ICTer 2024

Book of Abstracts

24th International Conference on Advances in ICT for Emerging Regions

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UCSC

Book of Abstracts

24th INTERNATIONAL CONFERENCE ON ADVANCES IN ICT FOR EMERGING REGIONS

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MESSAGE FROM THE DIRECTOR

Dr. Ajantha Atukorale
Director,
University of Colombo School of Computing**,**
University of Colombo, Sri Lanka

As the Director of the University of Colombo School of Computing (UCSC), it is my great pleasure to extend a warm welcome to all participants, researchers, and practitioners in the field of Computing at the ICTer International Conference 2024. The ICTer International Conference is a legacy that stems from the renowned International Information Technology Conference (IITC), which has been a pivotal academic conference in the landscape of Computing conferences in Sri Lanka since its inception in 1998. Building upon this rich history, ICTer now emerges as its successor, reaffirming our commitment to fostering innovation, sharing knowledge, and pushing the boundaries of technology.

In a world where the pace of technological advancement is relentless, it is vital that we create a platform for the exchange of ideas, insights, and research findings. ICTer aims to be precisely that platform. It is a unique opportunity for both seasoned researchers and emerging scholars to present their groundbreaking research results, innovative ideas, and practical deployments that are shaping the computing domains.

The ICTer offers a unique opportunity for authors. Full papers are published in a special issue of the ICTer Journal, which is the open-access companion of the ICTer International Conference. This allows authors to share their work with a wider audience and contribute to the body of knowledge that is advancing the technological landscape.

As we gather for the ICTer International Conference, I encourage all participants to take full advantage of this unique opportunity. Engage in the presentations, contribute to discussions, network with your peers, and foster new collaborations. In conclusion, I look forward to witnessing the stimulating discussions, the knowledge sharing, and the collaborative spirit that will define the ICTer International Conference. Together, let us shape the future of computing technology and contribute to a world that is smarter, more connected, and better informed.

MESSAGE FROM THE CONFERENCE CO-CHAIRS

Dr. Kasun Gunawardana
Department of Computation and Intelligent Systems
University of Colombo School of Computing
University of Colombo, Sri Lanka

Dr. (Mrs.) Lasanthi De Silva
Department of Communication and Media Technologies
University of Colombo School of Computing
University of Colombo, Sri Lanka

We are delighted to welcome you to ICTer2024, the prestigious international conference organized and hosted by the University of Colombo School of Computing, with a proud history of 24 years. This conference is the evolution of the International Information Technology Conference (IITC) which commenced in 1998. In 2007, IITC was rebranded as the International Conference on Advances in ICT for Emerging Regions (ICTer). This year, our conference is centered around the theme "Empowering Digital Transformation through Innovation and Inclusivity", demonstrating our dedication to nurturing a digital future that is both groundbreaking and accessible to all.

ICTer2024 is not just an academic conference; it is a dynamic platform where academia and industry converge. In the computing domain, the industry is often at the forefront of innovation and research. We hope that this blend of participants from both industry and academia will spark new ideas and collaborations that drive innovation in unique and impactful ways.

As you explore the abstracts and engage in discussions throughout the conference, we encourage you to take full advantage of the opportunities to connect with fellow researchers, share insights, and forge new collaborations. We are confident that the knowledge exchanged here will inspire future research and innovation that will shape the next generation of ICT solutions. Thank you for being a part of ICTer2024. We wish you a productive and enriching conference experience.

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CONFERENCE DAY 1 – AGENDA **Wednesday, 6th November 2024** **Location: Marino Beach Hotel, Colombo, Sri Lanka**	
07:30 AM	Registration
08:00 AM	Inauguration and Introduction of ICTer 2024
08:30 AM	Welcome address by the Conference Chair
08:35 AM	Address by the UCSC Director
08:40 AM	Address by the Vice Chancellor
08:50 AM	Address by the Chief Guest
09:00 AM	**Keynote - Dr. Mohamed Nabeel** Title: Securing AI: Navigating AI risks to build a safe digital world
10:00 AM	Tea Break
10:30 AM – 12:10 PM	Paper Presentation Session 01 (05 papers) Chaired by: Dr. A. R. Weerasinghe
10:30 AM	Instruct-DeBERTa: A Hybrid Approach for Aspect Based Sentiment Analysis in Textual Reviews
10:50 AM	Drug Recommendation system based on Medical Condition Classification and Sentiment Analysis of Drug Reviews
11:10 AM	Cash Valuation of Black Tea in the Nuwara Eliya District based on Sensory Quality Attributes: A Case Study
11:30 AM	Debiasing Hate Speech Classification Models for Queer Language Through Keyword Analysis
11:50 AM	Linguistic Analysis of Sinhala YouTube Comments on Sinhala Music Videos: A Dataset Study
12:10 PM	**Keynote - Prof. Chris Bain** Title: What in digital health is “free”?
01:10 PM	Lunch Break
02:10 PM	Tech talk (Dialog)
02:30 PM – 03:30 PM	Paper Presentation Session 02 (03 papers) Chaired by: Prof. N. D. Kodikara
02:30 PM	Climate-Driven Insights: Predicting Black Pepper Yield and Quality with Long Short-Term Memory Model
02:50 PM	Unraveling the Cognitive Secrets of Chess Experts: Investigating Dynamic Functional Brain Connectivity through rs-fMRI Analysis
03:10 PM	Convergence of Twitter Sentiment Analysis and Optimized Learning Models for Predicting Bitcoin Price Volatility
03:35 PM	Tea Break
04:00 PM	**Keynote - Prof. Thambipillai Srikanthan** Title: Cybersecurity of Infrastructure
05:00 PM	Reception

CONFERENCE DAY 2 – AGENDA **Thursday, 7th November 2024** **Location: Marino Beach Hotel, Colombo, Sri Lanka**	
07:30 AM	Registration
08:00 AM	Commencement
08:10 AM – 09:10 PM	Paper Presentation Session 03 (03 papers) Chaired by: Dr. D. N. Ranasinghe
08:10 AM	Transforming software size estimation with prompt engineering: A ChatGPT-based framework for component-based systems
08:30 AM	Density Based Query By Committee - Robust Active Learning Approach for Data Streams
08:50 AM	Utilizing Association Rules in Knowledge Graphs for Enhanced News Summarization
09:10 AM	**Keynote - Ludvig Kolmodin** Title: AI in HealthCare
10:10 AM	Tea Break
10:40 AM – 11:20 PM	Paper Presentation Session 04 (02 papers) Chaired by: Prof. K. P. Hewagamage
10:40 AM	Detecting Cryptographic Hash Functions through Electromagnetic Side-Channel Analysis
11:00 AM	Unsupervised Discovery of Salient Design Features of Websites
11:20 AM	**Keynote - Prof. Thiemo Voigt** Title: Towards 6G Ambient IoT with Backscatter and Intermittent Computing
12:20 PM	Lunch
01:20 PM – 02:20 PM	Paper Presentation Session 05 (03 papers) Chaired by: Dr. Asanka Sayakkara
01:20 PM	A Prototype to Detect the Alcohol Content of Local Toddy Based on an Electronic Nose
01:40 PM	Investigating the Efficacy of Brain-Computer Interfaces in Enhancing Cognitive Abilities and Facilitating Direct Brain-to-Machine Communication
02:00 PM	Securing IoT Servers: Strategies for Employing Shallow and Deep Neural Networks
02:20 PM	**Keynote - Lothar K. Becker** Title: Is Open Source with Co-Pilots at risk? Why LibreOffice Technology never could be an OpenAI case
03:20 PM	Tea Break
04:00 PM – 04:45 PM	Paper Presentations Session 06 (03 papers) Chaired by: Prof. S. P. Wimalaratne
4:00 PM	Modified Discrete Wavelet Transformation to Compress DICOM Medical Images with Run-Length Encoding
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KEYNOTES

