INFORMATICS INSTITUTE OF TECHNOLOGY

iCIIT 2025 SYMPOSIUM

Proceedings of the iCIIT Student Research Symposium 2025

PROCEEDINGS OF THE iCIIT STUDENT RESEARCH SYMPOSIUM 2025

INFORMATICS INSTITUE OF TECHNOLOGY, COLOMBO, SRI LANKA

June 2025

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iCIIT STUDENT RESEARCH SYMPOSIUM 2025

INFORMATICS INSTITUTE OF TECHNOLOGY, COLOMBO, SRI LANKA

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iCIIT Student Research Symposium 2025 Program

IIT City office, Informatics Institute of Technology, 435, Galle Road, Colombo 3

On Thursday, 19th June 2025 at 9.30 AM onwards

Time	Agenda Item
9.00 AM - 9.30 AM	**Registration**
9.30 AM - 9.45 AM	**Welcome Address** Dr. Ruvan Weerasinghe, Dean Academic, IIT Computing School
9.45 AM – 11.00 AM	**Session 1: Abstract presentations**
11.00 AM – 11.15 AM	**Address by Chief Guest** Dr. Andrea Martina, Assistant Head of School and the Director of International for the School of Computer Science and Engineering of the University of Westminster
11.15 AM - 11.45 AM	**Refreshments**
11.45 AM – 1.15 PM	**Session 2: Abstract Presentations**
1.15 AM - 1.45 AM	**Lunch**
1.45 PM – 3.15 PM	**Session 3: Abstract Presentations**
3.15 PM – 3:45 PM	**Q&A Session** Dr. Ruvan Weerasinghe, Dean Academic, IIT Computing School
3.45 PM – 4:00 PM	**Award Ceremony**
4.00 PM – 4:05 PM	**Vote of Thanks** Dr. Dinesh Arunatileka, Head, IIT Research Unit
4.05 AM - 4.45 AM	**Refreshments**

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iCIIT Student Research Symposium 2025

The inaugural IIT Student Research Symposium was held on the 19th of June at the IIT City Office. Organized as an academic event, the symposium featured selected research projects presented by final-year students from both the School of Computing and the Business School. A panel of judges evaluated the presentations and selected one outstanding project from each school.

The chief guest, Dr. Andrea Martina, Assistant Head of School and Director International, School of Computer Science and Engineering, University of Westminster, provided valuable feedback on the quality and presentation of the research, commending the students' efforts and the academic rigor on display.

The symposium was initiated with several key objectives in mind. It aimed to facilitate knowledge sharing through formal presentations of research findings and ongoing studies. It also encouraged constructive feedback from both peers and academic experts, providing presenters with insights to refine and strengthen their work. Another important goal was to foster collaboration by offering networking opportunities among students, faculty, and industry professionals. Additionally, the event supported professional development by exposing participants to current trends, tools, and methodologies relevant to their fields of study.

As the first event of its kind, the number of presentations was intentionally limited. However, broader participation and extended time for discussion and feedback are anticipated in future editions.

In addition to awarding the Best Paper from each school, the symposium also recognized the Most Popular Presentation from each session, as voted by participants online. All presenters received certificates of participation, with special certificates awarded to the best paper presenters.

Overall, the symposium was a successful and insightful event, offering valuable learning experiences for everyone involved and setting a strong foundation for future research engagements at IIT.

Message from the Dean Academic, IIT School of Computing

Dr. Ruvan Weerasinghe (Chair)

Dean Academic, IIT School of Computing, Informatics Institute of Technology, Sri Lanka

Students of IIT have over the years produced work, especially in their final year project, that is suitable as proof-of-concept and minimal viable products to solve real world problems. Many of these are showcased at the highly successful annual Cutting Edge exhibition. More importantly, some of their work has been of a more research nature, so that they have been published at national and international conferences. The iCIIT Student Research Symposium is a new platform created by IIT this year, to provide an opportunity for the best research projects carried out to be presented before an academic and research audience. This year, it attracted the very top research projects from both the Computing and Business Schools to be presented before academics, students and our visiting academics and guests from the University of Westminster.

The Symposium is expected to, at one and the same time, provide students with a forum for making conference presentations, facing questions, and improving their manuscripts into high quality papers to be published at conferences and in journals.

It is expected that in the years ahead, students will compete against each other to be accepted to present at the Research Symposium as a platform from which they could launch into their publishing career. It is also expected that academic supervisors also consider it prestigious for their student's work to be thus presented at the annual Research Symposium.

This book of abstracts would facilitate this process while still encouraging students and academics to target prestigious publication venues. Congratulations to all participants and thank you to the faculty and guests who make this launch year such a success. I look forward to seeing the impact of your research unfold in the years to come.

Message from the Dean Administration, Computing Faculty

Dr. Naomi Krishnarajah

Dean Administration, Computing Faculty, Informatics Institute of Technology, Sri Lanka

It is with great pride that I commend our students for their outstanding contributions to the Computing and Business IICT Symposium. The submission and presentation of their research abstracts reflect not only academic excellence but also a strong commitment to innovation and real-world impact. This platform offers a valuable opportunity for our students to engage in scholarly dialogue and showcase their potential as future leaders in technology and business.

