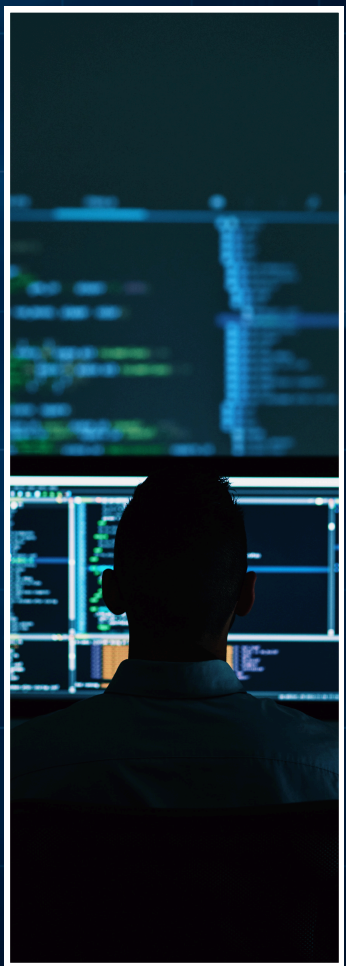
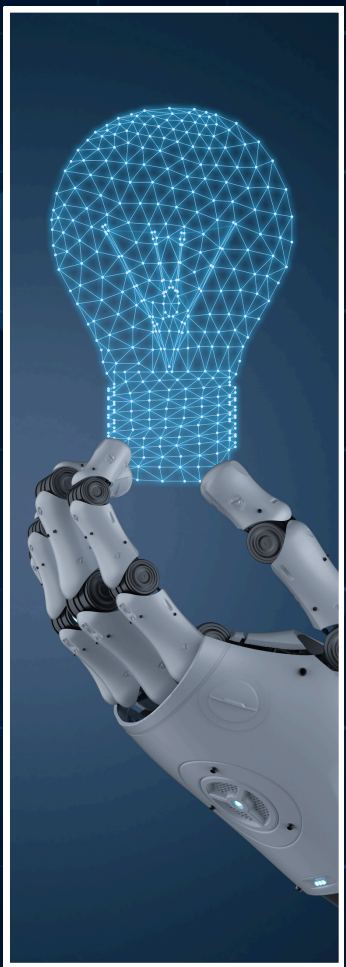
BOOK OF ABSTRACTS

1ST UNDERGRADUATE RESEARCH COLLOQUIUM - 2025

"Innovating the Future: Empowering Society through Digital Transformation"

17th-19th November 2025





DEPARTMENT OF INFORMATION & COMMUNICATION TECHNOLOGY
FACULTY OF TECHNOLOGY
SOUTH EASTERN UNIVERSITY OF SRI LANKA

URCDICT 2025

Book of Abstracts

1st Undergraduate Research Colloquium of DICT 2025

November 17th - 19th, 2025

"INNOVATING THE FUTURE: EMPOWERING SOCIETY THROUGH DIGITAL TRANSFORMATION"

Department of Information and Communication Technology
Faculty of Technology
South Eastern University of Sri Lanka
Sri Lanka

URCDICT 2025

1ST UNDERGRADUATE RESEARCH COLLOQUIUM OF DICT
SOUTH EASTERN UNIVERSITY OF SRI LANKA - NOVEMBER 17TH-19TH, 2025

Title : *URCDICT 2025, Book of Abstracts*

Published by : *Department of ICT, Faculty of Technology*
South Eastern University of Sri Lanka
Sri Lanka

Pages : *(XVII+63) Pages*

Layout : Ms. A.R. Fathima Shafana
Mr. K.K.Y.M. Alawathugoda

Cover Design : Mr. R.M.N. Rathnayaka
Ms. A.R. Fathima Shafana

ISBN : 978-955-627-147-8

e-ISBN : 978-955-627-148-5

Colloquium Secretariat
1st Undergraduate Research Colloquium of DICT - 2025
Department of ICT, Faculty of Technology,
South Eastern University of Sri Lanka
University Park
Oluvil #32360
Sri Lanka.

© South Eastern University of Sri Lanka 2025
This work is subject to copyright. All the rights are reserved by the publisher. Nothing in this work may be reproduced in any form, any part or as a whole, without express a written permission from the publisher.

Disclaimer
The views expressed remain the responsibility of the named authors and do not necessarily reflect those of publisher.

COLLOQUIUM EDITORIAL TEAM

CHIEF EDITOR
Mr. R.K. Ahmadh Rifai Kariapper

CO-EDITOR
Ms. A.R. Fathima Shafana

EDITORIAL TEAM MEMBERS

Mr. S.L. Abdul Haleem

Ms. M.S. Shafana

Dr. I.M. Kalith

Ms. A. Fathima Musfira

Ms. A. Fathima Sharfana

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

URCDICT 2025

CHAIRMAN

Mr. R.K. Ahmadh Rifai Kariapper
Head, Department of ICT
Faculty of Technology
South Eastern University of Sri Lanka

KEYNOTE SPEAKER

Dr. Veerachai Tanpipat (D.Eng.)
Senior Expert – Faculty of Forestry
Kasetsart University
Thailand

GUEST SPEAKER

Prof. S. Vasanthapriyan (PhD, SMIEEE)
Professor in Computing
Faculty of Computing
Sabaragamuwa University of Sri Lanka

COORDINATOR

Mr. M.J. Ahamed Sabani
Senior Lecturer
Department of ICT
South Eastern University of Sri Lanka

SECRETARY

Mr. M.S.S. Razeeth
Lecturer (Prob.)
Department of ICT
South Eastern University of Sri Lanka

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

COLLOQUIUM STEERING COMMITTEE

Mr. R.K. Ahmadh Rifai Kariapper	**CHAIRMAN**
Mr. M.J. Ahamed Sabani	**COORDINATOR**
Mr. M.S.S. Razeeth	**SECRETARY**
Mr. A. Mohamed Aslam Sujah	**TREASURER**

TRACK COORDINATORS

Mr. S.L. Abdul Haleem	Ubiquitous Computing Technologies (UCT)
Ms. M.S. Shafana	Network and Security Technologies (NST)
Dr. I.M. Kalith	Software Technologies (SWT)
Ms. A. Fathima Musfira	Multimedia and Gaming Technologies (MGT)
Ms. A. Fathima Sharfana	Artificial Intelligence Technologies (AIT)

COLLOQUIUM WORKING COMMITTEE

Mr. R.M.N. Rathnayaka
Mr. M.R.M. Hanan
Ms. R. Nivitha
Ms. M.V.D.P.D. Malawana
Mr. K.K.Y.M. Alawathugoda
Ms. U.A.F. Munaffara
Mr. J.A. Aathil

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

LIST OF REVIEWERS

Dr. I. M. Kalith, *Dept. of ICT, SEUSL*

Dr. M. M. Mohamed Mufassirin, *Dept. of Computer Science, SEUSL*

Mr. M. J. Ahamed Sabani, *Dept. of ICT, SEUSL*

Mr. R. K. A. R. Kariapper, *Dept. of ICT, SEUSL*

Mr. S. L. Abdul Haleem, *Dept. of ICT, SEUSL*

Mrs. A. Fathima Musfira, *Dept. of ICT, SEUSL*

Mrs. A. R. Fathima Shafana, *Dept. of ICT, SEUSL*

Mrs. M.S. Faathima Fayaza, *Dept. of IT, SEUSL*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

MESSAGE FROM THE VICE CHANCELLOR

It gives me great pleasure to extend my warm greetings to all participants of the first-ever Undergraduate Research Colloquium organized by the Department of Information and Communication Technology (DICT), Faculty of Technology. This inaugural event, featuring research contributions from the 2018/2019 final year ICT students, represents an important step in strengthening undergraduate research within the University.

The theme "Innovating the Future: Empowering Society through Digital Transformation" aptly captures the spirit of the times. As digital technology continues to transform education, industry, and social systems, this colloquium provides a much-needed platform for our students to share their findings and exchange ideas.

I take this opportunity to commend the Department of Information and Communication Technology for its foresight in initiating this academic forum and for its continuous commitment to cultivating a culture of knowledge dissemination through research and collaboration. The Department's efforts exemplify how higher education can empower students to engage in research that bridges theoretical learning with practical application.

To the student presenters, I encourage you to view this moment as the beginning of a scholarly journey that nurtures critical thinking, creativity, and lifelong learning. May your work continue to inspire future generations of researchers in the field of Information and Communication Technology.

I extend my sincere appreciation to the organizing committee for their dedication which made this event possible. I wish every success to this inaugural colloquium and the academic endeavors it will inspire.

Prof. S.M. Junaideen
The Vice Chancellor,
South Eastern University of Sri Lanka
Sri Lanka.

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

MESSAGE FROM THE DEAN

It is with great pleasure and honor that I present this message to the book of abstract of the maiden colloquium -2025 of the Department of information Communication Technology of the Faculty of Technology. This annual event stands as a testament to students' intellectual curiosity, creativity and commitment to academic excellence. The work showcased reflects here not only the academic knowledge they gained but also their ability to question, explore and contribute meaningful to their respective fields.

As a faculty, we take pride in nurturing a vibrant academic culture where inquiry is encouraged and innovation thrives. The research presented in this colloquium highlights the diverse talents of our students and their potential to address real world challenges through scientific thinking, critical analysis and ethical scholarship. I extend heartfelt appreciation to the student presenters, their supervisors, academic staff and the organizing committee for their hard work, commitment and dedication in making this event a success.

May this colloquium inspire our students to continue their pursuit of their knowledge and excellence and may it serve as a foundation for their future research endeavors.

I wish all participants a rewarding and enriching experience.

Dr. U. L. Abdul Majeed
Dean, Faculty of Technology
South Eastern University of Sri Lanka
Sri Lanka.

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

MESSAGE FROM THE CHAIRMAN

It gives me immense pleasure to extend my warmest greetings to all participants of the First Undergraduate Research Colloquium, organized by the Department of Information and Communication Technology, Faculty of Technology, South Eastern University of Sri Lanka, under the theme "Innovating the Future: Empowering Society through Digital Transformation."

This event marks a remarkable milestone in the department's journey, which, within just nine years since its inception, has demonstrated an exceptional commitment to fostering research culture and academic excellence among undergraduates. The tireless efforts of the academic staff and the organizing committee deserve the highest commendation for transforming this vision into reality within such a short period.

To our budding researchers, this colloquium serves as an ideal platform to showcase their creativity, innovative thoughts, and research capabilities. The world is rapidly evolving through advances in digital technologies, and the active engagement in modern ICT domains will play a vital role in shaping the future. Use your undergraduate years wisely to explore emerging technologies, enhance your soft and technical skills, and cultivate a lifelong passion for problem-solving. Your contributions to today's digital transformation journey will not only empower society but also define your professional and academic success. Let this be the beginning of a continuous legacy of innovation, research, and excellence within the department.

I convey my heartiest congratulations to the Department of Information and Communication Technology and its dedicated staff for this remarkable initiative, and I wish the department continued success in organizing this undergraduate colloquium in the years to come.

Mr. R.K. Ahmadh Rifai Kariapper
Chairman / URCDICT2025
Head, Department of ICT
Faculty of Technology
South Eastern University of Sri Lanka
Sri Lanka.

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

MESSAGE FROM THE COORDINATOR

It is with immense satisfaction that I introduce the First-ever Undergraduate Research Colloquium of DICT, organized by the Department of Information and Communication Technology, Faculty of Technology, South Eastern University of Sri Lanka. This inaugural event marks a significant step forward in promoting a research-oriented academic environment within the Department and provides a structured platform for students to share their innovative ideas and scholarly work.

The 2018/2019 ICT student intake deserves special recognition as the pioneering group to contribute their undergraduate research to this colloquium. Their studies, guided by dedicated supervisors and evaluated by academic experts, reflect both the depth of inquiry and the enthusiasm to address real-world challenges through technological innovation.

The theme “Innovating the Future: Empowering Society through Digital Transformation” embodies the essence of the Department’s vision to develop graduates capable of leading digital change with creativity, responsibility, and social awareness. By engaging in research and presentation, our students learn not only to solve problems but also to communicate their findings effectively and think beyond disciplinary boundaries.

I wish to express my sincere appreciation to the Vice Chancellor, the Dean of the Faculty of Technology, and the Head of the Department for their guidance and encouragement, to our keynote and guest speakers for their invaluable insights, and to the academic staff and organizing committee whose collective dedication has made this event a reality.

May this colloquium serve as a lasting foundation for nurturing research excellence among our undergraduates and inspire continued exploration and innovation in the field of ICT.

Mr. M.J. Ahamed Sabani
Coordinator / URCDICT2025
Department of ICT
Faculty of Technology
South Eastern University of Sri Lanka
Sri Lanka.

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

ABSTRACT AND MESSAGE FROM THE KEYNOTE SPEAKER

Today, digital transformation is one of the biggest forces shaping how we live, work, and connect with one another. It's not just about using new technologies—it's about changing the way people think, learn, and grow together. By combining innovation with human creativity, digital transformation gives us the tools to solve problems, improve lives, and create a fairer, resilient, and more sustainable world.

At its core, digital transformation means bringing modern technologies—like artificial intelligence (AI), cloud computing, data analytics, and the Internet of Things (IoT)—into daily life. These tools make work faster and smarter, help people make better decisions, and inspire new ideas. In education, online learning platforms make knowledge accessible to everyone, no matter where they live or what their background is. In healthcare, telemedicine and data-driven solutions make medical care more effective and easier to reach. In government, digital systems promote transparency, participation, and accountability, helping build trust between citizens and institutions.

However, the real strength of digital transformation isn't just in the technology—it's in the people who use it. Innovation only matters when it improves lives, empowers communities, and helps everyone learn and grow. A truly digital society isn't just connected; it's confident, ethical, and inclusive. That's why education and digital literacy are so important—they ensure that everyone can benefit from technological progress, not just a few.

Standing at the crossroads of technology and humanity, we are invited to innovate with purpose and empathy. Digital transformation can help us face global challenges like climate change, inequality, and public health by encouraging collaboration and the sharing of knowledge. When used wisely and compassionately, technology can bring out the best in humanity—our creativity, resilience, and shared drive for progress.

The Asia Pacific Advanced Network (APAN) is a great example of this vision in action. It's an international partnership of National Research and Education Networks (NRENs) across the Asia-Pacific region, covering over half of the world's population. APAN supports high-speed internet connectivity for research and education and promotes collaboration through various Working Groups and Task Forces. These groups focus on areas such as agriculture, disaster mitigation, e-culture, open data for science, telemedicine,

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

cloud computing, IoT, AI, 5G, and more. Everyone—researchers, students, industry professionals, government, and the public—is welcome to take part.

"When societies embrace digital change with wisdom and compassion, technology becomes a bridge—not a barrier. Ultimately, digital transformation is not just about machines, codes, or data—it's about people. It's about how we use technology to create opportunities, solve real-world problems, build a resilient and sustainable future. The future will belong to those who innovate responsibly, keep learning, and work together for the common good. Guided by ethics, compassion and vision, digital transformation becomes more than progress—it becomes a path toward shared prosperity, hope, equality, sustainability, and human fulfillment."

"It is Climate Crisis! Disasters and severe events are inevitable. Building resilience and sustainability among us is our ultimate goal for dealing with future climate uncertainties and extreme events - We are all in different boats, but we are in the same storm!! All hands on desk!!! Think Globally & Act Locally!! Imagine what we can accomplish when we work together. Stronger Together!! One For All and All for One!!!"

