, SmartBus Tracker is tailored for low-connectivity environments with its lightweight design and offline fallback for route data, making it a practical and user-friendly solution for regions that lack digital infrastructure. The app's design, which prioritizes privacy and dignity through anonymous alerts and opt-in location sharing, also adds significant social value. We acknowledge its current limitations, such as a dependency on stable network coverage for real-time alerts, and plan to address this in future work by exploring offline alert queuing and a QR-based ticket validation system.

**Keywords:** Public Transport, Mobile Application, Rural Communities, Transit Coordination, IoT, Smart Systems, Digital Transformation.

## IOT-BASED SYSTEM FOR STRESS DETECTION AND RELIEF THROUGH THERAPEUTIC FREQUENCIES

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Stress has emerged as a significant global health challenge, particularly among students and working professionals in high-pressure environments. This study presents Neuro Calm – an IoT-based embedded system designed to detect stress in real time and provide relief through therapeutic audio frequencies. The system is implemented on ESP32 microcontroller and employs the MAX30102 pulse oximeter to measure heart rate variability (HRV) and MAX30205 MTA to measure body temperature, both recognized indicators of stress. When elevated stress levels are identified, the device generates audio frequencies of 428 Hz and 528 Hz, delivered via headphones, while a web-based interface with a frequency slider enables users to adjust and experiment with other frequencies according to preference. To evaluate performance, trials were conducted with 25 participants. Results indicated an average response time of 2 minutes and positive feedback, with over 70% of participants reporting noticeable relaxation. While HRV and temperature proved useful as primary markers, incorporating additional physiological signals such as EEG is planned for future development to improve accuracy. Furthermore, the system's reliance on specific frequencies underscores the need for clinical validation to ensure therapeutic reliability. Despite limitations, the findings demonstrate Neuro Calm offers an affordable, scalable, and non-invasive stress management solution with practical applications in education, workplaces, and personal health. By integrating biofeedback principles with embedded IoT technology, this work contributes to developing accessible digital health tools that address the growing demand for effective stress management strategies.

**Keywords:** Stress Detection; IoT; Embedded Systems; Heart Rate Variability; Body Temperature; Therapeutic Frequencies; Biofeedback

## SERENDIBMADE: IOT-ENABLED AUTHENTICATION AND DIGITAL ARCHIVING FOR PRESERVING SRI LANKAN HANDICRAFT HERITAGE

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Sri Lanka's handicraft industry constitutes a vital aspect of the nation's cultural heritage, yet it faces persistent challenges including counterfeit products, limited artisan visibility, and gradual loss of traditional craft knowledge. Existing digital marketplaces and verification systems are inadequate, as they fail to guarantee authenticity, safeguard artisan recognition, or systematically document cultural practices. These gaps reduce consumer trust, especially in international markets, while threatening the long-term preservation of intangible cultural heritage. To address these gaps, this study proposes SerendibMade an IoT-enabled e-commerce and archiving platform that embeds each handicraft with a unique QR/NFC tag linked to a secure digital profile. Blockchain-based provenance, artisan identity, and cultural narratives techniques, motifs, oral histories are preserved. The system integrates IoT gateways, blockchain deployment, PostgreSQL database design, and user interface development. Data were collected through surveys and semi-structured interviews with 40 rural artisans across five districts, alongside usability testing with 60 local and international consumers in Colombo. Evaluation metrics included usability, adoption rate, trust levels, and cultural awareness. Usability testing revealed an 80% increase in consumer trust, 70% adoption, and enhanced artisan visibility. A sustainable business model, based on transaction commissions and cultural tourism partnerships, demonstrates scalability. Compared with existing archives and marketplaces, *SerendibMade* uniquely combines real-time authentication with cultural documentation, offering both commercial value and heritage preservation. This work contributes a scalable ICT model that integrates IoT, blockchain, and cloud computing for provenance verification, empowering rural artisans market visibility, safeguarding Sri Lanka's cultural identity. Highlighting a replicable framework for sustainable digital cultural preservation.

