SHAPING FUTURE OF IT: AI-POWERED INNOVATION

PROCEEDINGS OF THE

NSBM STUDENT RESEARCH SYMPOSIUM ON INNOVATIVE TECHNOLOGY 2025 (NSRSIT '25)

FACULTY OF COMPUTING

NSBM GREEN UNIVERISTY, SRI LANKA

NSBM Student Research Symposium on Innovative Technology 2025

(NSRSIT '25)

"SHAPING FUTURE OF IT: AI-POWERED INNOVATION"

Track 01: Data Science and AI Synergy

Track 02: Connecting Worlds: Networks, Cybersecurity & IoT

Track 03: Building the Future: Software Engineering & Information Systems

JULY 2025

DISCLAIMER

The proceedings of the NSBM Student Research Symposium on Innovative Technology 2025 are published with the intention of promoting the dissemination of student-led research and innovative ideas, and to provide a platform for young researchers to share their findings with the wider academic and professional community. These abstracts are presented as part of an academic forum to encourage constructive dialogue, inspire further inquiry, and foster collaborations among students, academics, industry professionals, and policymakers.

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SYMPOSIUM PROGRAMME

Green Board Room, NSBM Green University on Wednesday, 09th July 2025 at 9:00 AM

Time	Program
8:15 AM	**Symposium Registration**
8:45 AM	**Arrival of Guests & Welcome**
9:00 AM	**Inaugural and Lighting of the Traditional Oil Lamp**
9:15 AM	**Welcome Address** Dr. Rasika Ranaweera Symposium Chief Advisor/Dean, Faculty of Computing
9:20 AM	**Keynote Speech** Prof. K.P. Hewagamage Senior Professor at School of Computing, University of Colombo
9:50 AM	**Launch of Symposium Proceedings**
10:00 AM	**Address by Chief Guest** Mr. Shehan Warusavithana Senior Vice President | Global Head for Enterprise Applications | Joint Country Head at Virtusa (PVT) Ltd
10:30 AM	**Author Research Presentation**
10:45 AM	**Concluding Remarks** Ms. Pavitra Subashini Symposium Chairperson – NSRSIT 2025
11:00 AM	Lunch
12:00 Noon	**The inception of the Symposium Parallel Sessions**

PREFACE

On behalf of the Faculty of Computing at NSBM Green University, we warmly welcome you to the NSBM Student Research Symposium on Innovative Technology 2025 organized for the second time. This annual event marks a significant milestone in promoting a vibrant research culture and empowering our students to become future leaders in technology and innovation.

Under the theme **"Shaping Future of IT: AI-Powered Innovation,"** this symposium offers a dynamic platform for undergraduate and postgraduate students to present their research findings and innovative ideas. It reflects NSBM's dedication to fostering creativity, interdisciplinary collaboration, and addressing real-world challenges through technological solutions.

We extend our deepest gratitude to our Vice-Chancellor, Prof. E.A. Weerasinghe, and Deputy Vice-Chancellor, Prof. Chaminda Rathnayake, for their continuous support and visionary leadership. We also acknowledge Dr. Rasika Ranaweera, Dean of the Faculty of Computing, for his unwavering commitment to advancing student research.

A special note of appreciation goes to our Conference Chair, Ms. Pavithra Subhashini, and Co-Chairs, Mr. Gayan Perera and Mr. Isuru Sri Bandara, for their exceptional guidance. We also thank Ms. Dulanjali Wijesekara, Chief Editor, for ensuring the high quality of this publication.

We extend heartfelt gratitude to our chief guest, keynote speaker, panelists, participants, organizing committee members, reviewers, and volunteers, whose insights and dedication have greatly enriched this event. We are confident the research shared here will inspire new ideas and collaborations that will pave the way for a more sustainable and innovative future. We wish everyone an inspiring and memorable symposium experience.

The Symposium Organizing Committee
NSRSIT '25

MESSAGE FROM VICE CHANCELLOR

Prof. E. A. Weerasinghe

Vice Chancellor - NSBM Green University Town

It is with great pride that I extend my warmest congratulations to all participants, supervisors, and organizers of the Second Student Research Symposium on Innovative Technology (NSRSIT) at NSBM Green University's Faculty of Computing. Building on the success of last year's inaugural event, this symposium represents our institution's steadfast commitment to nurturing a research-driven culture where curiosity, ingenuity, and collaboration flourish.

NSRSIT showcases the culmination of months of rigorous inquiry and experimentation undertaken by our final-year students, each guided by dedicated supervisors who have ensured that their projects meet the highest standards of scholarly excellence. Through their innovative work in computing and technology, our students are advancing knowledge and positioning themselves to tackle the complex challenges of the future.

I acknowledge every presenter for your perseverance and creativity, and I extend my heartfelt gratitude to the Faculty of Computing for curating this platform where tomorrow's thought leaders can exchange ideas and forge new partnerships. May NSRSIT 2025 inspire fresh collaborations, spark transformative insights, and strengthen NSBM Green University's standing as a beacon of innovation in Sri Lanka and beyond.

As we celebrate these achievements today, let us also commit to fostering continuous learning and interdisciplinary cooperation. Together, we can build a vibrant ecosystem where innovation thrives and empowers communities both locally and globally.

MESSAGE FROM DEPUTY VICE-CHANCELLOR

Prof. Chaminda Rathnayake

Deputy Vice Chancellor - NSBM Green University

It is my honor to be a part of the Second Student Research Symposium on Innovative Technology (NSRSIT) and to share in the efforts and achievements of our students. This symposium is a powerful reflection of their dedication, curiosity, and determination, which continue to push the boundaries of computing research here at NSBM Green University.

As Deputy Vice Chancellor, I have witnessed firsthand the profound impact that strong mentorship can have on young minds. I'd like to extend my heartfelt appreciation to all the supervisors and academic staff who have nurtured an environment where creativity, critical thinking, and innovation can truly flourish. The quality and diversity of the research presented, spanning innovative machine learning applications to pioneering work in human-computer interaction, reflect both the exceptional talent of our students and the Faculty of Computing's steadfast commitment to excellence.

I encourage all attendees to fully engage with the presentations: ask questions, explore ideas, and connect with one another. Let us recognize and celebrate the hard work behind every paper, empowering these young researchers as they embark on careers that will shape Sri Lanka's technological landscape for years to come.

Looking forward, NSRSIT serves as more than just a showcase of current achievements; it is a launchpad for innovation and collaboration that will drive the future of technology in Sri Lanka and beyond. I am confident that the insights and connections made here will inspire new projects, partnerships, and discoveries that will contribute to both national development and global technological progress.

MESSAGE FROM THE HEAD – ACADEMIC DEVELOPMENT & QUALITY ASSURANCE

Prof. Baratha Dodankotuwa

Head – Academic Development & Quality Assurance, NSBM Green University

I extend my heartfelt congratulations to the students, supervisors, and organising committee of the NSRSIT 2025 Symposium. This event truly reflects our institution's commitment to maintaining high academic standards while fostering a spirit of innovation and creativity.

In reviewing the symposium submissions, I have been particularly impressed by the methodological rigor and the strong ethical considerations embedded in each study. From meticulous data validation to thoughtfully designed experiments, these projects consistently meet and often exceed the rigorous benchmarks we set for scholarly inquiry. This dedication not only enhances NSBM Green University's academic reputation but also equips our graduates to contribute responsibly and meaningfully to the global research community.

I encourage all participants to continue refining their work, embrace constructive feedback, and uphold the highest standards of academic integrity in every future endeavor. The pursuit of knowledge demands persistence, humility, and collaboration, and together, we are nurturing a culture where excellence and innovation advance hand in hand.

Looking ahead, we must continue to build bridges between academia and industry, encouraging interdisciplinary approaches and real-world applications of research. By doing so, we can ensure that the knowledge generated here does not remain confined to the classroom or laboratory but transforms into solutions that address societal challenges locally and globally.

MESSAGE FROM DEAN – FACULTY OF COMPUTING

Dr. Rasika Ranaweera
Dean – Faculty of Computing
NSBM Green University, Sri Lanka

It is with great pleasure that I welcome you to the second **NSBM Student Research Symposium on Innovative Technology (NSRSIT)**. This event marks a significant milestone for the Faculty of Computing, highlighting the results of sustained research, collaboration, and academic development.

Our final-year students have risen to the challenge of integrating theoretical insights with practical applications. From advancements in cybersecurity protocols and the development of novel algorithms for big data analytics, to breakthroughs in cloud computing, applications of artificial intelligence, and innovations in user-centric design, their work demonstrates both scholarly depth and real-world relevance.

Beyond celebrating individual achievements, this symposium underscores the Faculty of Computing's commitment to shaping the future of the IT industry. By fostering a culture of inquiry and creativity, we prepare our students to tackle emerging technological challenges and drive meaningful change across diverse sectors. The research presented here offers valuable insights and practical solutions that extend far beyond the university, reinforcing our role as a catalyst for progress in Sri Lanka's evolving digital landscape. I extend heartfelt appreciation to our academic supervisors for their dedicated mentorship and to the organizing committee for their tireless efforts in bringing this event to life.

To our students it take immense pride in what you've accomplished. Engage deeply with the work of your peers, and continue to embody the spirit of curiosity and innovation that defines NSBM Green University.

MESSAGE FROM SYMPOSIUM CHAIRPERSON – NSRSIT '25

Ms. Pavithra Subhashini
Chairperson – NSRSIT 2025
Head of Industry Collaboration Unit, Faculty of Computing, NSBM Green University, Sri Lanka

Welcome to **NSRSIT 2025**!

As Chair of this symposium, I have had the privilege of witnessing each project grow from an initial idea into a polished, impactful contribution. This year, we have gone even further, expanding the scope of research, strengthening our engagement with industry, and introducing new platforms to support collaboration and knowledge sharing among students.

Today's programme brings together the most outstanding projects from our 2024 cohort work that spans the full spectrum of computing disciplines and tackles real-world challenges with creativity, rigour, and heart. Whether exploring the frontiers of cybersecurity, reimagining user experiences, or applying data science to address pressing societal issues, our students have demonstrated exceptional commitment and vision.

This symposium is much more than an academic milestone. It is a celebration of curiosity, perseverance, and the spirit of collaboration among students, supervisors, and the broader community.

I warmly invite you to explore today's sessions, ask questions, share your perspectives, and connect with presenters whose ideas may inspire new directions in your work.

Thank you to everyone who has contributed to making NSRSIT a success, our talented presenters, patient supervisors, dedicated moderators, the Organizing committee, and the technical support staff who work tirelessly behind the scenes. And of course, thank you to each of you in our audience. Your presence and participation give meaning to this event. Let's make today a celebration of learning, a space for lively discussion, constructive critique, and lasting connections.