Congratulations to all participants on this remarkable achievement.

Message from the Dean, School of Business

Prof. P. S. M. Gunaratne

Dean, School of Business, Informatics Institute of Technology, Sri Lanka

I am delighted to extend my heartfelt congratulations on the publication of the proceedings from our recent student research conference at IIT. It was truly inspiring to witness the high-quality papers presented by students from both the School of Computing and the School of Business, showcasing their final year projects across six undergraduate programs. These contributions undoubtedly reflect the excellence of IIT's undergraduate curricula and its operations.

My observations are informed not only by my personal experience but also by the positive feedback received from the external judge panel and representatives from our partner universities, who attended the event. Their insights further underscore the remarkable standard of work displayed.

I would like to express my sincere appreciation to the Research Unit of IIT for organizing this important event amidst a busy academic calendar filled with commitments that could not be postponed. The conference provided students with a valuable platform to present their ideas, receive constructive feedback, and engage with a diverse and enriching audience. Such experiences are instrumental in building their confidence and advancing their research journey.

Most of the work presented went beyond mere academic exercises, offering practical solutions to real-world problems and demonstrating the application of knowledge acquired during their undergraduate studies. The decision to publish these papers as conference proceedings is commendable, as it will allow a broader audience to recognize and appreciate the efforts of these young researchers and their supervisors.

Finally, I would like to extend my gratitude to the supervisors whose mentorship and guidance have been foundational to these achievements. I am confident they will continue to nurture their students' development by encouraging them to refine their work and pursue publication in regional and international journals of repute.

Once again, congratulations to all involved. Your dedication and hard work are truly commendable. Wishing everyone continued success in future endeavors!

ABSTRACTS

iCIIT Student Research Symposium 2025

Note: In each abstract, the lead presenter is marked with an asterisk (*)

Interactive Virtual Reality Exposure Therapy System Utilizing a Smart, Sensor-Enabled Stress Ball for Adaptive Pain Management

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This study introduces an advanced interactive virtual reality exposure therapy (VRET) system tailored for pediatric pain management, motivated by initial trials that revealed the limitations of VR alone in adult pain relief during cystoscopy and the promising results when combined with physical interaction in paediatric patients. Traditional VRET systems lack real-time adaptive feedback and tactile integration, which This system addresses by incorporating a sensor-enabled stress ball with a force-sensitive resistor (FSR) sensor. This sensor captures tactile feedback such as grip force, squeeze frequency, and duration, transmitting the data wirelessly to a Virtual Reality Therapy application.

Initial trials conducted at the Asiri Central Hospital, Sri Lanka demonstrated that while VR alone was insufficient for adult pain management, with patients reporting high pain scores (7–9/10) during cystoscopy procedure. And during a trial conducted with the admitted Dengue patients at Royal Hospital, Sri Lanka, the combining VR with physical interaction significantly reduced pain scores in paediatric patients (1–5/10) and enhanced their engagement. These findings shifted the focus towards developing an interactive VR therapy specifically for children, integrating tactile feedback for a more immersive and responsive experience.

This system enhances interactivity and provide objective monitoring of patient responses. The non-invasive and cost-effective nature of the system makes it suitable for
various clinical and educational settings.

In conclusion, this interactive VRET system represents a significant advancement in adaptive therapeutic technology, effectively reducing pain and anxiety during medical procedures by integrating real-time tactile feedback and intelligent adaptation, particularly beneficial for patients.

Keywords: virtual reality exposure therapy, virtual reality, pain management, reinforcement learning, tactile feedback, pediatric care, adaptive therapy

End-to-End Sign Language Recognition Pipeline: Towards Energy Efficient Modeling

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This study proposes an energy-efficient, end-to-end sign language recognition (SLR) pipeline designed for Sri Lankan Sign Language (SLSL), with potential scalability to other sign languages. The pipeline is optimized for real-time inference on edge devices, combining lightweight MaskedConv1D layers, Bidirectional Long Short-Term Memory (BiLSTM) networks, and an attention mechanism to effectively extract spatio-temporal features from skeletal landmarks obtained via MediaPipe. A custom word-level segmentation model, coupled with adaptive temporal sampling and data augmentation, enhances the robustness and compactness of the input representation. To enable contextual understanding and accessibility, the predicted word sequences are passed through a prompt-optimized language model (Gemini 2.0 Flash) that performs grammatical correction and translation into beginner-friendly Sinhala. Evaluations done on the SSL400 dataset comprising of 384 classes and over 4,000 samples demonstrate high recognition performance, with validation accuracies of 96.7%, 94.6%, and 87.2% across 10, 100, and 300-class configurations, respectively. The model operates at over 200 FPS on a Raspberry Pi 4B (8GB RAM, no GPU), with inference latency of 0.15 seconds, energy consumption of 55.09J per prediction, and a compact model footprint (<1.5MB). Cross dataset benchmarking on WLASL, LSA64, ISL, and Arabic sign language datasets further confirmed the system's strong generalization capabilities. The integrated language model achieves BERTScores above 0.98 with low latency, ensuring high semantic fidelity. In summary, this work presents a compact, real-time, and energy-efficient sign language recognition (SLR) framework, purpose-built for low-resource environments. By addressing critical challenges such as signer variability, limited annotated data, and hardware constraints, the system significantly improves communication accessibility for the Sri Lankan Deaf community. Its open-source, scalable architecture promotes inclusive societal integration and paves the way for broader adoption across diverse linguistic and geographic contexts. The full implementation is available at: https://github.com/yohanAbhishek/Assistive-SLSL-Translator.

