ICITR
International Conference on Information Technology Research 2024

9th International Conference on Information Technology Research

ICITR 2024

"Harnessing the Potential of Information Technology"

ABSTRACTS OF THE PROCEEDINGS OF ICITR 2024

DECEMBER 5-6
FACULTY OF INFORMATION TECHNOLOGY
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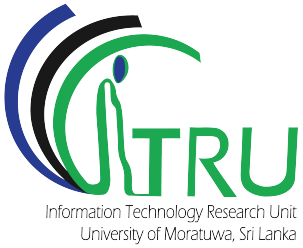

Abstracts of the Proceedings of ICITR 2024

of

9th INTERNATIONAL CONFERENCE ON INFORMATION TECHNOLOGY RESEARCH ICITR 2024

5th - 6th December 2024

"HARNESSING THE POTENTIAL OF INFORMATION TECHNOLOGY"

Information Technology Research Unit
Faculty of Information Technology
University of Moratuwa
Sri Lanka

International Conference on Information Technology Research (ICITR)
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International Conference on Information Technology Research

The 9th International Conference on Information Technology Research (ICITR 2024) is set to take place on December 5th and 6th, 2024. This annual event, organized by the Information Technology Research Unit (ITRU), the esteemed research dissemination arm of the Faculty of Information Technology at the University of Moratuwa, Sri Lanka, promises a dynamic exploration of cutting-edge technological developments.

Under the overarching theme of "Harnessing the Potential of Informaiton Technology," ICITR 2024 aims to provide a robust forum for in-depth discussions on the rapid advancements occurring in research and development within the realm of digital transformation. Esteemed as a cornerstone in the field of information and communications technology (ICT). ICITR invited paper submissions across five compelling tracks: computer vision, artificial intelligence, computing, data science and data-driven applications, and technology trends.

In a demonstration of collaborative support, ICITR 2024 is honored to receive technical co-sponsorship from the IEEE and the IEEE Sri Lanka Section Chapter, as well as financial sponsorship from NCINGA and WSO2 and strategic partnership from the RETINA Project at the University of Moratuwa, Sri Lanka, funded by OWSD-UNESCO and the International Development Research Centre (IDRC) in Ottawa, Canada. This year, the conference witnessed an impressive submission of around 171 research papers, with a discerning acceptance of 77, maintaining an acceptance ratio of approximately 45%. All accepted and presented papers will be submitted to the IEEE Xplore digital library, indexed by SCOPUS.

Editorial Board

Artwork & Cover Design

Abstracts of the blind-reviewed full papers are included in this conference proceeding.

Message from the General Chair

B. H. Sudantha
General Chair
International Conference on Information Technology Research (ICITR 2024)

Welcome to the University of Moratuwa and the 9th International Conference on Information Technology Research (ICITR 2024). The objective of the conference is to provide a forum for researchers worldwide to unveil their latest work in information technology research. The theme of the conference, "Harnessing the Potential of Information Technology," gives direction, and it covers a broad spectrum of allied fields as well.

Maintaining the high quality of a conference requires various levels of involvement, including a well-balanced review process. This year, 171 full papers were submitted to the conference. Each paper was subject to review by at least two reviewers, and finally, 77 papers were selected as full-paper publications for the conference. I would like to express my sincere thanks to the reviewers for their dedicated, efficient, responsible, and rigorous review process, ensuring the high quality of the conference papers. And I should be much more thankful to the authors who shared their research experiences at the conference for their hard work. It helps us prepare proceedings at an excellent level.

Two workshops were organized to benefit the conference participants in various new trends and stimulate their research experiences. A very special thank you should go to our two distinguished keynote speakers: Prof. Rahmat Budiarto from the College of Computer Science and Information Technology, Al-Baha University, Saudi Arabia, and Prof. Takahiro Yabe from the Tandon School of Engineering, Department of Technology Management and Innovation (TMI) & Center for Urban Science and Progress (CUSP), New York University, USA.

I would like to thank everyone who has given his or her time, energy, and ideas to assist in organizing this event, including all the members of the organizing committee, the TPC Co-Chairs, TPC members, and all the reviewers, for the quality and depth of the reviews

and their sense of responsibility and responsiveness under very tight deadlines. In particular, I would like to highlight and acknowledge the tremendous efforts of especially the Director, Information Technology Research Unit; the Editorial Board; the ICITR Committees, including various energetic chairs and organizing committees of workshops and the conference; and finally, our dedicated faculty staff members who gave their support and worked tirelessly on various conference-related tasks in order to bring the conference to this level.

Finally, we hope that the participants enjoy the outstanding conference program of the 9th International Conference on Information Technology Research, ICITR 2024.

I wish you all a very fruitful and rewarding conference!

Message from the General Co-Chair

Dr. I.T.S. Piyatilake
Director
Information Technology Research Unit

We are pleased to welcome you to the 9th International Conference on Information Technology Research (ICITR 2024) organized by the Information Technology Research Unit (ITRU), Faculty of Information Technology, University of Moratuwa. This year, we run the conference under the theme "Harnessing the Potential of Information Technology". The conference is well recognized as a forum to discuss the rapid advances in research and digital transformation development.

The research papers published in the proceedings are comprehensive in that they contain a wealth of information that is extremely useful to academics and professionals working in related fields. It is my pleasure to announce the participation of leading academics and researchers in their respective areas of focus from various countries at this event. The conference proceedings and the presentations made at ICITR 2024 are the end result of a tremendous amount of innovative work and a highly selective review process. This year, we received around 171 research articles, and 77 were accepted, maintaining an acceptance ratio of about 45%. ICITR 2024 is technically co-sponsored by the IEEE, the world's largest technical professional organization dedicated to advancing technology, and the IEEE Sri Lanka Section. All the accepted papers for the ICITR 2024 will be indexed in the IEEE Xplore Database. There will be "BEST PAPER AWARDS" for authors to recognize outstanding contributions and research publications.

We thank all authors for their participation, and we are happy that they have chosen ICITR 2024 as the platform to present their work. Credit also goes to the Program Committee members and review panel members for their contribution in reviewing and evaluating the submissions and for making ICITR 2024 a success. I wish all of you the very best in your future research.

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1. Keynote Speakers

Keynote Address 1

Prof. Takahiro Yabe
Tandon School of Engineering,
Department of Technology Management and Innovation (TMI) &
Center for Urban Science and Progress (CUSP),
New York University,
USA

Profe Takahiro 'Taka' Yabe is a tenure-track Assistant Professor at the Center for Urban Science and Progress and Department of Technology Management and Innovation at the Tandon School of Engineering, New York University. Taka's research develops data-driven methods to understand collective social dynamics during disruptions and to model the resilience of complex urban systems to natural hazards, pandemics, and mobility technology. He was previously a Postdoctoral Associate at the MIT Media Lab with Alex 'Sandy' Pentland. He received his Ph.D. in Civil Engineering from Purdue University and Master's and Bachelor's Degrees from the University of Tokyo. He is the recipient of the Emerging Researcher Award from the Complex Systems Society.

Keynote Title: Resilience of urban socioeconomic networks to behavioral changes

Abstract

Urban economic resilience hinges on understanding how shocks propagate across local businesses and amenities during pandemics, disasters, and technological shifts. While disruptions in supply chains have been extensively studied, it is imperative to recognize that human behavior changes may also amplify shocks to businesses and amenities that are connected via mobility and lifestyle patterns. In this talk, I will present our data-driven spatial network models to predict the cascades of shocks across cities, and further discuss applications to optimize civil infrastructure systems to achieve urban resilience. I will also discuss my ongoing research on cross-city transfer learning approaches to prepare cities for unprecedented shocks.