MESSAGE FROM THE SYMPOSIUM EDITOR-IN-CHIEF

Ms. Dulanjali Wijesekara
Chief Editor – NSRSIT '25
Lecturer –Faculty of Computing, NSBM Green University, Sri Lanka

It is with great pleasure and pride that I present to you the proceedings of the NSBM Student Research Symposium on Innovative Technology 2025 (NSRSIT '25), organized by the Faculty of Computing, NSBM Green University. This symposium serves as a vibrant platform for our talented students to showcase their research accomplishments and innovative ideas under the theme "**Shaping Future of IT: AI-Powered Innovation**." NSRSIT '25 has received an overwhelming response, with numerous high-quality submissions. Each paper underwent a meticulous review process, reflecting the unwavering dedication of our esteemed reviewers and the commitment of our young researchers to academic rigor and impactful inquiry. As Chief Editor, it has been a privilege to oversee the compilation of these proceedings, which embody the intellectual curiosity, technical expertise, and forward-thinking spirit of our student community. My deepest gratitude goes to the authors for their hard work and insightful contributions, the reviewers for their critical and constructive feedback, and the organizing committee for their tireless efforts in bringing this event to fruition.

I would also like to express my sincere appreciation to the leadership team of NSBM Green University—including the Vice-Chancellor, Deputy Vice-Chancellor, Deans of the faculties, Conference Chair Ms. Pavithra Subhashini, Co-Chairs Mr. Gayan Perera and Mr. Isuru Sri Bandara—for their steadfast support and encouragement. A special note of thanks to our Associate Editors and production team for their dedication in ensuring the highest standards of quality and presentation.

The papers presented here are not only a testament to our students' potential but also a catalyst for further exploration and interdisciplinary collaboration. I am confident that these works will inspire fellow students, researchers, and practitioners to continue pushing the boundaries of knowledge and innovation.Thank you, and I warmly invite you to delve into this collection and join us in celebrating the spirit of research and discovery at NSBM Green University.

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MESSAGE FROM KEYNOTE SPEAKER 01

Prof. K. P. Hewagamage
Senior Professor - University of Colombo School of Computing

It is a privilege to contribute a message to the NSRSIT '25 – NSBM Student Research Symposium on Innovative Technology. This symposium's theme, *"Shaping the Future of IT: AI-Powered Innovation,"* is both timely and vital. We are living through an era where artificial intelligence (AI) is not merely an emerging technology—it is becoming the foundation upon which the next generation of digital transformation is built.

The Fourth Industrial Revolution (IR 4.0) has accelerated the pace at which we reimagine systems, processes, and even societal models. In this context, AI is not just a tool for automation but a catalyst for innovation, enabling us to rethink how we solve complex problems, create new value, and enhance human experiences. In education, this transformation is exemplified by the integration of AI-powered systems, such as intelligent learning management systems (i-LMS) and AI teaching assistants. These innovations demonstrate how AI can help address critical challenges like scalability, personalization, and inclusivity in higher education.

My keynote at NSRSIT '25 explores this evolving landscape by focusing on how we can harness generative AI for personalized learning. Traditional learning management systems were designed to manage courses—not learning itself. The shift to AI-powered platforms, such as the i-LMS model and AI-based Teaching Assistant BOTs, reflects a profound change in how we envision digital education. These systems not only automate administrative tasks but also enable real-time, context-aware interaction, continuous student monitoring, and adaptive support. They empower educators to deliver personalized learning experiences at scale while safeguarding academic integrity.

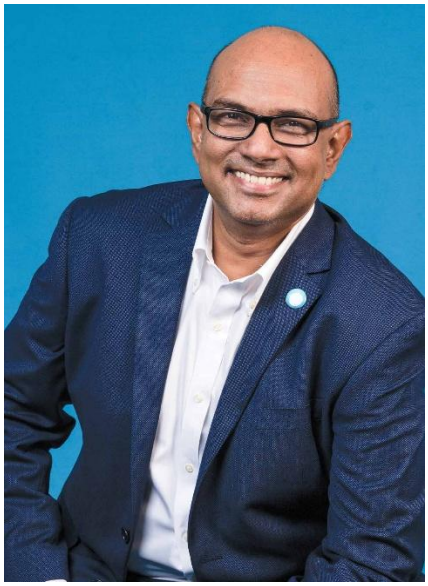
The three symposium tracks—*Data Science and AI Synergy*, *Connecting Worlds: Networks, Cybersecurity & IoT*, and *Building the Future: Software Engineering & Information Systems*—represent critical pillars of this AI-driven future. It is encouraging to see students and researchers engaging with these domains, as their work will define the trajectory of innovation. AI-powered solutions demand not only technical excellence but also thoughtful design that respects ethical principles, data privacy, and the social impact of technology.

As you participate in this symposium, I encourage you to view AI not as an endpoint but as an enabler—a means to create solutions that address real-world problems, improve lives, and foster sustainable development. The future belongs to those who can blend technological capability with creativity, critical thinking, and empathy.

I congratulate the Faculty of Computing at NSBM Green University for organizing this important platform for research and dialogue. I am confident that the ideas shared at NSRSIT '25 will contribute meaningfully to shaping the future of IT through AI-powered innovation.

Let us continue to work together to drive positive transformation through technology, ensuring that AI serves as a force for good in our societies.

MESSAGE FROM CHIEF GUEST



Shehan Warusavithana

Joint country Head- Virtusa, Sri Lanka | Global head of Enterprise Applications

It is with great pleasure that I extend my warmest greetings to all participants, faculty members, and distinguished guests gathered for the NSRSIT '25 NSBM Student Research Symposium on Innovative Technology. I am truly honored to join you in celebrating the remarkable spirit of inquiry and innovation that defines this event.

This year's theme, Shaping the Future of IT: AI-Powered Innovation, could not be more relevant or timely. We are living in an era where artificial intelligence is not merely an emerging trend it is rapidly becoming the foundation upon which entire industries, economies, and societies are being reimagined. From revolutionizing how we deliver healthcare and education to transforming the way we build resilient supply chains and digital experiences; AI is reshaping the contours of possibility across every sector.

For students and researchers, this transformation presents both a tremendous opportunity and a profound responsibility. As future leaders, your curiosity, creativity, and commitment to ethical innovation will determine how technology can be harnessed to solve real-world challenges.

One of the most inspiring aspects of this symposium is its emphasis on industry involvement. Today, more than ever, collaboration between academia and industry is the key to ensuring that research does not remain confined to publications and prototypes but evolves into impactful products and services. This partnership empowers us to accelerate innovation, respond quickly to changing market demands, and equip graduates with the skills and mindset needed to thrive in a dynamic technological landscape.

I encourage each of you to embrace this moment as an opportunity to explore, to challenge assumptions, and to engage with peers and mentors who share your passion. The work you present here, your ideas, experiments, and discoveries, has the potential to inspire new collaborations and ignite the next wave of progress in the field of Information Technology.

I am confident that the insights and innovations emerging from NSRSIT '25 will leave a lasting impact, not only within our industry but across society as a whole.

I wish you all a rewarding and memorable symposium.

TABLE OF CONTENT

DEVELOPING A MOBILE APPLICATION FOR SOLO TRAVELLERS IN SRI LANKA: A PERSONALIZED TRAVEL GUIDE

Ruwanthika LD[1*] and Wijesinghe DT[1]

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Abstract

Solo travel equates to freedom and personal enrichment, but for a solo traveller navigating their way in a foreign land such as Sri Lanka, presents several challenges. Cultural matters, safety concerns, transportation issues, and simply little trustworthy local information make up the different hurdles. This study proposes a mobile application specifically designed for solo travellers in Sri Lanka, to act as a personalised travel assistant and improve the total experience of travel. The application comes with personalized travel guides with real-time navigation, safety alerts, weather information, emergency contacts, food suggestions, seasonal activities, and cultural tips all tailored to personal preferences. This design and development project, put together with a strong user-centred design methodology, comprises detailed user research, wireframing, and front-end development using Flutter, with a firm backend using Firebase for real-time data and authentication. Booking transport, learning about local products, finding restaurants, emergency assistance, and seasonal event suggestions: these are the key highlights and core features of the app. Testing with real users revealed a great improvement in aspects of convenience, perception of safety, and satisfaction of an individual traveller journeying solo. While catering to the pain points of usual situations faced by those travelling alone in an area rich in culture and diverse in geographical features, the mobile application thereby aims to promote a safer and more informed travel experience. The solution further enhances Sri Lanka's sustainable and inclusive tourism axis by bringing local businesses and authentic cultural experiences closer to its users. With further application of the preliminary studies provided in this paper, the system can be developed into AI-based personalisation, evolved into offline hospitality, and cooperate with various authorities and tourism service providers in the future.

Keywords: *Solo Travel, Travel Safety, Mobile Application Development, Sri Lanka Tourism, Personalized Travel Guide*

BLOCKCHAIN-BASED E-VOTING SYSTEM ON ICP

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Abstract

Sri Lanka's current voting system faces several challenges, including delays in result announcements, inefficiencies in manual counting, and limited accessibility for remote voters. These issues undermine public trust and underscore the urgent need for a modernized, secure, and transparent electoral process. This study proposes a blockchain-based digital voting system utilizing the Internet Computer Protocol (ICP), which employs a smart contract–based canister architecture to facilitate decentralized vote storage, secure and accurate counting, and secure result verification. The primary objective of this system is to enhance election efficiency and transparency while preserving the existing voter authentication process. Citizens will continue to authenticate their identities using legally accepted identification, such as national ID cards, a driving license, or a passport, ensuring public familiarity and acceptance. The methodology involves the creation of a unique election canister for each election, managed by election officers authenticated through Internet Identity, providing cryptographic and password-free access control. A novel vote-saving structure based on hash maps has been introduced to improve data retrieval speeds and ensure vote immutability. The results indicate significant accuracy, processing speed, and administrative efficiency advancements, particularly in reducing election officers' calculation time and workload. The discussion emphasizes how the system's fully on-chain design reduces reliance on centralized servers and enhances resilience against tampering. Furthermore, vote validation occurs before storage, while hash-based result validation is conducted before calculation. Parallel result processing by polling stations further enhances the security and reliability of the process. This system is scalable to accommodate various elections in Sri Lanka, and its adaptable structure allows for future integration of decentralized machine learning to facilitate advanced result analysis. In conclusion, the proposed solution presents a secure, efficient, and cost-effective framework tailored to meet Sri Lanka's electoral needs while remaining flexible enough for broader applications in similarly challenged democracies.