Keywords: Sri Lankan Sign Language Recognition, LSTM, CNN, Attention, Efficiency

TraceFlow: Enhancing Blockchain-based Traceability in Sri Lankan Fresh Mushrooms for Export and International Trade

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The local fresh agricultural produce industry faces significant limitations with its reliance on manual, outdated documentation-based traceability practices. Despite growing international demand for traceable, ethically sourced goods, local smallholder farmers and exporters still rely on paper-based systems prone to human error and significant information loss. This is no exception for the fresh mushroom industry. These limitations are further exaggerated in the presence of international markets with Europian union regulations and food safety measures, thereby limiting the export potential of local fresh mushrooms. The project "TraceFlow", is aimed at developing a blockchain-enabled traceability system tailored explicitly for fresh mushrooms in the Sri Lankan small-holder farmer landscape.

The solution leverages a hybrid architecture integrating blockchain-based smart contracts with a Flutter mobile interface and React web interface to ensure immutable logging of harvests and defects throughout the supplychain. Smart contracts deployed on a private Ethereum network (Ganache) enforce data integrity, non-repudiation, and automated state transitions (e.g., LOGGED, APPROVED, REJECTED) managed via Web3.js. A key emphasis is placed on usability for stakeholders with low digital literacy offering streamlined functionality, QR-based scanning, and multilingual support. TraceFlow not only represents a technological innovation but also a people-centric intervention that empowers marginalized agricultural stakeholders. The key outcomes demonstrated a significant decrease in supply chain error and absence of information misplacement, strengthening the preparedness while ensuring regulatory compliance. While successful, the study identified potential areas for improvements including IoT integrations, off-line data logging, smart analytics, suggesting valuable opportunities for future growth of TraceFlow.

Keywords: Agricultural Traceability, Blockchain, Export compliance, Fresh mushroom, Supply chain

MMAD: Multi-model Adversarial Defense for Medical Images

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Adversarial attacks in medical imaging systems create serious risks against the trustworthiness of AI-driven disease diagnosis, as modifications, even imperceptible ones, can cause deep-learning models to misdiagnose diseases, meaning that patients could be put at risk for dangerous misdiagnoses. Most current defenses are derived from natural image applications and lack the generalizability to medical imaging and compromise performance on clean images. To address these issues, this work presents MMAD (Multi-model Adversarial Defense) a new, medical-first adversarial defense framework specifically tailored to defend modalities in medical image classification. MMAD is designed to detect and defend against adversarial perturbations for white-box attacks (FGSM, BIM, and PGD) during low-intensity attacks (ε = 0.01,0.03,0.05), while defending for medical diagnostic purposes. The system is composed of several innovative components. A hybrid classifier combines outputs of a customized Vision Transformer, Convolutional Neural Network (CNN), and Spiking Neural Network (SNN) with an attention-based logistic function that fuses features according to the formula:α = Softmax(W_attn·[f_vit, f_cnn,f_snn]) and f_fused= $\Sigma(\alpha\_i \cdot f\_i)$. This architecture provides a robust multi-model representation. The purification uses a multi-branch U-Net generator to produce three outputs such as a main, detail, and edge image (optimal formula: Purified Image = Main + 0.3 × Detail + 0.15 × Edge) to recreate the medical image without adverse noise. The architecture was further enriched with proper attention mechanisms (channel and spatial) and self-attention at the bottleneck. Auxiliary classifiers are also embedded into each computer architecture component with focal loss and label smoothing to indicate classification for each of the sub-networks. PatchGAN with spectral normalization aids in training stability, while optimizing the model for medical images with gradation calculation (ResNet-50) and constraints on value evolution. MMAD had an outstanding adversarial detection accuracy of 97.89% and classification accuracy of 92.47% on clean images for MRI, demonstrating it could address the typical trade-off between robustness and accuracy. MMAD also had 98% accuracy for FGSM, 96% for BIM, 90.4% for PGD, and 100% on clean for MNIST images with $\varepsilon = 0.05$. When evaluating the model in brain tumor MRI datasets, detection performance was 97.89% for FGSM, 86.93% for BIM, and 41.78% for PGD, providing the model was adaptable to the increase in attack complexity. The purification module produced high quality medical imaging, reaching peak PSNR of 34.61 dB and SSIM of 0.9551, and contained adversarial noise while maintaining important medical diagnostic structures. In conclusion, MMAD represents a paradigm change in adversarial defenses for medical AI, combining significant algorithmic innovation with medical-specific design principles, and provides a robust hybrid architecture combined with the purification procedure that changes the landscape of adversarial defenses, offering substantially more robust security and performance than existing defenses deployed in natural image classification while improving the clinical application of AI and trustworthiness of medical analysis.