Dr. Mohamed Nabeel
Principal Researcher,
Palo Alto Networks, USA

Mohamed Nabeel, PhD, is a principal researcher at Palo Alto Networks where he leads the efforts on graph-based threat intelligence research in the web security team. He is passionate about building AI-powered tools and techniques to help defenders stay one step ahead of Internet miscreants. During his spare time, he teaches AI/Data Science to graduate students. He has authored and presented 20+ US patents and 25+ papers at top security conferences and journals.

Securing AI: Navigating AI Risks to Build a Safe Digital World

Dr. Mohamed Nabeel

Today, we stand on the precipice of the Fourth Industrial Revolution, a transformative era driven by unprecedented advancements in AI. At the heart of this revolution lies GenAI (e.g. ChatGPT or Gemini), a branch of AI that holds immense potential to reshape every data driven opportunity. However, like any new groundbreaking technology, with great power comes great responsibility. As we harness the capabilities of AI, we must also address the inherent risks it poses and implement robust strategies to mitigate them. Make no mistake, with mitigation techniques in place, robust AI has the potential to create a safer world bringing a new era of prosperity.

Prof. Chris Bain
Faculty of Information Technology,
Monash University, Australia

Prof. Bain began his career in clinical medicine, spending 12 years across various healthcare settings from primary to quaternary care. He gained postgraduate experience in key clinical disciplines, worked in multiple public hospitals, and had broad exposure to primary care. From 1999-2001, he pursued postgraduate training in information technology, later earning a PhD in Information Systems with a focus on healthcare technology ecosystems in 2014.

Throughout his career, Prof. Bain held key positions at institutions like Melbourne Health, the Western and Central Melbourne Integrated Cancer Service, and Ambulance Victoria, where he developed and implemented information strategies supporting cancer reform and data governance. In 2011, he became the inaugural Director of Health Informatics at Alfred Health, and in 2015, the inaugural Chief Health Information Services Manager at Mercy Hospitals Victoria Ltd. Since November 2017, he has served as the inaugural Professor of Digital Health at Monash University, focusing on using technology and data to improve healthcare delivery. His work in digital health, technology usability, and EMR implementation has made him a national thought leader in health informatics. He has driven groundbreaking research, published extensively, holds a patent in hospital modeling, and has received several international awards. Prof. Bain is also a member of recognized professional groups and committees and is frequently invited to speak at global events.

What in Digital Health is “Free”?

Prof. Chris Bain

It is a particular challenge to deliver equity of access and equity of outcome when it comes to deploying digital health solutions into LMICs, with many tools and technologies designed for high income settings and representing a substantial cost. In this talk, Professor Bain will examine these challenges in more detail and provide examples from around the world where “free” or “low cost” technologies and tools have been – or could be – used to provide solutions in LMICs. These examples extend from the standards space to the end user application space.

Prof. Thambipillai Srikanthan
College of Computing & Data Science,
Nanyang Technological University, Singapore

Dr. Srikanthan has been a Professor at Nanyang Technological University's College of Computing & Data Science since 2005. He founded and directed the Centre for High-Performance Embedded Systems (CHiPES) from 1998 to 2014 and served as Chair of the School of Computer Science and Engineering from 2010 to 2016. During his tenure, he restructured the undergraduate curricula and oversaw 1800 students, 80 faculty members, and 360 PhD students. Under his leadership, the School was ranked 4th globally in Computer Science by Best Global Universities and 2nd by Microsoft Academic Research in AI & Simulation.

As Executive Director of the Cyber Security Research Centre at NTU (CYSREN) from 2016 to 2024, he secured significant funding for major projects, including S$46.5M for the CREATE program on public transport systems and S$21M for future medical device security. His leadership at CYSREN also led to a partnership with INTERPOL to establish a Centre of Excellence in Dark-net & Cryptocurrencies, securing over S$15M in external funding.

His research focuses on high-productivity embedded systems, computer arithmetic, and vision-enabled systems. He has graduated 48 PhD and MEng students and published 490 papers. His work in roadway navigation led to a spin-off company, which he successfully exited in 2017 after raising S$4.6M. He later co-founded a cybersecurity company, securing S$10.5M in VC funding and serving as its scientific advisor. In 2021, Dr. Srikanthan was awarded the Public Administration Medal (Silver) by the Singapore Government for his outstanding contributions to education and research.

Cybersecurity of Infrastructure

Prof. Thambipillai Srikanthan

The critical infrastructure sectors often rely on electronic systems, including Internet of Things (IoT) and operational technology (OT) devices and systems. This coupled with increased connectivity at corporate network edges and adoption of cloud services make securing technology infrastructure both more complex and more important than ever. The IT/OT convergence is also shaping new ways of working as businesses adapt to a shift in their organisational structure, and take on new challenges with compliance, cybersecurity, and data and technology management. As a result, many organizations have an expanding attack surface vulnerable to threats. Moreover, threats are also getting more and more complex, and IT security is only as good as the weakest link in the infrastructure. With cybersecurity threats on the rise, the industry is compelled to develop new levels of preparedness, and trends are showing that cybersecurity will once again be the top investment priority moving forward. This talk will discuss the major factors influencing the rapid growth in connected systems and in particular, the significance of IT and OT in convergence as technology evolves. It will introduce several in-house developed edge computing devices/systems for the fast-evolving connected systems infrastructure of Intelligent Transport Systems (ITS) and discuss the newly launched R&D program for engineering a secure connected systems infrastructure for healthcare. Ongoing research efforts and trends in software/hardware security for mitigating cyber threats in complex infrastructure will also be introduced.

Ludvig Kolmodin
Chief Technology Officer,
Cambio Group

Ludvig Kolmodin is an experienced technology executive with a proven track record of over 25 years in leading technology organizations. Currently serving as the Chief Technology Officer at Cambio Group, driving innovation and strategic technology initiatives. Previously held the CTO role at Trustly, where he defined a new target architecture to enhance scalability and time to market. With extensive experience, Ludvig has consistently demonstrated success in achieving industry certifications and restructuring development and operational processes. Ludvig's leadership spans across various roles, including multiple CTO assignments, Senior Vice President of Engineering, CIO, and Head of IT Operations.

AI in HealthCare

Ludvig Kolmodin

The fourth industrial revolution has made a huge difference in healthcare and in this talk, Ludvig Kolmodin, CTO of Cambio Group, will set the scene with a short background, introduce you to what is happening right now, and provide you with a glimpse of what could be waiting in the future. The focus will be on technologies, such as IoT and AI – assets to enable more sustainable, reliable, and intelligent healthcare.