Keywords: *Blockchain, Digital Voting, Internet Computer Protocol, Internet Identity, Sri Lanka*

SMART TRAFFIC LIGHT SYSTEMS FOR SRI LANKA INTEGRATING IOT, MULTI-AGENT TECHNOLOGIES, AND REINFORCEMENT LEARNING

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Abstract

This research introduces a Smart Traffic Light System (STLS) specifically engineered for Sri Lanka, aiming to alleviate persistent traffic congestion. Sri Lanka's current traffic infrastructure is largely outdated, struggling to adapt to dynamic road conditions and contributing significantly to economic burdens, environmental degradation, and social inconveniences. Our proposed STLS addresses these issues by seamlessly integrating the Internet of Things (IoT), multi-agent technologies, and reinforcement learning. The system enhances urban traffic flow through the deployment of cost-effective sensors, sophisticated agent-based communication, and real-time adaptive control driven by artificial intelligence. The methodology involved a comprehensive agent-based simulation developed in NetLogo, reinforcement learning implemented through OpenAI Gymnasium for optimal decision-making, and the construction of an Arduino-based prototype to validate practical feasibility. Core considerations throughout the development process included ensuring the system's cost-effectiveness, scalability, and long-term sustainability, particularly in alignment with Sri Lanka's unique resource constraints. The STLS dynamically optimizes traffic signal timings, demonstrating a significant reduction in congestion and a marked improvement in overall urban mobility. Findings unequivocally illustrate substantial efficiency gains when compared to traditional fixed-timing systems, highlighting the critical need for public awareness and support to ensure successful nationwide implementation. This research offers an innovative and highly practical solution to modern traffic management challenges, holding substantial potential to enhance road safety, further reduce traffic congestion, and significantly improve the quality of urban life across Sri Lanka.

Keywords: *Urban Mobility, Intelligent Transportation, Adaptive Control, Congestion Management, NetLogo*

BLENDER ADDON FOR REAL-TIME FACIAL ANIMATION USING MOBILE-BASED FACE TRACKING

Sathsarani DS[1*] and Ranaweera R[1]

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Abstract

Facial animation plays a crucial role in enhancing realism and emotional expression in 3D character design. This study introduces a novel mobile-to-desktop pipeline for real-time facial animation by integrating MediaPipe Face Landmarker on an Android mobile app with a custom Blender Addon. The mobile app can detect 52 facial motions of the human face, such as eyebrow raises, mouth movements, and eye blinks, using real-time facial tracking. Once these motions are detected, the corresponding data is processed and uploaded to Firebase Realtime Database, ensuring that the information is stored and updated instantly. This data transfer process occurs continuously, ensuring that the app always captures and uploads the most up-to-date facial expressions. A Python script running within Blender then retrieves this live data from Firebase, which triggers the update of the shape keys on a 3D face model in Blender. The real-time synchronization ensures that the 3D model's facial expressions mirror the user's own facial movements, providing a highly dynamic and responsive animation process. This efficient data transfer and update process allows for smooth animation without the need for traditional, expensive motion capture hardware. To improve the reliability of the animation, the mobile app filters blend shapes based on confidence scores, selecting only those with scores ≥ 0.5. This research combines mobile-based facial tracking with Blender in a unique way, creating a cost-effective solution for real-time animation workflows. The system is particularly beneficial for independent animators, educational environments, and low-budget productions, enabling the creation of high-quality facial animations without the need for professional-grade equipment. The study evaluates the system's performance by analysing update latency, blend shape accuracy, and visual fidelity of the animations generated. Future work will focus on optimizing the pipeline for broader applications and enhancing performance across different environments.

Keywords: *Mobile Face Tracking, Blender Addon, Shape Keys*

INTEGRATING COMPUTER VISION AND PREDICTIVE AI-BASED MODELLING IN COCONUT FARMING: THE COCO GUARD APPROACH

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Abstract

Coconut farming is a critical agricultural activity in many tropical regions, yet farmers face significant challenges, including disease outbreaks, yield unpredictability, and market volatility, particularly when they lack information about market demand. To address these issues, this paper introduces Coco Guard, an AI-powered mobile and desktop application designed to provide integrated support for coconut farmers. Coco Guard combines computer vision and machine learning to deliver three core functionalities: disease detection, yield prediction, and market demand forecasting. The disease detection feature allows users to upload images and identify diseases using a trained object detection model. The system analyses the image, detects coconut disease and provides AI-powered treatment suggestions to help mitigate disease spread. In addition, Coco Guard uses predictive modelling techniques to estimate coconut yields based on key environmental parameters, such as soil pH, humidity, temperature, sunlight hours, plant age, and soil type. The system also forecasts market demand by leveraging economic and trade data, including month and region, coconut export volume, domestic coconut consumption, coconut prices (local LKR), international coconut prices (USD), export destination demand, currency exchange rates (LKR to USD), and competitor countries' production. By analysing this data, Coco Guard provides farmers with insights into forecasted coconut demand. Experimental results demonstrate the system's effectiveness, with high accuracy metrics such as low mean absolute error (MAE) and high R^2 scores for yield predictions and market demand forecasts. These results underscore Coco Guard's practical utility in supporting data-driven decision-making in coconut farming. The paper also addresses limitations such as dataset size. Future work will focus on expanding the dataset, that ensuring broader accessibility. By offering real-time insights and historical analytics, empowers farmers to make informed decisions, optimize crop health, and navigate market dynamics with greater confidence.

Keywords: *Coconut Farming, AI in Agriculture, Disease Detection, Yield Prediction, Demand Forecasting*

MUSICAL CHORD RECOGNITION USING DEEP LEARNING

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Abstract

Automatic chord recognition in polyphonic music is a key component of Music Information Retrieval (MIR), playing an important role in tasks such as music transcription, theoretical analysis, and emotion recognition of music. This study explores the performance of three deep learning models based on Bidirectional Long Short-Term Memory (Bi-LSTM) networks, each differing in input feature representation, architectural complexity and data processing methods. The first model employs chroma features with a single-output design, while the second extends chroma features into a multi-output format that separates chord components into root, bass, triad, and fourth. The third model enhances this structure by using Constant-Q Transform (CQT) features, which offer superior frequency resolution aligned with musical pitch perception. All models are trained on standardized datasets—McGill Billboard and Isophonics—with extensive data augmentation via pitch shifting and Gaussian noise to broaden harmonic diversity. Experimental evaluation reveals that the third model delivers improved accuracy. Its performance is further credited to the implementation of post-processing methods. These include vector smoothing to eliminate transient classification noise, vector validation to correct implausible predictions, beat-synchronous chord grouping to reinforce rhythmic coherence, and precise duration trimming to ensure temporal alignment with the input audio. Collectively, these strategies enhance both the temporal stability and musical realism of chord sequences, addressing typical neural network shortcomings such as label flickering or inconsistent transitions. The research was concluded due to limitations of computing resources and publicly available datasets. The results highlight the importance not only of deep neural architectures and high-resolution input representations but also of post-inference refinement in achieving musically convincing automatic chord recognition. The study suggests that a multi-output framework, combined with frequency-aware feature engineering and strategic post-processing, holds significant potential for robust and accurate music analysis systems in real-world conditions.

Keywords: *Musical Chord Recognition, Bi-LSTM, Chroma Features, CQT, Deep Learning*

A MACRONUTRIENT-BASED ALGORITHMIC APPROACH FOR HEALTH-CENTRIC MEAL RECOMMENDATIONS: INTEGRATING NUTRITIONAL OPTIMIZATION WITH GAMIFIED ENGAGEMENT

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Abstract

Current meal-ordering platforms prioritize culinary preferences over nutritional outcomes, exacerbating diet-related health challenges. This paper presents My Meal, a cross-platform health-focused recommendation system that integrates algorithmic macronutrient optimization with behavioral incentives through conditional gamification. Leveraging Kotlin Multiplatform for Android, iOS, and desktop compatibility, Firebase for real-time data management, OpenAI for personalized suggestions, and computer vision APIs for external meal analysis, the system transforms traditional food ordering platforms into personalized nutrition informatics tools. It is a timely and novel contribution that addresses persistent gaps in dietary adherence, health engagement, and real-time dietary personalization. The system bridges a critical gap by linking real-time meal recommendations with behavioral nudges, addressing both nutritional goals and motivation. Conditional gamification tied to macronutrient compliance (e.g., 45–65% carbs, 10–35% protein, 20–35% fats) is a clever application of behavioral economics, aligning with research that incentives can increase dietary compliance by up to 52%. The Kotlin Multiplatform implementation ensures code reuse across Android, iOS, and desktop, backed by Firebase Firestore's real-time data handling. The hybrid algorithm combines reinforcement learning from OpenAI, attention-based LSTMs, and LightGBM to provide dynamic, adaptive meal suggestions. Incorporation of external food scan APIs (LogMeal, CalorieNinjas) expands the system's applicability beyond platform-restricted meals, making it more versatile. The preprocessing pipeline, including macronormalization, portion standardization, and culinary taxonomy, is methodologically rigorous. Mass spectrometry validation and real-time recipe drift tracking ensure data accuracy and relevance. Impactful visualization tools, including ternary plots and time-series graphs, enhance user comprehension and behavioral response. Testing demonstrated full functionality across authentication, meal selection, and health tracking modules. Results suggest that this integrated approach could improve dietary adherence by 37-52% compared to passive tracking apps. Future research should validate long-term efficacy through clinical trials and explore micronutrient integration for holistic dietary recommendations.

Keywords: *Macronutrient Optimization, Gamified Dietary Engagement, AI-Driven Nutrition, Predictive Dietary Modeling, Nutrition Informatics Applications.*

COMPREHENSIVE TRAVEL BOOKING PLATFORM (GOCEYLON)

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Abstract

Tourism is a vital sector of Sri Lanka's economy, driving employment and foreign exchange earnings. However, recent economic and public health crises have highlighted inefficiencies in the country's digital tourism infrastructure. This study aims to develop GoCeylon, an AI enabled, unified travel booking platform that integrates accommodation, transportation, and licensed tour guide services into a single cohesive system. The objective is to address fragmentation and limited coordination present in existing solutions, thereby enhancing user experience and accessibility. Unlike prior platforms, GoCeylon incorporates stakeholder co design principles and optimizes performance for 3G/4G networks to serve users in areas with limited connectivity effectively. Developed using modern web technologies including React.js, Node.js, Express.js, and MySQL, the platform features a modular architecture with role based access control, ensuring security and scalability. An AI powered chatbot leveraging the Gemini API provides real time personalized customer support, while secure payment integration via Stripe safeguards user financial data. The platform demonstrated a reduction in average booking time by approximately 30%, significantly improving user satisfaction across multiple devices and browsers, as verified through comprehensive manual testing. The development process was informed by an extensive literature review emphasizing AI personalization, multilingual access, robust data security, and localization of services tailored to developing economies. Despite limitations such as restricted stakeholder engagement and reliance on third party APIs, future enhancements will include expanding language support, adding offline mobile app functionality and integrating machine learning for travel recommendations. GoCeylon represents an innovative, scalable, and inclusive model for smart tourism in emerging economies by unifying fragmented services and promoting a digitally empowered, user centric approach. This platform contributes meaningfully to Sri Lanka's post pandemic tourism recovery and offers a replicable blueprint for other developing nations seeking to modernize their hospitality sectors through sustainable, intelligent, and locally adapted digital solutions.