Keywords: Adversarial Machine Learning, Algorithmic Innovation, Deep Learning, Medical AI security, U-Net Architecture.

Leveraging Global Data Diversity for ESG Score Prediction: A Novel Framework for Robust Machine Learning Models

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Machine learning (ML) models for predicting corporate Environmental, Social, and Governance (ESG) scores often exhibit poor reliability due to training datasets commonly biased towards large firms in developed economies, limiting their global applicability. To address this, we propose and evaluate a novel data-centric framework designed for the systematic curation of globally representative ESG datasets, integrating financial metrics, news sentiment, and ESG scores while ensuring diversity across geographical regions and company sizes through strategic resampling. We created a baseline dataset reflecting typical biases and contrasted it with a diversified dataset built using our framework. Experiments demonstrate that ML models, particularly non-linear ensembles, trained on the diversified dataset achieve substantial, statistically significant gains in predictive accuracy and robustness compared to the baseline. While within-distribution performance was noticeably enhanced, generalization to entirely unseen contexts revealed nuances, with diversified models showing a relative performance drop compared to their improved baseline. This study concludes that data diversity, achieved through systematic curation, is critical for developing reliable and robust ESG prediction models, though achieving true out-of-distribution generalization requires further attention.

Keywords: Data Diversification, ESG Score Prediction, Machine Learning, Model Robustness, Out-of-Distribution Generalization

The Influence of Brand Awareness on Purchase Intention: Mediating effects of Loyalty, Perceived Quality and Brand Association

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This study explores the relationship between brand loyalty, perceived qualty, brand association and brand awareness on purchase intentions relating to Samsung Smart phones. Prior studies have explored brand equity dimensions and their direct impact on consumer behavior (Ravichandran, 2023; Sapkota et al., 2024), however, few have assessed the comprehensive mediating roles of Brand Loyalty, Perceived Quality, and Brand Association between Brand Awareness and Purchase Intention. The majority of research overlooks the behavior in emerging markets like Sri Lanka, where consumer patterns differ due to cultural and economic factors (Ravichandran, 2023). Furthermore, customer loyalty as a mediator is under-explored within emerging markets, despite foundational frameworks emphasizing its importance (Karami, 2022; Sapkota et al., 2024).

A deductive research approach guided by a positivistic research philosophy guided the study.The minimum sample size is 384 (Krejcie & Morgan, 1978) and data was collected from 456 respondents using a self administered questionnaire. A pilot study was conducted to determine the relaibility of the research instrument. Data was analysed using SPSS version 26 and demographic analysis, descriptive statitistics, correlation, regression, reliability & validity, mediation and hypothesis testing was conducted.

The main findings of this study reveal that brand awareness has a significant and positive influence on purchase intention. Brand recognition plays a key role in supporting emotional loyalty, perceived value, and favorable brand impressions. The continuous strong positive link to Purchase Intention is coherent with Muhaqi and Nurbasari (2023), who demonstrated that greater brand familiarity significantly strengthens consumer confidence and reduces perceived risk among Samsung smartphone. This suggests that building strong brand awareness is not only advantageous but essential for influencing consumer decision-making at emotional and rational levels. Brand loyalty has the strongest positive influence on purchase intention. Perceived quality did not demonstrate a direct influence on purchase intention. Therefore, These findings suggest that fostering loyalty and building strong brand associations must remain integral to Samsung's brand strategy in the Sri Lankan Market.

The main limitations of this study are that reliance on self-reported data introduces the possibility of response bias, particularly in consumer perception and loyalty. The study solely focused on Samsung smartphones, and findings may not be generalizable to other brands and product types.

Keywords: Brand Loyalty, Brand Association, Brand Awareness, Perceived Quality, Purchase Intention

B-Track: Preventing Post-Expiry Blood Wastage in Sri Lanka using Demand-Based Forecasting and Proactive Inventory Management

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Healthcare services worldwide face a substantial challenge in the form of post-expiry blood wastage. Blood is an essential and irreplaceable healthcare resource, used for surgeries, emergency care, and chronic illness management. Despite technological breakthroughs, blood cannot be generated artificially and must be donated by volunteer donors, whose availability is intrinsically unpredictable. This variable donor availability, along with the fact that blood is a perishable product with a short-shelf life, makes it an essential resource that must be carefully managed - especially given the fluctuating blood demand. However, inefficiencies in demand forecasting, inventory optimization, and communication continue to contribute to substantial discards of this life-saving resource.

To address these inefficiencies, the project *B-Track* adopts a data-driven methodology by utilizing historical data from the National Blood Transfusion Service (NBTS) of Sri Lanka, covering monthly blood collection and transfusion rates from January 2020 to December 2024. Operational challenges and domain-specific requirements were further identified through expert interviews with healthcare professionals managing blood bank operations.

The proposed solution is a multivariate predictive Recurrent Neural Network (RNN) model integrated into a platform that supports proactive inventory management. By accounting for both quantitative trends and variable factors, *B-Track* facilitates more accurate demand forecasting and enables timely decision-making through automated alerts and redistribution mechanisms. This integrated system ensures that blood collection is aligned with anticipated demand while minimizing avoidable expiry-related losses.