Dr. Veerachai Tanpipat (D.Eng.)
Senior Expert – Faculty of Forestry
Kasetsart University
Thailand

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

MESSAGE FROM THE GUEST SPEAKER

It is with great pleasure and deep admiration that I extend my warmest greetings to all participants of the first-ever Undergraduate Research Colloquium of DICT organized by the Department of Information and Communication Technology, Faculty of Technology, South Eastern University of Sri Lanka. The chosen theme, "Innovating the Future: Empowering Society through Digital Transformation" is both timely and visionary, reflecting the immense potential of our young scholars to shape the digital landscape of tomorrow.

To the undergraduates presenting their research, I congratulate you for reaching this significant milestone. Your dedication, creativity, and resilience are visible in the work you showcase today. I encourage each of you to continue exploring the vast and rapidly evolving domains of ICT—artificial intelligence, data science, cybersecurity, cloud computing, mobile solutions, Internet of Things, and beyond. These areas are not only transforming industries but redefining the way societies function. Engaging with such fields now will position you as strong contributors and innovators in the digital era. Your undergraduate years are among the most valuable periods of your life. Use this time wisely to strengthen your technical competencies, refine your research abilities, and build a mindset of lifelong learning. Seek opportunities that challenge you, collaborate with peers and mentors, and continually polish the skills required to thrive in the future world of ICT. The trends ahead demand adaptability, creativity, and a commitment to staying ahead of technological shifts.

I also extend my heartfelt appreciation to the Department of ICT and its dedicated staff members for successfully initiating this remarkable colloquium within just nine years of the department's establishment. This achievement demonstrates vision, unity, and a strong commitment to student development.

I wish the department continued success and sincerely hope that this Undergraduate Research Colloquium becomes a lasting annual tradition that inspires generations to come.

Prof. S. Vasanthapriyan, PhD, SMIEEE
Professor in Computing
Faculty of Computing
Sabaragamuwa University of Sri Lanka

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

FIRST UNDERGRADUATE RESEARCH COLLOQUIUM OF DICT 2025

DEPARTMENT OF ICT | FACULTY OF TECHNOLOGY | SEUSL

"Innovating the Future: Empowering Society through Digital Transformation"

The Undergraduate Research Colloquium of DICT- 2025, organized for the first time by the Department of Information and Communication Technology (ICT), Faculty of Technology, South Eastern University of Sri Lanka (SEUSL), marks a significant milestone in promoting research and innovation among undergraduates. This inaugural event provides an inspiring platform for students to present their work, exchange ideas, and contribute to shaping a society strengthened by technological progress and digital empowerment.

This year's colloquium features 57 abstracts, representing diverse and forward-looking studies across five thematic tracks: *Artificial Intelligence Technologies, Multimedia and Gaming Technologies, Network and Security Technologies, Software Technologies, and Ubiquitous Computing Technologies*. Each track highlights emerging and globally relevant research directions within ICT.

The Artificial Intelligence (AI) Technologies track presents 14 papers focusing on machine learning, intelligent systems, and data-driven solutions addressing real-world challenges. The Multimedia and Gaming Technologies (MGT) track, comprising 9 papers, emphasizes Human–Computer Interaction (HCI), user experience, game development, and interactive design. The Network and Security Technologies (NST) track includes 9 papers dealing with cybersecurity, secure communication, and network performance enhancement. The Software Technologies (SWT) track, with 11 papers, explores innovative software design, development methodologies, and practical system implementations. Finally, the Ubiquitous Computing Technologies (UCT) track, featuring 14 papers, investigates emerging trends in pervasive systems, smart devices, and context-aware computing environments.

Collectively, these research contributions demonstrate the creativity, analytical ability, and dedication of young scholars in advancing technological solutions for societal benefit. The 1st Undergraduate Research Colloquium of DICT (URCDICT 2025) stands as a platform that nurtures innovation, encourages collaboration, and empowers the next generation of ICT professionals to lead transformative change for a sustainable future.

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

TABLE OF CONTENTS

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

TRACK – AI TECHNOLOGIES

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

IoT and Mobile Application-Driven Decision-Making for a Smart Paddy Measurement and Pricing System for Agricultural Efficiency in Sri Lanka

C.R.H.V. Ranaweera[1] and I.M. Kalith[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]hishanvimukthi888@gmail.com, [2]imkalith@seu.ac.lk

Abstract

Sri Lanka's paddy industry faces persistent challenges stemming from outdated manual measurement and pricing practices that compromise transaction transparency and farmer livelihoods. Traditional weighing methods suffer from human error, subjective moisture assessments, and inadequate record-keeping, creating disputes between farmers and buyers while hindering fair market participation. This research addresses these critical gaps through the development of an integrated Smart Paddy Measurement and Pricing System that combines Internet of Things sensor hardware with a comprehensive mobile application platform supported by cloud-based real-time data synchronization. The proposed system employs ESP32 microcontroller-based load cells and moisture sensors for precise field measurements, interfacing with a React Native mobile application that serves farmers, buyers, and administrators through role-specific dashboards. Firebase manages secure authentication, real-time database synchronization, and cloud storage, ensuring robust data integrity and multistakeholder accessibility. The methodology encompasses hardware design and calibration, firmware development for automated measurement workflows, cross-platform mobile application construction with offline capabilities, and comprehensive backend integration validated through systematic testing protocols. Implementation results demonstrate consistent measurement accuracy with real-time dashboard updates, enabling transparent price computation based on weight and moisture parameters, comprehensive digital record-keeping, and GPS-enabled supply chain traceability. The cloud-native architecture ensures scalability while maintaining data security through role-based access controls. This integrated technological solution enhances agricultural decision-making by reducing information asymmetry, supporting fair transactions, and providing data-driven insights for policy development. The research contributes a scalable reference framework for smart agricultural measurement systems, demonstrating practical pathways toward digital transformation that empower smallholder farmers and strengthen agricultural efficiency in developing economies.

Keywords: *Agricultural Efficiency, Cloud Data, Internet of Things, Mobile Application Paddy Measurement, Smart Agriculture, Synchronization*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

NLP based University Grants Commission Circular Recommendation System for Case Scenario Analysis in Sri Lanka

G. Malki Ishadi[1] and A. Mohamed Aslam Sujah[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]malkiishadi19@gmail.com, [2]ameersujah@seu.ac.lk

Abstract

The increasing number of University Grants Commission (UGC) circulars in Sri Lanka has made it hard for academics and administrative staff to quickly find relevant policy documents. Traditional search methods like keyword based or TF-IDF searches cannot understand the real meaning of the text, which often causes delays in decision making and confusion about rules. This study developed a semantic recommendation system using Natural Language Processing (NLP) to match user submitted case descriptions with related circulars based on meaning, not just keywords. The system used a Sentence BERT (SBERT) model that was optimized to measure how similar two pieces of text are in meaning. Circular data was collected, cleaned, and standardized from multiple excel files through a detailed data pipeline. Then, rule-based regular expressions were used to organize the circulars into twenty main categories. Since there was no labeled data available, more than 1,000 artificial case descriptions were created using templates and random variations to represent real administrative queries. The system measured the similarity between circulars and cases using cosine distance within a shared embedding space, which allowed both binary classification and ranked retrieval. The model performed very well, achieving 91.2% accuracy, 88.5% recall, 89.8% F1-score, and 90.3% top-1 precision. A lightweight web interface was developed using Gradio to provide real-time recommendations in a simple and user-friendly way. Overall, the study shows that transformer-based models like SBERT can effectively close the semantic gap in legal and administrative text retrieval. The proposed system offers a domain-specific, scalable, and explainable framework that can improve accessibility and decision making in higher education governance and beyond.

Keywords: *Information Retrieval, Natural Language Processing, Semantic Similarity, Sentence BERT, Transformer Model, UGC Circulars*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Enhance Sinhala Hand-Written Character Recognition using Hybrid Model

K. D. L. Prasanna[1] and A. Mohamed Aslam Sujah[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]lakmalprasannakd@gmail.com, [2]ameersujah@seu.ac.lk

Abstract

Recognizing handwritten Sinhala characters has become an important challenge in connecting language communities with modern technology. Although machine learning has advanced rapidly, Sinhala Optical Character Recognition (OCR) still struggles with the script's complex shapes, curved letters, and many different forms. Traditional methods that rely on manually designed features and small training datasets often fail to capture these variations. This study compares three deep learning models for recognizing isolated handwritten Sinhala characters: a basic Convolutional Neural Network (CNN), a Long Short-Term Memory (LSTM) based Recurrent Neural Network (RNN), and a combined CNN-LSTM hybrid model. The dataset used in this study includes a wide range of handwriting styles. A detailed preprocessing pipeline was applied to clean and expand the dataset, adding realistic noise and variations to simulate real-world handwriting conditions. Experimental results show that the plain CNN achieved the best accuracy for single character recognition, while the CNN-LSTM hybrid showed strong potential for handling sequential or continuous text. These findings confirm that deep learning provides a powerful foundation for Sinhala OCR and sets a new standard for future research. The outcomes of this work have practical applications such as digitizing historical manuscripts, automating administrative tasks, and developing inclusive assistive technologies. By addressing challenges related to script complexity, limited data, and model design, this research not only improves OCR performance but also helps preserve cultural heritage and promote digital equality.

Keywords: *CNN-LSTM Hybrid Model, Deep Learning, Hand-written Character Recognition, Sinhala Language OCR*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Environmental Factor Forecasting with Multivariate Time Series Analysis

Tharuka Anjalee Pathiranage[1] and A. Mohamed Aslam Sujah[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]anjaleetharu56@gmail.com, [2]ameersujah@seu.ac.lk

Abstract

Under growing environmental stress, correct environmental prediction has become vital for agriculture planning, disaster preparedness, and climate monitoring. Ignoring natural interdependencies between factors like temperature, humidity, and dew point, traditional univariate forecasting approaches examine variables separately, hence producing erroneous projections. This study overcomes these constraints by means of deep learning algorithms and multivariate time series analysis. Three sophisticated recurrent neural network designs such as Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU), and Transformer models were produced using over 17,000 historical environmental data points to capture temporal dependencies and cross variable interactions. The approach combines deep learning architectures best suited for short-term (24-hour) and medium-term (7-day) forecasting horizons with thorough data gathering, preprocessing with feature engineering and normalizing. Mean Absolute Error, Root Mean Squared Error, and Coefficient of Determination metrics were used to assess the performance of the model. Results indicate that with their good capture of long-term dependencies, notably in 7-day projections, LSTM networks beat traditional univariate methods in general. GRU models provided computational efficiency with competitive accuracy; Transformer models showed good performance without going above LSTM overall. Furthermore, a mobile application called "WeatherPop" was created using Android Studio and TensorFlow Lite to allow users to access predicted information and environmental statistics via on-device inference. Establishing a thorough framework, this study turns environmental prediction from responsive to proactive, therefore promoting climate resilience and sustainable environmental management as well as increasing accessibility via mobile phone integration.

Keywords: *Climate Monitoring, Environmental Forecasting, GRU Network, LSTM Networks, Multivariate Time Series Analysis, Transformer Model*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Development of NLP based Legal Act Recommendation System for Employee Case Scenario Analysis in Sri Lanka

G. Kajana[1] and A. Mohamed Aslam Sujah[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]gunaretnamkajana@gmail.com, [2]ameersujah@seu.ac.lk

Abstract

Employees in Sri Lanka are increasingly concerned about legal issues at work, but the country's legal system is so complicated, it can be difficult to determine which laws and sections apply to their circumstances. Many workers are unaware of their legal rights and have little access to professional legal counsel. The goal of this project is to create a Natural Language Processing (NLP) based Legal Act Recommendation System that would evaluate natural language employee case scenarios and provide the most pertinent labor laws and legal provisions in Sri Lanka. In order to comprehend the contextual meaning of user inputs and connect them to pertinent legal laws, the system combines sophisticated NLP and machine learning techniques, namely utilizing the BERT (Bidirectional Encoder Representations from Transformers) model. Real and fictitious employee complaints were matched to relevant Sri Lankan labor legislation to build a thoroughly controlled dataset. Linguistic consistency and data quality were guaranteed by extensive preparation procedures, such as tokenization, lemmatization, and stop-word removal. Strong dependability in legal text classification is demonstrated by the trained model's remarkable 90% accuracy and balanced performance across precision, recall, and F1-score. Using Streamlit and FastAPI, a user-friendly web-based platform was created that enables staff members to enter their problems in plain language and promptly receive recommendations for pertinent acts. The system's ability to bridge the gap between regular employees and intricate legal documentation was validated by the system's performance review. Overall, by providing an intelligent, approachable, and context-aware legal assistance tool that improves legal literacy, equips workers with fundamental legal knowledge, and promotes fair access to justice within Sri Lanka's workforce, this research makes a substantial contribution to AI driven legal informatics.

Keywords: *Employee Law, Legal Act Recommendation, Machine Learning, Natural Language Processing*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Sentiment Analysis of Tourist Feedback in Sri Lankan Tourism using Machine Learning and Natural Language Processing

M. F. Fathima Thahzeen[1] and A. Mohamed Aslam Sujah[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]fathimathahzeen898@gmail.com, [2]ameersujah@seu.ac.lk

Abstract

The study was undertaken in tourist reviews on Google Maps platform which have become crucial for understanding what tourists think about hotel service quality, but the large volume of reviews make manual analysis impractical. This research analyzes feedback from tourists in Sri Lankan hotels using sentiment analysis with Machine Learning (ML) and Natural Language Processing (NLP) techniques. A dataset of 5,000 real user reviews from September 2024 to November 2024 in English language, primarily collected from Google Maps, was compiled and carefully preprocessed including tokenization, stopping word removal, and lemmatization to enable accurate text classification. Several Machine Learning models including Naive Bayes, Support Vector Machine, Logistic Regression were trained using TF-IDF feature extraction, while a transformer-based model (DistilBERT) was fine-tuned to better capture complex contextual sentiment. The accuracy, precision, recall, and F1-score of the models were rigorously evaluated; DistilBERT achieved an impressive accuracy of 88% with three class labels such as Positive, Neutral, and Negative, outperforming classical approaches. The results were integrated into a web-based application using ReactJS and Fast API, allowing users to visualize sentiment trends and generate word clouds from feedback. The findings demonstrate how AI can turn unstructured feedback into actionable insights, helping stakeholders enhance service quality, improve visitor satisfaction, and promote sustainable growth in Sri Lanka's tourism industry. Overall, this research highlights the significant impact of modern NLP and Deep Learning on tourism analytics, laying a strong foundation for future improvements and practical application in the industry.