Keynote Address 2

Prof. Rahmat Budiarto
College of Computer Science and Information Technology,
Al-Baha University,
Saudi Arabia

RAHMAT BUDIARTO, received the B.Sc. degree in mathematics from Bandung Institute of Technology, Indonesia, in 1986, and the M.Eng. and D.Eng. degrees in computer science from Nagoya Institute of Technology, Japan, in 1995 and 1998, respectively. He is currently working as a Full Professor at the College of Computing and Information, Al-Baha University, Saudi Arabia. His research interests include intelligent systems, brain modeling, IPv6, network security, wireless sensor networks, and MANETs. He can be contacted at email: rahmat@bu.edu.sa.

Keynote Title: Building a Resilient Digital Infrastructure: The Role of Intelligent Network Monitoring

Abstract

Developing countries are facing a significant challenge in protecting their digital infrastructures from cyberattacks. This is shown by the high number of cybercrimes, including data breaches, identity theft, and hacks on government and private websites, often involving insiders. This challenge impacts significantly their digital infrastructure resilience. Developing countries' cybersecurity typically struggles with two problems: a lack of public understanding about cyber threats and a dependence on foreign technology for network monitoring. To address the issue of dependence on foreign technology for network monitoring and its sustainability, this talk discusses how network monitoring system is developed locally to fulfill local demands to reducing reliance on external resources and considering its sustainability. Nowadays, Network security is getting smarter all the time when it comes to finding threats in real-time. The biggest challenge is making sure the system only detects real threats, and does not get confused by normal activity. Adapting on-the-fly learning and re-using knowledge across different areas is the key to staying secure. Memory prediction

is gaining steam, but it is still early days compared to network security. Despite real-time attack/anomaly detection in network security has made big strides, there are still some important challenges researchers are working on. By tackling these challenges, researchers can create even more effective and reliable real-time attack/anomaly detection systems that make networks more secure against the ever-changing world of cyber threats. This talk shares the development of Instamon to support nation resilient on digital infrastructure.

2. Conference Workshops

Workshop 1

Dr. Asara Senaratne
College of Science and Engineering, Flinders University, South Australia.

Dr. Asara Senaratne is a Lecturer with the College of Science and Engineering at Flinders University, Australia, where she specializes in anomaly detection, data visualization, and knowledge representation within the realm of Computer Science.

Her research interests predominantly focus on applying Artificial Intelligence (AI), Machine Learning (ML), and Data Science techniques to enhance data quality and knowledge discovery. This includes exploring innovative methods for anomaly detection in graphs, advancing industrial automation, and improving human computer interactions. Currently, her research is centered on developing robust models for anomaly detection in diverse domains, including health data, the semantic web, cyberspace, and industrial and machine-generated data, thereby generating valuable insights for decision-making.

Workshop Title: Unsupervised Anomaly Detection in Graphs for Knowledge Discovery

Abstract

Anomaly detection is the process of discovering unusual or rare patterns in data that are significantly different from the rest of the observations in a dataset. The importance of the task stems from the centrality of discovering unique or unusual phenomena in science and industry, where anomaly detection is also of significant importance for businesses and governments. Although errors and noise in data are frequently regarded as anomalies, an anomaly need not be erroneous, as abnormal data can unveil interesting facts, thus generating knowledge.

Due to extensive connections between real-world objects, graph anomaly detection has received increased interest over the past years. While anomaly detection in tabular data aids in identifying anomalous records, the analysis of inter-relationships among records is required to find pairs or sets of abnormal records, which would otherwise be seen as normal when considered in isolation.

Hence, through this hands-on workshop, the attendees will (1) gain an understanding of the importance of graph-based anomaly detection in different application domains, (2) learn different machine learning and deep learning techniques that can be used for unsupervised anomaly detection, (3) gain hands on experience in developing an anomaly detection pipeline, (4) and learn a few visualization techniques which we can use to express findings.

Workshop 2

Dr. Shakthi Weerasinghe
Swinburne University of Technology, Department of Computer Science and Software Engineering in Hawthorn, Victoria.

Shakthi Weerasinghe received his Bachelor of Science (First Class Honors) degree in Informa on Technology from the Faculty of Informa on Technology in University of Moratuwa, Sri Lanka. He completed his PhD at Deakin University, Australia, having inves gated distributed caching algorithms for context informa on. Shakthi is a former soware engineer and a former lecturer at the University of Moratuwa. He is currently a Research Fellow at Swinburne University of Technology while leading his own research at Deakin University. Shakthi has authored a number of peer-reviewed ar cles which have been accepted into pres gious conferences and journals including PerCom, IEEE Communica ons, and ACM Transac ons in Internet of Things Journal. His research interests include Context-aware Compu ng, Internet of Things (IoT), Distributed Compu ng, and Interdisciplinary applica ons of Informa on Technology.

Workshop Title: Enhancing machine intelligence: The Role of Context-awareness in the IoT Ecosystem

Abstract

Context Informa on, or informa on that characterises an en ty's situa on, or its surroundings, is the backbone of relevant, useful, and mely smart applica ons. With the rapid development and widespread use of Internet of Things (IoT), including techniques to access big data (e.g., crowdsourcing), inferring and modelling situa ons anywhere in the world using a mul tude of heterogeneous data streams is extremely possible. Hence, in this workshop,

we will discuss the recent developments of the ubiquitous use of context informa on to enhance machine intelligence, further bridging the gap between ar ficial and human intelligence. First, we will focus on the fundamentals of inferring and managing context informa on. Then, let us delve into pervasive context intelligent applica ons that leverage the IoT ecosystem, considering several use cases, including autonomous vehicles and smart ci es, before discussing future direc ons of research in the area.

3. Programme Agenda

Day 1: 5th December, 2024

09.00 AM – 11.00 AM	Pre-Conference Workshop 1
Title	”Unsupervised Anomaly Detection in Graphs for Knowledge Discovery”
Resource Person	Dr. Asara Senaratne College of Science and Engineering, Flinders University, South Australia.
01.00 PM – 02.30 PM	Pre-Conference Workshop 2
Title	”Enhancing machine intelligence: The Role of Context-awareness in the IoT Ecosystem”
Resource Persons	Dr. Shakthi Weerasinghe Swinburne University of Technology, Department of Computer Science and Software Engineering in Hawthorn, Victoria.

Day 2: 6th December, 2024

07.45 AM – 08.30 AM	Registration of Participants
08:30 AM – 9:00 AM	Inauguration Ceremony
09:00 AM – 09:50 AM	Keynote Address by Professor Takahiro Yabe Tandon School of Engineering, Department of Technology Management and Innovation (TMI) & Center for Urban Science and Progress (CUSP), New York University, USA Topic: Resilience of Urban Socioeconomic Networks to Behavioral Changes
09:55 AM – 10:00 AM	Presentation by Platinum Sponsor NCINGA
10:00 AM – 10:45 AM	Keynote Address by Professor Rahmat Budiarto College of Computer Science and Information Technology, Al-Baha University, Saudi Arabia Topic: Building a Resilient Digital Infrastructure: The Role of Intelligent Network Monitoring
10:00 AM – 12.00 NOON	ICITR Technical Session 1
10:45 AM – 10:50 AM	Conference Photo
10:50 AM – 11:00 AM	Tea Break
11:00 AM – 01:00 PM	ICITR Technical Session 2 ICITR Technical Session 3 ICITR Technical Session 4 ICITR Technical Session 5 ICITR Technical Session 6 ICITR Technical Session 7
01:00 PM – 02:00 PM	Lunch
02:00 PM – 04:00 PM	ICITR Technical Session 8 ICITR Technical Session 9 ICITR Technical Session 10
04:00 PM – 04:20 PM	Tea Break
04:20 PM – 04:45 PM	Awards and Vote of Thanks

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4. Detailed Session Plan of ICITR 2024

Friday, 6th December 2024
ICITR 2024 Technical Session 1 - Data Science & Data Driven Applications