Key findings from this study demonstrate that the developed multivariate LSTM forecasting model achieved an accuracy of 63.79% in predicting blood demand, outperforming SARIMA (42.17%) and Univariate LSTM (50.21%) models. System testing further validated the effectiveness of real-time inventory tracking, automated near-expiry alerts and blood request and redistribution protocols in simulated inventory scenarios.

This research contributes to healthcare resource management by demonstrating how machine learning-driven forecasting combined with dynamic inventory optimization can enhance blood bank sustainability. By minimizing post-expiry blood wastage and improving blood usage, B-Track presents a scalable model for integrating emerging technologies for a more efficient and equitable blood supply chain.

Keywords: Blood Supply Chain, Blood Wastage, Demand Forecasting, Inventory Optimization, Recurrent Neural Network

VoiceBlockly: Voice Code Generation in Block-Based Programming Using a Novel Multi-Agent Framework

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Block-based programming (BBP) has proven effective in teaching programming concepts, offering a visual and more intuitive approach than traditional text-based programming. However, accessibility in BBP remains an underexplored area, particularly for students with disabilities who may benefit from alternative input methods, such as voice commands. This project aims to bridge this accessibility gap by integrating natural language processing capabilities into a BBP interface, enabling users to generate programming blocks through voice commands.

To achieve effective voice to block code generation, the project employs a novel multi-agent (MA) framework that integrates several large language models working together. Each model is designed to interpret user commands and generate corresponding block syntax. A novel aggregation algorithm based on uncertainty quantification is introduced to combine outputs from multiple agents, ensuring the accuracy and validity of the generated blocks. This approach enables the system to produce high quality output by utilizing the collective strengths of multiple agents.

The prototype demonstrates that the BBP environment effectively translates natural language input into accurately rendered code blocks within the interface. Testing and evaluation results indicate that the proposed MA framework outperforms the leading state-of-the-art MA framework by 6% in programming tasks, achieving a Pass@1 score of 75% on the HumanEval dataset. Furthermore, it surpasses the same MA framework by 6% in general domain tasks, attaining an accuracy of 65% on the TruthfulQA dataset.

Keywords: Accessibility, Block-Based Programming, Large Language Model, Multi-Agent Framework, Uncertainty Quantification

CricXpert: A Hybrid Approach Combining Facial and Spatio-Temporal Gait Analysis for Enhanced Player Recognition with LLM-Based Statistic Generation

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In the high-paced environment of T20 International (T20i) cricket, especially during the final overs of a match, accurately identifying fielding players presents significant technical challenges. Dynamic and poor lighting conditions, motion blur, player occlusions, and non-frontal views contribute to the frequent failure of traditional unimodal recognition systems. Simultaneously, accessing detailed player statistics via conventional interfaces often involves complex, multi-step filtering, reducing usability and timeliness. Addressing these gaps, this research presents CricXpert—a hybrid AI system that combines computer vision and natural language processing to deliver robust player recognition and intuitive statistics retrieval.

The proposed system employs a multi-tiered recognition pipeline consisting of Optical Character Recognition (OCR), facial recognition, spatial feature analysis, and temporal gait modeling. OCR, powered by EAST and Tesseract, serves as the initial recognition method by detecting jersey names and numbers. When OCR fails due to obstructions or camera angle issues, fallback mechanisms activate facial recognition using MTCNN for detection, FaceNet for embeddings and SVM for classification, achieving an accuracy of 95.83%. Further resilience is achieved via a spatial model that uses a frozen ResNet50 soley for feature extraction and a stacked ensemble of SVM, KNN, and logistic regression classifiers. The hybrid fusion ensemble model reached an impressive 98.14% accuracy. For cases involving significant motion, a GRU-based temporal gait model leverages pose-based features such as joint angles and step lengths, etc. to identify players with 95% accuracy.

To complement visual recognition, CricXpert introduces a natural language interface for statistics generation of players. This module integrates GPT-4o via LangChain and Pydantic, which interprets user-defined natural language queries and reliably translates them into syntactically correct SQL statements, followed by a querying from the database to output the relevant statistic . A test set of 100 cricket-related questions yielded a query success rate of 85–90%, outperforming baseline LLMs like LLaMA 13B and Gemini. The system also uses OutputFixingParser for automated query correction and schema-aware prompting to minimize hallucinations.

The CricXpert system has been evaluated both quantitatively using classification metrics and qualitatively via expert validation by national coaches and analysts. The modular design enables future expansion to additional sports or match formats. Overall, CricXpert represents a significant advancement in applied sports analytics, blending ensemble-based computer vision techniques with language model capabilities to deliver intelligent, real-world solutions for player recognition and data access.