Prof. Thiemo Voigt
Department of Electrical Engineering,
Uppsala University

Thiemo Voigt (Member, IEEE) received the Ph.D. degree in computer science from Uppsala University, Uppsala, Sweden, in 2002. He is currently a Professor of computer science with the Department of Information Technology, at Uppsala University. He also leads the Networked Embedded Systems Group, Research Institutes of Sweden (RISE) Computer Science, Stockholm, Sweden. His work has been cited more than 20,000 times and led to several best paper awards. His research interests are in low-power communication, in particular backscatter communications and in-body networking. Dr. Voigt is a Member of the editorial board for the IEEE IoT Newsletter and ACM Transactions on Sensor Networks (TOSN).

Towards 6G Ambient IoT with Backscatter and Intermittent Computing

Prof. Thiemo Voigt

6G Ambient IoT is expected to enable a wide range of new IoT applications across various industries, driven by the ability to deploy and manage billions of interconnected devices. 6G Ambient IoT devices rely on energy harvesting rather than batteries which makes ultra-low power consumption a key issue. To address this challenge, 6G Ambient IoT devices use backscatter communication which reduces the energy consumption by several orders of magnitudes compared to conventional active radios. As the telecommunications industry drives the development of 6G, the primary focus remains on efficient communication. In this talk, I first present some key technologies of 6G Ambient IoT. I will discuss harmonic backscatter, an approach that avoids self-interference between the carrier and data radio frequency waves. I will then present TaDA, a task decoupling architecture for energy harvesting devices and discuss its potential role in 6G Ambient IoT.

Lothar K. Becker
LibreOffice, Germany

Lothar is a dedicated advocate for open-source software and has made significant contributions to free office productivity software. He has a master's degree in Computer Science and Economics and completed one of the first master’s theses in Data Mining at the German Research Center for Artificial Intelligence. He and his company were among the first service providers in the ecosystem of StarOffice and OpenOffice.org. His extensive experience includes leading migration projects for open-source software and co-developing certification activities related to LibreOffice technology. During the pandemic, he served as the chairman of the board of The Document Foundation (TDF), the organization behind LibreOffice. Additionally, Lothar is a board member of the Open Source Business Alliance (OSBA) and actively advocates for digital sovereignty in both the private sector and public affairs.

Is Open Source with Co-Pilots at Risk? Why LibreOffice Technology Never could be an OpenAI Case

Lothar K. Becker

The use of AI-driven co-pilots is now becoming more prevalent in office productivity technology platforms. A notable player in this field is OpenAI with ChatGPT, which is the foundation for many AI pilots today. This has significant implications for the office productivity market, especially in professional applications. There is a growing focus on integrating AI-based functions with user-centric software solutions, including LibreOffice Technology. It is worth examining the potential AI-based extensions for LibreOffice and discussing the associated risks for industry organizations, particularly the potential shift from open-source to closed-source models similar to OpenAI.

PAPER ABSTRACTS

.

Instruct-DeBERTa: A Hybrid Approach for Aspect-based Sentiment Analysis on Textual Reviews

Dineth Jayakody[1], A.V.A. Malkith[1], Koshila Isuranda[1], Vishal Thenuwara[2], Nisansa de Silva[2], Sachintha Rajith Ponnamperuma[3], G.G.N. Sandamali[1], K. L. K. Sudheera[1]

[1]*Department of Electrical and Information Engineering, University of Ruhuna*

[2]*Department of Computer Science & Engineering, University of Moratuwa*

[3]*Emojot Inc.*

Abstract— Aspect-based Sentiment Analysis (ABSA) is a critical task in Natural Language Processing (NLP) that focuses on extracting sentiments related to specific aspects within a text, offering deep insights into customer opinions. Traditional sentiment analysis methods, while useful for determining overall sentiment, often miss the implicit opinions about particular product or service features. This paper presents a comprehensive review of the evolution of ABSA methodologies, from lexicon-based approaches to machine learning and deep learning techniques. We emphasize the recent advancements in Transformer-based models, particularly Bidirectional Encoder Representations from Transformers (BERT) and its variants, which have set new benchmarks in ABSA tasks.We focused on finetuning Llama and Mistral models, building hybrid models using the SetFit framework, and developing our own model by exploiting the strengths of state-of-the-art (SOTA) Transformer-based models for aspect term extraction (ATE) and aspect sentiment classification (ASC). Our hybrid model Instruct - DeBERTa uses SOTA InstructABSA for aspect extraction and DeBERTa-V3-baseabsa-V1 for aspect sentiment classification. We utilize datasets from different domains to evaluate our model's performance. Our experiments indicate that the proposed hybrid model significantly improves the accuracy and reliability of sentiment analysis across all experimented domains. As per our findings, our hybrid model Instruct - DeBERTa is the best-performing model for the joint task of ATE and ASC for both SemEval restaurant 2014 and SemEval laptop 2014 datasets separately. By addressing the limitations of existing methodologies, our approach provides a robust solution for understanding detailed consumer feedback, thus offering valuable insights for businesses aiming to enhance customer satisfaction and product development.

Keywords— Aspect-Based Sentiment Analysis, Aspect Extraction, DeBERTaV3, Hybrid Model, InstructABSA, Natural Language Processing, Sentiment Classification, Textual Reviews

Drug Recommendation system based on Medical Condition Classification and Sentiment Analysis of Drug Reviews

Navodya Rathnasekara[1], Udaya Wijenayake[2]
Department of Computer Engineering, University of Sri Jayawardenepura, Sri Lanka

Abstract— The steady growth of the internet has increased the amount of user generated data on the web. In the healthcare domain, patients now commonly post their reviews about medicines after consuming them to create public awareness. Natural Language Processing techniques significantly contribute to the medical field by analyzing these public reviews and identify the effectiveness of drugs as well as understanding medical conditions they are suffering from which will help healthcare professionals and pharmacovigilance systems to ensure the physical and mental well being of the patients. Hence, this research endeavors to develop a comprehensive framework for patient medical condition classification, sentiment prediction from patients reviews and recommend suitable medicines to them. Four algorithms: Multinomial Na¨ıve Bayes, Passive Aggressive Classifier, SGD Classifier and MLP Classifier have been applied to medical condition classification and two algorithms: Multinomial Naïve Bayes and Logistic Regression have been applied for sentiment prediction. The results demonstrate that the proposed framework has an accuracy of 94.4% for Passive Aggressive Classifier in medical condition classification and accuracy of 94.85% for Logistic Regression in sentiment prediction.

Keywords— Sentiment Analysis, Classification, Recommender System, NLP, NLTK, Machine Learning

Cash Valuation of Black Tea in the Nuwara Eliya District based on Sensory Quality Attributes: A Case Study.