Session Chairs	Dr. PLM Prabhani & Dr. S Ahangama
Time	10.00 AM – 12.00 NOON

Time	**Title & Author (s)**
10.00 AM – 10.15 AM	Fake News Detection on Twitter *B.C. Uyanage, G.U. Ganegoda*
10.15 AM – 10.30 AM	Fishing Location and Availability Prediction for Yellowfin Tuna in Sri Lanka *Tharmalingam N., Arulananthan I., Sharmini R, A.L.A.R.R. Thanuja*
10.30 AM – 10.45 AM	Examining Information Diffusion Patterns in YouTube Comment Networks, A Social Network Analysis Approach *Amila Chethana Nanayakkara, Banage T.G.S. Kumara, R. M. Kapila Tharanga Rathnayaka*
10.45 AM – 11.00 AM	Analyzing the Influence of Automated Water Distribution Systems on Precision irrigation for Orchids: A Case Study Using Dendrobium Phalaenopsis Orchid Group *R.P.G.S. Maleesha, P.D. Suranjini Silva*
11.00 AM – 11.15 AM	Enhanced Analysis of Media Interactions during Sociopolitical Unrest: Cross-Correlation Case Study of South African Unrest 2021 *Amila Chethana Nanayakkara, Banage T.G.S. Kumara, R. M. Kapila Tharanga Rathnayaka*

11.15 AM – 11.30 AM	Generalized Meta Framework for Forecasting *Theepana Govintharajah, Pavadaran Pathmaranjan, Gowsigan Kanagalingam, Priyanga Dilini Talagala*
11.30 AM – 11.45 AM	Optimal Allocation of Vaccines in a Meta-Population to Control COVID-19 in Sri Lanka *A.U.S.Adikari, H.C.Y. Jayathunga*
11.45 AM - 12.00 NOON	Impact on Celebrity Endorsement Essentials on Brand Awareness and Purchase Intention in Men's Wear Industry in Sri Lanka *Thisari Kavisha Hettiarachchi, Rivini Mataraarachchi, Ranga Abeysooriya*

ICITR 2024 Technical Session 2 - Computer Vision

Session Chairs	Dr. Jayamali De Silva & Dr. Thushari Silva
Time	11.00 AM – 01.00 PM

Time	**Title & Author (s)**
11.00 AM - 11.15 AM	Classification of Sri Lankan Skin Diseases Using Ensemble Deep Learning Models *Kayalvizhy Thapalingasivam, Veerapathirapillai Vinoharan, Pirabakaran Sivanesan*
11.15 AM - 11.30 AM	Layout Aware Research Paper Parsing and Draft Research Paper Layout-Error Detection Using NLP and Rule-based Techniques *Naveen Hedalla Arachchi, Ranul Navojith Dayarathne, Nipuna Dilshan Aluthdeniya, Wanuja Ranasinghe, Gamage Upeksha Ganegoda*
11.30 AM - 11.45 PM	Enhanced Change and Anomaly Detection for Intelligent Video Surveillance Systems *Siyumi Pathirana, Shafa Bishirhafi, Paboda Ratnayake, Kavinda Sandaruwan, Lakmini Abeywardhana, Dharshana Kasthurirathna*
11.45 PM - 12.00 PM	Tamil Alphabet Sign Language Recognition Using Mediapipe and Machine Learning *Vidura Perera, Vijayakanthan Ganesalingam, Vaishali Ravi, Jeyamugan Thirunavukkarasu*
12.00 PM - 12.15 PM	Trajectory-Based Anomaly Detection in Highway Traffic Surveillance Videos Using Unsupervised Learning Techniques *G.W.P.R.R. Wijesinghe, W.S.T. Sandaruwan, N.T.M Sajith, M.N.M. Aashiq*

12.15 PM - 12.30 PM	Enhancing Software Security Visualization through Adaptive Level of Detail (LoD) Mechanisms: A City Metaphor-Based Approach *Ishara Devendra, Chaman Wijesiriwardana, Prasad Wimalaratne*

ICITR 2024 Technical Session 3 - Computer Vision

Session Chairs	Dr. Asela Gunasekara & Dr. MFM Firdhous
Time	11.00 AM – 1.00 PM

Time	**Title & Author (s)**
11.00 AM - 11.15 AM	CataLight: A Novel Lightweight Approach for Cataract Severity Detection Using Digital Imaging on Edge Devices *Kavindhya De Silva, Uthpala Sooriya-Arachchi, Rasanjalee Rathnayake*
11.15 AM - 11.30 AM	Explainable AI-Driven Framework for Gemstone Quality Assessment *H D H Malintha Perera, B M Adithya Heshan, K.L.Pabasara Kavindi, P Ravindu Dilush, Dharshana Kasthurirathna, H.M. Samadhi Chathuranga Rathnayake*
11.30 AM - 11.45 PM	Integrated Human Motion Monitoring System for Enhanced Performance and Well-being in The Apparel Industry *Yusri M.A.M, Rathnayake R.M.K.D.B, Rupasingha W.P.S, Senadheera S.A.T.P, Samadhi Rathnayake, Supipi Karunathilaka*
11.45 PM - 12.00 PM	Intelligent CCTV-Based Motorbike Theft Detection System in Bike Parks with 3D Slot Identification and Posture Monitoring *W.A.P.N.Weerasinghe, N.H.Kalupahana, Shifak M.R.M, W.M.D.P Gunathilake, Harinda Fernando, Samanthi E.R Siriwardana*
12.00 PM - 12.15 PM	Advanced Plant Growth Recognition Model with Deep learning for the Coconut tissue culture *N. Sathisrajan, H.M.A. Chandeep, S.C Rathnayake, Samitha Vidhanaarachchi, V. R. M. Vidhanaarachchi*

ICITR 2024 Technical Session 4 - Artificial Intelligence

Session Chairs	Dr. Asanka P. Sayakkara & Dr. Saminda Premaratne
Time	11.00 AM – 1.00 PM

Time	**Title & Author (s)**
11.00 AM – 11.15 AM	Email Armour: A Multi-Layered Email Defense Solution *Lakmal K.T.A.U, Perera L.M.C, Padmika S.P.K, De Silva S.P.A, Dinithi Pandithage, Deemantha Siriwardana*
11.15 AM – 11.30 AM	Adaptive Particle Swarm Optimization for Enhanced Convolutional Neural Network Model Training *A.W.C.K.Atugoda, Subha Fernando*
11.30 AM – 11.45 AM	Enhancement of Image based Human Action Recognition using Transfer Learning with Pre-Trained CNN Architectures *K.A.N.C. Kanangama, S. Thirukumaran*
11.45 AM – 12.00 NOON	A Deep Learning Based Freestyle Swimming Stroke Posture Analysis and Feedback System *Amandi Jayawardene, Pradeep Kalansooriya*
12.00 AM – 12.15 AM	AI Assisted Diagnosis of Dengue Amid Arboviral Diseases, Severity Prediction, and Post Effects *Nivasheni B, Fernando V.G.S.O., Srihari M, Sarah M.I.L., Vishan Jayasinghearachchi, Samadhi Chathuranga Rathnayake*

12.15 PM – 12.30 PM	Identification of Sales Order Number Using Long ShortTerm Memory *W.A.D.U. Wijesinghe, L.D.C.S. Subhashini, H.A.D.U. Perera*
12.30 PM – 12.45 PM	Classification of defects of cotton yarns using convolutional neural networks *S.H.A. Arachchi, P.H.K.Vidushka, S.N. Niles, R.P. Abesooriya*
12.45 PM – 1.00 PM	Enhancing Personalized e-Learning Platform (LearnPath+) *SN.A.G.A.A. Nishshanka, K.A.K.N. Jayasinghe, N.A.P.K.R. Nishshanka, R.M.S.P. Abeykoon, Sanjeevi Chandrasiri, Akshi De Silva*