Keywords: *Hotel Review, Machine Learning, Natural Language Processing, Sentiment Analysis, Tourist Feedback*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Real Time Yoga Posture Correction System using Deep Learning

R. D. Swarnamali[1] and A. Mohamed Aslam Sujah[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]drathnayake133@gmail.com, [2]ameersujah@seu.ac.lk

Abstract

Home based yoga practice has grown significantly, yet 60-70% of practitioners make posture alignment errors that can lead to injuries over time due to lack of professional supervision. This research presents an Artificial Intelligence (AI) powered real-time yoga posture correction system designed to provide accessible, accurate guidance for safe self-practice. The system integrates MediaPipe Pose estimation and biomechanical joint angle analysis to identify 33 key body landmarks and assess posture accuracy. When deviations are detected, users receive immediate corrective feedback through visual and audio cues via a mobile application, replicating instructor guided adjustments in real-time. The system was evaluated with 35 participants performing three fundamental yoga poses: Plank, Double Leg Raises, and Cobra Pose. Testing was conducted under varied lighting and background conditions to ensure real world applicability. Results demonstrated 95% accuracy in pose detection and 99% precision in identifying posture errors, while maintaining smooth performance at 30-40 frames per second. To validate practical effectiveness, certified yoga instructors assessed the system and rated its accuracy at 9.1 out of 10. This research demonstrates that combining deep learning with biomechanical analysis can effectively support safe, independent yoga practice. The system addresses a critical gap in digital health by making professional quality yoga instruction accessible regardless of geographic location or economic constraints. By reducing injury risk and enabling proper technique development, this technology contributes to the advancement of accessible wellness solutions and establishes a foundation for AI assisted physical training applications in broader fitness and rehabilitation contexts.

Keywords: *Computer Vision, MediaPipe, Mobile Health, Personalized Feedback, Real-time Posture Correction, Yoga Pose Estimation*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

AI-Powered Home Workout Assistant: Real-Time Pose Estimation and Repetition Counting for Exercises

W.B.M.S.D.M.B. Wijekoon[1] and S.L. Abdul Haleem[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]samadhiwijekoon51@gmail.com, [2]ahaleemsl@seu.ac.lk

Abstract

This article proposes an AI-based home workout assistant that recognizes exercises and counts repetitions in real time, while providing form feedback using a standard webcam. The system extracts 18 body keypoints at 30 FPS using the OpenPose framework, thus providing skeletal data for analysis. Two major machine learning models were implemented: a Multi-Layer Perceptron (MLP) for frame-level pose classification and a Long Short-Term Memory (LSTM) network for temporal sequence analysis; the joint performance of both reached an overall accuracy of 89–90% for four well-known exercises, namely squats, push-ups, dumbbell raises, and flat dumbbell press. The correctness of the movements was analyzed using joint-angle calculations and rule-based thresholds to provide real-time feedback. A Windows desktop application was implemented that visualizes a skeletal overlay, displays angle measures, counts repetitions, and gives audio feedback during exercise. Testing with diverse video data demonstrated that the system runs reliably under real-time conditions and provides practical support for safe workouts at home. These results are indicative of great potential for this approach in fitness training, rehabilitation monitoring, and general physical activity assessment.

Keywords: *Computer Vision, Exercise Monitoring, Home Fitness, OpenPose, Pose Estimation, Real-Time Feedback*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

AI-Powered Crop Protection by Real-time Identification of Porcupine in Home Gardens

W.G.T.A. Rodrigo[1] and S.L. Abdul Haleem[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]teranceprivate@gmail.com, [2]ahaleemsl@seu.ac.lk

Abstract

In rural Sri Lanka, agriculture is a vital livelihood, but home gardens suffer significant crop damage from wild animals, especially the Indian porcupine (Hystrix indica). This leads to major losses in productivity. For small-scale farmers, traditional methods like fencing or night patrols are often too costly or simply do not work. Our research tackles this problem with an affordable, AI-based system that uses the YOLOv8 model to detect porcupines in real-time. To build the system, we first created a custom dataset of 1,200 images from various sources and manually annotated them. We used this data to train the YOLOv8n (nano) model for 100 epochs. The final system, built with Python and OpenCV, connects a standard webcam or IP camera to a PC. It processes the video live, and as soon as it spots a porcupine, it triggers two alerts: a local audio alarm and an email notification sent via SMTP. Our tests confirmed the system is highly reliable. On a dedicated test set, it achieved 95.2% mAP@0.5, 94.3% precision, and 91.7% recall. It also runs efficiently on consumer hardware, processing 28-32 frames per second with a very low false positive rate (0.75 alerts/hour). We believe this is a practical, low-cost, automated solution that can genuinely enhance crop protection. For future work, we plan to expand the model to detect other pests like wild boars, add automated deterrents, and adapt the system for low-cost embedded hardware.

Keywords: *Crop Protection, Home Gardens, Porcupine Detection, Real-Time Video Recognition, YOLO*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Fake News Detection: Comparative Analysis of Machine Learning, Deep Learning and Transformer Models

M.A.F. Shafna[1] and F.M. Ameer[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]shafnaazhar99@gmail.com, [2]ameermusfi@seu.ac.lk

Abstract

The misinformation spread speed on the Internet resources has increased the necessity of the emergency automated fake news detector. In this paper, a comparative analysis of the Machine Learning (ML), Deep Learning (DL), and Transformer-based models were evaluated using the Kaggle Fake News dataset. Algorithms such as Naive Bayes, Support Vector Machine, Convolutional Neural Network (CNN), Recurrent Neural Network (RNN) and transformer models (BERT and DistilBERT) were all tried. All the models were measured in terms of accuracy, precision, recall, and F1-score. The results show that DistilBERT was the most successful in terms of overall performance and F1-score of 0.999, which outperforms classical ML and DL methods. Transformer architectures had better contextual information and generalization, whereas traditional models had better interpretability and computational efficiency. The study comes to the conclusion that models based on transformers, especially DistilBERT, are the most promising with regard to fake news detection, but they consume more computational resources. A systematized comparison framework and practical advice towards constructing scalable, ethical, and interpretable misinformation detection systems that can be applied in the real world are also brought by this work.

Keywords: *BERT, DistilBERT, Fake News Detection, Misinformation, Natural Language Processing, Transformer Models*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Recognizing Ayurvedic Herbal Plants in Sri Lanka using Deep Learning with Enhanced Background Identification

H.D.R.N Samaranayaka[1] and A. Fathima Sharfana[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]ruchiranaveen24@gmail.com, [2]sharfana.atham@seu.ac.lk

Abstract

This research presents a Deep Learning–based framework for the automated identification of indigenous Ayurvedic herbal plants in Sri Lanka, addressing the limitations of manual recognition methods that are often slow, labor-intensive, and error-prone. The proposed system leverages Transfer Learning to fine-tune a mobile-optimized Convolutional Neural Network (CNN) for effective feature extraction and classification. To enhance robustness under real-world conditions, an Enhanced Background Identification (EBI) technique was integrated, enabling the model to distinguish plant leaf features from complex, naturally occurring backgrounds rather than relying on uniform or laboratory-controlled scenes. A localized dataset comprising 2,000 labeled leaf images—collected from Sri Lankan field environments and supplemented with public datasets—was used for training and validation after preprocessing through scaling, normalization, and data augmentation to improve generalization. The optimized CNN achieved a classification accuracy of 95%, outperforming traditional Machine Learning methods in both accuracy and stability. To ensure field usability, the trained model was converted into TensorFlow Lite and deployed as a real-time mobile application, allowing users to capture plant images and instantly receive identification results, along with relevant botanical and medicinal information. This study demonstrates the potential of localized Deep Learning applications for accurate, efficient, and scalable plant recognition, offering a practical tool that bridges modern AI with traditional knowledge systems. The developed framework contributes significantly to biodiversity conservation, Ayurvedic research, and the empowerment of non-expert users in rural and educational contexts.

Keywords: *Ayurvedic Plant Recognition, CNN, Deep Learning, Mobile Application, Transfer Learning*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Decoding Emotions in Music - An AI Approach to Emotion Detection

C. Mahadurage[1] and A. Fathima Sharfana[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]chathurangamahadurage@gmail.com, [2]sharfana.atham@seu.ac.lk

Abstract

This research aims to enhance music emotion recognition by developing a multi task CNN-LSTM model that jointly learns to predict a song's emotional category (Happy or Sad) musical key, leveraging the key information as an additional cue for more accurate emotion detection. Emotion recognition in audio remains challenging because happy and sad songs often share similar acoustic properties, such as tempo, timbre, rhythm, and energy, making it difficult for conventional models to distinguish emotional nuances. This research hypothesizes that the musical key (major or minor) acts as a strong latent cue for emotional perception, reflecting the underlying harmonic structure that influences how listeners experience emotion in music. To test this, a hybrid CNN–LSTM architecture was developed to learn both tonal and affective representations from Mel-spectrogram features of 2,377 labeled audio clips; 1,264 happy and 1,113 sad obtained from a public Kaggle dataset. The CNN layers captured spectral features, while the LSTM layers modeled temporal dependencies in the audio. The model was trained using weighted binary cross-entropy loss, enabling joint optimization of emotion and key prediction. Experimental results showed an F1 score of 0.81 and an accuracy of 84%, outperforming traditional machine learning baselines such as Decision Trees, Random Forests, and SVMs. These findings confirm that integrating tonal analysis through key detection enhances emotional inference, demonstrating that multi-task learning effectively captures both perceptual and structural aspects of music. The proposed model provides a lightweight, efficient, and accurate framework for music emotion recognition, offering new insights for applications in music recommendation, therapy, and affective computing.

Keywords: *CNN–LSTM, Deep Learning, Key Detection, Music Emotion Recognition*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Integrated AI System for Early Detection and Remediation of Paddy Crop Diseases to Enhance Agricultural Yield

Thivyana Paskaran[1] and A. Fathima Sharfana[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]paskaranthivyana8@gmail.com, [2]sharfana.atham@seu.ac.lk

Abstract

This study presents an AI-powered mobile application for the real-time detection of paddy leaf diseases in Sri Lanka, addressing a persistent challenge faced by rural farmers who rely on paddy cultivation as their primary source of income during the Maha and Yala seasons. Frequent outbreaks of diseases such as Brown Spot, Tungro Virus, Bacterial Leaf Blight, and Leaf Roller significantly reduce yield and grain quality, particularly under high humidity conditions. To mitigate this, a Convolutional Neural Network (CNN) model was trained using a dataset of approximately 7,500 images of paddy leaves, collected from a combination of publicly available sources and real field photographs taken from Sri Lankan paddy fields. The mobile application enables farmers to capture images of affected leaves and receive instant diagnoses and localized treatment recommendations in Sinhala or Tamil. After the CNN model identifies the specific disease, the system automatically generates remedial advice using a rule-based expert module that contains a predefined knowledge base of control measures sourced from the Department of Agriculture, Sri Lanka. Each identified disease is mapped to its corresponding treatment protocol, including recommended pesticides, organic alternatives, and preventive field management practices. Image preprocessing techniques such as scaling, contrast enhancement, and noise reduction were applied to improve diagnostic accuracy and reliability. The model achieved an overall accuracy of 96%, demonstrating strong potential for real-world field deployment. By enabling early disease detection and providing localized, actionable treatment advice, this system offers a scalable, affordable, and sustainable solution that bridges the gap between AI technology and rural agriculture, promoting smart farming and improved crop protection across Sri Lanka.

Keywords: *Agricultural Disease Detection, CNN, Mobile App, Paddy Leaf Diseases, Real-Time Detection, Sri Lanka Paddy Farming*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

AI-Driven Weed Identification and Herbicide Recommendation System for Paddy Fields with Sinhala Language Integration

P.G.K.K.K. Palle Gedara[1] and A.R.F. Shafana[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]kaushalya12pallegedara@gmail.com, [2]arfshafana@seu.ac.lk

Abstract

Weed infestation poses a significant challenge for paddy farmers in Sri Lanka since it reduces crop yield, degrades quality, and increases production costs. Despite the availability of many applications for weed detection and management, they are quite expensive, not real-time and limited to English language. To address these research gaps, this research proposes a real-time weed identification and herbicide recommendation system for farmers in Sinhala language. This research constitutes a mobile application integrated with an image-based deep learning model that detects and classifies the weeds at first and then recommends suitable herbicides in Sinhala. Deep learning models including Simple Convolutional Neural Network (SimpleCNN), MobileNetV2, and EfficientNetB0 were trained using a locally captured dataset of common weed species such as Carassula aquatica, Micranthemum, and Scurvy weed species commonly found in Sri Lankan paddy fields. The primary dataset consists of 300 records of 256x256 size images for each of the three classes, which were captured, preprocessed, augmented and annotated to increase data size, avoid overfitting and ensure class balance. For a fair comparison, all three models were trained with a batch size of 32, an initial learning rate of 0.001, 8 epochs, 0.05 label smoothing and with Adam optimizer. Among these, EfficientNetB0 outperformed the others, achieving 97.53% accuracy, 0.97 precision, 0.975 recall and 0.977 F1-score. The final model was converted to .tflite format and integrated into a Flutter-based mobile application. In addition, a secondary dataset on herbicides was obtained from online sources, with credibility verified by a local agricultural advisor. The developed mobile application provides users with weed identification results and herbicide recommendations in Sinhala language. Usability testing with eight farmers indicated that this system is a promising and cost-effective alternative for weed detection and management. This study contributes to enhancing sustainable agriculture through real-time weed detection and localized herbicides recommendations.

Keywords: *EfficientNetB0, Flutter Application, Sinhala Language, Weed Detection*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Vision Transformer-Based Identification of Banana Leaf Diseases: A Deep Learning Approach for Sustainable Agriculture

S. Sakkiya Sasi[1] and A.R.F. Shafana[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]sakkisasi1234@gmail.com, [2]arfshafana@seu.ac.lk

Abstract

Banana cultivation faces significant threats from leaf diseases including Black Sigatoka, Yellow Sigatoka, Fusarium Wilt, and Xanthomonas Wilt, causing yield losses ranging from 20% to 100% annually. Traditional manual disease detection methods are labor-intensive, subjective, and unsuitable for large-scale farming operations, particularly in resource-constrained environments. Whereas, the existing computational solutions suffer from poor performance in multi-disease classification. Despite the widespread applicability of Vision Transformers (ViT) in several other domains, its application in agricultural disease prediction is under-explored. This study aims to apply the vit_base_patch16_224 architecture from the timm library to train a carefully curated dataset of 3,000 banana leaf images distributed across four classes namely Healthy (1,000 images), Fusarium Wilt (800 images), Yellow and Black Sigatoka (800 images), and Xanthomonas Wilt (400 images). Class-weighted loss functions and WeightedRandomSampler were employed to address the class imbalance. Comprehensive data augmentation techniques including random horizontal flips, rotations (±15 degrees), color jittering, and random resized cropping were applied to enhance the robustness of the model. The model was trained for 50 epochs using the Adam optimizer with a learning rate of 3×10−4 on Google Colab with T4 GPU acceleration. The system achieved a notable performance with 95.17% test accuracy and balanced metrics across all disease categories. The confusion matrix demonstrated exceptional discriminative capabilities with 98% accuracy for healthy leaves, 99% for Fusarium Wilt, 100% for yellow and black sigatoka, and 97% for Xanthomonas Wilt. An interactive mobile application using React Native and Django REST Framework was also developed integrating the trained model that enables real-time disease detection through image uploads. This research contributes to sustainable agriculture by providing a scalable, accurate, and accessible AI-driven tool for early disease detection, empowering farmers with timely interventions that reduce crop losses and support food security in banana-growing regions worldwide.