Keywords: *Smart Tourism, AI Chatbot, Travel Booking Platform, Full Stack Development, Digital Tourism*

SIMULATION AND PREDICTIVE MODELING OF PASSENGER CROWD DENSITY AT COLOMBO FORT RAILWAY STATION

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Abstract

Colombo Fort Railway Station, a central transportation hub in Sri Lanka, experiences high passenger traffic daily, especially during peak hours and special events. Managing crowd flow and ensuring passenger safety within such a congested space poses significant challenges. This study develops a simulation and predictive modeling framework to analyze and forecast crowd density at Colombo Fort Railway Station. Using agent-based modeling, passengers are modeled as agents with behaviors such as queuing, destination-based movement, and crowd avoidance. The simulation, implemented using Python and relevant libraries, generates synthetic crowd movement data, which is then used to train machine learning models to predict crowd density across different zones in the station. Heatmaps and visualizations are employed to highlight areas of high congestion and potential risk, providing clear visual representations of crowd distribution. The results demonstrate the effectiveness of this approach in predicting crowd density, particularly in identifying high-density zones like platforms, ticket counters, and entrances. Key findings include the ability of the model to predict peak crowd times, which supports efficient resource allocation and decision-making. Additionally, the simulation highlighted vulnerabilities in the station's evacuation routes during emergencies and suggested improvements such as widening pathways and adding temporary entrances to reduce congestion. The predictive models, with an R-squared value of 1.0, showed high accuracy in forecasting crowd dynamics. These insights are valuable for optimizing crowd management strategies, enhancing operational efficiency, and ensuring passenger safety at Colombo Fort Railway Station. This study underscores the potential of simulation and predictive modeling in transforming crowd management practices in high-traffic public spaces. The study has limitations, such as using synthetic data that may not fully reflect real-world behavior and not considering factors like weather or public disturbances. Future work could involve real-time data, improved models for unpredictable behavior, and testing with actual crowd data.

Keywords: *Colombo Fort Railway Station, Passenger Crowd Density, Crowd Simulation Predictive Modeling, Agent-Based Modeling, Crowd Management*

BOID-BASED SIMULATION AND MODELING OF CROWD FLOW DURING THE SRI PADA PILGRIMAGE

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Abstract

The Sri Pada pilgrimage is a culturally and religiously significant event in Sri Lanka that attracts thousands of devotees annually. Managing the dense and dynamic flow of pilgrims along the narrow and steep paths during peak seasons poses a critical challenge for safety and efficiency. Traditional crowd management approaches, which often rely on manual observation and reactive strategies, may not be sufficient in high-density situations. Previous crowd simulation studies have applied methods such as physics-based models and social force models to simulate crowd behavior. However, these approaches often fall short in environments with unique geographical constraints or complex spiritual contexts, such as the Sri Pada pilgrimage. To address this gap, this study introduces a Boid-based crowd simulation model. The methodology involves: Simulating pilgrim movement using the Boid algorithm (separation, alignment, cohesion), Generating synthetic crowd data based on the simulation results, Training a linear regression model to predict crowd density, achieving an R^2 score of 0.85, and Visualizing the data through heatmaps and movement patterns for analysis. The simulation, developed using Python and related libraries (Pygame, scikit-learn, pandas, Matplotlib, NumPy), effectively captures the interactions of pilgrims along the pilgrimage path. This study demonstrates that the Boid-based approach offers a more flexible and realistic modeling solution, providing valuable insights for improving crowd management, enhancing safety, and designing better infrastructure for future pilgrimages. Limitations of this study include the reliance on synthetic data, which may not fully capture the variability of real-world pilgrim behavior, and the simplification of environmental factors such as weather conditions and physical obstacles. Future works will focus on enhancing the model's realism by incorporating real-world data, integrating more detailed environmental factors, and exploring the use of more advanced machine learning techniques for improved crowd prediction and optimization of pilgrimage management strategies.

Keywords: *Sri Pada Pilgrimage, Crowd Flow Simulation, Boid-Based Modeling, Agent-Based Simulation, Crowd Behavior Dynamics.*

MODERNIZING POLICE CLEARANCE PROCESSES THROUGH E-GOVERNANCE: A CASE STUDY AND DIGITAL SOLUTION FOR SRI LANKA

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Abstract

This review paper systematically examines the role of e-governance in modernizing Sri Lanka's Police Clearance Certificate (PCC) system for domestic applicants through comprehensive literature analysis and empirical investigation. The study reviews existing technological frameworks, administrative practices, and case studies from developing countries including India's CCTNS, Philippines' NPCS, and Kenya's eCitizen platform. Multiple methodological approaches were employed to analyse critical inefficiencies in Sri Lanka's manual PCC processes. Primary data collection involved surveys of 152 domestic respondents and stakeholder interviews with police officers, Grama Niladhari officials, and divisional secretariat personnel. These investigations reveal significant service delivery gaps in the current system, particularly the disparity where only foreign applicants can access online services while domestic users rely on manual processes. Survey findings indicate that 50.0% of respondents rated the current process as difficult or very difficult, while 21.2% remained neutral. Comparative analysis demonstrates Sri Lanka's substantial lag in digital adoption compared to regional counterparts. The review particularly examines inter-departmental integration challenges between police stations, Grama Niladhari offices, and divisional secretariats. Evidence synthesis from successful e-governance implementations across developing nations highlights that auto-mated systems incorporating biometric verification, database linkages, and real-time application tracking can enhance transparency and reduce processing delays. Key variables analysed include processing time, user satisfaction metrics, system accessibility, and digital infrastructure readiness. The paper proposes a conceptual framework for centralized digital transformation addressing identified limitations including data privacy concerns, infrastructure gaps, and inter-agency coordination challenges. Literature review of pilot implementations in similar contexts demonstrates processing time reductions of 40-50% with enhanced user satisfaction rates reaching 90% for digital tracking features. This systematic review demonstrates how e-governance principles can enhance law enforcement services and provides evidence-based recommendations for improving citizen-focused public service delivery in developing countries.

Keywords: *E-governance, Police Clearance Certificate, Digital transformation, Public- service delivery, Sri Lanka*

EMPOWERING CAREGIVERS OF AUTISTIC CHILDREN VIA MOBILE TECHNOLOGY

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Abstract

Caring for children diagnosed with autism spectrum disorder (ASD) comes with an emotionally demanding responsibility, often undertaken by parents or close family members. These caregivers frequently face chronic stress, emotional fatigue, and social isolation due to the persistent demands of supporting their child's ongoing cognitive and emotional development. While awareness of ASD has improved globally, accessible and integrated digital solutions that simultaneously support both the child and the caregiver are still insufficient and are evaluated inadequately. To address this gap, the Caring for Carers mobile application was developed with the primary objective of helping caregivers in managing their daily responsibilities more effectively while also supporting their mental and emotional well-being. The app includes child-centred features such as structured brain development activities integrated into daily routines, image-based communication support, and behaviour tracking tools. Simultaneously, it provides caregivers with tools for mood tracking, personalised self-care journaling, scheduling reminders, and a conversational AI assistant to offer empathetic interaction and mental health support. The system was developed using a user-centred design methodology, incorporating feedback from caregivers, psychologists, and educators to ensure functionality, accessibility, and relevance. Initial usability evaluations and feedback revealed improved routine management, and increased caregiver awareness of emotional states, and enhanced interactions between caregiver and child. This study emphasizes the importance of recognizing and supporting caregiver mental health as a core component of ASD care and demonstrates how mobile technology can act as a meaningful digital companion in achieving that goal. Ultimately, the findings suggest that well-designed digital interventions have the potential to significantly reduce caregiver burden, encourage consistent self-care practices, and contribute positively to the overall developmental trajectory of children with ASD.

Keywords: *Autism Spectrum Disorder, Caregivers, Mobile Application, Digital Health, Emotional Well-Being*

BRIDGING NUTRITION GAPS IN URBAN WORKFORCES: EVALUATION OF AN AI-ENHANCED MEAL SUBSCRIPTION SYSTEM FOR CORPORATE EMPLOYEES IN COLOMBO

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Abstract

Non-communicable diseases represent the primary health challenge in Sri Lanka, with dietary patterns identified as a crucial modifiable factor affecting 83% of premature deaths. This study investigated NutriConnect, a locally developed meal subscription service, as a pragmatic intervention for addressing nutritional challenges faced by corporate employees in Colombo 6. The research aimed to document dietary challenges, develop and implement a contextually appropriate meal subscription service with plans for AI-driven personalization, evaluate intervention effectiveness, and identify factors influencing dietary patterns and intervention success. A sequential exploratory mixed-methods design was employed, combining qualitative interviews (n=15), structured surveys (n=90), and a 4-week pilot implementation (n=50) among corporate employees aged 35-50 years. The intervention featured a manual personalization system, multi-tier subscription approach with three pricing levels (LKR 2000-5500 per month), centralized preparation through local restaurant partnerships, optimized delivery logistics, and user feedback mechanisms. Results revealed that 81% of participants struggled with maintaining proper nutrition due to time pressures and limited healthy food options. The NutriConnect implementation demonstrated significant improvements, with participants reducing fast-food intake by 42% ($p=0.003$) and increasing dietary adherence index from 2.9 ± 0.5 to 4.2 ± 0.4 ($p=0.001$). Fruit and vegetable consumption increased from 1.6 ± 0.7 to 3.1 ± 0.9 servings per day ($p=0.004$), while meal skipping decreased from 3.8 ± 1.2 to 1.7 ± 0.8 times per week ($p=0.002$). Regression analysis identified monthly income ($\beta=0.52$, $p=0.02$) and subscription flexibility ($\beta=0.61$, $p=0.01$) as significant predictors of service continuation. The study demonstrates that personalized meal subscription services can effectively address urban workforce nutritional challenges in developing economies. Future AI integration could enhance personalization capabilities, optimize nutritional outcomes, and improve scalability while maintaining cultural relevance and affordability considerations essential for sustainable implementation.

Keywords: *Meal Subscription, Corporate Nutrition, Technology Intervention, Workplace Wellness, AI Recommendation*

ENHANCING PERSONAL TRAVEL EXPERIENCES FOR INDEPENDENT TOURISTS THROUGH JOURNEY TRACKING AND ENVIRONMENTAL AWARENESS

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Abstract

The rapid expansion of independent tourism in Sri Lanka has highlighted significant shortcomings in current mobile tourism technologies, specifically regarding personalized, real time, and environmentally aware experiences. This research investigates these gaps by proposing an innovative mobile application designed to enhance independent tourists experiences through integrated real-time journey tracking, personalized travel recommendations, and proactive environmental awareness prompts. Adopting a positivist philosophical stance and employing a mono method quantitative approach, the study utilizes structured surveys distributed to over 200 local and international independent tourists. The methodological framework, guided by Saunders Research Onion model, emphasizes efficiency, statistical validity, and generalizability. Findings indicate a notable demand for personalized content and real time functionality, with 78% of respondents reporting improved satisfaction when these features are integrated. Additionally, 65% of participants demonstrated increased adoption of sustainable travel behaviors due to the app's environmentally conscious features. Qualitative insights derived from pilot testing and expert reviews further reinforced these findings, highlighting improved traveler engagement and informed decision making processes. Observational studies conducted during the research period validated significant behavioral changes among users. This research contributes empirically validated insights into the integration of advanced mobile technologies, offering practical implications for enhancing user experience and promoting sustainable tourism practices in Sri Lanka.