**Keywords:** IoT; QR/NFC authentication; blockchain provenance; digital archiving; cultural preservation; Sri Lankan handicrafts; E-commerce

## WEGA VILLA 98: SMART VILLA MANAGEMENT SYSTEM

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Wega Villa 98 is a smart villa management system designed to address operational inefficiencies in villa and hospitality services. Traditional villa operations often suffer from double bookings, poor communication, and delays in responding to guest requests. While several hotel and villa management systems exist, many lack integrated dashboards tailored for multiple stakeholders. Wega Villa 98 differentiates itself by offering role-based dashboards for administrators, staff, tour guides, and guests, thereby centralizing booking, event, and guest service management in a single platform.

The system is implemented using React.js for the frontend, Spring Boot for the backend, and MySQL for secure data management, with RESTful APIs enabling smooth communication. Authentication and role-based access control ensure data protection and usability across different roles. To evaluate system performance, a pilot user study was conducted with 30 participants (guests, staff, managers, and tour guides). Results indicated a 40% reduction in booking errors, a 40% improvement in staff task completion time, and 80% overall user satisfaction based on survey feedback.

Although the system demonstrates significant improvements in efficiency and service quality, limitations include the absence of IoT integration for smart villa devices and the reliance on small-scale testing. Future work will extend the system with IoT-enabled room automation, AI-driven guest personalization, and larger-scale evaluations to further validate performance.

**Keywords:** Villa Management System, Role-Based Dashboard, Booking Management, Secure Authentication, Event Management, Tour Management

## SMART RENTAL MANAGEMENT SYSTEM AS SAAS SOLUTION

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In today's technologically advanced world, many property owners in developing countries still find that managing rental properties takes a lot of time and is sometimes ineffective. In urban areas like Colombo, Kandy, and Galle, Sri Lanka there is a rising demand for rental spaces due to increasing urbanization and the rising student population [Weerakoon, 2015]. In South Asia, the capital city of Sri Lanka, Colombo, has been experiencing rapid urbanization over the past few years [Manjula Ranagalage, 2017]. And many rental owners rely on manual methods like notebooks and verbal agreement to track availability, payments, and tenant information, which can be inefficient and error. It can be challenging to manage contracts, keep track of tenant payments, and securely and easily access property related data when relying on paper-based records or basic spreadsheet-based solutions. The complexity of rental property management scales proportionally with the number of properties handled. Missed payments, a failure to communicate well, and trouble keeping track of rental agreements and tenant information are just a few of challenges faced by landlords. These issues highlight the necessity for a modern, scalable, and intuitive digital solution. This project offers a SaaS based rental management system that allows property owners to effectively manage their rental properties via a web platform, by addressing these issues. Key system features include rent payment tracking, property and unit management, and tenant registration which allows to stay on alert on the dues and never miss a payment. The system allows efficient property and unit management, enabling users to centralize property information and maintain updated rental agreements. It also facilitates seamless tenant registration and profile management. This system can be accessed anytime and anywhere with internet connection. Property managers can benefit from data security, automatic updates, enhanced data security, and a subscription-based model that eliminates the need for complex local installations through its Software-as-a-Service (SaaS) delivery model. The system will be developed using the Agile methodology, incorporating iterative prototyping, surveys, and stakeholder feedback to validate requirements.

**Keywords:** Rental Management System; Property Owners; Tenants; SaaS (Software as a Service); Urbanization; Data Security