W.A.R.H. Rodrigo[1], C.H. Magalla[2], W.M.N.D. Basnayake[3]
[1,2]Department of Statistics, Faculty of Science, University of Colombo, Sri Lanka,
[3]La Trobe University, Melbourne, Australia

Abstract— The cash valuation of tea; estimated price of tea, decided prior to the auctions, is influenced by sensory assessments from tea brokers and tasters up to a certain degree, although market conditions and customer preferences decide the auction price. This study aims to predict the cash valuation of black tea using sensory quality measures and to identify the key factors that impact these valuations overall and grade specific. This information is crucial for stakeholders to maintain the quality standards of Sri Lankan Tea, supporting the export economy. While past research mainly focused on auction price prediction, few studies have modeled estimated prices using sensory quality parameters. However, using categorical sensory measures is significant in the current study as it was not previously implemented by past researchers. The study analyzed 1,119 tea samples with 13 attributes, finding that tea grade and ordinal sensory attributes are important for cash valuation. Due to the attributes being ordinal, numerical encoding was used to predict prices for the entire dataset and for each grade, using statistical and machine learning regression methods. With advanced analysis showing gradient boosting regression as the best predictive model foroverall cash valuation of tea, the model achieved a minimum RMSE of 79.75. The study identified that tea grade, average weight of a tea sample and dry leaf color are essential in cash valuation, with DUST1 and BOPF being the most expensive grades. Cash valuations for these tea grades were observed to be higher when the dry tea leaves were in shades of black.

Keywords— tea, sensory quality measures, estimated price, machine learning

Debiasing Hate Speech Classification Models for Queer Language Through Keyword Analysis

D.S. Yahathugoda[1], Rupika Wijesinghe[2], Ruvan Weerasinghe[3]
University of Colombo School of Computing, Colombo, Sri Lanka

Abstract— This article uses words or language that is considered profane, vulgar, or offensive by some readers. Detecting hate speech is critical for moderating harmful content on social media and the Internet. However, existing models often struggle to accurately identify hate speech targeting queer communities due to inherent biases in training data and language usage. This research explores debiasing techniques for hate speech classification models, with a focus on queer language via keyword analysis. By analyzing established hate speech datasets and queer-specific linguistic traits, this study aims to identify words and phrases the models pay attention to the most and apply different debiasing approaches such as reweighting and adversarial debiasing to enhance the efficacy and equity of hate speech aimed at queer communities, without unfairly silencing queer voices. We found that these methods improved the accuracy of queer-specific datasets but showed a decrease in performance on more general datasets. These findings suggest that we must develop more community-specific models to safeguard them from harmful content. This research contributes to advancing the understanding of bias in hate speech detection models and provides practical guidance for devising more inclusive and fair classification systems for online content moderation.

Keywords— Hate Speech Detection, Algorithmic Bias, LGBT, Queer.

Linguistic Analysis of Sinhala YouTube Comments on Sinhala Music Videos: A Dataset Study

W. M. Yomal De Mel, Nisansa de Silva
Department of Computer Science & Engineering, University of Moratuwa, Moratuwa, Sri Lanka

Abstract— This research investigates the area of Music Information Retrieval (MIR) and Music Emotion Recognition (MER) in relation to Sinhala songs, an underexplored field in music studies. The purpose of this study is to analyze the behavior of Sinhala comments on YouTube Sinhala song videos using social media comments as primary data sources. These included comments from 27 YouTube videos containing 20 different Sinhala songs, which were carefully selected so that strict linguistic reliability would be maintained and relevancy ensured. This process led to a total of 93,116 comments being gathered upon which the dataset was refined further by advanced filtering methods and transliteration mechanisms resulting into 63,471 Sinhala comments. Additionally, 964 stop-words specific for the Sinhala language were algorithmically derived out of which 182 matched exactly with English stop-words from NLTK corpus once translated. Also, comparisons were made between general domain corpora in Sinhala against the YouTube Comment Corpus in Sinhala confirming latter as good representation of general domain. The meticulously curated data set as well as the derived stop-words form important resources for future research in the fields of MIR and MER, since they could be used and demonstrate that there are possibilities with computational techniques to solve complex musical experiences across varied cultural traditions.

Keywords— MIR, MER, Linguistic analysis, Sinhala, YouTube Comments

Climate-Driven Insights: Predicting Black Pepper Yield and Quality with Long Short-term Memory Model

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Abstract— In the context of climate variability, predicting agricultural output remains a pressing challenge, particularly for high-value crops like black pepper in Sri Lanka, a leading spice exporter. This study introduces a novel machine-learning approach to predict black pepper yield and quality, utilizing thirty years of detailed weather data from the Matale district. Employing Long Short-Term Memory (LSTM) networks, the complex dependencies between weather conditions—including rainfall, temperature, and humidity—and crop productivity are modeled. The analysis demonstrates that LSTM models can effectively forecast black pepper yield and quality by learning from historical weather patterns and corresponding crop performance data. The models achieved a mean absolute error of 18-20% for quality predictions and a mean squared error reflecting consistent model performance across different evaluations. By providing reliable yield and quality estimates, these models serve as valuable tools for farmers and policymakers to better plan and manage black pepper cultivation in response to anticipated climate conditions. Furthermore, the research highlights the potential for enhancing model accuracy by incorporating diverse regional data, thereby contributing to more resilient agricultural practices in the face of global climate change.

Keywords— black paper, pepper Quality, yield prediction, Climate Change, Machine Learning, LSTM

Unraveling the Cognitive Secrets of Chess Experts: Investigating Dynamic Functional Brain Connectivity through rs-fMRI Analysis

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Abstract— This study investigates the dynamic functional connectivity (DFC) in resting-state fMRI (rs-fMRI) data of chess players using a Vector Auto-Regression (VAR) model. The VAR model was constructed using the Group Lasso and Sliding Window technique. The study included 116 brain regions, and their correlation was examined in the context of their dynamic connection. Statistical feature selection techniques were used to determine which dynamic connections of brain areas were crucial in discriminating chess masters from novice players. After identifying key DFCs related to these brain regions, a classification model was built to classify chess experts and normal control individuals.

Our classification model achieved an accuracy of 96.33% under a 10-fold cross-validation framework. This performance represents a substantial improvement over previous studies utilizing only rs-fMRI data, which reported a maximum accuracy of 85.45%, indicating a 10.88% enhancement in accuracy. Moreover, our model outperformed methods that combined rs-fMRI with T1-weighted MRI data, which achieved an accuracy of 88%, yielding an additional 8.33% improvement. These results demonstrate that our approach, relying solely on rs-fMRI data, offers a notable advancement in the classification of chess expertise.

Keywords— Dynamic Functional Connectivity, Vector Auto-Regression, resting-state fMRI, Chess Masters and Novices, Classification

Convergence of Twitter Sentiment Analysis and Optimized Learning Models for Predicting Bitcoin Price Volatility

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Abstract— Bitcoin has attained increasing recognition and interest from individuals and corporations, with more than $1billion market capitalization. Twitter users' sentiment on the topic is a major factor that influences volatility of Bitcoin's price. Compared to other financial markets, there are a limited number of studies that discuss the price fluctuation prediction of Bitcoin using Twitter sentiment. A dataset with 16 million tweets from August 2018 to October 2019 was utilized for finding the correlation between the daily close price of Bitcoin and Twitter sentiment. This dataset was pre-processed by following steps such as removing null, duplicate and non-English tweets. The sentiment analysis was carried out using VADER sentiment analyzer. This research utilized hyperparameter optimization and improved two deep learning models (with Long Short-Term Memory and Convolutional Neural Network architectures), for the tasks of direction and magnitude prediction with accuracies of 82.35% and 72.06%, respectively on test datasets. With hyperparameter optimization this research was able address a gap in the existing research of this research area, which was not utilizing hyperparameter optimization to improve deep learning models.