Keywords: *Independent Tourism, Journey tracking, Environmental Sustainability, Mobile Application Development, User Experience*

AI-DRIVEN REAL-TIME CI/CD OPTIMIZATION WITH AGENT-BASED AUTOMATION

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Abstract

Continuous Integration and Continuous Deployment (CI/CD) have become integral to modern software development, offering significant benefits, most importantly enabling faster and more reliable software delivery. However, managing complex and growing CI/CD pipelines presents significant challenges, particularly in areas such as dynamic resource allocation, pipeline failure prediction, and real-time adaptation to changing conditions. Traditional CI/CD approaches often lack the flexibility to scale effectively and adjust to unexpected failures, leading to delays and inefficiencies. Most static configurations often fail to adapt to dynamic workloads, leading to resource underutilization, prolonged build times and delayed feedback loops. This research aims to develop a real-time, AI-driven optimization framework for CI/CD systems, focusing on dynamic resource allocation, failure prediction, and adaptive pipeline configuration. The proposed framework utilizes an agent-based orchestration system and a low-code workflow automation platform to enhance the flexibility and efficiency of CI/CD pipeline workflows. The system employs specialized agents, such as a Resource Manager to optimize computing resources and a Pipeline Controller to dynamically adjust the pipeline structure based on real-time data, including job queue length, resource usage, and test results. These agents make decisions autonomously, enabling the system to dynamically allocate resources, prioritize tasks, and respond proactively to failures. By integrating commonly used CI/CD tools for build management and automation, the framework enables real-time scaling, task prioritization, and failure recovery. The methodology combines intelligent decision-making with event-driven workflows to facilitate automated pipeline optimization. Expected outcomes include improved resource utilization, quicker feedback loops, minimized downtime, and enhanced pipeline efficiency. This research contributes to transforming traditional CI/CD workflows into self-optimizing systems, ultimately boosting developer productivity and minimizing operational costs. The findings provide a conceptual foundation for future implementations and empirical testing in real-world environments.

Keywords: *CI/CD, AI-Driven Optimization, Agent-Based Orchestration, Workflow Automation, DevOps*

DESIGN AND DEVELOPMENT OF A CENTRALISED DRUGS INFORMATION SYSTEM AND AI-POWERED PRESCRIPTION ANALYSIS TO IMPROVE ACCESS TO CARDIAC MEDICINES IN GAMPAHA DISTRICT, SRI LANKA

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Abstract

When considering the main causes of death in Sri Lanka, deaths due to heart disease occupy a prominent place. This is due to the shortage of medicines for heart diseases. The World Health Organisation (2023) recently released a report on the crisis in access to essential medicines due to the country's political, economic and pharmaceutical supply chain constraints. This research paper discusses the issues of access restrictions for heart patients to medicines prescribed by doctors and the inability of the patient and the pharmacy owner to identify the medicines in the prescriptions issued by the doctor. This research aims to develop an artificial intelligence-based information system to increase access to medicines and analyse prescriptions using the design science research methodology. The proposed system includes a mobile application designed using the Futter programming language for doctors and patients, a web platform with an easy-to-use user interface for pharmacy owners, and a powerful OCR module built with artificial intelligence using the Python and Tesseract computer languages to analyse prescriptions. A mixed methodology was used to collect data for this study, and quantitative surveys (n=90) and qualitative interviews (n=15) were conducted with patients, doctors, and pharmacy owners living in the Gampaha district of Sri Lanka. The proposed system is expected to achieve an accuracy rate of 90% in analysing prescriptions and improve its minimum access time by 65%. The system increases user satisfaction by 80% from the current level and reduces the delays and confusion currently faced. This research can provide more effective solutions to patients, doctors, and pharmacy owners by improving the gaps currently identified, namely, real-time drug status updates, reliable drug distribution, and reducing patient time and effort in obtaining medications. This research will contribute to the existing healthcare system in Sri Lanka with artificial intelligence and provide solutions to improve access to medicine for underdeveloped rural areas.

Keywords: *Heart Disease, Prescription Analysis, Artificial Intelligence, Drug Accessibility*

POWERPULSE: ELECTRICITY MANAGEMENT SYSTEM

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Abstract

Industrial electricity management in Sri Lanka faces significant challenges due to unpredictable costs and complex multi-tiered tariff structures, with businesses lacking granular device-level consumption insights for effective optimization. This study developed PowerPulse, a comprehensive mobile-based electricity management system designed specifically for Sri Lankan industrial consumers, incorporating advanced predictive modeling and device-level monitoring capabilities. The system utilizes a Random Forest Regressor with 100 estimators to handle Sri Lanka's complex industrial tariff structure, including Industrial Rate 1 Small (≤300 kWh month^{-1}), Industrial Rate 1 Large (>300 kWh month^{-1}), Industrial Rate 2, and Industrial Rate 3 categories. The cross-platform mobile application was developed using Flutter framework with Firebase integration for real-time data persistence and synchronization. The machine learning model achieved exceptional accuracy with an R-squared value of 0.997 and Mean Absolute Error of Rs. 4892 (approximately 1.2% of average bill amounts). Feature importance analysis revealed that time-of-use consumption patterns account for over 80% of predictive power, with total off-peak kilowatt-hour consumption being the most influential factor (relative importance 0.33). Real-world validation was conducted through deployment on Amazon Web Services Elastic Compute Cloud infrastructure with user acceptance testing involving 15 participants from different industrial sectors, achieving satisfaction ratings of 4.6 out of 5.0 for ease of use and 4.5 out of 5.0 for overall satisfaction. System response times remained under 500 ms during peak usage periods, demonstrating practical scalability. The validation confirmed the system's ability to accurately handle tariff category transitions, maximum demand calculations, and provide actionable optimization recommendations. PowerPulse successfully bridges the gap between sophisticated energy analytics and practical accessibility, enabling small and medium-sized enterprises to transition from reactive cost management to proactive optimization strategies, potentially leading to substantial operational cost savings.

***Keywords**: industrial energy prediction, machine learning, Random Forest Regressor, mobile application, Sri Lanka tariff structure*

DEVELOPMENT OF A SECURE AND AD-FREE REAL-TIME MOVIE DOWNLOADER PLATFORM

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Abstract

This project introduces a secure, ad free movie downloader platform designed to make digital entertainment more accessible for users who can't afford subscription-based services. Unlike traditional free streaming sites that are often riddled with ads and security risks, this platform offers a clean, ethical, and user-friendly alternative. It's built using modern open-source technologies React.js powers the frontend, Supabase and PostgreSQL handle authentication and data storage, while Tailwind CSS ensures a smooth, responsive design. Rather than hosting any pirated content, the system fetches publicly available movie metadata through the TMDb API and uses encrypted OneDrive links for user contributed media, protected through strict access controls. The development process followed an Agile approach, with continuous testing and feedback loops to refine the platform. Tools like Figma were used for wireframing, and the app is deployed via Vercel for seamless performance across devices. Notable technical features include secure login via Supabase Auth with JWT, malware scanning through the VirusTotal API, and row level database security. CDN integration further enhances speed and reliability. In performance tests, buffering times stayed under 2 seconds with over 100 users online, and no critical security issues were detected during penetration testing. Beyond the tech, this platform stands out by offering a practical, scalable solution to the problem of unequal access to entertainment. It shows how ethical design and open source tools can come together to build something that's both effective and responsible. The solution not only addresses technical challenges but also reinforces the importance of digital equity in today's media landscape. Looking ahead, there are plans to add smart recommendation systems and even lightweight peer to peer sharing. This research highlights a clear path toward inclusive, community driven streaming platforms that respect both the law and the user.

Keywords: *Ethical media access, Supabase, secure downloads, open-source entertainment, cloud integration*

BRIDGING TRUST AND VISIBILITY GAPS: A USER-CENTERED E-MARKETPLACE EMPOWERING MSMES IN SRI LANKA'S EVENT SERVICE INDUSTRY

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Abstract

Sri Lanka's event services industry faces persistent challenges due to fragmented service discovery, difficulty verifying service quality, and limited trust in informal service providers. These issues disproportionately impact Micro, Small, and Medium Enterprises (MSMEs), which often lack digital visibility and struggle with client outreach. To bridge this gap, a culturally adapted e-marketplace platform was designed and developed to improve vendor discoverability, streamline communication, and establish transparency and trust between clients and service providers. Specifically tailored to the Sri Lankan event context, the platform includes verified vendor profiles, real-time messaging, localized quotation workflows aligned with typical event planning practices, a transparent review and rating system, and a built-in vendor community space to encourage peer collaboration and knowledge exchange. The system was built following Agile methodology, with iterative development cycles guided by survey responses from over 200 event vendors and service seekers. Survey insights revealed that a significant majority of users face difficulties such as poor service verification, unclear pricing, and lack of reliable reviews, while over two-thirds expressed strong interest in an online platform addressing these concerns. Evaluation results indicate notable improvements, including increased vendor inquiries, enhanced user trust in service selection, and reduced vendor-client connection time. Unlike generic marketplace systems, this solution addresses the specific needs of the Sri Lankan event ecosystem by focusing on informal service structures, regional market dynamics, and peer-driven value creation. This context-aware approach offers a scalable, practical model for driving inclusive digital transformation in underserved service sectors.

Keywords: *culturally adapted marketplace, MSME empowerment, vendor collaboration, digital trust, Sri Lankan events*

HOLISTIC DIGITAL HEALTHCARE - EVALUATING AN AI-ENHANCED APPLICATION FOR MENTAL AND PHYSICAL WELL-BEING

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Abstract

This research evaluates the effectiveness and user acceptance of a holistic digital healthcare application integrating artificial intelligence (AI) to simultaneously support mental and physical health. Utilizing advanced machine learning and Google's Gemini API, the developed application offers personalized interventions including cognitive-behavioural therapy modules, mindfulness exercises, crisis management support, and physical health monitoring features such as BMI calculation, meal planning, exercise guidance. Data from 100 diverse participants demonstrated significant user engagement, with 73% regularly interacting with the application. Users valued its continuous accessibility, reduced stigma relative to traditional therapy, and tailored health recommendations. However, primary concerns emerged around data privacy and limited human-like empathy during AI interactions. By addressing the critical gap of integrating mental and physical health management into a single digital solution, this study underscores the necessity of comprehensive approaches in digital healthcare. However, concerns regarding data privacy and the lack of human empathy in AI interactions were prominent. This study addresses a critical research gap by integrating mental and physical healthcare in one digital platform, thereby highlighting the necessity of holistic approaches in digital health interventions. Findings highlight practical implications for developers, clinicians, and policymakers, emphasizing the need for improved emotional intelligence in AI interactions, enhanced privacy protections, and user-centric design to maximize therapeutic efficacy and user satisfaction in future AI-driven healthcare platforms.