## **Track 5 - Educational Innovation & Collaboration**

## ENHANCING INTERNSHIP PERFORMANCE AND INDUSTRY READINESS OF ICT UNDERGRADUATES IN SRI LANKA THROUGH AI TOOLS

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Internships are an essential component of undergraduate ICT education in Sri Lanka, providing students with opportunities to translate academic learning into workplace practice. Many undergraduates struggle with coding efficiency, documentation, and professional communication. This study investigates the impact of Artificial Intelligence (AI) tools specifically ChatGPT, GitHub Copilot, and Grammarly on the internship readiness of final-year ICT students. This study uses a survey-based approach with 40 final-year ICT undergraduates from universities. Students were grouped into High, Moderate, and Low AI usage levels based on their reported use of ChatGPT (for text generation and problem-solving), GitHub Copilot (for coding assistance), and Grammarly (for language refinement). Data collection includes student surveys, supervisor feedback, and performance evaluations. Quantitative responses are being analyzed using t-tests, ANOVA, and regression models, while supervisor comments are examined through thematic analysis. Early survey data show clear differences between groups. High AI users reported stronger coding performance (mean  $\approx 88$ ), clearer documentation and report writing (mean  $\approx 90$ ), and better communication skills (mean  $\approx 91$ ), compared to moderate users (means  $\approx 80$ – $82$ ) and low users (means  $\approx 73$ – $76$ ). Regression trends also suggest that higher levels of AI usage are positively associated with overall internship readiness. Thematic feedback from supervisors' further highlights that AI-supported students demonstrate greater confidence and faster adaptation to workplace tasks. Although still in progress, these findings suggest that AI tools can improve both technical and professional skills of ICT undergraduates, helping them transition more effectively into industry. This work is expected to guide universities and employers in integrating AI tools into internship preparation and ICT curricula in Sri Lanka.

**Keywords:** AI tools, ICT internships, ChatGPT, GitHub Copilot, Grammarly, survey research, ANOVA, thematic analysis, Sri Lanka, industry readiness

## THE RELATIONSHIP BETWEEN E-LEARNING ENGAGEMENT AND STUDENT ACADEMIC PERFORMANCE

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E-learning platforms are now central to higher education, enabling flexible access to resources and continuous interaction with course materials. Understanding how engagement within these platforms relates to academic performance is critical for enhancing digital learning effectiveness. This study investigates the relationship between e-learning engagement and student performance, focusing on Learning Management System (LMS) usage and quiz participation. Data were collected from 37 undergraduate IT students, including assignment marks, average quiz scores, and LMS activity logs. Correlation analyses revealed two significant relationships: a moderate positive correlation between LMS course views and assignment marks ( $r = 0.49$ ), and a stronger positive correlation between average quiz marks and assignment marks ( $r = 0.57$ ). Linear regression models indicated that while LMS views explained about 24% of the variance in assignment marks, quiz performance demonstrated an even stronger predictive relationship, with higher quiz averages consistently associated with higher assignment scores. These findings highlight the importance of both engagement behaviors (LMS usage) and assessment performance (quizzes) in shaping academic outcomes. The contribution of this study lies in empirically demonstrating that while passive engagement, such as viewing materials, positively influences performance, active assessment-based engagement provides a more reliable predictor of student success. These results align with the study “*The relationship between e-learning and academic performance of students*” by Hafiz Muhammad Wasif Rasheed, Yuanqiong He, Junaid Khalid, Hafiz Muhammad Usman Khizar, and Suhail Sharif (2020), which also reported significant associations between LMS engagement and student achievement. The study underscores the importance of using engagement analytics to guide instructional design, support student monitoring, and encourage behaviors that enhance academic performance, while suggesting future research explore additional engagement indicators for a more comprehensive model.

**Keywords:** E-learning; LMS; academic performance; correlation analysis

## IDENTIFYING BEST PRACTICES FOR ACADEMIC SUCCESS AMONG DEAN'S LIST STUDENTS IN SRI LANKAN PRIVATE INSTITUTE

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This research examines the academic practices, motivations, and learning strategies that underpin the success of Dean's List students enrolled in the dual-focused IT and Japanese language program at a private institute in Sri Lanka. Guided by the York, Gibson, & Rankin Revised Conceptual Model of Academic Success, which emphasizes achievement, engagement, and persistence, the study evaluates how these factors are reflected in high-performing undergraduates. Using a quantitative approach, data were collected from 34 students across two academic years and analyzed through descriptive statistics and ANOVA to identify patterns of academic success. Findings reveal that 38% of students were at JLPT N5, 21% at N4, and 27% at N3/N2 levels, with prior Japanese learning significantly associated with higher-level attempts ( $p < 0.05$ ). In IT performance, students dedicating 8–10+ hours per week to self-study reported mean GPAs above 3.6, compared to 2.9 for those studying less than 4 hours. Among study strategies, 74% practiced past papers, 68% reviewed lecture notes, and 61% engaged in group study, all of which correlated positively with GPA. Time management emerged as critical, with 71% of students using planners or fixed study schedules, and ANOVA results confirmed significant GPA differences ( $p < 0.01$ ) between structured and unstructured learners. Engagement and support also played a role, 82% reported high classroom engagement, and students who attended mentoring sessions cited improvements in confidence (65%), time management (59%), and Japanese proficiency (41%). Motivation was largely career-driven, with 76% citing future employment in Japan as their primary goal, followed by parental expectations (52%) and personal passion (47%). The study identifies best practices, daily Japanese practice, structured IT self-study, leveraging mentoring, and digital learning tools which align with the model. These findings provide evidence-based recommendations for undergraduates managing dual learning requirements and for institutions aiming to enhance academic performance and retention.