Keywords— bitcoin fluctuations, deep learning, bitcoin predictions, twitter sentiment, hyperparameter optimization

Transforming software size estimation with prompt engineering: A ChatGPT-based framework for component-based systems

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Abstract— In software project management, it is essential to estimate software size accurately since knowing the size of the program allows for more efficient planning, estimation, and scheduling of its development. The conventional software size estimation approaches such as use of Function Points (FP) and its extensions often prove to be time consuming, resource-intensive, and thereby a costly exercise, demanding specialized human expertise. This has no difference when it comes to the modern software development paradigms like Component-Based Systems Development (CBSD). On the other hand, Concerning Artificial Intelligence (AI), the large language model-based chat-bots like ChatGPT, Bard AI, DALL-E and Midjourney are excelling at automating traditional human activities and interactions in various domains including software engineering. Among all these AI tools, ChatGPT has proven its applicability in many industries including software engineering, acquiring around 100% accuracy over other chat-bots. In this paper, we therefore developed and validated an innovative framework based on AI, to measure the size of a Component-Based Systems (CBS) using ChatGPT. The framework which consists of a set of prompts has been designed to expedite the size estimation process of a CBS using an extension of FP called Component Point (CP) while substantially reducing the need of human involvement and financial outlay. Our aim is not only to enhance the efficiency of software size estimation but also to conserve both time and financial resources otherwise be spent on practicing conventional approaches. We therefore envision that the proposed approach would revolutionize the landscape of software project management.

Keywords— Artificial Intelligence (AI), ChatGPT, Component Point (CP), Component-Based Systems (CBS), Software sizing

Density Based Query By Committee – Robust Active Learning Approach for Data Streams

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Abstract— Acquiring precise labels for continuously flowing data streams is resource-intensive and costly. Active learning offers a potential strategy for training precise models while minimizing label requirements with minimal annotation effort. However, adapting active learning to streaming data becomes intricate due to the ever-changing data distributions, known as concept drift. Existing approaches for active learning in data streams predominantly rely on uncertainty sampling and Query by Committee (QBC) due to their simplicity and ease of implementation. This paper introduces a novel and a robust active learning approach tailored for data streams merging key elements from QBC and density-weighted sampling to effectively address the challenges posed by concept drift. Through a comprehensive analysis using benchmark datasets widely used in the literature related to data streams, we demonstrate the superior performance of our proposed method across various data stream scenarios. This includes instances with no concept drift, instances with the presence of concept drift, as well as scenarios involving severe concept drift. In addition, the results reveal that strategies based on uncertainty sampling and its variants exhibit limitations in the presence of concept drift, whereas QBC and its variants prove to be inadequate when faced with significant concept drift. In contrast, our approach, which combines the strengths of QBC and density-weighted sampling using Gower's distance as a similarity measure, exhibits remarkable adaptability to evolving data distributions.

Keywords— Density-Based Sampling; Query By Committee; Active Learning; Evolving Data

Utilizing Association Rules in Knowledge Graphs for Enhanced News Summarization

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Abstract— The rapid progress in web news articles has led to an abundance of text content, often than needed, and consequently, misleading readers. Recent Knowledge Graph (KG) based approaches have proven successful in abstract summary generation due to their ability to represent structured and interconnected knowledge with semantic context. The KG ranking algorithm responsible for selecting graph data for inclusion in the abstract still relies on the traditional ranking algorithms which lack the consideration for semantic relationships between graph nodes, heightened memory consumption and processing times, and increased complexity. Knowledge discovery plays a crucial role in improving the quality of summarization by uncovering hidden patterns and enhancing contextual understanding. Therefore, our study centers on introducing a novel KG ranking algorithm, aiming to achieve a statistically significant enhancement in abstract generation by combining knowledge discovery techniques. The suggested ranking algorithm considers the semantic and topological graph properties and interesting relationships, patterns, and features in text data using Association Rule Mining techniques to identify the most significant graph information for generating abstracts. The experiments conducted using the DUC-2002 dataset indicate that the suggested KG ranking algorithm is effective in producing detailed and accurate abstracts for a collection of web news articles.

Keywords— Knowledge graph, association rules, abstract generation, ranking algorithm

Detecting Cryptographic Hash Functions through Electromagnetic Side-Channel Analysis

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Abstract— In the era of Industry 4.0, the Internet of Things (IoT) has emerged as a transformative force, with the proliferation of IoT devices permeating various aspects of our daily lives. However, this rapid adoption of IoT technology has also given rise to an alarming increase in cyberattacks targeting these devices. Among many avenues of cybersecurity, Electromagnetic Side Channel Analysis (EM-SCA) stands as a crucial branch of information security that enables attackers to eavesdrop on and exfiltrate sensitive information, making it a critical concern for IoT security. Among various security measures taken on IoT platforms, data integrity is ensured through cryptographic hash functions. This work explores the potential of utilising EM-SCA to detect the presence of cryptographic hash functions on IoT devices, which would play an important role at the surveillance stage of an attack. In pursuit of this objective, this study employs a set of supervised Machine Learning (ML) algorithms that are intricately crafted to automatically identify distinct patterns of EM radiation emissions associated with different hash algorithms. The results of this investigation demonstrate that the proposed methods can achieve classification accuracy rates exceeding 80%. The findings of this work highlights that an attacker can inspect an IoT device in a non-invasive manner to identify its critical data integrity mechanisms before a suitable subsequent action is taken to compromise it.

Keywords— Electromagnetic Side-Channel Analysis, Cryptography,Hash Functions, Internet of Things

Unsupervised Discovery of Salient Design Features of Websites

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Abstract— Web development is one of the fastest-growing fields in the IT industry. User Interface (UI) design of a website is critical in attracting new users, which helps businesses increase sales and revenue. A unique website design will encourage user interaction among website visitors and ensure that the time and resources spent on a webpage are worthwhile. Web designers create websites using pre-existing templates or from scratch. The web designer's design skills heavily influence the overall appearance of a website. However, such websites do not always meet the client's expectations. As a result of these challenges and the ever-changing web development trends, the automatic website generation concept has emerged, which generates websites without relying on human interaction. In this concept, it is useful to understand how to classify websites based on their appearance and how to identify design features that distinguish websites. This study aims to develop a classification system for websites on the internet based on their salient design features.

Keywords— web designing, automatic website generation, templates, clustering, self-organizing-map

A Prototype to Detect the Alcohol Content of Local Toddy Based on an Electronic Nose

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Abstract— For the purpose of preserving product quality and guaranteeing regulatory compliance, accurate alcohol detection in alcoholic beverages, particularly local toddy, is crucial. The goal of this study is to produce a reliable alcohol detection device employing electronic nose (e-nose) technology customized for local toddy. The envisioned device includes a sensor array that can detect and examine volatile substances linked to alcohol in local toddy. The system enables real-time alcohol content readings by gathering and analyzing sensor data, allowing for accurate quality control and monitoring. Extreme learning machines, artificial neural networks, and multiple linear regression, multiple nonlinear regression are used to examine the sensor responses to alcohol-associated volatile chemicals. Performance evaluation of the prototype showed that the Artificial Neural Network (ANN) model outperformed other models, achieving a Mean Squared Error (MSE) of 1.0000 across multiple test runs, compared to MSE values of 85.627444 for MLR and MNLR models. The Mean Absolute Error (RAE) for the ANN model was as low as 0.0001 in certain runs, demonstrating its precision. These quantitative findings suggest that the ANN model is best suited for accurate alcohol detection in local toddy, offering a significant improvement over traditional methods. The results demonstrate the potential of machine learning methods for detecting alcohol in alcoholic beverages and shed light on the intricate connection between sensor data and alcohol concentrations. These algorithms provide encouraging ways to improve quality control procedures and guarantee constant product quality.