Keywords: *Banana Leaf Disease, Django REST Framework, React Native, Vision Transformers*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

TRACK – MULTIMEDIA AND GAMING TECHNOLOGIES

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Investigating the Effectiveness of a Sinhala Voice-Operated Game Application for Enhancing Cognitive and Physical Rehabilitation among Amputee Individuals

M.S.S.C Wijayananda[1] and I.M Kalith[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]sapumalcharuka97@gmail.com, [2]imkalith@seu.ac.lk

Abstract

Rehabilitation of amputee patients requires psychological and cognitive adaptation, beyond physical recovery, to restore independence and quality of life. In Sri Lanka, one of the major challenges for effective rehabilitation of patients is the nonavailability of culturally and linguistically appropriate digital tools for Sinhala speaking patients. This study addresses the identified gap by designing and evaluating a Sinhala voice-activated gaming application, Echomaze, aimed at facilitating cognitive and physical rehabilitation in amputee patients. The study introduces a voice-controlled game interface to improve motivation, engagement, and accessibility for performing therapy exercises by using natural voice commands in Sinhala. A dataset of 400 one-second-long voice samples, each representing one of four directional commands, was collected and preprocessed for training. Two modeling approaches were tested: a traditional MFCC with DTW method and an advanced transfer learning-based YAMNet with the SVM-RBF model. Five-fold cross-validation testing showed that the YAMNet-SVM-RBF model resulted in an average accuracy of 87%, compared to the baseline model achieving 81%, while ensuring real-time recognition on mobile devices. This trained model was integrated with the Echomaze game turned what would have been considered regular therapy into an interactive, culturally aligned rehabilitation experience. Tests with users revealed satisfaction, motivating engagement, and positive cognitive stimulation. Although the original study had limitations in dataset size and environmental variability, it presents a case for the application of local AI-driven rehabilitation tools to ensure inclusivity and participation. These findings further support the notion that Sinhala voice-based therapy technology is indeed an original contribution to digital health innovation, with the potential to modernize and personalize rehabilitation among amputee patients in Sri Lanka.

Keywords: *Audio Preprocessing, Machine Learning, Speech Recognition, Sinhala Language, Transfer Learning*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Smart Fan Automation System: Integration of Sensing, Presence Detection, and Hand Gesture Control for Energy-Efficient Operation

E.A.P. Nayanajith[1] and R.K.A.R. Kariapper[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]nayanajithedirisinha@gmail.com, [2]rk@seu.ac.lk

Abstract

This thesis introduces an intelligent Smart Fan Automation System designed to address the shortcomings of traditional fan controls in terms of energy efficiency, user convenience, and accessibility. The problem stems from conventional fans' reliance on manual switches or basic motion sensors, leading to unnecessary energy consumption and poor adaptability to real occupancy patterns. To overcome these challenges, the proposed methodology integrates a layered sensing approach: a Passive Infrared (PIR) sensor detects motion, an ultrasonic sensor confirms proximity, and a camera module utilizes the YOLOv8 deep learning model for human verification, ensuring that only genuine users are detected. Once human presence is confirmed, hand gestures—recognized in real-time by the MediaPipe framework—allow intuitive contactless control of the fan's power and speed. The system was implemented using an ESP32 microcontroller coordinating sensor readings, coupled with Python-based AI processing. Comprehensive testing revealed 96.8% accuracy in human detection with YOLOv8n and 96% accuracy in gesture recognition. Automatic deactivation after 15 seconds of absence and memory of previous speed settings led to an average 42% reduction in energy use compared to traditional systems. User testing with participants of varying ages indicated high satisfaction and improved accessibility, especially for individuals with mobility challenges. In conclusion, the Smart Fan Automation System effectively combines sensor fusion, computer vision, and user-centric control to create a robust, scalable energy-saving solution for modern smart homes. Further recommendations include adopting edge computing for real-time AI processing, upgrading to more industrial-grade sensors, and expanding system features such as real-time environmental sensing and voice command integration. These enhancements would further improve reliability, energy efficiency, and user experience, supporting broader adoption in diverse environments.

Keywords: *Energy Efficiency, Gesture Recognition, Sensor Fusion, Smart Fan Automation, YOLOv8 Human Detection*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Artificial Intelligence-Based Hand Gestures Mouse Control

P. Logarjana[1] and F.M. Ameer[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]palipodylogarjana@gmail.com, [2]ameermusfi@seu.ac.lk

Abstract

Artificial Intelligence (AI) is changing human-computer interaction by creating touchless control systems. In the 1960s, the computer mouse was invented by Engelbart. It changed how people use computers. However, it still has issues such as wrist pain, clicking noise, short battery life, and scroll wheel problems. The survey showed that 77.8% of users have issues with traditional mouse devices. Most existing studies have developed touchless mouse systems with basic functions like left click, right click, scrolling, and other functions; however, advanced functions like zoom in, zoom out, and drag and drop are still underdeveloped. The main objective of this study was to develop an artificial intelligence-based hand gesture mouse control that can perform zoom-in, zoom-out, and drag-and-drop functions using left-hand gestures. The project was done in two phases. Phase 1 is library-based, using OpenCV, MediaPipe, and CVZone to detect hand movements. Phase 2: Convolutional Neural Network (CNN)-based training using a custom image dataset to detect hand movement. Both phases were developed using Python and tested in real-time using an external web camera. The analysis revealed that while users show particular hand movement in external camera phase 2, the CNN-based model performed better than phase 2, and real-time testing showed 90% accuracy for zoom in and zoom out and 80% accuracy for the drag and drop function. The developed artificial intelligence-based hand gesture mouse control performs well for zoom-in, zoom-out, drag, and drop functions using phase 2 with better accuracy. The system is simple, low-cost, and touchless, making computer use more comfortable, clean, and easy for everyone.

Keywords: *CVZone, CNN, Hand Gesture Recognition, MediaPipe, Mouse Control, OpenCV*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

MindFusion: Gamified Support for Mental Wellness and Addiction Recovery

K. Danusan[1] and F.M. Ameer[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]danusan.official@gmail.com, [2]ameermusfi@seu.ac.lk

Abstract

Mental health challenges and alcohol addiction have become serious social and health concerns among young adults, affecting their emotional balance and overall quality of life. These conditions often lead to reduced productivity, social withdrawal, and psychological difficulties. Therefore, it is essential to create accessible, technology-based support systems to promote mental wellness in today's society. However, many existing mobile applications designed to improve mental wellness struggle to keep users engaged or provide continuous support. Most lack motivational features and adaptive interaction, making it difficult for individuals to stay committed to recovery. This highlights the need for a more interactive and user-centered digital platform to sustain engagement and encourage positive behavioral change. The main aim of this study was to design and develop MindFusion, a gamified mobile application that supports individuals with alcohol addiction to gradually reduce their consumption and build healthier habits through self-management and motivational engagement. A mixed-method approach was followed, which included user feedback collection, prototype testing, and performance evaluation. The application was developed using React Native, Node.js, Express.js, and a secure database, ensuring flexibility and scalability across platforms. Findings from a pilot study involving 30 participants showed a noticeable improvement in user motivation, engagement, and commitment to recovery activities. The results demonstrate that gamification can serve as an effective and practical approach to supporting mental wellness and addiction recovery in the Sri Lankan context.

Keywords: *Addiction Recovery, Behavioural Change, Gamification, Mental Wellness, Mobile Application, User Engagement*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Gamified Handwriting Recognition: Enhancing Interactive Language Learning for Sinhala and Tamil through a Mobile App

K.K.K. Jayaweera[1] and F.M. Ameer[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]kavindujayaweera98@gmail.com, [2]ameermusfi@seu.ac.lk

Abstract

Conventional techniques of learning language may not sufficiently involve contemporary students who like interactive, technology-driven settings. In the current digital era, dealing with this gap is very important to improve learning results and inspiration. Although digital education has advanced, few studies and development are on gamified handwriting recognition techniques customized for native Sri Lankan languages including Sinhala and Tamil. The primary aim of this research is to create and use a mobile application combining handwriting recognition and gamification ideas to provide a more interesting, efficient, and enjoyable way for Sinhala and Tamil language learning. Specifically created and trained for Sinhala and Tamil character identification was a TensorFlow Lite (TFLite) model. The technique uses a hybrid recognition algorithm that combines neural network processing, geometric stroke analysis, and pattern matching. The dynamic drawing interface of the app offers pronunciation advice and real-time feedback. Including handwriting recognition with gamified learning improves accuracy in spotting handwritten Tamil and Sinhala letters as well as increases involvement. Using the interactive and visually guided feedback tools on the app helped students show better involvement, motivation, and retention. This project helps to promote native languages' educational technology by providing a fresh, simple approach to preserve and instruct Sinhala and Tamil scripts. It shows how gamification and AI-driven handwriting recognition can be used together in digital classrooms to make learning more effective and improve the user experience.

Keywords: *Educational Technology, Gamified Learning, Handwriting Recognition, Interactive Learning, Sinhala Script, Stroke Analysis*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

An Empirical Investigation on the Engagement, Competence, and Immersive Nature of Interactive Multimedia for Science Learning in Kids

S.T. Hewage[1] and A.R.F. Shafana[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]sewminihewage1999@gmail.com, [2]arfshafana@seu.ac.lk

Abstract

In an era defined by rapid technological advancements, interactive multimedia tools have garnered global attention for their transformative potential in education. Despite having significant advantages, the incorporation of interactive multimedia, especially the growing field of Augmented Reality (AR), is less adopted in Sri Lankan teaching contexts. This study is primarily focused on empirically investigating the competence, engagement, and immersive nature of a custom-made AR app in science learning among primary children in Sri Lanka, while having equivalent YouTube content as a baseline control group. The controlled study involved 24 fourth-grade students randomly assigned either to an experimental group intervened with AR app (n=12) or to a control group (n=12) intervened with similar YouTube video content focusing on solar system concepts. The results suggested that the AR-based application significantly outperformed YouTube content in terms of competence, which could be attributed to the additional kinesthetic learning feature prevalent in AR applications alone. Although the effect on immersion and engagement was high for both media, it was not statistically significant; that might be due to the fact that the aesthetic appeal of both media would have given similar engagement and immersion experiences to students. The findings of this study could be useful for educational practitioners and policymakers when implementing new technological educational reforms.

Keywords: *Augmented Reality, Educational Technology, Immersive Learning, Primary School, Science Education*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Gamified Learning for Road Safety in Sri Lanka: Assessing the Efficacy of Traffic Rules Educational Game

R.M.A.S. Madusankha[1] and A.R.F. Shafana[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]ashansubodha8@gmail.com, [2]arfshafana@seu.ac.lk

Abstract

Traffic-related accidents pose a significant socioeconomic problem in Sri Lanka. One of the main causes of the increasing number of road accidents is the limited understanding of traffic rules among the general public. Despite many government-led initiatives to create awareness, most of them were found to be passive and led to limited effectiveness. This study aims to address this problem by designing and developing a gamified educational application that teaches traffic rules through interactive gameplay built using Unity 6 and C#. The game environment is custom-made and contextualized to Sri Lankan Road conditions, including region-specific vehicle types and traffic signs. The flow state of this game is maintained through the use of game mechanics including reward coins and badges; point generation for correct application of rules; punishments such as on-screen alerts and penalty sounds; and adaptive difficulty of levels that progress from basic to complex rules. These elements are designed in line with Self Determination Theory (SDT) principles to support autonomy, competence, and relatedness. Preliminary user testing with six participants on the game prototype confirmed that this is fully functional on an Android platform, providing an engaging and realistic virtual driving experience. Feedback from participants also indicated that the game improved their awareness of traffic rules. Future work will focus on conducting empirical usability testing to assess the educational efficacy of the game.

Keywords: *Game-Based Learning, Gamification, Road Safety, Serious Games, Sri Lankan Traffic Rules*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

An Empirical Investigation on the Accessibility of Super Apps for Sri Lankan Senior Citizens

A. Azky Sarafath[1] and A.R.F. Shafana[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]azkysarafath@gmail.com, [2]arfshafana@seu.ac.lk

Abstract

The concept of Super Apps is gaining wide attention in the global digital landscape, offering significant benefits to various age groups, including senior citizens. However, the adoption of super apps among Sri Lankan senior citizens is still in its infancy. In this context, the aim of this study is two-fold. At first, it seeks to identify the reasons for this adoption gap among senior citizens and then to empirically investigate a custom-made super app overcoming the identified issues for its usability. For this, a preliminary study on WCAG-based features involving 20 senior citizens through semi-structured interviews was conducted and found that the potential reasons for this adoption gap is the basic accessibility features, including text resizing, high-contrast themes, and visible labels in addition to the recurring issues that included problematic use of small fonts, hidden menus, complexity of navigation, places where information was poorly localized, and anxiety about making errors when using transactional services. Based on the insights from the interview, a super app named "CarePoint" including a specific mode for seniors was developed and tested for its system usability. The senior mode of the app had large, resizable typography, large icons, flat predictable navigation, plain-language labels, multimodal help facilities, clear confirmation/undo affordances, and biometric authentication with a PIN fallback. The final application, developed through participatory design and iterative development, achieved a System Usability Score (SUS) of 82, while the task success rate exceeded 90%, compared to some emerging super apps, such as PickMe, Uber, and MyDialog, which served as the baseline. In addition, the specific senior mode had a reduced error rate and reduced support requests. The findings of this study suggest that the introduction of a specific mode for senior citizens with interface-level changes could assist in bridging the adoption gap among this group while paving the way for more inclusive super apps.

Keywords: *Adoption Gap, Senior Mode, Super Apps, System Usability Score*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Arabic Handwriting Recognition for Native Tamil Users: A Smart Validation and Feedback System

S.A.F. Sifana[1] and F.M. Ameer[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]sifanasif862@gmail.com, [2]ameermusfi@seu.ac.lk

Abstract

Learning to write in Arabic is a big challenge for the Tamil speaker; whereas Tamil script flows from left to right with distinct, separate letters, Arabic moves right to left in a flowing, connected style where each letter takes different shapes depending on where it is found in a word. In addition to the structural problem of finding teaching materials that cater to the specific needs of Tamil learners, it would indeed be very challenging for Tamil speakers to achieve proficiency in Arabic writing despite the religious, academic, and career benefits that come along with such a skill. This study tackles these obstacles by creating a mobile-based handwriting recognition system built specifically for Tamil-speaking individuals learning Arabic. The system uses a specially trained Convolutional Neural Network (CNN) that analyzes handwriting samples collected from Tamil users attempting to write Arabic characters. Learners practice writing on a touchscreen interface, receiving instant feedback on their attempts. When mistakes occur, the application provides clear corrective support through short demonstration videos showing proper letter formation, accompanied by authentic Arabic pronunciation audio. The research methodology consisted of a survey of learner difficulties, the design of an intuitive mobile interface, data collection of handwriting from Tamil writers, the development of the recognition model using TensorFlow Lite, and the development of the application using Flutter. Piloting with Tamil-speaking volunteers revealed that the system correctly identified letters 92% of the time, and participants reduced their writing mistakes by 45% after using the system. Learners were very satisfied, rating the feedback functionalities 4.6 out of 5. Results have shown that appropriate learning technologies, when designed with consideration for cultural and linguistic contexts, can actually aid individuals in the transition between writing systems. This approach provides a practical, educationally effective tool that enables self-directed learning while strengthening both skill and confidence in Arabic handwriting.