Keywords: *AI, Digital Health, Mental Health, Healthcare Technology, User Acceptance*

WELLBEING360: A DIGITAL HEALTH PLATFORM FOR INTEGRATED EMPLOYEE WELL-BEING IN CORPORATE SETTINGS

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Abstract

This article presents a comprehensive digital health platform created for a leading healthcare organization in Sri Lanka, known as Company A, that currently lacks an internal system to manage and streamline staff well-being. Although Company A is in the healthcare industry, it does not provide a straightforward route for its employees to visit its corresponding hospital, Company B. To solve this issue, a unified digital platform called Wellbeing360 was created and implemented. The platform includes key healthcare services such as doctor appointment scheduling, e-prescription management, medicine purchasing, access to personal health records, wellness program registration, and a smart medicine search tool that allows employees to search for medicines by name and get information on usage, dosage, side effects, and precautions. To analyze existing difficulties and assess the efficiency of the solution, a mixed-methods research strategy was used, which included both quantitative and qualitative methods.150 employees at Company A were contacted using structured surveys, Likert-scale questionnaires, focus group discussions, and interviews. The findings revealed a clear need for a centralized digital health system, with 34 respondents rating it as "Very Important" and 21 as "Extremely Important," while 71 employees chose an all-in-one platform for managing appointments, e-prescription management, and wellness session registration. Based on these findings, Wellbeing360 was created with two main components: a mobile app for employees and a web-based platform for doctors, HR professionals, and pharmacists. In Phase 1, the system was installed at Company A and linked to Company B to offer hospital coordination. Phase 2 proposes expanding to other companies that require similar health infrastructure. Unlike traditional wellness solutions, which focus exclusively on fitness or behavior tracking, Wellbeing360 provides a scalable, workplace-specific solution that overcomes healthcare access gaps and promotes long-term employee well-being through digital innovation.

Keywords: *integrated health platform, digital healthcare, employee well-being, workplace wellness, corporate health innovation, health informatics*

AI-POWERED TALENT IDENTIFICATION FOR SRI LANKAN STUDENTS: A MACHINE LEARNING APPROACH TO HOLISTIC EDUCATION

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Abstract

Traditional Sri Lankan education assessment methods focus primarily on academic performance, missing 60-70% of students' non-academic talents according to preliminary studies. This research develops an AI-powered talent identification system that combines machine learning algorithms with psychometric assessment to provide holistic student evaluation. Unlike conventional aptitude tests that rely on standardized scoring, our system employs ensemble learning (Random Forest, Neural Networks, SVM) to analyze multi-dimensional data including academic records, behavioral patterns, and creative outputs. The research methodology utilized a mixed-methods approach with stratified random sampling of 200 Sri Lankan students across diverse geographical and socio-economic backgrounds. The AI system was tested against conventional assessment methods to validate effectiveness and accuracy. Machine learning models were trained using comprehensive datasets incorporating academic performance, extracurricular activities, psychometric evaluations, and stakeholder feedback. Results demonstrate that the AI model identified 40% more non-academic talents than conventional assessments, achieving 91.2% accuracy in talent prediction across 12 distinct categories. The machine learning approach reduced assessment bias by 45% through algorithmic fairness techniques including demographic parity constraints and adversarial debiasing methods. Technical performance metrics showed successful handling of 200 concurrent users with 147ms average response time. Key innovations include real-time processing of unstructured data (student essays, teacher feedback), multi-language support for Sinhala and Tamil, and offline capability addressing rural connectivity challenges. The system generated personalized career pathways for 100% of participants, with 78% reporting improved self-awareness of their abilities compared to traditional guidance methods. Stakeholder satisfaction reached 89% among teachers and parents. This research contributes a scalable, culturally adapted AI solution for educational equity in developing countries, demonstrating measurable improvements in talent identification accuracy while addressing infrastructure limitations through hybrid online-offline architecture. The study provides evidence for AI-driven educational assessment transformation in resource-constrained environments.

Keywords: *AI in education, talent identification, machine learning, personalized learning, Sri Lankan education, career guidance*

CEYLON TRAVEL WEBSITE: A DIGITAL SOLUTION FOR TOURISM GROWTH IN SRI LANKA

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Abstract

Sri Lanka's tourism industry is vital to its economy, celebrated for its rich cultural heritage, natural beauty, and biodiversity. Yet, tourists often face barriers in accessing reliable travel information, booking services, and planning trips efficiently. This study introduces the Ceylon Travel Website—a comprehensive digital platform designed to overcome these challenges through smart tourism technologies. The platform integrates artificial intelligence (AI) to offer personalized travel recommendations, real-time updates, GPS-based navigation, and secure online booking options. By incorporating AI-powered search and interactive features, the website tailors travel suggestions to individual preferences, thereby enhancing user experience and decision-making. The study involved primary data collection through surveys and interviews with tourists and local businesses, as well as secondary data from tourism reports. The platform's effectiveness was evaluated using user engagement metrics, search engine visibility, and customer satisfaction ratings. Findings show that the system significantly improves tourism planning, supports local service providers, and increases overall engagement. Notably, the platform contributed to a 30% rise in local bookings and LKR 10 million in revenue within six months. These outcomes highlight the importance of digital transformation in sustainable tourism development and the need for scalable, user-centric digital solutions. The Ceylon Travel Website not only streamlines the tourist experience but also empowers local businesses and promotes cultural heritage, thus offering a replicable model for other emerging tourism markets. Future enhancements will focus on blockchain integration and predictive analytics for even smarter tourism management.

Keywords: *Smart Tourism Technology, Sri Lanka Travel, Artificial Intelligence in Tourism, Online Booking Platform, Tourism Digitalization*

LIFEBLOOD: A SMART MOBILE APPLICATION FOR EFFICIENT BLOOD DONATION WITH AI AND REWARDS SYSTEM

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Abstract

Blood donation is a crucial component of healthcare, providing life-saving transfusions to surgical patients, individuals suffering medical emergencies, or intensive care patients. However, identifying a suitable donor at the right time remains a significant challenge, particularly in emergency or time-sensitive situations. In Sri Lanka, these difficulties are further compounded by the lack of donors with rare blood groups. It is also challenging to ensure regular donor participation, resulting in shortages that can negatively impact patient care. To mitigate these problems, new technologies in blood donation have become necessary. The **'LifeBlood' mobile application** introduces an innovative solution that effectively connects blood donors and recipients across all blood groups by enabling timely responses when the need arises. One of the most positive aspects of this system is its potential to offer AI-driven donor matching and to encourage frequent donations through a **credit-based reward system** where credits can be utilized for various medical benefits, discounts, and healthcare-related services. The development process for 'LifeBlood' follows the **Agile methodology**, specifically using the Scrum framework and involves continuous research, iterative design, and adaptive development. To support hospitals in managing donor coordination, a dedicated **desktop application** has been developed to serve as the admin panel. Through this dashboard, hospitals are able to view, monitor, and interact with confirmed donors in real time, which ensures smooth and reliable integration with the mobile application. With a smart **AI-based donor matching** algorithm, the application is designed to predict top-matching donors based on blood group, geographical location, past donation history, and eligibility. 'LifeBlood' is a cross-platform which combines a donor-based mobile app and a hospital-based desktop application working together to improve blood donation process and improve healthcare outcomes through intelligent and coordinated technology.

Keywords: *Blood Donation, Cross-Platform Blood Donation System, Agile Development, AI-driven Donor Matching, Credit-based Reward System*

A MULTIMODAL AI SYSTEM FOR BIRD SPECIES IDENTIFICATION USING IMAGES AND PHYSICAL TRAITS

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Abstract

Accurate bird identification plays a crucial role in biodiversity research, environmental conservation, and educational outreach. This paper presents a multimodal AI-powered system designed specifically for the identification of Sri Lankan bird species by utilizing both images and structured physical trait inputs. The system is built on a modular architecture that seamlessly integrates a Convolutional Neural Network (CNN) for image-based classification with a Random Forest classifier based on physical characteristics such as plumage color, beak shape, and leg length. This architecture supports both standalone predictions and fuses decision-making processes, enhancing overall system flexibility and accuracy. Leveraging transfer learning techniques and advanced data augmentation strategies, the system ensures robust training outcomes even with limited datasets. Model interpretability techniques such as feature importance analysis are employed to offer transparency in decision-making. The system is optimized for deployment on mobile devices and in low-resource environments, increasing its accessibility for field use by researchers, conservationists, and citizen scientists. Evaluation across curated Sri Lankan datasets and selected public bird image repositories demonstrates strong classification performance, high generalization capability, and practical usability in field conditions. Results reveal substantial potential for application in ecological monitoring programs, citizen science platforms, and educational tools aimed at promoting avian awareness. The paper also discusses current limitations and outlines future development directions, including deeper multimodal fusion strategies and the potential incorporation of bird vocalization analysis for enhanced identification. To improve user engagement, a simplified interface is also under development for real-time usage in the field. This added feature aims to encourage wider adoption among non-technical users, including school students and hobbyists. The proposed system represents a significant advancement in automated bird identification for Sri Lanka, with broader implications for global conservation technologies.

Keywords— *Bird Identification, Multimodal Learning, Image Classification, Convolutional Neural Network (CNN), Interpretability*

PLEX.LK: TOURISM GAMIFICATION APPLICATION

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Abstract

Tourism plays a vital role in showcasing a country's identity, culture, and natural beauty. In Sri Lanka, a nation rich in historical landmarks, breathtaking landscapes, and vibrant traditions, a key challenge is sustaining tourist engagement beyond the first visit. Many travelers feel they have experienced all major attractions during their initial trip, resulting in low revisit rates and underexposure of hidden destinations. This project addresses this issue by introducing Plex.lk, a web-based platform that uses gamification to enhance tourist interaction with lesser-known locations across the island. The goal of this system is to increase tourist engagement through a location-based gamification platform that rewards users for visiting diverse attractions. Users earn digital points, called "plexes," by checking in at destinations ranked by difficulty. Key gamification features include point systems, digital badges, QR code check-ins, leaderboards, and a public memory wall for stories and photos. The platform integrates GPS-based location tracking, responsive design for mobile usability, a learning hub for site histories, and a visa subdomain for practical travel support. Developed using NextJS, and Tailwind CSS with MySQL as the database, the platform offers a fast, scalable, and interactive user experience. Usability testing among travelers revealed high engagement and interest in offbeat travel routes, accompanied by positive feedback on interface clarity and motivational features. Unlike traditional travel guides, Plex.lk turns exploration into an achievement-based experience that keeps users engaged even after their first visit. Plex.lk reimagines the travel journey by turning exploration into a game, encouraging deeper cultural connections and repeat visits, and serving as a distinctive tool for promoting sustainable tourism in Sri Lanka. Its scalable architecture also provides opportunities for expansion into other countries with rich cultural and ecological diversity.