Keywords— toddy, alcohol content, calibration, e-nose, machine learning

Investigating the Efficacy of Brain-Computer Interfaces in Enhancing Cognitive Abilities for Direct Brain-to-Machine Communication

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Abstract— Brain-Computer Interfaces (BCIs) are assistive technologies used to facilitate direct communication between the brain and external devices. This paper explores the potential of BCIs to enhance artificial cognitive abilities in systems and enable direct brain-to-machine communication. The integration of Artificial Intelligence (AI) with BCIs is explored to identify the improvements in accuracy, personalization, user experience, and integration of cognition into BCI systems. The study emphasizes the potential uses of BCIs in robotics, human-computer interfaces, healthcare, and rehabilitation. Based on the systematic literature review done in this paper it is noted that BCIs can be effectively used to improve cognitive functions like memory, attention, and creativity, assist with motor rehabilitation for individuals with disabilities, create more natural and intuitive human-robot interaction, and develop personalized therapy approaches for various conditions like ADHD. However, it is necessary to address current low accuracy problems, user interface challenges, and limited cognitive abilities in BCIs. While addressing technological improvements through rigorous research it is necessary to ensure the responsible and ethical evolution of BCI technology for integrating cognitive abilities in computer systems.

Keywords— Brain-Computer Interface (BCI), Cognitive capabilities, Brain-to-Machine Communication, Artificial Intelligence (AI), Artificial Cognitive Systems (ACS)

Securing IoT Servers: Strategies for Employing Shallow and Deep Neural Networks

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Abstract— This study investigates the potential employability of Shallow and Deep Feed Forward Neural Networks (FFNs) in detecting attacks on low-resourced IoT application servers. It employed a Shallow FFN model with a single hidden layer of 512 neurons, and a Deep FFN model with 7 hidden layers, having between 256 to 4 neurons respectively. The study constructed four Shallow and Deep FFN models, utilizing two balanced UNSW-NB15 datasets containing 20 and 40 features. Experiments were conducted to detect network attacks on IoT networks. The results demonstrated that the Deep FFN model utilizing 40 features, despite slightly longer prediction times and higher resource usage, consistently outperformed other models, achieving an accuracy of 98.37%. Therefore, Deep FFN models prove suitable for protecting high-resourced IoT application servers. The Shallow model, achieving a faster detection time and moderate accuracy of 93%, is potentially employable in resource-constrained, low-latency IoT servers. This research enhances IoT security by employing Shallow and Deep FFN models based on different resource levels in IoT environments. Furthermore, it proposes integrating the Deep model into next-generation firewall systems to protect higher-value IoT servers. Future work involves exploring hybrid FFN architectures for protecting edge servers from network attacks.

Keywords— IoT Server Security, Neural Networks, Network Attack Detection, Deep and Shallow models

Modified Discrete Wavelet Transformation to Compress DICOM Medical Images with Run-Length Encoding

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Abstract— With rapid advancements in medical imaging technology, a substantial amount of image data has been produced to assist clinical diagnostics, nevertheless, storing and transmitting medical images with high-resolution content presents a formidable challenge that needs to be addressed. This study proposes a technique to compress DICOM images using a Modified variant of Discrete Wavelet Transform (MDWT) including Run-Length Encoding and DEFLATE algorithm. The proposed mechanism decomposes a DICOM image to its frequency sub-bands, namely, approximation (LL), horizontal detail (LH), vertical detail (HL), and diagonal detail (HH) coefficients which are then thresholded and quantized in an adaptive manner using uniform scalar quantization. The quantized coefficients are run-length encoded with a modified scheme to traverse the data including linear, diagonal, and spiral approaches. Subsequently, DEFLATE algorithm-based compression is performed for further reduction in data volume. Results indicate a noteworthy improvement in compression ratio with the modifications while preserving a high level of detail.

Keywords— Discrete Wavelet Transform (DWT), Run-length Encoding (RLE), Huffman Encoding, Uniform Scalar Quantization

AI-Based 3D Simulation for Drone Flight Dynamics

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Abstract— Unmanned aerial vehicles (drones) have provided new potential in areas like surveillance, transportation, construction, and agriculture. Simulating drone dynamics is vital in these domains, as it allows researchers to test drones in complex or risky circumstances. However, evaluating drone behavior is complicated because to the various elements involved. Traditional models based on Newtonian and fluid dynamics use parameters including force, gravity, propeller characteristics, and air density. While these models can replicate a generic drone, they are not realistic for replicating the dynamics of a specific drone due to the complex nature of the parameters. An AI-based technique gives a simpler way to model drone dynamics compared to these older methods. This approach leverages advanced AI models trained on massive datasets from real-world flight events. The datasets cover a range of flight maneuvers, including figure-eight, circular, and lazy-eight patterns, illustrating several sorts of drone motions. Several methods were utilized to develop the models, including multi-output regression, support vector machines (SVM), neural networks (NN), and convolutional neural networks (CNN). The CNN model achieved the highest accuracy at 78%. To validate the models, anticipated drone shifts were compared with realworld flight data. Future work will focus on further refining the CNN-based model and integrating it with a virtual reality environment for improved simulation.

Keywords— Artificial Intelligence, Conventional Neural Networks, Drone Dynamics, Simulation, Three-Dimensional Space

Music Genre Classification with Multi-Model Properties of Lyrics and Spectrograms

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Abstract— Music Genre classification is widely used in online music streaming platforms. Deep learning has enabled extracting musical information more effectively, and there have been various research works done to improve their accuracy with power spectrogram images and lyrical features. This paper evaluated the optimum usage of multiple modalities such as lyrics and spectrogram images based on the richness of their features. Furthermore, proposes a hybrid-fusion-based deep learning multimodal, multi-class classifier, that employs Mel Spectrograms, Mel-Frequency Cepstral Coefficients, and Lyrics to classify musical genres more accurately. Finally, the proposed model benchmarked with 3 previous studies, with a prepossessed dataset from the Music4All dataset with country, jazz, metal, and pop genre classes and obtained the highest F1-Score of 0.72 for the proposed model.