Keywords: *Arabic Handwritings Recognition, Convolutional Neural, Educational Technology, Feedback System, Network (CNN)*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

TRACK – NETWORK AND SECURITY TECHNOLOGIES

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

AI-Driven Real-Time Phishing Detection and Mitigation for Employee Email Systems

S.A.D.T.S. Subasingha[1] and M.J. Ahamed Sabani[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]sesadithilara@gmail.com, [2]mjasabani@seu.ac.lk

Abstract

The study provides the design, implementation, and evaluation of an intelligent detection and response system that is real-time and specific to the corporate email environment to protect against the threat of phishing. The paper investigates the performance of four machine learning and rule-based hybrid systems, which seek to improve the phishing detection process by an automated backend and a user-friendly front-end interface. The tested methods are: (1) a baseline Logistic Regression model that extracts features using TF-IDF, (2) a keyword-augmented Logistic Regression model for targeted detection, (3) the One-Class Support Vector Machine (OCSVM) used to flag novel threats, and (4) the main contribution is a hybrid model, combining Logistic Regression with a domain-whitelist system. This two-layered solution allows automated detection in the back end, while allowing the users to provide mitigation in a visual, user-friendly front end, directly integrated into the email client. The front-end interface will utilize a color-coded system, displaying red for identified phishing messages and green for confirmed legitimate ones, allowing employees to react promptly and with the appropriate response. System training and testing were done using known phishing datasets, which are found on the Hugging Face Hub. The domain whitelist-enhanced classifier model was the best performing model with an overall accuracy of 97.8% and a precision of 98.1%. It also received emails more effectively from trusted sources, and it was faster and secure. The results support the recommended combination methodology, i.e., a hybrid phishing defense system, in which computational intelligence is combined with human decision support. Combining real-time detection and easy-to-use feedback, the system will reduce vulnerability to phishing attacks and social engineering schemes in the business setting to significantly lowering the risks. The research is a worthy inclusion of a useful and scalable approach to securing email messages through the interaction of AI-based automation and human engagement.

Keywords: *Email System, Logistic Regression, Phishing Detection, Rule-Based Systems, Real-time Systems, SVM*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Enhancing Academic Integrity through a Blockchain-Based Attendance System in Sri Lankan Universities

T. Kovarthani[1] and M.J. Ahamed Sabani[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]kovarthani171016@gmail.com, [2]mjasabani@seu.ac.lk

Abstract

The traditional attendance management systems adopted by universities in Sri Lanka are decentralized and operate on central databases and manual systems, meaning they are likely to be prone to manipulation of data, inefficiencies, and a lack of transparency. These limitations undermine academic integrity, delay in administration and mistrust to institutional records. In order to address these problems and enhance efficiencies within higher education, this paper aims to create a safe, verifiable, and tamper-proof attendance management system through blockchain technology. An approach was adopted, involving theoretical study, system design and prototype development. The proposed solution was implemented using Ethereum, Solidity, and InterPlanetary File System (IPFS), and a mobile application was designed to support the communication between the students and lecturers. Smart contracts were regarded as the main tool that ensured attendance records were secure, verifiable, and tamper-proof. Data security, transparency, and response time were used to analyze the performance of the system against the conventional methods. The prototype was able to show a noteworthy advance in the integrity of the data, prevent unauthorized access, and simplify the process of tracking attendance. The decentralized structure made records unchangeable and the mobile interface easy to use in marking attendance and real-time verification. However, scalability issues were noted, especially with gas charges and network delays incurred with the public blockchain platform. To eliminate these constraints, it is possible to research future work on hybrid blockchain models to maximize efficiency and minimize the cost of operation. Altogether, the present research contributes to the expanding branch of blockchain in education by introducing a convenient, safe, and transparent model of attendance control. The suggested system promotes academic equity, institutional responsibility, and the overall digital transformation of Sri Lankan universities.

Keywords: *Academic Integrity, Attendance System, Blockchain, Smart Contracts, Transparency*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

AI-Enhanced Intelligent Power Management Solution for Wireless Access Points

W.A.R.L. Siriwardana[1] and M.J. Ahamed Sabani[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]waravindulakshan@gmail.com, [2]mjasabani@seu.ac.lk

Abstract

A major reason that has led to the rate of energy consumption is the extensive use of wireless access points (WAPs) in current network infrastructures. Their power management systems are largely founded on the concept of static power that guarantees that the power used in transmission remains constant regardless of network demand or environmental conditions. The study introduces an AI-based smart power management scheme that dynamically optimizes the energy efficiency of the WAP without disrupting the network functionality. To visualize real-time data, the system includes four major components: a Ruckus ZoneFlex R310 WAP to gather network data with the use of SNMP, an ESP32-DHT22 sensor module to scan a real-time environment, a backend server with the Gradient Boosting machine learning model, and a cross-platform mobile dashboard created in Flutter. Network data, such as power consumption, data rates, number of clients, and channel utilization were continuously collected and stored in a Firebase Realtime Database. These indicators are used to activate an adaptive power optimization engine that is situation sensitive and suggests adaptive power settings. They were tested and trained based on 1, 217 records of various scenarios of operations. Gradient Boosting worked better than other algorithms, such as the Random Forest, Support Vector Machine, and Logistic Regression with a 98.91% accuracy and a similar F1-score. The mobile dashboard was shown to be very efficient in real-time, with a synchronization delay of 1-3 seconds in Android and iOS platforms. The empirical evidence demonstrates that the AI-based algorithm hypothesized to potentially reduce the WAP energy use by around 37% of the operation time compared to the traditional locked power control without the alteration of the network quality. This deliverable shows that it is feasible and viable to utilize machine learning and IoT to achieve sustainable and adaptive power management in wireless networks, in order to accommodate more environmentally friendly ICT infrastructures.

Keywords: *Energy Efficiency, Gradient Boosting, IoT, Power Management, SNMP, Wireless Access Point (WAP)*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Secured Tourist Aid App: A Blockchain-Based Privacy-Preserving Approach to Prevent Scamming

G.P.I.A.P. De Silva[1], M.J. Ahamed Sabani[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]av.studio.as@gmail.com, [2]mjasabani@seu.ac.lk

Abstract

The tourism sector is one of the most important pillars in the Sri Lankan economy; however, the development of the sector is increasingly deterred by emerging scams, intrusion of privacy, and unreliable service providers. These problems have majorly affected travellers' confidence and have become an impediment to the sustainable development of the industry. The lack of secure systems of digital booking and effective systems of protection of identities underscores the necessity of a transparent solution based on technology. This study presents a blockchain-based secure platform for tourism, aiming to reclaim safety and trust through data integrity. The system was developed with an approach to user-centered design based on establishing a more transparent, secure, and user-trusting environment using decentralized identity management, and with a combination of web and mobile development frameworks and blockchain smart contract technology (e.g., Laravel, Vue.js, React Native, Solidity), it was developed. The decentralized storage and blockchain-based smart contracts were used to ensure data storage and transaction integrity. Results show that the adoption of blockchain can greatly improve the authenticity of booking, data protection, and transparency of transactions in comparison to the conventional centralized tourist guide systems. More precisely, decentralization and tamper-proof records are guaranteed by blockchain and minimize the risks of data manipulations and interference by third parties, which centralized systems are prone to. Results of the tests confirmed the safe operation of the decentralized identity capabilities and the irreversibility of the booking history. Nonetheless, testing was achieved only in controlled settings with a blockchain focused test network, and additional testing was necessary to determine the scalability and real-world implementation. The study offers an innovative approach to the use of decentralized technologies in the travel industry in Sri Lanka. The proposed system can be used to minimize fraud and empower users to control their personal data and sustain digital transformation in tourism in the long term by addressing key trust and privacy issues.

Keywords: *Blockchain, Decentralized Applications, IPFS, Privacy Preservation, Smart Contracts, Tourism Security*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Optimizing LAN Topology Design for Minimal Data Loss

K.D.S.N. Madusara[1] and F.M. Ameer[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]madusara1999@gamil.com, [2]ameermusfi@seu.ac.lk

Abstract

This research studies the optimization of Local Area Network (LAN) topologies for minimizing data loss and emphasizes the star topology as the modern standard in small-scale wired networks. The experiment was conducted entirely in the GNS3 environment, replicating real-world network behavior using virtual devices configured to resemble actual routers, switches, and end systems from multiple vendors. Both network and end devices running on different operating systems, including Windows and Linux, were incorporated to ensure realistic and diverse testing conditions. Python scripting was integrated for automating traffic generation, managing network simulations, collecting data efficiently, and evaluating performance using libraries such as Scapy, ping3, pandas, and matplotlib. The analysis was focused on two key performance indicators: packet loss and latency (RTT). Both parameters were continuously monitored, recorded in a CSV file for structured analysis, and later visualized through detailed line and bar graphs to identify performance trends and anomalies. A comparative analysis was also carried out based on past research studies and literature data on bus, ring, and mesh topologies, which once dominated early LAN architectures before the introduction of centralized switching designs. However, the findings and historical studies clearly illustrate how the star topology surpassed earlier designs and, owing to its scalability, fault tolerance, and ease of management, ultimately became the de facto standard and preferred configuration in modern LAN environments used in educational, corporate, and industrial contexts.

Keywords: *Data Loss, GNS3, Local Area Network (LAN), Network Optimization, Star Topology*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Stay Safe Online: Real-Time Phishing Protection for Browsers with Smart Browser Extension

K.U.T. Siriwardhana[1], A. Fathima Sharfana[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]ushantharuka2222@gmail.com, [2]sharfana.atham@seu.ac.lk

Abstract

Phishing attacks remain one of the most prevalent cybersecurity threats, deceiving users into revealing sensitive information through fraudulent websites that mimic legitimate ones. This study presents a machine learning–based approach for the automatic detection of phishing websites using URL characteristics. A comprehensive dataset comprising both phishing and legitimate URLs was compiled from reputable sources, including PhishTank, OpenPhish, and Cisco Umbrella Top Sites. After preprocessing, a set of discriminative URL-based features was extracted, such as URL length, presence of HTTPS, frequency of special symbols, and randomness indicators. Several classification algorithms Random Forest, Support Vector Machine (SVM), Logistic Regression, and XGBoost were trained and evaluated to determine their effectiveness in distinguishing between legitimate and phishing URLs. Experimental results demonstrated that the XGBoost model achieved the highest accuracy of approximately 90%, outperforming the other models in both detection performance and computational efficiency. The trained model was integrated with a web browser extension through a Flask-based API, enabling real-time URL analysis and phishing alerts during web browsing. This implementation provides users with proactive protection by identifying suspicious sites before credentials or personal data are compromised. The novelty of this study lies in integrating a lightweight real time phishing detection model with a browser extension. It checks instant URL analysis without relying on external databases. Future work will focus on expanding the dataset, enhancing model robustness, and extending the system's compatibility to additional browsers and mobile platforms.

Keywords: *Cybersecurity, Machine Learning, Phishing Detection, Real-time Detection, XGBoost*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Sinhala-Driven Encryption Techniques for Securing Internet of Things Networks

B.A.R.U. Abayathunga[1] and A.R.F. Shafana[2]

[1,2]*Department of Information and Communication Technology, Faculty of Technology, South Eastern University of Sri Lanka*

[1]slravindu20@gmail.com, [2]arfshafana@seu.ac.lk

Abstract

The rapid proliferation of the IoT ecosystem has led to an ever-increasing demand for efficient and secure data transmission among resource-constrained devices. Despite the robustness of conventional encryption algorithms such as AES and RSA, they are not suitable for low-power embedded systems due to their computational intensity. This study introduces the Sinhala-Driven Lightweight Encryption Framework (SDLEF), which leverages the structural characteristics of the Sinhala alphabet in devising a dynamic and context-sensitive encryption scheme optimized for IoT environments powered by microcontrollers. The framework of this study was implemented on the ESP32 microcontroller, Arduino IDE, and Firebase Realtime Database for cloud data transfer, while the decryption is performed through an Android application developed in the research work. Performance evaluation was conducted in terms of processing latency, CPU usage, size of firmware, and memory footprint. Results indicated that the Sinhala-driven cipher achieved an average CPU utilization of less than 15%, with firmware size less than 120 KB and encryption latency at approximately 1.6 seconds, outperforming traditional AES and ECC algorithms in resource-constrained scenarios. In addition, the linguistic dynamic substitution approach showed resilience against frequency analysis attacks, thus ensuring the confidentiality of the data while transferring it over IoT communication. The proposed SDLEF contributes to the growing body of literature on localized encryption methodologies, integrating cultural linguistics with lightweight cryptography to enable secure, energy-efficient, and context-aware protection of IoT data from developing regions.

Keywords: *Internet of Things (IoT) Security, Localized Encryption Framework, Lightweight Cryptography, Microcontroller-Based Data Protection, Sinhala-Driven Encryption*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Development of a Secure Data Management Application for Small and Medium-Sized Businesses

K.J. Ranathunga[1] and A.R.F. Shafana[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]kjranathunga99@gmail.com, [2]arfshafana@seu.ac.lk

Abstract

In the modern digital landscape, many small and medium-sized businesses (SMBs) continue to rely on outdated and insecure data management methods such as Excel spreadsheets, manual record-keeping, and email attachments. These approaches expose business data to significant risks including unauthorized access, accidental modification, and data breaches. This research presents the design and development of a secure, web-based data management application specifically designed for SMBs, addressing the need for an affordable, efficient, and reliable data management solution. The system is developed using Next.js for the frontend, Nest.js for the backend, and PostgreSQL with Prisma for database management, ensuring scalability, maintainability, and high performance. Each stage of development follows the Security-Centric SDLC which includes protection mechanisms incorporated into every phase. The core security features include AES-256 encryption for data confidentiality, bcrypt for secure password hashing, and JWT-based authentication for the session securities. Role-Based Access Control (RBAC) is utilized in the system for controlling user permissions based on assigned roles, while Two-Factor Authentication (2FA) is employed for strengthening user verification against phishing or brute-force attacks. The application was subjected to extensive functional, security, and usability testing through simulated user scenarios, confirming that it is capable of providing secure, efficient, and user-friendly data management. Results show that the proposed system effectively shifts insecure manual processes to a central, cloud-based platform with improved confidentiality, data integrity, and operational efficiency. It also enables SMBs to achieve enterprise-level data protection and management standards with open-source technologies at a fraction of the traditional cost which contributes to the advancement of secure digital transformation among small enterprises.

Keywords: *Role-Based Access Control (RBAC), Secure Data Management Application, Security-Centric SDLC, Small and Medium-Sized Businesses (SMBs)*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Network Traffic Analysis and Machine Learning-Based DNS Spoofing Detection through Web Firewall Integration

K.N.S. Sandakelum[1] and M.S. Shafana[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]nipunshanaka99@gmail.com, [2]zainashareef@seu.ac.lk

Abstract

Internet applications are dependent on the Domain Name System (DNS), yet it is a constant source of risk as it lacks integrity checks and authentication. DNS spoofing is one such vulnerability, as in this case, attackers can use such responses to divert users to illegitimate web destinations. In response to this problem, this paper suggests a machine learning-based detection algorithm and a web-based firewall dashboard that provides real-time information and visualization. DNS traffic was obtained in a testbed setting by capturing valid resolver traffic, and by creating spoofed entries using Scapy in order to mimic cache poisoning and replay attacks. The extraction of features occurred through TShark and considered the packet-level indicators including TTL, the query type, IP consistency, response time, and origin address traits. This dataset generated consisted of around 10,000 labelled DNS response examples, divided into 7,000 authentic and 3,000 spoofed records and was sorted into training (70%), validation (15%), and test (15%) sets. Random Forest was selected for creation of pertinent features because it is efficient in modeling non-linear and complex relationships based on network data. Further, during training and validation, stratified k-fold cross-validation was used to achieve balanced representation of classes in all folds but model performance was assessed using several evaluation measures including accuracy, precision, recall, F1-score, and ROC-AUC. The results of the experiments proved the ability of the model to discriminate between spoofed and legitimate DNS responses with a rather low false positive rate. The final classifier was integrated into a Flask-based dashboard, which contained interactive graphs on the detection results, threat statistics, and DNS traffic patterns. Despite the fact that the framework did not provide automated mitigation, it produced reliable detection rates even when running on hardware with low computational capability, highlighting its relevance to the small and medium-sized network infrastructures.