ICITR 2024 Technical Session 5 - Data Science & Data Driven Applications

Session Chairs	Dr. TMKK Jinasena & Dr. CRJ Amalraj
Time	11.00 AM – 1.15 PM

Time	**Title & Author (s)**
11.00 AM – 11.15 AM	Kills or Turrets: An Exploratory Data Analysis and Win Prediction of League of Legends Based on Early-Game Data *Minandi Wilathgamuwa*
11.15 AM – 11.30 AM	Determining the Risk of Natural Disasters in Sri Lanka using Fuzzy-AHP *L.K.D. Madhushani, I.T.S. Piyatilake*
11.30 AM – 11.45 AM	Early Disease Outbreak Detection in Spatio-Temporal Data Using Predictive Modeling and Extreme Value Theory *Senevirathne E.G.M.A., Priyanga Dilini Talagala*
11.45 AM – 12.00 NOON	Improving Class Imbalance in the Classification of Multi-Dimensional Data: Interpretable Model Design and Evaluation *Gayathri Sivakumar, Chambavy Balasundaram, Vithursan Thevendran, Priyanga Dilini Talagala*
12.00 PM – 12.15 PM	Enhancing Human Safety through Early Detection of Floods and Landslides in Sri Lanka *Karunawardhana K.P.I, Munasinghe S.P, Samiru J.G.S, E.M.H.K.B. Ekanayake, Nelum Chathuranga Amarasena*
12.15 PM – 12.30 PM	An Analysis of Readability of Sri Lankan Short Stories Generated by Large Language Models *Sandaruwani Pathirage, Thilina Thanthriwatta*

12.30 PM – 12.45 PM	Galaxy Clustering and Classification using Machine Learning Algorithms and XAI *Amasha Elvitigala, Udani Navaratne, Samadhi Rathnayake, Kapila Dissanayaka*
12.45 PM – 1.00 PM	Enhancing Demand Forecasting in Food Manufacturing: Hierarchical Analysis of Aggregated and Individual Models *Achala Hasini Perera, Priyanga Dilini Talagala, H. Niles Perera, Amila Thibbotuwawa*
1.00 PM – 1.15 PM	Real Time Crime Data Analysis with Hadoop and MapReduce: A Case Study from Sri Lanka *Dhanuka Dayawansa, Hamza Nauzad, Sithara Kumarasingha, Uthpala Isuranga, Prasanna S. Haddela, Samadhi Rathnayake*

ICITR 2024 Technical Session 6 - Artificial Intelligence

Session Chairs	Dr. Rukshima Dabare & Dr. Thilina Thanthriwatta
Time	11.00 AM – 1.00 AM

Time	**Title & Author (s)**
11.00 AM – 11.15 AM	Developing a Dysgraphia Handwriting Dataset for Early Detection of Dysgraphia in Sinhala-Speaking Children *Sandushi Weraduwa, Dinesh Asanka, Thilini Mahanama, Swarna Wijeatunge*
11.15 AM – 11.30 AM	IDeploySmart: A Machine Learning-Based Approach for Predicting the Deployment Type of Identity Servers *Mamoru D. L. S., Amjadh Ifthikar*
11.30 AM – 11.45 AM	Optimizing YouTube Video Discoverability through Trend Analysis and Hashtag Generation *Chamodhya Manawathilake, Gamage Upeksha Ganegoda*
11.45 AM – 12.00 NOON	Image-Based Cryptocurrency Trend Prediction with Explainable Deep Learning *Shavin Fernando, Nethmi Wijesinghe*
12.00 NOON – 12.15 PM	Hybrid Predictive Model for Efficiency Forecasting in Garment Production: Integrating Ensemble and TimeSeries Approaches *Zamith Ahamed, PPG Dinesh Asanka, Chathura Rajapakse*

12.15 PM – 12.30 PM	Few-Shot Melanoma Stage Classification with Siamese Networks and ResNet Encoders: A Focus on Data Leakage Prevention *Menaka Mohanakumar, C.R.J. Amalraj, P.G.S. Upeksha*
12.30 PM. – 12.45 PM	AI-Based Early Intervention for Enhancing Facial Emotion Recognition in Children with Autism Spectrum Disorder in Sri Lanka *Menaka Mohanakumar, C.R.J. Amalraj, P.G.S. Upeksha*
12.45 PM – 1.00 PM	Enhancing Text Segmentation with Positional Encoding and Sentence Embeddings: An Unsupervised Clustering Approach *C.D.R.M. Weerasinghe, M.R.A.A.K. Gunasinghe, H.B.K.S. Siriwardana, Indika Perera*

ICITR 2024 Technical Session 7 - Artificial Intelligence

Session Chairs	Dr. Chathurika Sewwandi Silva & Dr. Waruna Premachandra
Time	11.00 AM – 1.00 AM

Time	**Title & Author (s)**
11.00 AM – 11.15 AM	IOT Based Smart Plant Growing and Caring Platform for Urban Environments *I.A.S. Ilangaweera, S.E.M.H. Naramada, N.T.M. Sajith, M.N.M. Aashiq, M.N.A. Hinas*
11.15 AM – 11.30 AM	A Machine Learning Framework for Accurate Skin Tone, Type, and Disease Detection with Web Scraping and NLP for Dermatological Insights *Lakshana Kugaraj, D.M.G.T. Dassanayake, Karthiga Rajendran*
11.30 AM – 11.45 AM	Voicense:AI-Powered Lecture Note Generation Tool *A.W.R.P. Karunarathna, T.U.M.N. Premarathna, R.G.S. Dilshan, W.A.K.H.R. Wanniarachchi, Y.M.C.N. Bimsara, I.T.S. Piyatilake*
11.45 AM – 12.00 NOON	Real-Time Motion Detection for Language Translation and Literacy Enhancement in Hearing-Impaired Children *Navodya K.T., H.M.O.C.B. Herath, K.D.S. Sandeepanee, R.G.P.T. Rajapaksha, Wishalya Tissera, Samitha Vidhanaarachchi, Hansi De Silva*
12.00 NOON - 12.15 PM	Saliency-Based Token Swap – A Language-Agnostic Data Augmentation Method for Text Classification *Hiroshan Ilangeshwaran, Lakmini Abeywardhana, Samadhi Rathnayake*

12.15 NOON - 12.30 PM	Advanced Machine Learning Methods for the Study of Globular Clusters in Virgo and Fornax Galaxies *Udani Navaratne, Amasha Elvitigala, Samadhi Rathnayake, Kapila Dissanayaka*
12.30 PM – 12.45 PM	Large Language Model-Based Student Intent Classification for Intelligent Tutoring Systems *Malshan Keerthichandra, Tharoosha Vihidun, Shanuka Lakshan, Indika Perera*
12.45 PM - 1.00 PM	MyRecommender: Personalized Activity Recommendation based on Negative Emotions Classification *Zaidh Shafraz, Hiroshan Ilangeshwaran, Shifan M.R.M, Chanul Vithanage, Lakmini Abeywardana, Samadhi Rathnayake, Rizka Ismath*

ICITR 2024 Technical Session 8 - Technology Trends

Session Chairs	Dr. Maheshi Ruwanthika & Dr. MFM Firdhous
Time	2.00 PM – 4.20 PM

Time	**Title & Author (s)**
2.00 PM – 2.10 PM	Key Situation Awareness Requirements for Aspirants in the IT Sector in Sri Lanka: An Expert Interview Approach *B.L.M. Dananjaya, M.B. Mufitha, T.C. Sandanayake, P.G.S. Upeksha*
2.10 PM - 2.20 PM	Artista - A Digital Art Marketplace *Buddhi Bandara, Gihan Jayathissa1, Dhanushka Karunarathna, Janani Siriwardane, Kaumi Nethma, K.A. Dilini T. Kulawansa, Randima Lahiru*
2.20 PM - 2.30 PM	Tactile Device for Braille-Based Communication in Inclusive Education *H.L.A.I. Udana, B.M.N.U. Mendis, H.M.K.K.M.B. Herath, S.L.P. Yasakethu, Udesh S. Oruthota*
2.30 PM - 2.40 PM	Blockchain in Healthcare: Introducing Novel Proof of Accountability (PoAV) Consensus Algorithm and Custom Blockchain Network *G.L. Kodithuwakku, KSD Fernando*
2.40 PM - 2.50 PM	Metaverse to Enhance Experimental Learning in Higher Education *M.H.M.Wickramasinghe, S. R. Liyanage*
2.50 PM - 3.00 PM	Tacit knowledge-based expert model for decision support in injection mould design *K.H.J. Mangala, R.K.P.S. Ranaweera, H.K.G. Punchihewa*