Keywords: *Gamification, tourism, knowledge, location-based experience*

IVIAI: AI INTERVIEW PLATFORM

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Abstract

IVI.AI is an AI-powered interview platform that simulates real-time technical interviews through natural, voice-based interaction. It helps candidates prepare for industry-level assessments by delivering role-specific, adaptive mock interviews tailored to their domain, role, and experience. Unlike traditional text-based tools, IVI.AI offers a dynamic, voice-first experience that closely mirrors real interview scenarios. The platform is built on a modern tech stack: Next.js powers the responsive frontend, while Firebase handles secure backend services, including real-time data, hosting, and authentication with optional SSO. Google Gemini enables context-aware question generation and semantic evaluation of user responses. VAPI facilitates real-time voice synthesis and processing, enabling natural, two-way conversation between the AI and the user. What makes IVI.AI unique is its ability to adapt interview flow in real time and provide immediate feedback based on spoken answers. The system was tested with 60 participants using structured surveys and pre/post-evaluation scores. Results showed that 85% of users reported increased confidence, and 73% demonstrated improved communication and articulation. Users appreciated the platform's realism, citing its similarity to tools like Google Meet and Microsoft Teams. IVI.AI also includes a feedback dashboard that tracks progress over multiple sessions, allowing users to identify patterns and target specific weaknesses. These features collectively help users build confidence, reduce anxiety, and perform better in actual interviews. Additionally, session transcripts and AI-generated recommendations are provided after each mock interview to support reflection and continuous improvement. The platform supports a wide range of technical roles, including software engineering, data science, and cybersecurity, with questions aligned to industry standards.

Keywords: *Conversational AI, voice-based interview simulation, generative AI, AI-driven assessment platform, technical interview preparation*

AI-DRIVEN CYBER ATTACKS AND DETECTION: A COMPREHENSIVE REVIEW

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Abstract

Artificial Intelligence (AI) is increasingly reshaping the landscape of cybersecurity by enabling systems to autonomously detect, predict, and respond to a wide array of digital threats. This paper investigates the comparative effectiveness of various AI-powered detection techniques including supervised machine learning, deep learning, anomaly detection, heuristic-based models, and graph neural networks. Each technique is evaluated based on its strengths, limitations, and resilience against adversarial tactics such as data poisoning and evasion attacks. Publicly available datasets such as CICIDS2017, DARPA TC 2000, and CADETS were used to benchmark detection performance using standard metrics like accuracy, precision, recall, F1-score, and false positive rate. The study also evaluates federated learning as a privacy-preserving solution in decentralized environments, such as Internet of Things and mobile systems. A key contribution of this paper is the inclusion of a tabulated comparison of these technologies to support the final discussion and aid the reader in understanding operational trade-offs. Additionally, this research addresses the ethical and legal implications of deploying AI in cybersecurity. These include concerns over algorithmic bias, transparency, data privacy, and accountability in autonomous decision-making. While AI enhances threat detection capabilities, it also introduces new risks related to misuse, surveillance, and unjustified profiling if not properly governed. Legal frameworks such as the General Data Protection Regulation (GDPR) emphasize the need for explainability and consent in automated systems, which many current AI-based tools struggle to meet. The paper concludes by advocating for a multi-layered, ethically aligned defence framework that combines technical performance with legal compliance and societal trust. By synthesizing technical evaluation with ethical considerations, this work contributes a balanced view of AI's promise and peril in modern cybersecurity operations.

Keywords: *Artificial Intelligence, Cybersecurity, Intrusion Detection, Federated Learning, Ethics*

IOT-ENABLED SMART VERTICAL FARMING FOR SUSTAINABLE URBAN AGRICULTURE

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Abstract

This paper introduces the design, development, and test of a smart vertical farm system, which incorporates the internet of Things (IoT) technologies to measure and control the key environmental factors-light intensity, water flow, temperature, humidity, and nutrient delivery in real-time. Arduino and Raspberry Pi microcontrollers, DHT11 sensors, soil moisture sensors, and automated actuators, such as water pumps and LED grow lights were used to build a system that can be adaptive and intelligent to bring about indoors based farming. Environmental conditions could be controlled freely and in an automated manner using a user interface. The main goal of this study will be to offer an environment-friendly, space-conserving answer to an urban food production conundrum utilizing the precision agriculture approach to space-limited settings. The experiment conducted on the prototype took place in an indoor controlled environment within a 12-week window. Performance was assessed by growing the leave greens in different controlled situations and contrasting measures of growth with traditional soil farming. In important parameters, some of these were the measurements of the overall yield of the plant, water consumption, energy consumption and cost effectiveness. Findings also proved that 30 per cent of improved crop yield, 70 per cent water consumption and 50 per cent on energy consumption were achieved over traditional approaches. Also, the system was economically viable because it was estimated to pay off in less than two years. In this context, the prospect of merging IoT-based automation and real-time feedback loops into the realm of vertical farming sheds a new light on the applicability of this system to a wide range of crops and the fidelity of overlaying it onto an urban setting. The evidence contributes to the prospect of smart vertical farming as the possible efficient, cost-effective, and viable model of high-efficiency farming in resource-poor and highly populated areas, such as Sri Lanka.

Keywords: *Smart farming, IoT, vertical agriculture, precision agriculture, urban farming*

GAN-BASED SATELLITE IMAGE TAMPERING DETECTION SYSTEM WITH ELK TOOL

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Abstract

This research presents the development of a real-time satellite image tampering detection system that integrates Generative Adversarial Networks (GANs), interactive geospatial visualization, and the ELK Stack (Elasticsearch, Logstash, Kibana) for secure and transparent log monitoring. Satellite imagery is increasingly used for critical decision-making in disaster response, military surveillance, and environmental management. However, these images are susceptible to tampering using advanced artificial intelligence (AI) tools such as GANs, which can insert or modify regions to mislead interpretation. The proposed system allows users to upload single or multiple satellite images and detect anomalies based on GAN-specific visual artifacts and pixel difference analysis. It provides insight labels such as object insertion, region swap, colour anomaly, compression artifact, splicing or texture clone, enhancing interpretability for analysts. The system includes a global heatmap dashboard, animated tampering timelines, and a real-time alert module triggered by high-confidence events. All tampering data is securely logged and visualized in Kibana for forensic auditing. North Dakota was used as the pilot region due to its diverse land cover types—urban, forest, bare land, river, residential and agricultural—which enabled broad validation across real-world terrain. While the system demonstrates strong detection accuracy and operational usability, limitations include the absence of live satellite data integration, reliance on rule-based detection instead of deep learning models, and challenges in detecting highly subtle or GAN-optimized forgeries. Future improvements may involve cloud deployment, dynamic satellite API feeds, and enhanced AI models for more precise anomaly detection. Ethical and legal concerns, particularly regarding the misuse of AI for surveillance or false attribution, are addressed through transparent logging and user-controlled data handling. This project offers a scalable and explainable framework for satellite data verification, bridging the gap between image forensics and operational security intelligence.

Keywords: *satellite tampering detection, generative adversarial networks, ELK Stack, geospatial dashboard, North Dakota*

DIGITAL ORPHANAGE MANAGEMENT SYSTEM TO ENCOURAGE ADOPTIONS AND DONATIONS

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Abstract

In Sri Lanka, many orphanages continue to operate using manual or fragmented systems, resulting in inefficiencies such as lost records, poor donor transparency, delayed adoption processes, and a lack of post-adoption follow-up mechanisms. This study aims to develop a centralized, secure, and AI-assisted orphanage management information system that addresses these operational gaps. Unlike traditional digital tools, the proposed system uniquely integrates core modules—donation tracking, adoption management, legal support, and post-adoption monitoring—within a single platform. The research adopts the Design Science Research Methodology (DSRM), a user-centered development model that ensures iterative design, stakeholder involvement, and real-world validation. Primary data was collected through interviews with orphanage staff and surveys from donors and adoptive parents in the Homagama region, revealing that 67% of respondents experienced a lack of transparency in donations, while 58% noted delays in the adoption process. The system leverages decision support features powered by AI integration to analyze trends, improve user insights, and enhance service delivery across modules. Usability testing with key users is planned as part of the ongoing development process to ensure scalability, user satisfaction, and performance. This research contributes to the domain of child welfare information systems by offering a measurable and adaptable solution tailored to the Sri Lankan context. Future enhancements include integrating mobile accessibility and expanding the system across multiple districts. The findings serve as a framework for transforming orphanage operations through intelligent, responsive digital systems.

Keywords: *AI-powered orphanage management, post-adoption digital monitoring, Child welfare information systems, DSRM for social impact, Decision support system.*

"PLANTS VIEW" AI BASED PLANT AND DISEASE IDENTIFY MOBILE APPLICATIONS

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Abstract

As cities grow, it becomes harder for gardeners to observe and understand issues affecting plants and diseases. Nowadays, tools in use are limited in giving proper advice and education, as well as in suggesting personalized care, so their solutions are poorly coordinated. PLANTS VIEW bridges the gaps with an application that uses AI and supports four main features: identifying plants and diseases, recommending different tasks depending on the weather, making the experience more fun with quizzes and reinforcing learning about flowers and the environment. The program is programmed with a Convolutional Neural Network (CNN) algorithm, trained on 87,000+ images from Kaggle's New Plant Diseases Dataset in 38 categories. This deep learning model and algorithm helps diagnose diseases across plants, reaching an accuracy of 98% for powdery mildew and bacterial blight. Based on real-time data from Tomorrow.io API, local weather care can be adjusted according to temperature, humidity and UV index. Because the app is built on Flutter and Firebase, it quickly handles 2MP images (taking less than 3 seconds on mid-range phones) and provides the same performance on Android and iOS devices. The main points are that it offers authentication security, growth reminders and educational quizzes. After completing an Agile cycle of 16 weeks, the project addressed problems with PyTorch optimization and API restriction. Factors that currently limit it are the need for internet connectivity, reduced accuracy for rare species, and limited offline functionality. The following improvements will include greater detection of diseases, adding IoT sensors for soil control and adding offline capabilities. By uniting AI technology, environmental data, and educational features, PLANTS VIEW not only empowers home gardeners and farmers but also contributes to biodiversity education and sustainable agriculture.