Keywords: Computer Vision, Gait Analysis, LLM SQL Generation, Player Recognition, Sports Analytics

Equity Portfolio Builder: Minimum Variance Portfolios for the Colombo Stock Exchange Stocks

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Since the post-pandemic market rally, local and foreign investor participation in the Colombo Stock Exchange (CSE) has grown steadily. Despite this growth, the CSE remains undervalued compared to the regional peers, with a price-to-earnings (P/E) ratio of approximately 8x and a market capitalisation to GDP of 19%, signalling significant untapped potential for long-term capital allocation. One of the major causes for this is the lack of retail investor participation. Retail and novice investors face challenges in constructing diversified, risk-minimised portfolios due to low liquidity, the lack of awareness in the Sri Lankan capital markets, and the lack of tools and applications for portfolio creation and management. They often rely on ad-hoc advice or personal sentiment, resulting in suboptimal returns and heightened exposure to market fluctuations. Due to its cost, personalised premium investment advice is often limited to high-net-worth and institutional investors.

This project proposes the *'Equity Portfolio Builder'* web application that empowers retail investors to build and manage risk-optimised equity portfolios across all CSE-listed companies. Grounded in Markowitz's Modern Portfolio Theory, the application uses a quadratic optimisation engine to compute optimal weight allocations, minimising portfolio variance by analysing historical price data to generate covariance matrices. It features automatic portfolio rebalancing to adapt to changing market conditions and user goals. It is delivered through an intuitive, transparent interface that simplifies complex statistical processes to be accessible to average retail and novice investors. This tool democratises sophisticated portfolio construction, enabling retail and novice investors to make informed, data-driven decisions, bridging a critical gap in Sri Lanka's capital markets by offering a cost-effective, self-directed solution to enhance investment management and encourage market participation.

The Equity Portfolio Builder empowers retail and novice investors to make data-driven, informed investment decisions by abstracting complex statistical calculations behind a clear, informative, and transparent interface. This product addresses a long-standing gap in the Sri Lankan capital markets and retail investment landscape by offering a cost-effective, informative and self-directed support tool to manage investments.

Keywords: Colombo Stock Exchange, Covariance Matrices, Modern Portfolio Theory, Minimum Variance Portfolios, Portfolio Optimisation

The Effect of UGC Quality on Brand Engagement on Instagram in the QSR Industry in the Colombo District: The Mediating Role of Perceived Value

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User-Generated Content (UGC) has become a strategic driver of brand-consumer interaction in the digital era, particularly on visually dominant platforms like Instagram (Goh et al., 2023). The conceptual foundations of UGC lie in the shift from passive media consumption to active content creation, as highlighted by Jenkins (1992) through participatory culture and Bruns (2008), who introduced the idea of "produsage." These works, along with Marti-Parreño et al. (2015), who established a marketing-focused typology of UGC, laid the groundwork for understanding UGC's impact in digital branding.

Despite UGC's growing significance, limited empirical research has assessed how the *quality* of UGC, defined by content, design, and technical dimensions, affects brand engagement, particularly in the Quick Service Restaurant (QSR) sector within emerging economies like Sri Lanka. Furthermore, the mediating role of perceived value, comprising emotional and functional dimensions, remains underexplored in this context (Mohammad et al., 2024; Zhou & Xue, 2022).

This study adopted a deductive approach underpinned by positivism, collecting data from 390 active Instagram users in Colombo through a judgmental purposive sampling method. Analysis was conducted using SPSS v29, employing correlation, regression, and Sobel mediation testing. The findings reveal that UGC quality significantly and positively influences both perceived value and brand engagement within Instagram's QSR context. Well-crafted UGC, featuring high content clarity, aesthetic design, and technical usability, not only boosts brand visibility but also enhances consumer trust and participation.

Perceived value was found to significantly mediate the relationship, aligning with the Stimulus-Organism-Response (S-O-R) framework and Uses and Gratifications Theory. These findings suggest that consumers are more likely to engage with QSR brands when they derive both emotional enjoyment and functional utility from UGC (Godey et al., 2016; Wang et al., 2018). Thus, perceived value is not just an outcome of UGC but a mechanism through which engagement is triggered.

The study's limitations include its cross-sectional design and its exclusive focus on Instagram. Future research could adopt longitudinal approaches, explore platforms like TikTok, or assess additional mediators such as brand trust or user-brand identification.

Keywords: Brand Engagement, Instagram, Perceived Value, QSR Industry, UGC Quality

LLM based Automatic Speech Recognition for Medical Documentation

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This project is dedicated on leveraging Automatic Speech Recognition (ASR) within the medical domain, which emphasizes on refining and enhancing the accuracy of the transcription through Large Language Model (LLM) based approach.

The major challenge discussed is the difficulty of manual documentation which is time consuming and laborious. ASR meets the challenge of transcribing medical conversations, but still struggles to understand the intricacies in patient-doctor consultations. These problems arise mostly because there are complexities in medical language, nuanced phrases, detailed medical terms and people speaking with different accents. Poor performance with special vocabulary and frequent transcription errors are usual for general ASR models in these domain-specific information systems. Different accents can further disrupt word understanding which adds more challenges to transcription. This issue is very serious because inaccurate information from transcription may affect how patients' treatment and diagnosis. An illustrative example of this problem is that "Cystic fibrosis" being misinterpreted as "65 Roses".