3.00 PM - 3.10 PM	Smartwatch-based Gait Authentication Using Siamese LSTM Networks *Rumeth Randombage, Nuwan Jayawardene*
3.10 PM – 3.20 PM	Early Prevention of Cardiovascular Disease: A review of technology, risk scoring, and non-invasive methods *Nilantha Premakumara, Hao-Ting Cheng, Kuo-Wei Chen, Hao-Neng Fu, Xian-Yi Chen, Chan-Yun Yang*
3.20 PM – 3.30 PM	Enhanced Detection of Evil Twin Attacks in Public Wi-Fi Networks Using Machine Learning Algorithms *J.D.A.S.K. Nanayakkara, M.M.P.R.M. Bandara, M.S. Mawjood, R.A.P.M. Perera, Kavinga Yapa, Deemantha Siriwardana*
3.30 PM – 3.40 PM	A Comprehensive Location-Based Travel Forum and Service Network for Promoting Responsible Tourism and Enhancing Safety in Sri Lanka *Sandunika Subasinghe, Imasha Gamage, Harendra Samarawickrama, Pathum Weerasooriya, Kapila Dissanayaka, Junius Anjana*
3.40 PM – 3.50 PM	CodeSafari: A Customized Mobile Solution for Introducing Programming Concepts to Children *Fahmi M.F.A., Sanjeevan M.C.M.A, Samanthi E.R. Siriwardana, Mihiri Samaraweera*
33.50 PM - 4.00 PM	TripTractix: Optimizing Outing Planning with Advanced Computational Techniques *Faizan Muthaliff, T.G.D.K. Sumanathilaka*
4.00 PM . – 4.10 PM	Adaptive Learning System for Enhancing Mathematical Aptitude in English Medium Sri Lanka O-Level Mathematics Education *Jayasuriya N.J.T.A.G.R.A, Hettihamu T.C., Manimendra N.H.*

4.10 PM - 4.20 p.m.	Software Quality Assurance Practices Towards Waterfall and Agile Information Systems Projects of BOI Registered Software Companies in Sri Lanka *Pathiraja A. L. C. D.*

ICITR 2024 Technical Session 9 - Computing

Session Chairs	Dr. Pradeep Kalansooriya & Dr. Upeksha Ganegoda
Time	2.00 PM – 4.00 PM

Time	**Title & Author (s)**
2.00 PM – 2.15 PM	Distributed Deep Neural Networks Training *Gowsikan Nakuleswaran, Jathurshan Sownthararasa, Jananie Jarachanthan*
2.15 PM - 2.30 PM	Electromagnetic Insights Acquisition Through a Forensics-as-aService Platform *Senal Punsara, Dinil Ratnayake, Janitha Devin Ratnayake, Asanka Sayakkara, Akila Wickramasekara*
2.30 PM - 2.45 PM	Popularity Prediction of Sinhala YouTube Videos *C.L.Gunawardana, K.D.Thamarasee*
2.45 PM - 3.00 PM	K8s Pro Sentinel: Extend Secret Security in Kubernetes Cluster *Kavindu Gunathilake, Indrajith Ekanayake*
3.00 PM - 3.15 PM	Reputation Scoring System for IoT Devices *S.S.Weerasinghe, U.W.A.V.N.Dissanayake, K.D.M.Morrison, Harinda Fernando, Deemantha Siriwardana*
3.15 PM - 3.30 PM	Cognitive-Integrated Complexity Analysis: A Comprehensive Software Visualization Tool *Kasun R. Sampath, Dilshan I. De Silva*

ICITR 2024 Technical Session 10 - Artificial Intelligence

Session Chairs	Prof. Asoka Karunananda & Dr. Biman Hettiarachchi
Time	2.00 PM – 3.15 PM

Time	**Title & Author (s)**
2.00 PM – 2.15 PM	An Integrated Framework for Self-Adjusting Temperature, Humidity, and Airflow Direction in Smart Air Conditioning Systems *Hiruni Saparamadu, Nuwani Dilara, Thamasha Bandara, Anjalika Meriyan, Jenny Krishara, Samadhi Rathnayake*
2.00 PM – 2.30 PM	Early Diagnosis of Alzheimer's Disease from MRI Images Using Machine Learning Approach *W.M.R.M Wijesuriya*
2.30 PM - 2.45 PM	SingRAG: A Translation-Augmented Framework for Code-Mixed Singlish Processing *S.M.M. Rukshan J. Senanayaka, A.W.A.D. Nethmin Dulsara, M.G. Nipuni Nikeshala Premadasa*
2.45 PM - 3.00 PM	UAV-based Building Crack Detection using Convolution Neural Networks *D.M.K.I. Dissanayake, R.S.M.P.W. Rathnayake, N.T.A. Sathsara, Chathurika S. Silva*
3.00 PM - 3.15 PM	Autonomous Detection and Removal of Paddy Weeds (Monochoria vaginalis and Limnocharis flava) using Computer Vision and Deep Learning *T.H. Warnakulasooriya, E.M.U.S. Bandara, N.D.P. Wanigasuriya, Chathurika S. Silva*

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5. Abstracts of the Full-Papers of ICITR 2024

5.1 Classification of Sri Lankan Skin Diseases Using Ensemble Deep Learning Models

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Abstract - Skin disease detection is a critical component of dermatological healthcare, traditionally dependent on dermatolo-gists' expertise for accurate diagnosis. However, manual diagnosis can be time-consuming and prone to errors, especially in regions with limited access to specialized care. To address these issues, this study proposes a novel approach utilizing deep learning techniques for the automated detection of skin diseases. We employed state-of-the-art deep learning architectures, including VGG16, VGG19, EfficientNetB0, and ResNet50, to classify four prevalent skin conditions: Eczema (Dermatitis), Psoriasis, Tinea, and Vitiligo. A comprehensive dataset of 600 images from these classes was collected from Vavuniya General Hospital, Sri Lanka. To our knowledge, this is the first study to apply deep learning for skin disease detection specifically South Asian skin types, particularly type IV and V in Sri Lankan patients. The images underwent preprocessing, annotation, and data augmentation to enhance the models' ability to capture distinct features of each condition. Performance evaluations revealed that VGG16 and ResNet50 achieved accuracies of 87%, while VGG19 and EfficientNetB0 also showed strong results. To further improve predictive performance, these models were combined into an ensemble model, achieving a final accuracy of 91%. To make this research practically applicable, a Flask application was developed that allows users to upload an image of a skin disease that predicts the disease name. This research fills a significant gap in medical image analysis, providing a foundation for future advancements in automated skin disease detection.

Keywords—Sri Lankan Skin disease, Deep Learning, Con-volutional Neural Network.

5.2 Layout Aware Research Paper Parsing and Draft Research Paper Layout-Error Detection Using NLP and Rule-based Techniques

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Abstract - The growing demand for precise formatting and content organization in academic writing has created a need for tools to help undergraduates prepare high-quality research papers for better conference acceptance. This paper introduces a layout-aware content extraction and error detection system, employing a fine-tuned layout parser classification model alongside rule-based algorithms to enhance section classification accuracy and formatting compliance in research papers. The proposed system achieves an average accuracy of 0.8737 and demonstrates better performance across various sections with an average cosine similarity exceeding 0.8900, reflecting its effectiveness in preserving the content. Additionally, the error detection component identifies layout issues, such as section availability, reference duplication, and column misalignment, with high accuracy and F1 scores, showcasing its potential to streamline the drafting process. Unlike existing methods focused solely on text or entity extraction, this system integrates layout- aware content extraction with error detection to provide a comprehensive solution. It addresses diverse academic publisher standards and layout complexities, assisting students in refining their drafts to ensure higher quality and compliance. Future enhancements will incorporate transformer-based models and expanded datasets to improve adaptability, semantic understanding, and the detection of additional formatting errors, further advancing research paper quality.