Keywords— Music Genre Classification, Music Information Retrieval, Lyrical Information, Audio Information, Hybrid Fusion

POSTERS

Algorithmic Approach to Predict Electric Taste Stimuli to Simulate Organic Sour Taste Sensations Using EEG Data

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Abstract— Taste perception involves complex interactions between the tongue and the brain. Simulating the tongue with electric signals rather than utilizing chemical compounds is known as electric taste. Previous studies suggest that electric signals induce mostly sour taste sensations. Although electric taste has been characterized based on participants' subjective perspectives, the neural activation associated with it remains underexplored. Therefore, this study aims to investigate the potential of simulating organic sour taste perception using electric signals by analyzing EEG data collected during experiments and utilizing machine learning models. The experiments involve approximately 30 healthy adult participants with no known taste or neurological disorders. Baseline EEG activity is recorded without any taste stimulation as the control trial. During the organic taste trials, participants receive organic sour taste solutions while their EEG responses are recorded, followed by the collection of subjective feedback. In the electric taste trials, varying electric stimuli are applied, with EEG responses and subjective feedback being collected. The data is preprocessed to remove noise and artifacts. Statistical and machine learning models are then used to analyze the EEG data and subjective taste perceptions to identify key features related to organic sour taste. These key features, along with EEG data from both experiments, are used to train a machine learning model to capture the relationship between neural firings and electric signal parameters, enabling the prediction of the electric signal when sour taste neural firings are provided. This study has the potential to enable sour taste digitization, enhancing VR, AR, and human-computer interaction by simulating taste sensations with electrical signals. The findings will deepen our understanding of the neural mechanisms underlying taste perception, benefiting computational neuroscience and neural engineering. Additionally, this research could pave the way for medical applications, helping individuals with dietary restrictions, taste disorders, or diminished taste sensations due to chemotherapy enjoy healthy meals.

Keywords: Virtual Taste, Digital Taste, Taste Characterization, Electrical Stimulation of Taste

Decoding Dyslexia: NLP Based Linguistic Analysis for Dyslexia Friendly Content Creation in Sinhala

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Abstract— Dyslexia is a neurodevelopmental disorder that primarily affects the skills involved in accurate and fluent word reading and spelling. Dyslexia-friendly content refers to written material specifically designed for dyslexic individuals in a way that is more accessible and understandable, helping them overcome the difficulties in navigating written communication. While there are many dyslexia-friendly content creation approaches for foreign languages like English, resources for Sinhala languages remain scarce. Linguistic patterns, such as phonetic rules, spelling patterns, and grammar structures, play a significant role in how dyslexic individuals process written language. When it comes to Sinhala language, there's a lack of studies done to understand these linguistic patterns and based on the few studies already conducted, it is evident that being an alpha syllabic language, Sinhala language has language specific language characteristics that are different from English language. Hence, understanding them is crucial for creating content that caters specifically to the needs of Sinhala speaking dyslexic individuals. This research examines and analyze the unique linguistic patterns associated with dyslexia in Sinhala language using NLP based algorithms and leverage these insights into creating more effective dyslexia friendly content, ultimately surpassing the limitations of existing methodologies and enhancing the overall accessibility, comprehension, and engagement of content for the Sinhala-speaking dyslexic population in Sri Lanka. An in-depth analysis is conducted on handwriting data samples and speech samples of dyslexic people in Sinhala language and identify language specific linguistic features focusing on phonological, morphological, and orthographic aspects using NLP algorithms. Quantitative evaluations are used to measure the effectiveness of the developed algorithms in transforming text into dyslexia-friendly formats, using metrics such as readability scores and user feedback. Qualitative evaluation will involve expert reviews as well as feedback from individuals with dyslexia for assessing the usability and appropriateness of the dyslexia friendly content. By addressing the scarcity of dyslexia-friendly resources in the Sinhala language, the study aims to create tailored content that meets the specific needs of individuals with dyslexia, thereby bridging an important gap in accessibility and support.

Keywords: Dyslexia, Dyslexia-friendly content, Natural Language Processing (NLP), Linguistic Analysis, Linguistic Patterns

Enhancing User Experience for Data Visualization in Three-Dimensional Immersive Space

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Abstract— Data visualization in Data Science transforms complex datasets into graphical formats to facilitate analysis and decision-making. However, traditional 2D data representations can hinder comprehension of complex datasets. Virtual Reality (VR) with Head-Mounted Displays (HMDs) can enhance data visualization by offering a more intuitive and immersive way to interact with complex datasets. This study aims to improve the user experience for data visualization in 3D immersive spaces. We hypothesize that making the visualization more user-friendly and three-dimensional will enhance comprehension and decision-making in data science applications. This research addresses limitations in current VR data visualization tools, including poor user-friendliness, dataset non-neutrality, and limited 3D chart types. Our approach enhances the user experience with an intuitive interface, auditory and visual cues, advanced data manipulation tools, and gesture-based interactions. This study would significantly transform data visualization technologies, particularly in corporate and industrial settings. The study employs the Design Science Research (DSR) approach, focusing on problem identification, design, demonstration, evaluation, and refinement to identify key design principles, chart types, and user interactions for 3D immersive data visualization. These elements will be integrated into a framework for prototype development and evaluation. The research will use a mixed-method approach for evaluation. Quantitative metrics, including task completion time, error rate, and System Usability Score (SUS), will assess efficiency and user satisfaction. Qualitative insights will be gathered from user feedback, observational notes, and the think-aloud protocol to deepen the understanding of user experience. Additionally, user experience heuristic evaluation will ensure the prototype adheres to usability principles. By creating a versatile tool that utilizes HMDs and gesture-based interactions, the research aims to lay a foundation for future VR-based visualization tools. It is designed to enhance data interpretation, increase user engagement, and improve communication of complex datasets, potentially setting new standards and influencing future developments across various sectors.

Keywords: Data Visualization, Human-computer Interaction, Immersive Space, Virtual Reality System, Head Mounted Displays

Establishing Emotional Baseline through Multimodal Emotion Recognition

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Abstract— Human emotions are dynamic and individualized, varying across lifetimes, cultures, and contexts. The same stimulus can evoke different emotional intensities among people. Emotional baseline, a relatively stable state to which an individual returns after temporary fluctuation, is crucial for accurate personalized emotional assessment. Current methods focus on identifying emotional states at specific moments, without considering baseline emotional profile, which cannot interpret emotional fluctuations in a personalized manner. This research develops a framework for emotional baseline identification with multimodal inputs, enabling the system to identify each user's emotional deviation from the baseline in a personalized manner.

A framework is implemented using existing models developed for facial expressions, eye movements, and touch interaction patterns to extract arousal and valence values. These values are captured at intervals and then combined through multimodal fusion, which employs a weighted function to assign different weights to each input method based on the specific emotion. Then, fed into a reinforcement learning model to identify a user-specific emotional baseline based on observed patterns of emotional return which will be refined through iterative processes incorporating user feedback allowing for continuous adaptation over time. After establishing the baseline, the system calculates deviations by comparing current arousal and valence values from the multimodal emotional recognition system against the personalized baseline. The personalized nature of the system encourages users to provide accurate feedback for optimal customization. Initial training uses standard published datasets, followed by fine-tuning to adjust weights to the experimental context.

The evaluation compares predicted baselines with self-reported emotional states using tools like PANAS and SAM. The rate of improvement across iterations is assessed to determine convergence towards a stable baseline point. This research contributes by providing a robust method for incorporating personalized emotional baselines into emotion recognition systems, offering personalized responses through a more accurate understanding of emotional states.