Keywords: *Cache Poisoning, DNS Cache, DNS Spoofing, Flask Web Dashboard, Random Forest DNS Classifier, Web Firewall*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

TRACK – SOFTWARE TECHNOLOGIES

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Automated Examination Scoring and Performance Analysis System using OMR and Machine Learning Techniques

H.M.H.P. Kumara[1] and I.M. Kalith[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]harsha99114@gmail.com, [2]imkalith@seu.ac.lk

Abstract

Manual evaluation of multiple-choice question (MCQ) papers remains a time consuming and error-prone process in educational institutions, particularly where large student populations exist. The lack of analytical insights and delayed feedback further hinders the efficiency and effectiveness of academic assessment. This research aims to develop an automated exam scoring and performance analysis system that leverages Optical Mark Recognition (OMR), Convolutional Neural Networks (CNN), and Artificial Intelligence (AI) to automate MCQ evaluation and provide data-driven feedback for continuous learning improvement. The proposed system integrates a deep learning-based image processing pipeline developed using OpenCV for preprocessing answer sheets, including grid detection, alignment correction, and noise removal. A CNN trained on real-world answer cell images classifies marked and unmarked responses with 96.8% accuracy. The Gemini API adds intelligent validation and personalized feedback generation. The Android-based application, developed in Java with Firebase Realtime Database, ensures secure data handling, real-time synchronization, and performance tracking. Validation on 75 Sri Lankan school answer sheets achieved 97.2% question-level accuracy compared to manual grading, processing each sheet in 4.1 seconds, representing a 95% time reduction. Usability testing yielded a System Usability Scale score of 78.3, reflecting high satisfaction. The system achieved 98.2% overall grading accuracy at a significantly lower operational cost. The model's current training data is limited to structured MCQ templates, requiring further adaptation for diverse exam formats. This research introduces a hybrid CNN-AI framework that effectively combines pattern recognition and contextual reasoning to deliver a low-cost, scalable, and intelligent exam assessment tool, especially valuable for resource-constrained educational environments.

Keywords: *Artificial Intelligence, Automated Assessment, Convolutional Neural Network, Optical Mark Recognition, Performance Analysis*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Facial Recognition-Based Attendance Management Systems

W.M.S.T.L. Wijethunga[1] and I.M. Kalith[2]

[1,2]*Department of Information and Communication Technology, Faculty of Technology, South Eastern University of Sri Lanka*

[1]sureshthiwanka1234@gmail.com, [2]imkalith@seu.ac.lk

Abstract

Facial recognition-based attendance systems are increasingly critical for automating and securing attendance workflows in educational environments. This colloquium presents a technically focused implementation of a full-stack attendance management system that integrates a FaceNet embedding-based recognition pipeline with a modern web application architecture to deliver real-time, robust, and scalable attendance verification. The system extracts 128-dimensional face embeddings using FaceNet and performs similarity-based matching to identify students without requiring model retraining for new enrollments. A real-time processing pipeline minimizes latency through optimized face detection, embedding extraction, and approximate nearest-neighbor search, reducing opportunities for proxy attendance and enabling immediate feedback at classroom entry. The frontend is implemented in React to provide responsive role-based interfaces for students and instructors, while the backend uses Django REST to orchestrate recognition workflows, session management, and business logic. Stateless authentication is achieved via JSON Web Tokens (JWT), ensuring secure, scalable communication between clients and services. All biometric templates, user metadata, and attendance logs are persistently stored in a MySQL database with careful schema design for rapid lookups and archival integrity. The talk will detail system architecture, enrollment and verification protocols, trade-offs made for latency versus accuracy, and measures for privacy, such as storing embeddings rather than raw images and employing HTTPS and token revocation. Implementation considerations for edge processing, multi-face group detection, and database indexing strategies for large student populations will be discussed alongside evaluation metrics observed in pilot deployments. By combining FaceNet embeddings with a production-ready web stack, the system demonstrates a practical, extensible approach for integrating state-of-the-art facial recognition into institutional attendance management.

Keywords: *Attendance Management System, Biometric Authentication, Django–React Architecture, Facial Recognition, FaceNet Embeddings, Real-Time Verification*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

ML-based G.C.E. Advanced Level Science-Oriented Stream Selection Advisor for Sabaragamuwa Province

M.M.H.N. Kumari[1] and M.J. Ahamed Sabani[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]hansikanuwanthikumari@gmail.com, [2]mjasabani@seu.ac.lk

Abstract

The selection of the most appropriate Advanced Level (A/L) subject stream is an important academic choice among the students in Sri Lanka because it will largely determine their success and their prospective career. Yet, this choice is rather difficult for many students who do not find personal guidance according to their abilities, interests, and career perspectives. This paper provides an intelligent recommendation system based on machine learning to predict a more suitable A/L stream (Science, Mathematics, or Technology) along with a subject combination, and the expected career path for the students in the Sabaragamuwa Province. The system uses previous history such as results of Ordinary Level (O/L) exams, desired A/L streams and career expectations. It also applies the local industry data regarding the demand for skills and trends in employment to make it more realistic. The proposed framework includes data preprocessing, model training based on the Decision Tree, Random Forest, and Support Vector Machine (SVM) algorithms, and a recommendation engine that makes stream suggestions on an individual basis. Flask and Flutter were used to develop the web and mobile applications. They enable students to provide their O/L results and get recommendations immediately that relate their subject choices to possible career paths. Random Forest algorithm had the highest accuracy of 94.41% of the tested models relative to Decision Tree (93.78%), and SVM (65.80%). These results indicate the effectiveness of the ensemble methods in processing the educational data with categorical and numerical variables. The system recommendations were correlated to both the expert judgments and the actual student results, which warrants their reliability and utility. This work shows how evidence-based and personalized guidance is essential in the planning of education. The suggested system will enable students to make informed A/L subject decisions that will reflect their abilities and labor market requirements. Through this, it helps in positive academic performance and workforce readiness as it provides a bright future of intelligent educational support systems in Sri Lanka.

Keywords: *Advanced Level (A/L) Stream selection, A/L Science Oriented Stream, Educational Prediction, Sabaragamuwa Province*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Water Level Indicator and Alarm System for A Kelani River

H.D.K.V. Hiripitiya[1] and R.K.A.R. Kariapper[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]kalindavomikah@gmail.com, [2]rk@seu.ac.lk

Abstract

Flooding in Sri Lanka, especially along the Kelani River, remains a persistent natural disaster with severe repercussions for surrounding communities. Traditional flood-monitoring systems in the region depend on manual observation, resulting in delayed and often inadequate responses. This research addresses the urgent need for an intelligent solution by developing an Internet of Things (IoT)-based water level indicator and alarm system, integrating real-time monitoring, data analytics, and user-friendly visualization. The project employs an ESP32 microcontroller networked with multiple environmental sensors—ultrasonic (for water level), DHT22 (temperature and humidity), BMP180 (atmospheric pressure), and a rain sensor—to enable comprehensive parameter measurement. Sensor data are continuously transmitted to the Firebase cloud, where supervised Artificial Neural Networks analyze trends and predict potential flooding events. A dedicated web dashboard and mobile application were also developed to present live environmental data and issue early flood alerts. Results demonstrate that the proposed system ensures high accuracy and reliability in capturing water-level variations and associated meteorological conditions. The practical deployment confirmed real-time data synchronization, prompt alarm activation, and effective early warning notifications, improving both community awareness and disaster preparedness for the Kelani River basin. Discussions identify minor challenges, such as sensor calibration and network latency, which were mitigated through iterative testing and system optimization. In conclusion, the research proves a low-cost, scalable, and robust approach to flood monitoring, transforming flood management from reactive to proactive. Future enhancements are recommended, including the deployment of industrial-grade sensors, integration of GSM/LoRa communication for remote locations, and expansion to multiple monitoring sites. Such improvements will further strengthen the system's contribution to sustainable flood-risk reduction and community resilience in Sri Lanka.

Keywords: *Artificial Neural Networks, Early Warning System, Environmental Sensors, Flood Monitoring, IoT Water Level Indicator*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Smart Notification System for Detecting and Identifying Obstacles Reducing Solar Panel Efficiency in Solar Power Farms

K.P.D.L. Udayanga[1] and R.K.A.R. Kariapper[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]lakshithaudayanga018@gmail.com, [2]rk@seu.ac.lk

Abstract

With global energy demand rising, solar power is increasingly vital; however, its efficiency is compromised by environmental obstacles, especially dust accumulation on photovoltaic (PV) panels. This thesis addresses the urgent challenge of maintaining optimal solar panel performance in large-scale solar farms, where manual inspection is impractical and inefficient. The research problem centers on developing a real-time, cost-effective system to detect and report efficiency-reducing obstacles, primarily dust, to enable timely, data-driven maintenance interventions. The methodology involves designing and prototyping an IoT-enabled smart notification system, integrating a GP2Y1010AU0F dust sensor, Arduino Uno microcontroller, and SIM900A GSM module for sensor data acquisition, processing, and downstream SMS-based alerts. Iterative prototyping and testing under simulated and real-world conditions guided the selection and configuration of hardware and algorithmic thresholds. The system was rigorously validated for its ability to detect dust density above a critical threshold (0.35 gm) and automatically notify operators, ensuring proactive maintenance before substantial efficiency losses occur. Results demonstrated reliable real-time sensing, robust alert transmission with a 98% message delivery rate, and sensor accuracy within 0.04 gm of commercial references. The discussion highlights system reliability, low power use, cost-effectiveness, and scalability potential, with recommendations for future enhancements such as automated cleaning, cloud integration, and AI-driven predictive maintenance. In conclusion, this research validates an economical and scalable approach to solar farm maintenance, showcasing how IoT solutions can streamline photovoltaic management and support sustainable energy generation. Future work should focus on expanding system capabilities for other obstacles and integrating cloud-based analytics and remote automation to further improve efficiency and reduce operational costs.

Keywords: *Dust Sensor, IoT Notification System, Photovoltaic Maintenance, Predictive Maintenance, Solar Power*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Warning Device for Preventing Train Vehicle Collisions at Railway Crossings

A.A.S. Dilshan[1] and R.K.A.R. Kariapper[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]sameeradilshan1999amarathunga@gmail.com, [2]rk@seu.ac.lk

Abstract

Railway crossings in Sri Lanka, particularly in rural and semi-urban areas, pose significant safety challenges due to outdated manual gate operations and unreliable warning systems, leading to frequent train-vehicle collisions. This thesis presents the development of a cost-effective, decentralized warning device leveraging wireless RF communication, IoT microcontrollers (ESP32), and sensor integration to address these issues. The proposed system utilizes NRF24L01PALNA RF modules for real-time signal transmission between trains and crossings. Upon train approach, the transmitter initiates RF signals detected by the receiver at the crossing, activating audible (buzzer) and visual (LED) alerts, and automatically closing the gate via a servo motor. Ultrasonic and vibration sensors confirm the train's clearance before reopening the gate, ensuring high detection accuracy and minimizing false alarms. The entire system is powered by solar energy, with added lightning protection for operational reliability in remote locations. Methodologically, the project included both laboratory and field testing stages, focusing on sensor calibration, system integration, and validation for robust operation. Results demonstrated the system's responsive performance, reduced accident risk, and suitability for unmanned crossings without internet connectivity. The solution's low-cost, modular design makes it scalable for national deployment. The discussion highlights challenges such as signal interference and environmental impacts, addressed through improved sensor logic and hardware protection. The study concludes that such decentralized, IoT-based systems offer a practical alternative to expensive centralized solutions, enhancing safety and operational efficiency. Recommendations include further field testing in diverse conditions, addition of GPS/GSM modules, improved data encryption, and centralized dashboard integration to ensure real-time monitoring and future scalability.

Keywords: *IoT Microcontroller, RF Communication, Railway Crossing Safety, Sensor Integration, Solar-powered Warning*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Intelligent Ambulance Detection and Traffic Signal Preemption System using GPS and Siren Detection

H.A.Y.C. Perera[1] and R.K.A.R. Kariapper[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]yashasvichandupa@gmail.com, [2]rk@seu.ac.lk

Abstract

Traffic congestion at urban intersections often impedes ambulances, risking timely emergency response. This thesis presents a cost-effective, intelligent ambulance detection and traffic signal pre-emption system that combines GPS geofencing with machine learning-based siren recognition. The problem addressed is the inadequacy of single-sensor systems—GPS-only solutions suffer from positional errors and delays, while siren-only schemes can trigger false positives. The proposed two-stage methodology integrates real-time ambulance tracking via ESP32 microcontrollers with GPS/GSM modules, and a CNN-powered siren detector analysing live audio at intersections. When an ambulance enters a defined 1 km geofence, the traffic controller initiates a moderate extension of green time in the expected lane. Once the siren signature is detected locally, the system grants full pre-emption with immediate green for the ambulance route. Location and audio data are synchronized through Firebase for low-latency control. Results from implementation and tests demonstrated the system's accuracy in detecting ambulances (96.4% siren detection accuracy), low latency (1.2 seconds from siren detection to signal change), and robustness under diverse environmental conditions. Fusion logic prevented unnecessary traffic interruptions and false triggers, achieving a reliable balance between early warning and safe confirmation. Key challenges included limited dataset diversity, occasional GPS signal loss, and hardware constraints, mitigated through modular design and local data fallback mechanisms. The hybrid architecture significantly improves ambulance passage and intersection safety over traditional systems. It is practical and scalable for developing regions, with tested reliability and low cost. To strengthen deployment readiness, future work should expand the siren dataset, embed lightweight AI models for edge inference, enhance localization by fusing GPS with other sensors, and undertake broader field trials with integration to commercial traffic controllers. Collaborations with regulatory authorities and the use of multi-modal detection (visual, V2X) are essential for real-world adoption and scalability. This staged fusion approach is an effective blueprint for modernizing emergency vehicle priority at traffic lights, thereby saving lives and reducing urban response times.

Keywords: *Ambulance Detection, GPS Geofencing, Machine Learning, Siren Recognition, Traffic Signal Pre-emption*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Accident and Fire Detection System with Real Time Emergency Alert

K.A.M.S. Kodikara[1] and R.K.A.R. Kariapper[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]mudithasasanka7@gmail.com, [2]rk@seu.ac.lk

Abstract

Road accidents and vehicle fires continue to pose major threats to public safety in Sri Lanka, often exacerbated by delayed emergency responses due to communication gaps or lack of reliable network connectivity. Addressing these issues, this thesis presents the development and deployment of a cost-effective, real-time Accident and Fire Detection System leveraging IoT technologies and GSM/SMS-based communication, optimized for use in local road environments. The core problem targeted is the absence of an authentic, robust alerting mechanism that can promptly notify emergency responders and family members, especially in areas with poor internet or mobile data coverage. Existing solutions tend to rely heavily on internet access and often suffer from inaccurate positioning and delayed notifications. To overcome these shortcomings, the methodology combines an ESP32 microcontroller with MPU6050 (accelerometer), YL-99 (airbag sensor), and flame sensors; all interfaced with SIM800L (GSM/SMS) and Neo-6M (GPS) modules to detect accidents or fires. When an event is recognized, the system allows a 15-second window for manual cancellation to avoid false alarms. If confirmed, alerts (with precise GPS coordinates) are sent via SMS to registered contacts and an Android SMS Server, which parses and relays location data to the cloud using Firebase. Emergency responders receive real-time push notifications, enabling rapid action. System testing demonstrated high reliability: average SMS alert times were under 6 seconds, GPS accuracy within 5 meters, and false alarms were efficiently managed through the cancellation feature. The solution showed a significant reduction in emergency response times, particularly in rural regions, and proved scalable and feasible for wider deployment in the Sri Lankan context. The system achieved the objectives of autonomous, real-time incident detection and notification, enhancing road safety and contributing to life-saving interventions. Recommendations include further improvements in hardware efficiency, sensor calibration, and battery management, as well as national-scale integration with emergency services and exploring AI-driven enhancements for even greater reliability and coverage.