Keywords — Layout aware, Multiclass Classification, Research paper parser, Text extraction, NLP, Rule-based Techniques

5.3 Enhanced Change and Anomaly Detection for Intelligent Video Surveillance Systems

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Abstract - This research proposes an enhanced real-time video surveillance system with robust change detection and hybrid anomaly detection methodologies. The change detection module identifies significant environmental changes by combining Gaus-sian filtering, frame differencing, and manual labeling, yielding a precision of 89.7% and recall of 87.3%. The hybrid anomaly detection module utilizes a YOLO model for the precise detection of hidden faces, weapons, and fire with an average precision of 80%. It incorporates this with the RNN model to detect novel anomalies through temporal analysis, achieving 94.99% accuracy. The system was successfully deployed in a user-friendly web interface, that supports real-time threat monitoring and response. Although low-light conditions and dataset limitations remain a challenge, future enhancements with larger datasets, thermal imaging, and behavioral analysis promise broader applicability in diverse surveillance scenarios.

Keywords—Anomaly Detection, Change Detection, Intelli- gent Surveillance, Real time detection.

5.4 Tamil Alphabet Sign Language Recognition Using Mediapipe and Machine Learning

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Abstract - Tamil is an ancient and unique language with 247 characters, and it can be challenging for the deaf and mute community to communicate its alphabets through sign language to others, often leading to social exclusion. To bridge this communication gap, we propose a real-time Tamil sign language recognition system using the Mediapipe framework and various machine learning algorithms. Our study trained multiple models,including Support Vector Machine (SVM), Random Forest, XG- Boost, and Gradient Boosting, using a publicly available dataset specifically developed for Tamil letters and their corresponding signs. Among these models, the Random Forest classifier demonstrated the best performance, achieving an accuracy of 96.45%. This outcome provides a state-of-the-art, efficient real-time Tamil sign language translator, enhancing communication and promoting inclusivity within the Tamil community.

Keywords- Machine Learning, Mediapipe, Random Forest, Tamil sign language

5.5 Trajectory-Based Anomaly Detection in Highway Traffic Surveillance Videos Using Unsupervised Learning Techniques

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Abstract - An effective novel abnormal event detection approach is proposed in traffic monitoring systems based on trajectory data analysis to enhance the accuracy and efficiency of anomaly identification. The proposed method introduces a novel data manipulation algorithm for the effectively distinguishing of abnormal trajectory data from normal trajectory data. The unsupervised approach used for effectively recognize various traffic incidents, such as abrupt stoppages, vehicle breakdowns, and accidents. Considering a dataset of high-definition videos, the results demonstrate a significant increase in the rate of detection and a considerable reduction of false positives compared to the traditional methods. This innovative approach not only streamlines the process of real- time anomaly detection but also provides a scalable solution adaptable to various traffic conditions and environments. These results highlight the promise of this approach in further contributing to improve road safety and optimization of traffic management systems, thus paving the way for future research and applications in intelligent transportation systems. Notably, our model achieved an F1 score of 0.9230, underscoring its robustness and reliability in real-world applications.

Keywords— Abnormal Event Detection, Highway Traffic Video Analysis,

5.6 Enhancing Software Security Visualization through Adaptive Level of Detail (LoD) Mechanisms: A City Metaphor-Based Approach

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Abstract - As software becomes larger and more complex, the need for effective visualization techniques that can adaptively display different levels of detail is increasing. With the visualization of software security vulnerabilities, software practitioners may understand the code issues well and look for necessary solutions. While there are existing solutions for visualizing software securely in complex codebases, a critical need still exists for novel interactive visualization techniques that can adaptively present various aspects of software systems, including security vulnerabilities, code structures, dependencies, relationships, and performance bottlenecks. As software systems become increasingly complex, the Level of Detail (LoD) mechanism encounters several challenges in enabling the efficient exploration and comprehension of sophisticated code structures in a user-friendly manner. To address these challenges, this paper proposes an advanced LoD mechanism, utilizing a city metaphor for software visualization. This approach enhances software visualization by dynamically adjusting the Level of Detail (LoD) presented based on user roles and tasks, code metrics, and real-time code changes. This method is expected to contribute to more effective outcomes, particularly in enhancing the effectiveness of content-aware LoD switching, real-time performance optimization, and user- centric customizations. Furthermore, this approach seamlessly integrates into the software development process, providing continuous feedback and enabling developers to identify security vulnerabilities and performance bottlenecks.

Keywords— Adaptive Level of Detail (LoD), Software Visualization, City Metaphor, Dynamic Data Representation

5.7 CataLight: A Novel Lightweight Approach for Cataract Severity Detection Using Digital Imaging on Edge Devices

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Abstract - Cataract is a leading cause of blindness around the world, and many people who are affected reside in rural areas with limited access to health services. The traditional approach to cataract detection is a manual examination by ophthalmologists. Currently, no healthcare system globally can ultimately support the detection of cataract severity from digital eye images, particularly in places with limited access to healthcare. Early cataract detection can help people to improve their vision and quality of life. The study proposes CataLight, a lightweight and efficient method for detecting cataract severity classified as mild, severe, or normal on edge devices using digital camera eye images. Further, CataLight is designed to function offline and is suitable for deployment in regions without internet access. The approach uses advanced computer vision and image processing techniques to evaluate cataract severity and processes images from standard digital cameras, such as those found in smartphones. Before the classification, a lightweight segmentation model extracts the lens region by generating an iris mask. In the study, MobileNetV2, NASNetMobile, DenseNet121, and custom Convolutional Neural Network (CNN) models are tried out for cataract severity detection, and MobileNetV2 achieves the highest accuracy of 99.52%. By providing an easy-to-use, cost-effective diagnostic tool, CataLight aims to improve early detection of cataracts, ultimately reducing preventable blindness and enhancing healthcare accessibility in underserved communities.

Keywords—Computer Vision, Cataract Severity, Digital Imaging, Iris Extraction, Image Processing

5.8 Explainable AI-Driven Framework for Gemstone Quality Assessment

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Abstract - Gemstones play a significant role in the global economy as a key export product. This paper presents a comprehensive approach to optimizing gemstone damage identification and grading through an integrated mobile application. Utilizing real-time computer vision-based techniques and explainable AI (XAI), the system addresses the critical challenges of subjective grading and inconsistent assessments. The application enhances accuracy in gemstone grading by employing advanced deep learning algorithms, particularly convolutional neural networks (CNNs), and provides explainable insights into damage detection processes. Findings demonstrate that the model significantly reduces human error and increases transparency, offering gemologists, traders, and enthusiast's reliable decision-making support. This approach enhances operational efficiency and promotes standardization across the gemstone industry, making it a valuable tool for global market stakeholders. Keywords— Gemstone, CNN, XAI, Gemstone Damages Detection, Gem sensedatasets, thermal imaging, and behavioral analysis promise broader applicability in diverse surveillance scenarios.

Keywords— Gemstone, CNN, XAI, Gemstone Damages Detection, Gem sensedatasets, thermal imaging, and behavioral analysis promise broader applicability in diverse surveillance scenarios.