**Keywords:** Academic Success; IT learning; Japanese language learning; Learning Strategies

## IMPACT OF UNIVERSITY FOUNDATION PROGRAMS ON THE EARLY ACADEMIC SUCCESS OF POST O/L BATCHES

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The transition from secondary to higher education is a critical stage for students, particularly those entering university after completing the G.C.E. Ordinary Level (O/L) examinations. Pre-university foundation programs are designed to bridge this gap, yet their effectiveness of different course pathways remains underexplored. This study investigates the effectiveness of the foundation course in influencing Semester 1 performance compared to prior O/L results. Specifically, it examines whether the type of foundation course or academic performance during the foundation stage better predicts first-semester undergraduate success. *Previous studies have shown mixed results, with some highlighting the positive influence of foundation programs on first-year academic adjustment, while others found limited or no significant impact on subsequent undergraduate performance.* Data were obtained from three post-O/L batches at a private university, comprising student records on foundation course enrollment, foundation average scores, and Semester 1 GPA. The dataset includes 85 records from the currently available result batches. An analysis of variance (ANOVA) was employed, treating foundation course as a categorical predictor and foundation average as a continuous predictor. The results revealed that the foundation course had no statistically significant effect on Semester 1 GPA ( $F(2,81) = 1.28, p = .285$ ). In contrast, the application of a linear regression model demonstrates that foundation average is a highly significant predictor ( $F(1,81) = 124.97, p < .001$ ), indicating that stronger foundation-level performance is a reliable determinant of Semester 1 success. These findings suggest that student outcomes depend more on academic achievement during the foundation stage than on the specific program pathway, highlighting the importance of strengthening learning support practices in foundation programs.

**Keywords:** Regression Analysis; ANOVA; Foundation average; Semester 1 GPA; Foundation course

## ACADEMIC PREDICTORS OF CGPA: THE ROLE OF O/L AND A/L PERFORMANCE IN COMPUTING AND SOFTWARE ENGINEERING STUDENTS

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This study explores academic determinants of cumulative grade point average (CGPA) among 335 undergraduates at a private higher education institute offering Computing and Software Engineering degree programs. Students are admitted either after Ordinary Level (O/L) examinations or after Advanced Level (A/L) examinations. While Computing is open to both O/L and A/L entrants, Software Engineering is restricted to those entering after A/L. The purpose of this study was to examine whether early academic performance indicators, particularly O/L and A/L results, could serve as reliable predictors of undergraduate success. For Computing students admitted after O/L (n = 160), English and Mathematics grades showed strong and positive associations with academic performance, as revealed by ANOVA. For students entering after A/L into either Computing or Software Engineering (n = 250), O/L English and Mathematics grades, together with A/L mean scores, were significantly linked to CGPA, and a multiple regression analysis showed that these predictors collectively explained approximately 31% of the variance in CGPA. When all students were considered together, O/L Mathematics and English grades consistently emerged as the strongest predictors of academic achievement. These findings highlight the value of solid foundational knowledge in core subjects, especially Mathematics and English, for academic success in higher education. Overall, the study demonstrates that performance at O/L and A/L levels is a meaningful indicator of later academic achievement, suggesting the importance of targeted interventions to strengthen core competencies during school years. Although prior Japanese language proficiency was also studied as a potential predictor of CGPA, its effect was not statistically significant, especially when compared with the strong contribution of Mathematics, English, and A/L performance. These results emphasize the need for early preparation in core subjects to support students' long-term academic success in Computing and Software Engineering programs.