This work aims to analyze interconnections between context and ASR results related to medical terms and accents which will help to fix parts of current technology and thereby enhance accuracy in ASR. The approach improves the problem area by creating a medical ASR system that considers the context and adapts to the accent used by both patients and healthcare providers.

For its first ASR component, the developed system recorded a Word Error Rate (WER) of 12%. Following this, a Large Language Model (LLM) helped to correct the errors made by speech recognition. This new method with LLMs makes it easier to understand sentences more completely. It depends on deep learning methods, especially neural networks and contextual understanding, for speech recognition in the medical domain.

The outcome of this project is anticipated to serve on optimally deploying ASR in healthcare settings. This research addresses the critical need for domain-specific ASR system which is adaptable to diverse accent and is contextually aware regarding the medical terminology. As a result, this contributes to improve the overall patient satisfaction and the productivity of medical documentation within clinical settings.

Keywords: Accent Variation, ASR, Contextual Understanding, Health Care, LLM.

LEGORA: An LLM-Based Multi-Agent Framework for Employment Contract Compliance Using Sri Lankan Judicial Precedents

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This research presents LEGORA, the first precedent-aware multi-agent legal compliance system designed to analyze employment contracts in line with Sri Lankan labour laws and judicial precedents. Addressing the limitations of static rule-based systems and manual legal reviews, LEGORA leverages the capabilities of large language models (LLMs), a rule engine, and retrieval-augmented generation (RAG) to deliver dynamic, contextually relevant, and legally compliant assessments.

LEGORA's architecture comprises two core workflows: (1) a legal knowledge pipeline that structures over five years of Supreme Court and Appeal Court judgments (2020–2025) into a semantically searchable vector database using fine-tuned sentence embeddings; and (2) a compliance analysis pipeline that extracts clauses from employment contracts and evaluates them against codified rules and relevant case law using similarity scoring and multi-agent coordination.

To enhance performance, the system incorporates supervised LLM fine-tuning, few-shot prompt engineering, and agent backstory templates to guide role-specific outputs. LEGORA also integrates a specialized fine-tuning framework that leverages synthetic question-and-answer pairs generated by large language models. These are used to fine-tune its embedding model, resulting in significantly improved retrieval accuracy and semantic relevance. The fine-tuned embeddings were benchmarked using models such as ModernBERT and LegalBERT across multiple dimensions, including Top-K accuracy, MRR, and semantic diversity. LEGORA achieved 82% semantic similarity with legal expert annotations, validating its effectiveness in clause understanding and precedent alignment.

The system was evaluated using a benchmarking dataset of 50+ Sri Lankan employment contracts reviewed by six legal professionals. LEGORA demonstrated superior performance in clause extraction accuracy, legal justification generation, and retrieval precision compared to baseline models such as GPT-4o-mini, Gemini Pro, LLaMA, and Flan-T5.

This work contributes a fully automated, legally grounded compliance solution tailored to Sri Lankan law, filling critical gaps in legal NLP for developing jurisdictions. It also introduces a reusable precedent dataset, a fine-tuned legal embedding model, and a scalable compliance pipeline ready for deployment in legal and HR contexts. LEGORA represents a significant step forward in making AI-driven legal compliance more intelligent, adaptive, and locally relevant..

Keywords: Artificial Intelligence, Employment Law, Legal Compliance, Multi-Agent Systems, Sri Lanka

Digital Mentor

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Organizations face serious difficulties as a result of poor employee onboarding, which can result in high turnover costs, uneven training quality, and a delayed return to productivity. The main source of these issues is unstructured traditional onboarding techniques, which frequently fall short in offering well-chosen training materials and sufficient assistance. In order to solve this, the "Digital Mentor" project concentrated on creating, developing, and deploying an AI-driven digital platform that would provide a well-curated and organized onboarding process. The project followed a structured methodology that included requirements engineering (use cases, functional and non-functional requirements), UML (Class and Activity diagrams) for system design, and a modern full-stack approach for developing prototypes that included Next.js, Prisma, Python/Flask, and AI integration through LlamaIndex/OpenAI. The minimum viable product's (MVP) key features were validated through manual functional testing.

A working prototype of the "Digital Mentor," with features like curated learning pathways, video resource distribution, AI-generated quizzes, an AI chatbot trained on custom content for contextual assistance, and strong administrative controls for managing users, content, and mentors, was the primary outcome .

The operational state of crucial user workflows was validated by preliminary evaluations. The results of the project show that a digital platform powered by AI can successfully address serious flaws in conventional onboarding programs. The "Digital Mentor" acts as a scalable tool that improves employee training, which speeds up the productivity of new hires and lowers turnover-related expenses for companies, ultimately fostering sustainability and efficiency.

For future work the main focus points would be developing HRIS integration, putting automated test suites in place for long-term stability, improving analytics capabilities for better ROI measurement, and empirically validating the AI features (such as bias and quiz efficacy). For production readiness, it will also be essential to address scalability and security

Keywords: AI-powered, Digital Mentor, Employee Onboarding, Learning Pathways, Training.