5.9 Integrated Human Motion Monitoring System for Enhanced Performance and Well-being in The Apparel Industry

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Abstract - In the apparel industry, maintaining consistent quality and efficiency in sewing processes is essential. The General Sewing Data (GSD) protocols are a set of standards designed to optimize sewing operations and ensure uniformity across production lines. Adherence to these protocols is critical for achieving reliable outcomes and maintaining a competitive edge. However, monitoring compliance in real-time poses significant challenges, including detecting whether hand movements align with GSD procedures, ensuring employees maintain the correct sitting posture, identifying target employee in the workspace environment, and predicting the future skill levels of employees. This paper introduces an innovative strategy to provide real- time feedback on whether sewing machine operators are following GSD protocols, thereby enhancing productivity and efficiency. Our application employs advanced computer vision techniques such as OpenCV, MediaPipe, and YOLO v8, along with supervised learning algorithms like SVM and Random Forest, to address these challenges. The Random Forest model identifies incorrect hand movements with an accuracy of 94%. The YOLO v8 model detects obstacles with an accuracy of 89%. The SVM model and computer vision techniques capture incorrect sitting postures with an accuracy of 85%. Additionally, a gradient boosting model categorizes employee states with 95% accuracy. By providing immediate feedback, this system ensures compliance with GSD protocols, thereby optimizing sewing processes and enhancing quality control.

Keywords— General Sewing Data (GSD), Hand movement analysis, Computer Vision, Apparel Industry, Obstacle detection, Posture detection, Skill level prediction, Real-time feedback

5.10 Intelligent CCTV-Based Motorbike Theft Detection System in Bike Parks with 3D Slot Identification and Posture Monitoring

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Abstract - Due to the increase in theft and unauthorized access, the security of motorcycle parking facilities has become a critical concern. Traditional security systems often fail to provide complete monitoring and control solutions. This study introduces an integrated approach that reflects two main aspects witch is precise parking slot bounds identification and user activity monitoring within each parking slot to identify threats. The parking slot detection model uses object recognition techniques to accurately identify specific parking slot. Then further process it to get exact slot area as a 3D slot, identifying parking slot bounding box accurately. Meanwhile, the motorcycle security system uses MediaPipe Pose analysis to identify any behavior that could indicate attempted theft by analyzing user activity, identifying suspicious behaviors that may indicate theft or unauthorized entry. There is another model to detect Motor bikes. All these models together develop complex systems that improve the efficiency and safety of motorcycle parking areas.

Keywords— 3D Parking Slot, Motorbike Security, Object De- tection, Parking Slot Detection, Pose Detection, Real-time Surveil- lance, Theft Detection, User Activity Monitoring

5.11 Advanced Plant Growth Recognition Model with Deep learning for the Coconut tissue culture

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Abstract - Coconut cultivation holds significant economic, nutritional, and environmental importance in Sri Lanka. However, traditional tissue culture methods for propagating coconut plants rely on time-intensive manual measurements that limit accuracy and scalability. This study proposes an advanced method for automating tissue culture growth analysis using machine learning. By employing YOLOv8 object detection and keypoints estimation, the study enables precise measurement of plant growth metrics, including shoot length, leaf width, and structural attributes, regardless of plant posture. Additionally, a novel growth rate formula is introduced to assess developmental progress, and an automated subculture timing recommendation system is developed, supporting optimized propagation practices. This machine learning approach not only improves measurement accuracy and efficiency but also contributes to a scalable, sustainable coconut tissue culture methodology, offering tangible benefits for the agricultural sector and enhancing productivity in tropical regions.

Keywords— Coconut Plant Tissue Culture, YOLOv8, Object Detection, Pose Estimation, Growth Analysis, Keypoints Estimation, Growth Parameters, Growth Rate Calculation

5.12 Email Armour: A Multi-Layered Email Defense Solution

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Abstract - Phishing and spam emails are evolving threats in today's digital landscape, posing significant risks to small and medium-sized businesses (SMBs). Despite the growing demand for email security solutions, SMBs often face barriers such as high costs and complexity. To address this gap, this study introduces a cost-effective, multi-layered email security solution leveraging machine learning. The proposed system comprises four core components: (1) spam detection using natural language processing (NLP) to analyze email content, (2) phishing URL and QR code detection by identifying malicious patterns and attributes, (3) attachment security analysis to detect malware and harmful scripts, and (4) suspicious URL detection focusing on JavaScript obfuscation. The model was trained and validated on publicly available datasets, achieving an overall accuracy of 85% and demonstrating effectiveness in identifying diverse email threats. Designed as an email client, this tool empowers SMBs to secure communication with an accessible and robust defense against email-based attacks.

Keywords— MLF (machine learning function), %feature extraction, naïve bayes, binomial, attachments, URL', header, LSTM, RFC

5.13 Adaptive Particle Swarm Optimization for Enhanced Convolutional Neural Network Model Training

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Abstract - Deep Neural Network (DNN) models find extensive application in many domains such as engineering, research, biomedical science, and autonomous systems. Among the various DNN models, Deep Convolutional Neural Networks (DCNNs) are particularly effective for solving nonlinear problems, such as im- age classification tasks. Optimizing neural networks is crucial in these applications to achieve high accuracy and reliable outcomes. Traditionally, many studies have focused on weight optimization, employing techniques like Stochastic Gradient Descent (SGD) and the Adam optimizer. However, these methods often suffer from issues like getting trapped in local minima and requiring large memory storage, leading to suboptimal performance. To address these challenges, researchers have turned to Swarm Intelligence (SI) approaches, known for their speed and robust- ness in global optimization. Among the various SI algorithms, Particle Swarm Optimization (PSO) is particularly favored due to its simplicity and lack of derivative requirements. However, some studies have shown that standard PSO may struggle with slow convergence and high memory demands. Therefore, this study proposes using an Adaptive PSO method to improve the efficiency of CNNs. The performance of the model is evaluated on three benchmark datasets—MNIST, CIFAR-10, and CIFAR- 100. The results demonstrate that the Adaptive PSO method significantly outperforms conventional optimization techniques on these datasets.

Keywords— particle swarm optimization, weight optimiza- tion, deep convolutional neural network

5.14 Enhancement of Image based Human Action Recognition using Transfer Learning with Pre-Trained CNN Architectures

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Abstract - In recent years, significant advancements have been made in human action recognition using deep learning techniques. Unlike traditional methods that utilize video sequences, this study focuses on the challenging task of recognizing human actions from still images, which lack temporal information. Convolutional neural networks pre- trained on large datasets have been leveraged to improve performance through transfer learning. Several state-of-the-art convolutional neural network architectures, including DenseNet121, VGG16, InceptionV3, InceptionResNetV2, and Xception, have been employed in this research. The dataset, comprising five different daily activities: cycling, drinking, eating, running, and sleeping, has been divided into training, testing, and validation sets in the ratios of 70respectively. The selected model, fine-tuned using this dataset, has been subjected to data augmentation techniques to enhance generalization. The performance of the models has been evaluated using metrics such as precision, recall, F1-score, and accuracy. Among the tested architectures, the highest accuracy of 93.92transfer learning with deep convolutional neural networks in advancing human action recognition from still images is highlighted by the findings, presenting a significant step towards more robust and efficient recognition systems in real-world applications.

Keywords— Convolutional Neural Networks, Human-action dataset, Human Action Recognition, Transfer Learning

5.15 A Deep Learning Based Freestyle Swimming Stroke Posture Analysis and Feedback System

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Abstract - Freestyle swimming stroke is the basic yet the most technically challenging stroke in swimming. Proper technique is critical to minimize the risk of overuse injuries, mainly seen in the shoulders, lower back, and knees. This research paper presents a deep learning-based system that utilizes Long Short- Term memory (LSTM) networks to automate analysis of freestyle swimming stroke posture. The system evaluates swimmers' videos, identifying key joints and movements. By analyzing sequential movements, the LSTM model determines whether the swimmer's posture is correct or incorrect which lowers the risk of injury and improves the swimmer performance. The model was trained with a curated dataset of both correct and incorrect swimming poses, achieving an overall accuracy of 85%, demonstrating a strong performance in classifying stroke correctness. This study demonstrates a significant advancement in sports technology by integrating deep learning techniques for stroke posture analysis.