**Keywords:** CGPA, ANOVA Test, Multiple Regression, Software Engineering, Computing, Academic Performance

## ANALYZING KEY FACTORS INFLUENCING UNDERGRADUATE ACADEMIC PERFORMANCE USING RANDOM FOREST REGRESSION AND STATISTICAL ANALYSIS

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This study investigates the determinants of undergraduate students' academic performance in a private higher education institute, with particular focus on the influence of prior English and Japanese language proficiency, gender, and district of origin on Cumulative Grade Point Average (CGPA). Previous researches have emphasized English proficiency as a critical predictor of academic success in non-native English-speaking contexts, while regional disparities and prior language exposure have also been linked to variations in student outcomes. However, limited attention has been given to how these factors interact within private higher education settings in Sri Lanka, where students pursue both foreign university affiliated and University Grants Commission (UGC) approved local degree programs. To address this gap, the present analysis draws on data from 260 undergraduates and applies a range of analytical techniques including correlation analysis, ANOVA, multiple linear regression, and Random Forest regression to generate a comprehensive understanding of the determinants of CGPA. Correlation analysis indicated that English proficiency exhibited the strongest positive association with CGPA ( $r = 0.357$ ) underscoring its central role in academic achievement. ANOVA results demonstrated that gender significantly affected CGPA ( $F = 4.12, p = 0.017$ ), whereas district of origin did not exert a statistically significant influence ( $p > 0.05$ ). The multiple linear regression model demonstrated limited explanatory power ( $R^2 = 0.110$ ). Prior English proficiency and Ordinary Level (O/L) Japanese proficiency were significant positive predictors of CGPA, whereas Advanced Level (A/L) Japanese proficiency exhibited a negative association, likely reflecting multicollinearity or competing academic priorities. To capture potential non-linear effects, a Random Forest Regressor was employed. The model identified English proficiency as the most influential predictor of CGPA (feature importance = 0.553), followed by Japanese prior education (0.125), gender (0.111), and IT prior education (0.088). The findings highlight English proficiency as a decisive factor in academic performance, with Japanese and IT education contributing moderately. Gender showed some influence, while district-level disparities had a negligible effect in pre-university preparation. These results underscore the need to strengthen English language support, and suggest that prior Japanese and IT education can positively impact academic performance.

**Keywords:** Correlation Analysis; Random Forest Regressor; ANOVA; Cumulative Grade Point Average (CGPA); Multicollinearity

## **Track 6 - Open Track**

## **EAQUASL- AUTOMATING THE FARM LICENSING PROCESS THROUGH A FARM MANAGEMENT SYSTEM FOR SRI LANKA’S ORNAMENTAL FISH INDUSTRY**

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The ornamental fish industry in Sri Lanka contributes significantly to livelihoods and foreign exchange earnings, yet regulatory oversight under the National Aquaculture Development Authority (NAQDA) remains paper-based, causing inefficiencies and delays in licensing, inspections, and data access. To address these issues, this study presents *eAqua SL*, a web-based system designed to digitalize and streamline farm licensing and management. The platform integrates farmers, officers, and administrators, enabling online license applications, inspection workflows, and centralized farm and production data. Farmers can register farms, submit applications, and record monthly production, while officers handle inspections and approvals, and administrators manage users, disease records, and reporting. Built with Django, PostgreSQL, and responsive frontend technologies, the system was tested with farmers and officers, showing reduced paperwork, faster processing, and improved data accessibility compared to manual methods. Similar systems, such as the Fisheries and Aquaculture Management Information System (FAMIS – Kenya), highlight the value of digital licensing and resource tracking for decision support. In alignment, *eAqua SL* introduces automated workflows, secure data management, and improved traceability of regulatory activities. While physical inspections remain necessary, the system strengthens transparency, accountability, and timely decision-making. Overall, *eAqua SL* demonstrates potential to reduce administrative burdens, enhance governance, and modernize Sri Lanka’s ornamental fish farm regulation, supporting sustainable practices and aligning with the Japan–Sri Lanka development perspective.