Keywords: *Accident Detection, Emergency Notification, Fire Detection, GSM SMS Communication, IoT Alert System*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Sinhala Sign Language Recognition and Real-Time Text Generation for Enhanced Communication

J.A.T.T. Chathuranga[1] and A. Fathima Sharfana[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]thushanthemiya@gmail.com, [2]sharfana.atham@seu.ac.lk

Abstract

This study presents a real-time Sinhala Sign Language (SSL) Translator developed to enhance communication for the deaf and speech-impaired community in Sri Lanka. Sinhala Sign Language possesses its own grammar and regional variations, making automated recognition particularly challenging due to the subtle temporal and spatial dependencies inherent in sign gestures. To address these challenges, this research employs temporal modeling combined with landmark-based feature extraction to effectively capture both static and dynamic gesture characteristics. Using MediaPipe Hands, 21 key hand landmarks corresponding to 63 spatial coordinates per frame were extracted from gesture videos recorded by the author to build a custom SSL dataset. Each gesture was represented across 100 frames and pre-processed for normalization and consistency before training. A Long Short-Term Memory (LSTM) network was then implemented to model sequential motion patterns, achieving a test accuracy of 99.69% and test loss of 0.0194, significantly outperforming a prior Convolutional Neural Network (CNN) baseline, which achieved approximately 45% accuracy and a 1.7 loss value. The trained model was integrated into a desktop-based real-time translation application, which recognizes gestures via webcam and converts them into Sinhala text, offering users options for editing, copying, and reuse. User testing conducted with ten participants confirmed that the desktop interface provided greater consistency, visibility, and usability compared to mobile versions. This research demonstrates the feasibility of real-time SSL recognition using temporal modeling and landmark-based learning, establishing a foundation for future bilingual sign translators, extended vocabularies, and cross-platform accessibility tools, ultimately promoting social inclusion and digital accessibility for Sri Lanka's deaf community.

Keywords: *CNN, Gesture Recognition, LSTM, MediaPipe, Real Time Translation, Sinhala Sign Language*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Exploring Sri Lankan Food Culture: An Intelligent System for Food Recognition and Information Dissemination to Tourists

N.A.N.A. Bandara[1] and I. M. Kalith[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]nipunbandaraict@gmail.com, [2]imkalith@seu.ac.lk

Abstract

The increasing overlap between Artificial Intelligence (AI) and mobile technologies has altered the culture and culinary experience sharing system worldwide. In Sri Lanka, traditional food is not only a gastronomy but also a vital part of the culture. Nonetheless, tourists usually experience difficulties with recognizing and appreciating local cuisine because of the lack of information access. This study aims to develop and deploy a smart mobile app, which identifies traditional Sri Lankan cuisines and offers users all cultural and culinary details, which builds cross cultural awareness and promotes gastronomy tourism. The system includes AI-powered image recognition on the basis of the MobileNetV2 deep learning model, trained on a curated dataset comprising 5,750 images across five categories Asmi, Egg Hoppers, Kokis, Kottu, and Pol Roti divided into training, validation, and testing sets. Model development was done using TensorFlow and Keras, and deployed using Fast API to serve predictions as RESTful APIs. The Flutter framework was used to create an easy to use cross platform interface with a connection to a MongoDB back-end to store data. The fine-tuned model achieved 97% accuracy with precision, recall, and F1-score all at 0.97, demonstrating consistent recognition across traditional Sri Lankan dishes. The mobile application has been able to provide recognition outcomes with cultural description, preparation techniques and user interaction elements such as reviews and favorites. The limitations of this study is the use of a relatively small data set and the lack of real-time location-based restaurant suggestions. This application, in addition to technical success, enhances the gastronomy and tourism in Sri Lanka by exploring the cuisine. Connecting technology and culture will help it keep traditional Sri Lankan cuisine and share it with the world, and demonstrate the way AI solutions can foster smart tourism and digital storytelling.

Keywords: *Artificial Intelligence, Cultural Tourism, Deep Learning, FastAPI, Flutter, MobileNetV2*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

TRACK – UBIQUITOUS COMPUTING TECHNOLOGIES

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Developing a Smart Device for Detecting Adulteration and Ensuring the Quality of Cooking Coconut Oil in Sri Lanka

R.M.K.R. Rajapaksha[1] and I.M. Kalith[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]rmkrr99@gmail.com, [2]imkalith@seu.ac.lk

Abstract

Adulteration of coconut oil has become a serious food safety issue in Sri Lanka. It presents a threat to consumer health and market integrity. Large-scale admixing of pure coconut oil with cheaper vegetable oils, such as palm oil or reused frying oil, carries serious health risks. Although laboratory tests offer very accurate determinations, they are much too expensive and time-consuming for practical routine quality monitoring by small-scale operators and market inspectors. This necessitates the availability of affordable, fast, and accessible screening solutions. To address this gap, this study presents a low-cost, IoT enabled smart device for the detection of coconut oil adulteration using a multi-parameter analysis system. The proposed system integrates three sensing technologies, namely capacitance measurement of dielectric properties, UV light absorption-based oxidation detection, and load cell-based density measurement. An ESP32 microcontroller manages real-time data collection, with temperature monitoring ensuring measurements are conducted under stable environmental conditions. The device transmits data to a Firebase cloud database via Wi-Fi, and an Android application allows users to view the results easily with color-coded quality classification and actionable recommendations. Validation testing with systematically prepared samples containing 10-50% adulterants (used coconut oil, palm oil, and used palm oil) gave an overall classification accuracy above 70% for adulteration levels above 30%. It comes with a total hardware cost of less than $50, making the device a practical alternative to laboratory testing, an effective preliminary screening tool for the field inspectors, producers, and vendors. Overall, the system is proof that low-cost, user-friendly quality monitoring systems can improve food safety in developing countries.

Keywords: *Coconut Oil Adulteration, Food Quality Screening, IoT Sensor System, Multi-Parameter Detection, Real-Time Monitoring*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

IOT-Based Smart Storage Bottle

K.P.N. De Silva[1] and I.M. Kalith[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]niwantha444@gmail.com, [2]imkalith@seu.ac.lk

Abstract

The effective management of small, high-value or time-sensitive inventory (such as medication, sensitive reagents or perishable goods) is often hindered by reliance on manual tracking, leading to inventory inaccuracies, potential misuse, and critical loss due to expiration. This project introduces an Internet of Things (IoT) based Smart Storage Bottle system designed to provide real-time, accurate monitoring of stored item levels, usage patterns, and critical shelf-life status. The solution utilizes an integrated hardware platform featuring a continuous content level measurement, for local processing and Wi-Fi connectivity, and a robust cloud-based backend. The system wirelessly transmits data, allowing users to monitor the bottle's contents, temperature, and usage via a dedicated application. A core functionality of this system is the proactive Expiration Date Warning Alert System. Upon initial item storage, the user inputs the expiration date directly through the mobile application. The system then stores this date and automatically generates multi-stage warnings sent directly to the user's mobile device or dashboard. Additionally, the system provides automated low-level alerts to trigger timely reordering and optional security features like tamper detection or access logging. Through empirical testing, the prototype demonstrated an accuracy of content measurement and a latency of data transmission. This system effectively transforms a static storage container into a smart, connected asset, significantly reducing operational inefficiencies and enhancing user safety and accountability.

Keywords: *Automated Low-Level Alerts, Expiration Date Warning Alert System, Internet of Things (IoT), Inventory Management, Mobile Application*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Smart Medicare: An IoT AI-Based Smart Medicine Dispensary for Patient Safety

R.W.A.S.N. Ranasinghe[1] and M.S.S. Razeeth[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]savindinayananjalee85@gmail.com, [2]razeethsuhail@seu.ac.lk

Abstract

Ensuring the medications behaviors of chronic illnesses patients, remains a major challenge in healthcare, especially among older and adults. Traditional approaches, such as using pillboxes or paper reminders, often fall short in helping patients take their medications on time, and providing proper monitoring. As a result, patients may miss doses, and experience treatment delays, which leads to higher health risks. The SmartMediCare system offers a modern solution by combining IoT and AI technologies with a smart medication dispenser. Built on an ESP32 hardware platform, the device uses servo motors to dispense medicine accurately, incorporates real-time scheduling to ensure timely doses, and features secure authentication through a keypad so that only authorized users can access their medications. It works autonomously to deliver the right medicines at the right time while keeping track of observance with RTC sensor. Besides the hardware, a mobile application provides notifications, records medication intake, and alerts to caregivers if a dose is missed. All information is stored in the cloud using Firebase, enabling remote monitoring from anywhere. An AI module observes user patterns to predict when a dose might be missed and adapts reminders to better suit the user's habits, creating a personalized experience. By integrating secure automated dispensing, intelligent monitoring, and an easy-to-use app, SmartMediCare overcomes many limitations of traditional medication management. It offers practical and scalable solutions that can improve adherence, ease caregiver responsibilities, and promote better health outcomes, particularly in healthcare settings with limited resources.

Keywords: *AI, Chronic Illnesses, IoT, Smart Dispensary, Smart Medicare*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Coryza Guard: An IoT-Deep Learning System for Coryza Detection in Poultry

S.A. Hanan Aafreen[1] and M.S.S. Razeeth[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]hananiafrin@gmail.com, [2]razeethsuhail@seu.ac.lk

Abstract

Infectious Coryza caused by *Avibacterium paragalli*narum, is the name of a highly contagious respiratory disease that causes economic impact on the poultry sector due to the loss from the reduction of egg production, death of birds, and increased vet costs. Traditional ways took a lot of time and were expensive, and the interventions were delayed and spread over a large area. To overcome this issue, this study proposes CoryzaGuard, a system which consists of IoT, deep learning, and mobile technology to detect disease automatically and in real-time. CoryzaGuard uses a three-step detection. Initially, an ESP32-CAM identifies infected chickens by analyzing eye area using a deep learning model trained with eye swelling and healthy images. Second, wearable devices with sensors controlled by a NodeMCU monitor environmental and behavioral parameters. Finally, the images of the recognized chickens are subject to a series of processes including pre-processing, segmentation, detection, and classification by using deep learning models like Transfer Learning, Segmentation, Object Detection, and CNN. The Android app provides data to the farmers with real-time notifications. The performance was tested on 658 chicken images that were divided into 80% training and 20% testing sets. Among the models used, Unet++ proved the most efficient by achieving accuracy of 98%, precision of 96.9%, F1-score of 97.3%, and IoU of 94.8%. The CoryzaGuard has been presented as a cost-efficient, and user-friendly solution that can enhance the health monitoring of farm animals in Sri Lanka's poultry farming.

Keywords: *Deep Learning, Infectious Coryza, IoT, NodeMCU, Poultry Health Monitoring*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

An IoT Based Multifunctional Smart Backpack for Enhanced Outdoor Safety and Activity Tracking

L.G.A.S Aqeela[1] and M.S.S. Razeeth[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]aqeelah1501@gmail.com, [2]razeethsuhail@seu.ac.lk

Abstract

The use of backpacks has become a vital part of modern life, especially among travellers, students, and outdoor enthusiasts. Yet, the safety and security of personal items on travel have become a primary challenge. IoT technology has brought about a vast array of innovations from sensors to microcontrollers. Considering this, this study focuses on the development of a smart backpack using IoT components. The main purpose is to provide a high level of user security, environment, and convenience. The proposed backpack system features a fingerprint recognition sensor, which allows the authorized user to access it. The raindrop sensor, which detects the spillage of water inside the backpack, gives a notification message to the user remotely using a mobile app connected to Firebase. The backpack design also contains a GPS module, which provides real-time tracking services using the MyBag mobile app. In addition, a two-way communication system based on LoRa technology has been implemented. The backpacks, which include main and complementary backpacks, send notifications signalling emergencies using a button-pressed LED notification, even without internet connectivity. The air quality sensor MQ135, has been used along with a DHT11 temperature and humidity sensor. The sensors are responsible for detecting the environmental conditions, which are then displayed on the backpack's LCD display. The proposed multifunctional smart backpack can be very valuable for use among travelers, hikers, as well as outdoor workers.

Keywords: *Firebase, GPS Tracking, IoT, LoRa Communication, Smart Backpack*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

IoT-Based Smart Digital Water Meter with Automated Billing System in Sri Lanka

W.R.M.P. Fonseka[1] and M.S.S. Razeeth[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]roshenmalsha11@gmail.com, [2]razeethsuhail@seu.ac.lk

Abstract

Water is a vital natural resource. Efficient monitoring and management have become increasingly important to address growing demand and limited supply. In Sri Lanka, most domestic and urban water systems still rely on traditional manual reading and billing methods, which are time-consuming, inaccurate, and prone to human error. This study focused on the design and development of an IoT-based Smart Digital Water Meter System that enables real-time water consumption monitoring, automatic billing, and remote control of the water supply. The system is built using an ESP32 microcontroller integrated with a YF-S201 water flow sensor for continuous data collection. The measured readings are transmitted to the Firebase cloud platform through Wi-Fi, allowing secure data storage and synchronization. A mobile application, developed using Android Studio with Kotlin, provides users with real-time usage information, billing details, and an online payment feature. The system can automatically disconnect the water supply via a solenoid valve when payments are overdue and reconnect it upon settlement. Additionally, it includes a simple leakage detection function to identify abnormal water flow patterns. Testing confirmed accurate measurement, reliable data transmission, and stable mobile connectivity. Overall, this research project offers an effective, low-cost, and sustainable solution for modernizing Sri Lanka's water management through IoT and digital automation.

Keywords: *Automated Billing, IoT, Leak Detection, Smart Water Meter, YF-S201 Flow Sensor*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

IoT-Driven and Mobile App-Based Approach for Sustainable Plastic Waste Reduction in Sri Lankan Universities

H.B.D.M. Hewabandara[1] and M.S.S. Razeeth[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]dilshanmadumesha175@gmail.com, [2]razeethsuhail@seu.ac.lk

Abstract

Plastic pollution has become one of the most persistent environmental challenges in Sri Lankan universities. The widespread use of disposable plastic bottles, combined with limited recycling initiatives, has led to large volumes of unmanaged waste on campuses. This study introduces an integrated solution that combines Internet of Things (IoT) technology and a mobile based platform to encourage responsible waste disposal and reduce plastic waste generation. The system includes an IoT-enabled smart bin equipped with a load cell, capacitive proximity sensor, and ESP32 microcontroller. A lightweight CNN model was trained using a custom dataset of plastic and non-plastic objects to classify bottles accurately. 3000 images of plastic and non-plastic were collected and trained using CNN models. The model achieved accuracy of 97.2% in 50 epochs. Once a plastic bottle is detected, the bin records the activity real time. A mobile application was developed with Firebase database to increase student involvement. The app functions as an eco-friendly social network, allowing users to log in, share posts, comment, exchange points, and purchase eco-friendly goods. It also evaluates the positive environmental impact of each user's recycling actions by displaying the number of bottles collected, CO_2 reduction, and other sustainability metrics. A reward-based system encourages students to recycle by offering points and leaderboard rankings. System evaluation showed reliable communication between the IoT bin and mobile app, as well as high detection accuracy from the trained CNN model. The study also demonstrates how technology can create a practical and engaging pathway for promoting environmental sustainability within universities.