Keywords: Emotion recognition, Reinforcement Learning, Multimodal Emotion Prediction, Emotional baseline, Machine learning

Leveraging Processor Electromagnetic Radiation for Radio Tomography

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Abstract— Sensor networks have expanded human capabilities beyond the limitations imposed by senses. One aspect that has been surpassed is observing objects and phenomena that are Non-Line of Sight with tomographic imaging techniques. Tomography refers to producing images by analyzing cross sections of a subject from data gathered in different angles using reflections or transmissions. This is an emerging technology of computer vision and wireless sensing. Nevertheless, prevailing methods require a complex sensor grid built with transmitters and receivers of radio waves which should be geometrically symmetric, immobile and externally powered, detecting only the objects within the grid. Hence tomographic imaging is infeasible in circumstances where this sensor grid cannot be installed, and purpose-built transmitters are not present. This research proposes utilizing unintentional electromagnetic (EM) radiation of electronic devices to mitigate this issue. The EM emission from electronic devices is due to changing currents inside the physical system caused by current flow or switching of transistors. The proposed method consists of a far field antenna, a software defined radio and GNU radio companion for signal processing. Preliminary experiments have been conducted to capture EM emissions from an Intel Core i5 processor in which the workload of the processor was controlled by running stress-ng tool in Linux environment. stress-ng is a workload generator used in this experiment to adjust the workload thus changing the EM emission from the processor. Preliminary experiments consider a constant distance to measure the strength of EM emissions when the CPU workload is stabilized using stress-ng tool. It has been observed that the received signal strength is as high as -65 dbm from 7 feet. The feasibility of utilizing EM emissions from a targeted device for wireless sensing and tomography can be evaluated with further experiments based on this observation.

Keywords – Tomography, Electromagnetic emissions, Signal processing, Far field antenna, GNU radio companion

Machine Learning and Electroencephalography Data to Assess Attention Patterns in Children with Attention Deficit Hyperactivity Disorder

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Abstract— Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterised by recurrent patterns of hyperactivity, impulsivity, and inattention. Children with ADHD struggle to sustain attention that negatively affects their academic performance, social interactions, and overall quality of life. Traditional ADHD diagnosis and monitoring (including evaluating attention levels in ADHD) methods rely heavily on subjective assessments, such as clinical evaluations, which can be imprecise and biased, resulting in less confident decision-making.

Extensive research has been undertaken to diagnose ADHD using objective methodologies that examine various data, including physiological data like eye-tracking and neuroimaging data like Electroencephalogram (EEG) and fMRI. This research aims to fill the void by developing a novel, objective machine learning-based method that assesses attention levels in children with ADHD by analysing their EEG data to be used in interactive learning environments for alerting teachers to assist in taking real-time corrective decisions.

The research utilises a publicly accessible dataset comprising 44 healthy controls and 48 participants with ADHD. It contains EEG recordings from 56 channels at a 500 Hz sample rate obtained during a time estimation task across 300 trials. The methodology involves processing EEG signals, extracting key features, investigating action potential data such as ERP and evoked potentials, and using machine learning models to evaluate attention trends. The dataset is partitioned into two segments - to train the machine learning model and to simulate the real-time processing of EEG signals. The expected outcome is an analysis of attention spans and fluctuation levels intended to be graphically visualised through a mobile application to be used by interested stakeholders, including parents, teachers, and healthcare professionals. This research intends to advance knowledge of the mechanisms behind attention in children with ADHD and aid in the creation of real-time evaluation tools for therapeutic and educational contexts.

Keywords: Attention-Deficit Hyperactivity Disorder (ADHD), Electroencephalogram (EEG), Event-Related Potential (ERP), Attention, Machine Learning

PepperTester: A Non-Destructive Approach to Assess the Purity of Black Pepper Seed Samples

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Abstract— The increasing need for quality assessment in agricultural products has resulted in the development of innovative tools that use technology to assist customers and traders. This research *PepperTester* application represents a significant advancement in quality assurance of agricultural products, focusing on testing the quality of *black pepper seeds* that are available in the market. *Black pepper* seeds are often mixed with impurities such as papaya seeds to *increase profits unethically*. Most customers are impacted adversely by purchasing contaminated spices for the price of genuine goods. Meanwhile, vendors are also compromised by this process when farmers sell contaminated seeds at agro-product distribution centers. Implementing a mobile application with a backend server uses image preprocessing techniques for image segmentation, enhancement and feature extraction. It uses the *YOLOv8* model to detect impurities, assesses the quality of the given black pepper sample and sends the *pepper seed purity score* to the mobile application. The training data set consists of *1000 samples of images*, and the system achieved a 94% accuracy level. In Sri Lanka, where *black pepper* is a major spice in cuisine, the use of a *PepperTester* could significantly reduce customers' purchases of contaminated black pepper seeds. The goal of this research was to develop a mobile application for the users to provide images of samples to connect to a backend server running a Machine Learning model that assesses the quality of the given samples. This research contributes to consumer protection by providing a practical tool to help customers and vendors identify black pepper seeds using digital images.

Keywords: Agro-Products Quality Assurance, Machine learning, Image Preprocessing, Object Detection, Impurity Detection, Black Pepper

Task-based Optimisation Model for UAVs: Optimizing Liquid Fertiliser Application Under Dynamic Wind Conditions

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Abstract— The use of Unmanned Aerial Vehicles (UAVs) for fertilizer spraying marks a significant advancement in agricultural technology, offering precise and efficient application over traditional methods. UAVs facilitate the precise application of fertilizers, preventing both excessive and insufficient application, thereby optimizing resource use, enhancing crop yields, and supporting sustainable farming practices. However, wind-induced droplet drift poses a challenge in UAV fertilizer application. To address this, we developed a task-based optimization model that incorporates dynamic wind conditions to enhance spraying precision. We simulated a quadcopter's real-time response to wind, focusing on adjustments in spraying patterns to maintain uniform coverage. The drone follows a lawnmower path pattern, dynamically adjusting its trajectory based on wind data to minimize drift and optimize efficiency. Our model consists of several components. It includes a spray drift model to predict the movement of fertilizer droplets upon release, a simple turbulence model to account for variations in wind and a drone flying model to manage the navigation and spraying actions of the drone. The simulation field is 25m by 25m, with the spray height set at 4 meters above the ground and the spray angle set at 45 degrees relative to the vertical axis of the drone. The simulation results demonstrate that wind speed significantly influences the drone’s trajectory and the step size between passes. In the absence of wind, the step size was 4.12 meters. However, with a wind vector of [5, 0, 0], the step size increased to 6.99 meters. The drone adjusts its path to maintain maximum coverage of the sprayed liquid, compensating for the drift caused by the wind. Additionally, the step size between each pass of the lawnmower pattern depends on the spray angle of the drone's nozzle. This angle influences how widely the liquid is dispersed, necessitating adjustments to ensure even coverage. This research shows that integrating real-time wind data into UAV flight models can significantly enhance the precision and efficiency of liquid fertilizer applications, reducing waste and improving sustainability in agriculture. This advancement not only supports more sustainable agricultural practices by reducing waste but also enhances the overall effectiveness of drone operations in the agricultural sector.

Keywords: Precision Agriculture, Agricultural UAVs, Spray Simulation, Wind Dynamics, Spry Drift Control

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