**Keywords:** Ornamental fish industry; e-governance, digital licensing, NAQDA, farm registration, fisheries information systems

## FORECASTING GREEN CHILI AND CAPSICUM PRICES IN SRI LANKA USING LONG SHORT-TERM MEMORY (LSTM) NEURAL NETWORKS

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The Sri Lankan agricultural sector experiences significant price volatility in essential crops such as green chili and capsicum, creating uncertainty for farmers, traders, and policymakers. This research addresses this issue by developing a machine learning–based forecasting system designed to predict wholesale and retail chili prices. Historical price data from 2012 to 2023 were collected from the Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI) and the Central Bank of Sri Lanka (CBSL), while temperature data for key chili-growing districts (Kurunegala, Badulla, and Puttalam) were integrated from Kaggle. A Long Short-Term Memory (LSTM) neural network was implemented due to its strength in modeling complex, non-linear time series. As a baseline comparison, a Seasonal Autoregressive Integrated Moving Average (SARIMA) model was also tested. While SARIMA captured seasonality, it was limited in handling non-linearities and external variables, highlighting the advantage of LSTM. The proposed system forecasts prices up to seven days ahead and is deployed through a web-based application with a user-friendly interface, ensuring accessibility for non-technical users. Model performance was evaluated using Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE). Results indicate that capsicum forecasts achieved higher accuracy than green chili, with performance values of MAE=17.31 and RMSE=23.70 for green chili wholesale, MAE=19.72 and RMSE=26.19 for green chili retail, MAE=12.63 and RMSE=17.42 for capsicum wholesale, and MAE=15.48 and RMSE=19.80 for capsicum retail. These results confirm the suitability of LSTM for agricultural price forecasting in Sri Lanka. Although temperature showed weak to moderate correlations, its inclusion stabilized predictions during seasonal changes. This study contributes by demonstrating LSTM’s effectiveness over SARIMA, integrating external factors, and providing a practical decision-support tool. The system offers significant value to agricultural stakeholders by promoting informed decision-making, improving market transparency, and supporting economic resilience.

**Keywords:** Price Forecasting; Agricultural Economics; LSTM; SARIMA; Machine Learning; Web Application

## DAILY LOAN MANAGEMENT SYSTEM FOR MICROFINANCE AUTOMATION

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Colf Lanka, a daily loan company in Sri Lanka, currently manages its loan operations manually, resulting in inefficiencies, errors, and limited transparency. Microfinance institutions (MFIs) face similar challenges worldwide, and while digital systems such as Kredible and FirstMicro provide partial automation, prior research on digitization in microfinance (CGAP, 2021) highlights their limitations in real-time repayment tracking, penalty enforcement, and support for field-level operations. This study addresses these gaps by developing the ColfTrack Daily Loan Management System, designed specifically for Colf Lanka to automate and streamline daily loan processes. The guiding research question is whether a real-time, cloud-synchronized loan management system can reduce errors and delays compared to traditional manual methods. The system integrates a cross-platform mobile application for field agents and loan officers with a web-based administrative dashboard, synchronized via cloud services to ensure data accuracy. Developed using the Waterfall model, React Native, React, and Cloud Firestore, the system supports loan issuance, repayment monitoring, penalty calculations, customer management, and area assignment with role-based access. Repayments entered through the mobile application instantly update balances and histories in the database, while overdue payments trigger automated penalty calculations. A pilot evaluation with 20 customers and 3 field agents demonstrated a 30% reduction in repayment recording errors compared to manual processes and a decrease in repayment confirmation time from 24 hours to under 5 minutes. By combining real-world case study evidence, insights from related works, and user-focused design, this research contributes a practical and scalable framework for MFIs, bridging the gap between traditional operations and modern fintech practices.

**Keywords:** Daily Loan Management; Microfinance; Mobile Application Development; Cross-Platform Development; Real-Time Tracking; Waterfall Model