Keywords: *AI-based plant identification, convolutional neural networks (CNNs), disease diagnosis, Kaggle plant dataset, real-time weather integration,*

GOWAY: A SMART MOBILE-BASED PUBLIC TRANSPORT SERVICE FOR URBAN SRI LANKA

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Abstract

Sri Lanka's urban bus transport system struggles with inefficient seat reservations, lack of real-time tracking, limited digital payment options, and weak emergency response, causing low user satisfaction, delays, and safety concerns. The absence of an integrated digital framework hampers modernization and accessibility of public transport services. Goway, a Flutter and Firebase-powered mobile app, revolutionizes public transport for passengers, drivers, and administrators. It offers real-time bus tracking, QR-based digital payments via a secure in-app wallet, and live trip monitoring. Unique safety features include GPS-enabled emergency alerts, location-aware complaint submission with photo/video support, and automated email notifications to authorities. Enhanced features include offline mode for accessing schedules and tickets in low-connectivity areas, crowd density indicators for informed trip planning, accessibility tools like voice navigation and screen reader support, driver feedback for service quality enhancement, trip planning with optimal route and time suggestions, in-app chat for real-time passenger-driver communication, eco-tracking to display carbon footprint savings, lost-and-found functionality for item recovery, dynamic fare adjustments based on demand or promotional offers, predictive maintenance alerts for vehicle reliability, and user behavior analytics for optimizing routes and schedules. These features ensure safety, transparency, and convenience, making Goway a holistic solution for modernizing Sri Lanka's public transport system. Rigorous testing validated Goway's performance. A study with 150 participants (passengers and drivers) reported a 77% satisfaction rate, with 87% favoring digital wallet transactions over cash, confirming its effectiveness in addressing critical pain points. By leveraging mobile technology with a user-centric design, Goway sets a precedent for digitally transforming public transport in developing regions, enhancing efficiency, safety, and accessibility.

Keywords: *smart public transport, location tracking, QR fare system, real-time tracking, emergency response.*

ENHANCING STUDENT SERVICES LLMS WITH RAG: A SYSTEMATIC REVIEW

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Abstract

In the higher education sphere, there is an increasing need for scalable, convenient, and responsive support for student queries, yet traditional systems often fail these requirements, bound by static knowledge, high hallucination rates, and limited adaptability and inflexible delivery mechanisms. These insights highlight how AI systems must evolve beyond static training to dynamically align with student needs. In this paper, themes such as Natural Language Processing (NLP) and academic assistance is studied through forty-two scholarly papers published through the period of 2008 to 2024. This facilitates an in-depth analysis of a system, which utilizes the Retrieval-Augmented Generation (RAG) architecture as an innovative model for standing out in terms of knowledge updating, adaptability, and efficiency while delivering academic, administrative, and well-being support in the higher education field is explored. Coupled with large language models (LLMs) and real-time semantic retriever, RAG supports the generation of accurate, contextual, and personalized responses. A detailed theme analysis centered on the multiple use cases in the domains of academic advising, career counseling, and mental health advising underscores the immense potential of RAG, or Retrieval-Augmented Generation. This potential encompasses the ability to successfully minimize the incidences of hallucinations, which may hamper communication, automate responses that are of little value, and foster a sense of information equity among the students from varied backgrounds and with different abilities. The ethical considerations related to privacy, transparency, and bias unavoidable in the rollout and embedding of artificial intelligence in learning environments are thoroughly addressed. Challenges related to implementation and practical considerations for the application are critically analyzed. The findings unveil an innovative model for the ethical embedding of AI in learning environments and identify directions for future work in multimodal RAG and human-AI collaboration.

Keywords— *Retrieval-Augmented Generation, large language models, thematic analysis, reduced hallucinations, artificial intelligence in learning environments*

NOTESNAP-AI POWERED CHROME EXTENSION FOR WEB-BASED NOTE-TAKING AND SUMMARIZATION

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Abstract

In the context of increasing reliance on browser-based information access, tools for seamless in-browser notetaking and summarization remain scarce. NoteSnap is a novel Chrome extension that enables users to capture, categorize, summarize, and export web-based content without disrupting their browsing flow. A pre-development survey conducted with 31 participants including students (51.6%), professionals, and independent learners revealed that although web content is heavily used, only 32.3% of users had a consistent method for organizing copied information. These insights directly influenced the development of NoteSnap. Built using HTML, CSS, JavaScript, and Chrome Extensions API, the tool enables right-click note creation, editable fields, collapsible category views, and color-coded categorization. A backend server developed with Node.js and hosted on DigitalOcean integrates securely with OpenAI's ChatGPT API, allowing users to receive real-time AI-generated summaries of their notes. Additionally, a PDF export feature was integrated using jsPDF to allow users to create polished, branded documents that include their original and summarized content. Notes are stored using Chrome's local storage, maintaining user privacy while ensuring offline availability. Compared to broader tools like Notion or Google Keep, NoteSnap's focused in-browser functionality, AI integration, and export capabilities set it apart as a lightweight but powerful solution for modern information workflows. The final product achieved all its development objectives and addressed key usability concerns revealed in the initial research. It demonstrates that when browser-native solutions are designed with minimalism, automation, and accessibility in mind, they can significantly improve how users manage and retain knowledge online.

Keywords: *Browser Extension, Note Organization, Digital Note Management, AI Summarization, Chat GPT Integration*

CRYPTOGRAPHY IN SECURE CLOUD COMPUTING

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Abstract

Abstract Cloud computing has revolutionized data storage and access, offering scalable and efficient solutions across industries. However, it also introduces critical challenges concerning data confidentiality, integrity, and security. As sensitive information increasingly migrates to cloud platforms, robust cryptographic strategies become essential to protect data both at rest and in transit. This study explores the evolution and performance of encryption techniques in cloud computing, with a focused analysis on emerging cryptographic trends. Traditional symmetric encryption algorithms, such as AES, offer high-speed encryption but pose risks in key distribution and scalability. Asymmetric algorithms, while secure for key exchange, suffer from computational overhead. To address these limitations, our review narrows in on homomorphic encryption—a transformative approach that allows computations on encrypted data without decryption. Despite its promising capabilities for privacy-preserving operations, homomorphic encryption incurs significant performance costs. Through comparative analysis with traditional encryption schemes, we examine trade-offs in latency, storage, and computational requirements. Furthermore, the study briefly evaluates post-quantum cryptographic algorithms designed to withstand quantum-level threats, emphasizing the need for forward-compatible systems. An overview of recent research (2023–2025) on key management best practices is also presented, including hierarchical key structures and cloud-native key vaults. Our findings indicate that while no single method offers a complete solution, hybrid models combining classical and advanced techniques show potential for balancing performance and security. The study contributes to the field by synthesizing current cryptographic practices in the cloud, highlighting experimental results from recent benchmarks, and proposing considerations for future implementations in secure cloud environments. This abstract provides a concise overview of our analysis aimed at improving the reliability and resilience of cloud cryptographic infrastructure through modern innovations.

Keywords: *Cloud Computing, Homomorphic Encryption, Cryptographic techniques, Data Security, Post-Quantum cryptography*

THE ROLE OF CRYPTOGRAPHY IN BLOCKCHAIN: ENSURING IMMUTABILITY, TRANSPARENCY AND SECURITY

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Abstract

This review paper discusses the essential role of cryptography in blockchain technology, providing a detailed exploration of how cryptographic methods ensure the security, integrity, and functionality of blockchain systems. It offers a comprehensive analysis of the synergistic relationship between blockchain and cryptography, emphasizing their combined ability to enable critical features such as immutability, transparency, and trust in decentralized networks. The paper examines the application of key cryptographic techniques, including hashing algorithms like SHA-256 and Keccak-256, asymmetric cryptography with public-private key pairs, digital signatures, and symmetric cryptography, highlighting their roles in securing data integrity, authenticating users, ensuring transaction non-repudiation, and enabling secure communication. Hashing algorithms facilitate tamper-proof block chaining and efficient transaction verification through Merkle trees, while digital signatures provide robust authentication and prevent unauthorized transaction modifications. The review also critically assesses the strengths of cryptography in blockchain, such as its effectiveness in preventing double-spending and supporting transparent, auditable ledgers, alongside limitations like vulnerabilities to quantum computing advancements and complexities in private key management. Real-world use cases, including supply chain management such as IBM Food Trust for food traceability and healthcare, demonstrate the practical impact of cryptographic techniques in enhancing transparency, security, and efficiency. The paper further explores future directions, including the development of post-quantum cryptography to address quantum computing threats, advanced privacy-preserving techniques like zero-knowledge proofs exemplified by zk-SNARKs and the integration of blockchain with emerging technologies such as the Internet of Things and Artificial Intelligence. These advancements aim to overcome current scalability, privacy, and efficiency challenges. The review concludes by emphasizing cryptography's indispensable role in underpinning blockchain's core value propositions of security, transparency, and trust, offering valuable insights for researchers, practitioners, and stakeholders seeking to understand and advance the evolving landscape of blockchain technology.

Keywords: *Blockchain, Cryptography, Hashing Algorithms, Asymmetric Cryptography, Digital Signatures*

A DIGITAL REDISTRIBUTION PLATFORM FOR SURPLUS AGRICULTURAL PRODUCE: REDUCING WASTE AND EMPOWERING FARMERS

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Abstract

Surplus agricultural produce poses a persistent challenge worldwide, leading to significant food waste and economic losses for farmers. Addressing this issue requires innovative solutions that can efficiently redistribute excess produce to reduce waste and improve farmers' livelihoods. This paper presents the design and development of a digital platform aimed at facilitating the redistribution of surplus agricultural produce by connecting farmers with diverse buyers such as wholesalers, retailers, charities, and community organizations. The platform leverages user-centered design principles to create an intuitive interface that supports produce listing, price negotiation, and logistics coordination, thereby optimizing supply chains and enhancing market access for farmers. The study employs a mixed-methods approach, combining quantitative data from surveys and platform analytics with qualitative insights from stakeholder interviews. Key variables analyzed include farmer-specific factors (surplus quantity, digital literacy), buyer characteristics (demand volume, price sensitivity), platform usability, and outcome measures such as reduction in post-harvest losses and changes in farmer income. Preliminary findings indicate that seamless logistics integration and transparent pricing mechanisms significantly enhance user engagement and trust. The redistribution facilitated by digital platforms has been shown to reduce food waste substantially while opening new markets for farmers, thereby increasing their income. However, challenges such as digital literacy gaps and the need for reliable delivery infrastructure remain critical barriers. The discussion addresses how the proposed platform design mitigates these challenges and explores the environmental and economic impacts of surplus produce redistribution. In conclusion, the digital platform developed in this research offers a scalable and sustainable solution to the global problem of agricultural surplus. By connecting surplus producers with a broad spectrum of buyers and incorporating efficient logistics, the platform contributes to food security, waste reduction, and farmer empowerment. Future research should focus on expanding the platform's reach, enhancing digital literacy among farmers, and integrating advanced technologies such as the Internet of Things (IoT) for real-time produce tracking and supply chain optimization.

Keywords— *Surplus agricultural produce, Digital platform, Food waste reduction, Farmer livelihoods, Supply chain optimization*