Keywords: *Deep Learning, IoT, Plastic Waste Management, Smart Bin, Sustainability*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

IoT-Integrated Ambulance Dispatch System for Efficient Emergency Response

K.I.L. Chathuranga[1] and R.K.A.R. Kariapper[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]ishanlasithc0308@gmail.com, [2]rk@seu.ac.lk

Abstract

This thesis presents the development and validation of an IoT-Integrated Ambulance Dispatch System designed to optimize emergency medical response by bridging patient health monitoring with intelligent hospital selection. The research addresses the critical challenge of delays and mismatched hospital referrals experienced in emergency situations, primarily due to insufficient real-time data and lack of automated decision-making. Utilizing an ESP32 microcontroller integrated with biomedical sensors (MAX30102 for heart rate and SpO_2, AD8232 for ECG, and GSR for stress detection), the system continuously collects vital patient data at the scene. This information is securely transmitted via Wi-Fi to the Blynk.cloud platform, enabling real-time analytics and visualization. Hospital profiles stored in the cloud are dynamically matched against patient needs, with the system displaying the most suitable nearby hospital on an OLED screen for ambulance staff. In addition, the project incorporates basic cybersecurity protocols, including WPA2 encryption, API key authentication, and firewall logic, to ensure data confidentiality and integrity. Testing and validation showed that the proposed system significantly reduces response times and improves hospital selection accuracy, particularly benefiting rural and under-resourced areas. The real-time data transmission and automated hospital matching offer a tangible improvement over conventional methods, potentially enhancing survival rates. However, certain limitations were noted in terms of hardware scalability and the exclusion of GPS-based routing. Recommendations for future enhancements include integrating GPS for location tracking, adopting AI-driven data analysis for better decision-making, improving networking via 5G, and strengthening cybersecurity using advanced techniques. Overall, the IoT-enabled solution demonstrates a practical step towards smarter, more responsive, and secure emergency healthcare systems, laying important groundwork for future innovation.

Keywords: *Ambulance Dispatch, Biomedical Sensors, Emergency Response, Hospital Selection, IoT Healthcare*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

IoT- Development of A Smart Dustbin System for Enhanced Waste Management and Safety Monitoring

B.M.K.P.M. Basnayake[1] and S.L. Abdul Haleem[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]kalpab1998@gmail.com, [2]ahaleemsl@seu.ac.lk

Abstract

Rapid urbanization and population growth have led to a significant rise in solid waste, overwhelming traditional management systems that rely on fixed schedules. This approach results in overflowing bins, inefficient resource use, and severe environmental and safety hazards, including the emission of flammable methane (CH4) and toxic ammonia (NH3) gases, posing health and fire risks. To address these deficiencies, this research presents the design, development, and evaluation of a low-cost, IoT-based Smart Dustbin System for enhanced waste management and real-time safety monitoring. The primary objective was to create an integrated system capable of monitoring waste levels, detecting hazardous gases, and identifying fire risks. The prototype is built upon an Arduino Uno R3 microcontroller, integrating an HC-SR04 ultrasonic sensor for waste fill-level detection, MQ-4 and MQ-135 sensors for methane and ammonia, and an infrared flame sensor. For communication and safety, the system incorporates a SIM900A GSM module to send automatic SMS alerts to authorities and a servo motor to control the lid, locking it when hazardous conditions are detected. Prototype testing under controlled laboratory conditions demonstrated high efficacy. Waste level detection maintained an average error rate below 5%, while gas sensors responded within 3-5 seconds of exposure. Critical alerts were successfully transmitted via GSM and received within 4-6 seconds, and the automated lid mechanism effectively sealed the bin when gas thresholds were breached. This study successfully demonstrates a scalable and cost-effective solution that enhances operational efficiency, promotes public hygiene, and ensures worker safety. By enabling real-time monitoring and automated alerts, the system optimizes collection routes and mitigates environmental hazards, aligning with UN Sustainable Development Goals (SDG 11 and 13) and offering a practical framework for smart city initiatives in developing nations.

Keywords: *Hazardous Gas Detection. Internet of Things (IoT), Real-time Monitoring, Smart Dustbin, Waste Management*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Smart Decision Support System for Irrigation Pond Monitoring in Sri Lanka

T.S. Rashmika Deemantha[1] and S.L. Abdul Haleem[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]rashmikat99@gmail.com, [2]ahaleemsl@seu.ac.lk

Abstract

Inefficiencies in traditional water management, which rely heavily on manual verification and estimations, present a significant and persistent challenge to the agricultural sector in Sri Lanka. This research addresses this critical gap by presenting the design and implementation of a Smart Decision Support System (SDSS) specifically engineered for the real-time monitoring of irrigation ponds. The primary objective of this study was to conceptualize and develop a comprehensive, integrated system utilizing Internet of Things (IoT) technology, scalable cloud computing infrastructure, and accessible, user-centric mobile-based decision support. The resulting system is intended to empower farmers and local stakeholders to transition from conventional methods toward efficient, data-driven irrigation management practices. The methodology involved the deployment of a low-cost, field-operable hardware unit centered on an ESP8266MOD DOIT.AM microcontroller. This central hub connects to a multifaceted sensor array comprising an ultrasonic sensor for precise, non-contact water level measurement, a DHT11 sensor for localized temperature and humidity detection, and a dedicated rain detection module to identify precipitation conditions. All collected sensor data are automatically transmitted via IoT protocols to a secure cloud platform for robust data logging and aggregation. This cloud data is then synchronized in real-time with a cross-platform, Flutter-based mobile application, which features a purpose-built, rule-based decision module designed to analyze these incoming environmental parameters. The system successfully provides end-users with intuitive, real-time data visualization via the mobile interface, alongside critical alerts and actionable irrigation recommendations. The rule-based module generates key outputs as direct, plain-language insights delivered to the user, such as "Irrigation Required," "Sufficient Water Level," or "Rainfall Detected – Irrigation Not Required." These alerts facilitate immediate and appropriate operational responses, preventing resource waste. In conclusion, the proposed SDSS effectively demonstrates how the strategic integration of low-cost IoT technology and high-accessibility mobile platforms can significantly enhance irrigation efficiency. This framework supports more accurate, timely decision-making by farm managers and actively promotes sustainable water resource management, offering a scalable and practical solution relevant to Sri Lanka's vital agriculture sector.

Keywords: *Decision Support System, ESP8266 Microcontroller, IoT-based Monitoring, Irrigation Management, Mobile Application, Ultrasonic Sensor*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Smart Motorcycle Control System using IoT, Biometric Authentication, and Mobile Application

H.V.D.S.D. Abeywickrama[1] and F.M. Ameer[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]dilshansaduu@gmail.com, [2]ameermusfi@seu.ac.lk

Abstract

Motorcycle theft is a recurring problem worldwide, and traditional key-based ignition systems are becoming increasingly ineffective in the face of contemporary security risks. A revolutionary route toward safe and private vehicle access control systems is provided by the combination of Internet of Things (IoT) technologies with biometric authentication. This study fills a significant research gap: while previous studies have looked at biometric, Internet of Things, and GSM technologies separately, integrated multi-path authentication architectures with offline, privacy-preserving operation have not been sufficiently investigated. There are three goals: (1) design and implement a smart motorcycle control system that is not dependent on cloud services and incorporates biometric and multi-factor authentication, (2) to create a mobile application using Flutter that enables control and monitoring via SMS and Bluetooth, and (3) to use empirical testing to confirm system security performance, authentication effectiveness, and dependability. A dual-path control architecture is used in the proposed system: a primary biometric verification path that makes use of the R503 fingerprint sensor and K202 board, and a secondary multi-modal path that integrates RFID, GSM, and Bluetooth communication through an ESP32 microcontroller. To protect data privacy and ensure offline functionality, the implementation steers clear of cloud dependencies. Experimental evaluation demonstrated 95% theft prevention efficacy, authentication response times of less than 5 seconds for SMS and less than 1 second for Bluetooth, GPS accuracy within 5 meters, and reliable hardware performance under various operating conditions. The outcomes provide a useful reference model for upcoming IoT-based intelligent vehicle security architectures and validate the system's affordability, dependability, and privacy protection.

Keywords: *Biometric Access Control, IoT-Based Vehicle Control, Multi-Factor Authentication, Privacy-Preserving IoT Architecture, Remote Ignition and Tracking, Smart Motorcycle Security*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Elephant Intrusion Detection and Automated Alarming System

E.P.D. Imal[1] and A. Fathima Sharfana[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]deepaja1999imal1024@gmail.com, [2]sharfana.atham@seu.ac.lk

Abstract

This research presents an automated elephant detection and alerting system designed to mitigate the persistent human–elephant conflict in rural Sri Lanka, which continues to cause extensive crop losses, property damage, and casualties among both humans and elephants. Conventional mitigation methods such as electric fences, spotlights, and manual patrols are often ineffective, particularly under low-light or poor weather conditions. The novelty of this project lies in the utilization of thermal imaging through a hybrid data acquisition approach, enabling wide-area farm monitoring even in limited-visibility environments. The system integrates thermal cameras, a Convolutional Neural Network (CNN) for image-based detection, and an IoT-based alert mechanism that sends real-time SMS notifications to farmers. A balanced thermal dataset of 17,971 images (11,857 elephant and 5,541 non-elephant) was collected using a handheld thermal camera at distances of 0–50 meters under nocturnal and low-light conditions. The dataset was divided into training (12,177), validation (3,479), and testing (1,743) subsets, and processed using ImageDataGenerator for augmentation and normalization. The CNN model, implemented with TensorFlow and Keras, achieved training and validation accuracies of 97.3% and 97.5%, respectively, demonstrating strong robustness in detecting elephants from unseen images. Upon detection, the system automatically issues alerts via a GSM/IoT communication module, enabling rapid response and minimizing potential conflicts. The proposed framework offers a cost-effective, scalable, and sustainable solution for wildlife monitoring, promoting human–elephant coexistence and rural safety. Future developments will focus on expanding the dataset, enhancing long-range detection, integrating drone-based surveillance, and deploying the model on edge devices for real-time autonomous operation.

Keywords: *Convolutional Neural Network, Human-Elephant Conflict, IoT, Real-Time Alert System, Thermal Imaging*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

IoT Integrated Machine Learning Model for Poultry Gender Prediction based on Egg Morphometric

R.M.L. Pathminda[1], A.R.F. Shafana[2], M.G. Mohamed Thariq[3], and M.M. Muneeb[4]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka, Sri Lanka*
[3,4]*Department of Biosystems Technology, South Eastern University of Sri Lanka, Sri Lanka*

[1]pathmindalakshitha@gmail.com, [2]arfshafana@seu.ac.lk, [3]mgmthariq@seu.ac.lk, [4]muneeb@seu.ac.lk

Abstract

The poultry sector encounters considerable ethical, operational, and financial issues, especially due to the widespread culling of male chicks that are non-viable for egg laying and yield less meat. This practice leads to substantial resource wastage and ethical issues, with around 7 billion male chicks being exterminated worldwide annually. Moreover, inefficiencies in the conventional sex identification method, typically performed after hatching, lead to higher operational expenses and greater environmental effects. This study introduces a non-invasive, in-Ovo sexing method that integrates Internet of Things (IoT) and Machine Learning (ML) to forecast the gender of chicken eggs prior to incubation, primarily aimed at minimizing waste, enhancing hatchery efficiency, and addressing ethical concerns. The prediction model was developed using engineered egg morphometric features including height, width, egg shape index (ESI), aspect ratio, approximate perimeter, approximate area and the difference between egg height and width. The dataset comprised 1,098 records, including 102 locally measured eggs, whose gender was confirmed after 28 days of incubation, while the remaining records were from reliable repositories. The dataset was split in an 80-20% ratio and used to train classifiers such as Random Forest, K-Nearest Neighbors (KNN), Support Vector Machine (SVM), Decision Trees, Logistic Regression and Gradient Boosting (GB) following a hyperparameter optimization. Among them, the Random Forest classifier outperformed other classifiers with an accuracy of 99.04%. The real-time gender prediction system was then implemented using a 5 MP USB camera module connected to a Raspberry Pi 4, where egg morphometric features were extracted using OpenCV. The optimized Random Forest model was deployed into a Flutter based mobile application to display the egg gender in a user-friendly interface. This system contributes to decreasing energy consumption, lessens wastages, and addresses the ethical concerns related to chick culling, providing a scalable and sustainable option for commercial hatcheries globally.

Keywords: *Biometric Egg Morphometric, Egg Shape Index, In-Ovo Sexing, IoT Development, Machine Learning*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Smart IoT-Based System for Detecting and Deterring Monkey Intrusions in Agricultural Fields

N.A.R. Chamod[1] and M.S. Shafana[2]

[1,2]*Department of Information and Communication Technology, South Eastern University of Sri Lanka*

[1]naraveenchamod@gmail.com, [2]zainashareef@seu.ac.lk

Abstract

Monkey incursion has been recognized as a major security threat to the households and agricultural output in Sri Lanka often leading to substantial losses of crops and finances. There has been an increase in demand of intelligent, automated wildlife control systems because the traditional methods of deterring animals, including fences, loud-noise sounds, or scarecrows are usually time-consuming, short-term and mostly inefficient. To overcome this obstacle, the present paper introduces the Smart Monkey Detection Model, a real-time vision-based system, which is able to detect the activities of monkeys on its own and give out the necessary warnings to enable preventative resolution of conflicts. The architecture combines the use of deep learning, computer-vision algorithms, and edge-processing so that they can be run on low-energy platforms, such as the Raspberry Pi to process the live video data in real-time. The model is built on a one-class classification paradigm and makes use of MobileNetV3-Small to get salient features and a central reference based on labeled monkey images. Data that was used in this study included 2,104 images of monkeys and 720 images depicting non-monkey objects, which form a strong foundation in terms of training and validation. It was found that the model achieved significant classification performance with an accuracy of 81% and a high discriminative ability as indicated by an ROC-AUC OF 0.883, F1-score of 0.876, precision was 0.854 and recall was 0.899. The affordable and scalable solution has a modular architecture that is ready to be expanded in the future with addition of the multi-species detection, IoT-based environmental tracking, and predictive analytics powered by artificial intelligence.

Keywords: *Cosine Similarity, IoT-Enabled Crop Protection, Monkey Intrusion Detection, ONNX Runtime, Real-Time Object Detection*

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

Notes:

ISBN 978-955627-147-8 | e-ISBN 978-955-627-148-5

URCDICT 2025

Department of ICT
Faculty of Technology
South Eastern University of Sri Lanka
University Park
Oluvil
Sri Lanka

www.seu.ac.lk

#urcdict
#urcdict2025
#dictft

Media Support:

Technical Support:

e-ISBN 978-955-627-148-5

ISBN 978-955-627-147-8