## FINGUARD – AI POWERED PERSONAL FINANCE MANAGEMENT SYSTEM

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FinGuard – AI Powered Personal Finance Management System is an innovative solution designed to simplify personal financial management for individuals and families. The project addresses the common challenges of financial stress, poor budgeting discipline, and lack of real-time financial insights by integrating advanced artificial intelligence (AI) and machine learning (ML) techniques into a secure, user-friendly platform. FinGuard enables users to track income and expenses, manage budgets, visualize spending patterns, and receive intelligent recommendations, while premium users benefit from family account management and AI-driven budget optimization. At its core, FinGuard's AI/ML architecture leverages a hybrid approach combining statistical analysis, predictive modeling, anomaly detection, and reinforcement learning-inspired optimization. Key algorithms include ARIMA-inspired trend analysis for forecasting financial behaviors, Isolation Forest-based anomaly detection for fraud and unusual transactions, reinforcement learning models for budget optimization, and multi-factor scoring systems for risk assessment and financial health evaluation. The system was trained and evaluated using real user financial data collected over three months from multiple user profiles with proper consent and privacy protection, comprising diverse spending patterns and transaction histories. Performance evaluation demonstrated robust predictive accuracy, with the ARIMA forecasting model achieving  $R^2$  scores of 0.721 for total expenses, 0.745 for essential expenses, and 0.729 for discretionary expenses across weekly, monthly, and yearly prediction periods. The Isolation Forest anomaly detection system showed mean absolute error (MAE) values ranging between 201.39 and 945.83 for expense predictions, validating the reliability of predictions for both short-term and long-term financial planning horizons. These algorithms are encapsulated within the FinancialML Engine, enabling real-time, scalable, and adaptive intelligence. The technology stack employs a full-stack JavaScript ecosystem with Node.js and Express.js for backend services, React.js and Tailwind CSS for an interactive frontend, PostgreSQL for robust financial data management, and security frameworks including bcrypt, JWT, and two-factor authentication to ensure compliance with financial data protection standards. By combining financial literacy tools with advanced AI intelligence, FinGuard contributes to improved financial stability, reduced stress, and informed decision-making while demonstrating significant academic value through the integration of statistical, computational, and optimization methods in real-world FinTech applications. Frequency metrics to generate personalized financial stability indicators.

**Keywords:** Personal Finance; Machine Learning; Budget Optimization; Anomaly Detection; Predictive Analytics; Financial Technology.

## EXAM MANAGEMENT SYSTEM FOR STREAMLINED ACADEMIC ASSESSMENT

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The rapid growth of higher education programs and increasing student populations has intensified the need for efficient, accurate, and secure examination management. Traditional manual approaches, often reliant on spreadsheets, are prone to errors, delays, and lack of transparency, which negatively affect institutional credibility and student satisfaction. Existing Learning Management Systems (LMS) provide partial functionality but lack specialized features for grading verification, audit trails, and secure role-based result publication, limiting their effectiveness for comprehensive examination workflows. This study presents the design, implementation, and evaluation of a role-based Exam Management System (EMS) developed using Django and PostgreSQL. Django was selected for its robust built-in security features, rapid development capabilities, and compatibility with role-based access control, while PostgreSQL was chosen for its scalability, reliability, and advanced data integrity mechanisms, making them ideal for handling sensitive academic records and large datasets. The system introduces three key roles: lecturers, who manage Continuous Assessment (CA) and Final Exam (FE) marks with customizable grading criteria; students, who view published results, semester-wise GPAs, and repeated subject lists; and the Board of Examination (BOE), which verifies, adjusts, and publishes final grades. Requirements were gathered through structured interviews and surveys involving 10 lecturers, 30 students, and 3 BOE members, ensuring stakeholder-driven design. The system was built using the MVC architectural pattern, with secure role-based access control and data encryption to protect sensitive information. A three-tier testing process was conducted: unit testing, integration testing, and user acceptance testing, along with a basic security review to ensure compliance with academic integrity standards. The EMS was piloted with 12 courses and 180 students. Results demonstrated a 40% reduction in result publication time, a 70% decrease in grade calculation errors, and a 25% improvement in student satisfaction, compared to manual processes. These outcomes were validated through real-user feedback sessions with lecturers and students. By centralizing exam data and automating workflows, the system enhances transparency, scalability, and decision-making, while maintaining strict security controls for academic data. Limitations of this study include its deployment in a single institution and a limited pilot group, which may affect generalizability. Future work will focus on integrating AI-driven grade prediction models, mobile application support, and advanced analytics for continuous improvement, thereby further aligning with digital transformation initiatives in higher education.

**Keywords:** Examination Management; Django; PostgreSQL; Academic Assessment; Automation; Result Publication; Rol-Based Access Control; Security

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