From Genes to Diagnosis: An Interpretable AI Approach to Early PCOS Detection

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Polycystic Ovary Syndrome (PCOS) is a complex endocrine disorder affecting up to 10% of women of reproductive age, with early detection remaining challenging due to its heterogeneous presentation. Traditional diagnostic approaches relying solely on clinical markers often miss subtle molecular indicators, while genomic analyses alone fail to incorporate crucial clinical context, resulting in delayed diagnosis and suboptimal treatment outcomes.

This project addresses these limitations through a novel multi-modal approach integrating omics data (from GEO datasets including GSE5090, GSE54248, GSE54250) with clinical biomarkers using a sophisticated architecture combining Graph Neural Networks (GNNs) and feed-forward networks. The implementation features separate processing pathways: omics data flows through GNN layers (GATConv/GCNConv) modeling gene-gene interactions, while clinical markers pass through conventional neural networks. These pathways converge in a fusion mechanism with adaptive weighting based on clinical indicators like AMH levels.

Domain adaptation techniques mitigate batch effects across datasets, while transfer learning leverages pre-trained encoders to improve generalizability.

Comprehensive evaluation demonstrates the system's effectiveness with a cross-validated mean AUC of 0.653 (±0.116). Refined threshold tuning yields a precision of 0.975, recall of 0.870, and classification accuracy up to 95%. The integration of explainable AI tools provides transparent visualization of feature importance, showing that AMH levels, β-HCG measurements, and their derived ratios consistently emerge as critical predictors.

This approach not only enhances diagnostic accuracy but also provides actionable insights into the molecular mechanisms underlying PCOS.

Keywords: Domain Adaptation, Explainable AI, Gene Regulatory Networks, Multi-Omics Data Fusion, Polycystic Ovary Syndrome

Floro-X: A Stock Prediction System for the Floriculture Industry to Reduce Wastage

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The floriculture industry faces a major issue due to the extremely perishable characteristics of its products, including inventory uncertainty due to demand variability across consumers and seasonality. Seasonal fluctuations have the impact of leading to enormous wastage of flowers, monetary loss, and inefficiency in handling stocks. The traditional method of inventory control, which is still in use in small and medium-scale florist enterprises, lacks the tools, technologies and prediction capabilities required to take necessary measures to address such issues. As a solution to these constraints, this project introduces **Floro-X**, a forecasting-based inventory management system for the floriculture industry.

Floro-X is a web-based software that helps florist managers align inventory with actual demand using a machine learning model trained with historical sales and seasonal trends. Built with Facebook Prophet. The prediction algorithm delivers forecast accuracies above 85% for almost all flowers, enabling users to make better inventory and sales planning decisions to avoid overstocking or running out of stock. The system features a user-friendly interface accessible via desktop, with fundamental modules of stock management, demand planning, and user profile handling. Florist managers are able to update the inventory details, place future demand forecast orders, and examine previously calculated outcomes, all from a single, user-friendly console.

The initial version of Floro-X uses fixed training datasets, but future enhancements include integrating with POS systems for real-time sales tracking, using weather data for improved forecasting, and expanding predictions to more flower types. Lastly, **Floro-X** addresses a major issue in the flower supply chain by introducing digital transformation to a traditionally manual and labour-intensive industry, helping florists make smarter, on-time, data driven decisions. At its core, the adoption of **Floro-X** facilitates a more profitable, robust, and sustainable floral system, a platform for future innovation and growth within the floriculture sector across the globe.

Keywords: Demand Prediction, Digital Transformation, Facebook Prophet, Floro-X, Floriculture, Inventory Management

EduGraphAI: Using LLMs for Automated Construction of Pedagogy aware Educational Knowledge Graphs

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Technology drives educational development which enables students to pursue self-guided learning through Large Language Models (LLMs). LLMs need organization-specific educational data to generate responses that follow a specific syllabus. Educational Knowledge Graphs give structure to education but building them requires manual work which proves challenging to users. The promise of automated EduKG construction through LLMs holds potential while researchers have not thoroughly investigated how to include pedagogical metadata concerning learning outcomes and learner states during this process.

This project focuses on addressing this issue by developing a framework for incorporating LLMs for the automated construction of pedagogy aware educational knowledge graphs. A hybrid of ontological modeling and an LLM based approach was taken to construct the Educational Knowledge Graph. In order to implement the natural language querying functionality, data flow was established with the EduKG and the LLM to perform a combination of GraphRAG(Graph Retrieval Augmented Generation) and VectorRAG(Vector Retrieval Augmented Generation). Also a workflow has been set to integrate data about learners and their state on the same EduKG to enable personalization and provide more visibility on the pedagogical alignment.

The evaluation of the LLM-powered EduGraphAI system combined qualitative expert reviews with quantitative model testing. Expert interviews assessed design relevance, accuracy, and adaptability. Quantitatively, the system's ability to extract Learning Outcomes and Concepts was benchmarked against a gold standard dataset using Precision, Recall, and F1 Score metrics. Learning Outcome extraction achieved balanced scores of 82.35%, while Concept extraction scored 80.00% Precision, 87.50% Recall, and an F1 Score of 83.58%, demonstrating the system's effectiveness in educational knowledge graph construction.

Keywords: Educational Knowledge Graph, Large Language Models, Pedagogy, Retrieval Augmented Generation, Graph Database

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