Keywords— Deep Learning, Long Short-Term Memory (LSTM), Freestyle stroke, Sports technology, Swimming Posture Analysis

5.16 AI Assisted Diagnosis of Dengue Amid Arboviral Diseases, Severity Prediction, and Post Effects

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Abstract - This paper aims to examine the applicability of machine learning models for aiding in the diagnosis and management of arboviral illnesses, especially Dengue. The study focuses on three key objectives: Diagnosis of Dengue, prediction of prognosis of severe disease, and the identification of the post dengue effects. Multiple strategies were used to address these challenges. They are feature engineering based multiclass classification of arboviral diseases, enhancement of standard conventional machine learning algorithms for binary classification of severe Dengue and finally MLSOL enhancing ensemble model for drawing future effects of Dengue infections. The comparison of traditional models included both Random Forest, XGBoost, and also ensemble method while applying the feature selection methods of SFA and RFE. This study presents the comparison of traditional individual models and optimal ensemble method for the multiclass classification in arboviral diseases. In the case of binomial classification, the best accuracy level was 0.93 achieved by the Random Forest with RFE feature selection compared to Logistic Regression as well as the Gradient Boosting. Furthermore, the study proposed an MLSOL augmented ensemble approach to handle label imbalance problem in the dataset which in turn substantially enhanced the prediction accuracy. This approach decreased Hamming Loss to 0. 12 and increased the F-measure to 0.82, this has the capability of handling the imbalanced dataset and improving the predictive accuracy and performance. This machine learning framework offers great potential for clinical use in such aspects as early intervention and in effects following Dengue fever. It is meant to help healthcare practitioners and policy makers on how to better prevent and combat Dengue in Sri Lanka.

Keywords—Dengue Fever, DENV, Post Dengue effects, Disease epidemiology, Severe Dengue, Arboviral Disease

5.17 Identification of Sales Order Number Using Long Short-Term Memory

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Abstract - This research addresses the challenge of invoice number extraction in document automation workflows. Previous models have shown lower accuracy due to limited feature extraction. To improve performance, we present a Long Short- Term Memory (LSTM) model specifically designed for automatic invoice number extraction, utilizing deep learning to enhance accuracy and reliability. A pattern-matching technique is introduced to refine the model's feature selection mechanism. Through empirical analysis, the study evaluates the LSTM model's effectiveness, comparing it with traditional rule-based methods. The findings provide valuable insights into algorithm selection and model performance, contributing to more efficient and accurate handling of invoices. This work holds potential for advancing document automation across industries by improving the accuracy and efficiency of invoice processing workflows.

Keywords—LSTM, Invoice Number, TensorFlow

5.18 Classification of Defects of Cotton Yarns using Convolutional Neural Networks

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Abstract - The detection and classification of defects in cotton yarn are crucial in maintaining the quality of textile production. This is hardly getting attention in the literature due to the complexities and non-homogeneous features appearing in the cotton yarn. This study explores the application of transfer learning techniques in convolutional neural networks (CNNs) to classify yarn defects, including neps, thick and thin places, hairiness, and snarls, as well as identifying non-defective yarns. A dataset of 1,250 images was divided into five classes to evaluate three CNN models: ResNet-50, VGG-16, and Inception-v3. Inception-v3 achieved the highest validation accuracy at 98.8ResNet-50 reached 77.2successful in detecting complex yarn defects. The study further emphasizes the capability of CNNs to automate yarn defect identification by decreasing the processing time, by allowing CNN models to integrate with GPUs.

Keywords—Yarn defects detection, Convolutional Neural Networks, VGG-16, InceptionV3, Resnet50, Textile quality

5.19 Enhancing Personalized E-Learning Platform (LearnPath+)

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Abstract - Today online learning platforms are critical in the process of providing education in the digital society. However, these systems are not individualized as the majority utilizes such mass-information distribution techniques which include static contents, thus are not effective in enhancing user interactions, ability to recall information in the future, and happiness. As it is witnessed, most of the current e-learning strategies employ the 'blanket approach' where it does not take into consideration the different needs and learning needs of different students. To overcome these constraints, the study suggests "LearnPath+: An innovative private custom blended learning solution called "Building Up Personalized E-Learning." With LearnPath+, personalized learning paths are proposed, such that change based on the actual learner behaviors, preferences and performances with the help of machine learning. The technique encompasses all the stages that consist of needs analysis, creation of framework, development of the algorithm, implementation of the system, and final and comprehensive evaluation of the system. This method entails the use of user experience design, machine learning and technological advancement in producing an e-learning platform that is user-oriented. The general user level of LearnPath+ project is to fill the gap between distribution of good material and delivering it to specific learners to enhance student satisfaction, learning effectiveness and engagement which must be continually tested and adapted. Inasmuch as this will change the way education is delivered via the internet. This study also highlights the possible benefits of such a novel framework and calls for attention to the limited scale literature reviewing the practical implementation of the adaptive learning models in realistic context of e-learning.

Keywords— Adaptive Learning, Personalized E-Learning, Machine Learning, User Engagement, E-Learning Platforms

5.20 Developing a Dysgraphia Handwriting Dataset for Early Detection of Dysgraphia in Sinhala-Speaking Children

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Abstract - In the realm of machine learning diagnostics for learning disabilities, the availability and quality of data are crucial for developing effective models. Specifically, in identifying dysgraphia in Sri Lanka, no public database provides paired handwriting samples for comparison between Sinhala-speaking children with and without dysgraphia. To address this gap, this research develops a detailed offline Sinhala dataset with well- defined data collection, preprocessing, and labeling methods. The dataset includes 373 handwriting images from 84 participants (73 dysgraphic and 300 non- dysgraphic samples), all converted to binary format with color inversion for analysis. The dataset was constructed using words sourced from Sinhala textbooks and adapted psychological assessments. This study also considers demographic factors, such as age and gender, in dataset development, which will be integral to future model validation stages. Although this research focuses on dataset construction, an extended evaluation using Convolutional Neural Networks (CNN) is planned to validate the dataset's utility for early dysgraphia detection, leveraging metrics like accuracy and F1-score. The availability of paired samples supports robust comparative studies, enabling researchers to explore unique handwriting characteristics of dysgraphia in the Sinhala script. This foundational work addresses a critical gap in resources, setting the groundwork for developing machine learning models that aid in early diagnosis and educational intervention for Sinhala- speaking children.

Keywords— Dysgraphia, Handwriting Analysis, Image Processing, Predictive Model, Sinhala Handwritten Dataset

5.21 IDeploySmart: A Machine Learning-Based Approach for Predicting the Deployment Type of Identity Servers

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Abstract - Identity servers are integral to modern Information Technology (IT) infrastructures, managing secure access to critical applications through authentication and authorization processes. However, determining the optimal deployment strategy for these servers in complex environments remains challenging, especially when considering factors like performance, scalability, and security. This paper introduces IDeploySmart, a machine learning-based system designed to predict the most efficient deployment type of identity servers. By employing Gradient Boosting Regressor, IDeploySmart achieves a prediction accuracy of 92.5%, surpassing industry benchmarks. The system was tested across multiple deployment scenarios, showing significant improvements in system performance, scalability, and security. This paper details the system's design, data preprocessing techniques, model evaluations, and real-world applications, providing insights into how machine learning can enhance identity server deployment strategies in modern IT infrastructure.

Keywords—Identity Servers, Machine Learning, Predictive Modeling, Deployment Optimization, Identity and Access Management, RandomForestClassifier, Gradient Boosting Regressor.

5.22 Optimizing YouTube Video Discoverability through Trend Analysis and Hashtag Generation

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Abstract - YouTube has established itself as one of the most influential platforms in the digital media landscape, offering content creators an unparalleled opportunity to reach and engage with vast audiences. As the volume of content on YouTube continues to grow, creators are increasingly seeking strategies to improve the discoverability of their videos within this expansive ecosystem. Among the many factors that contribute to a video's visibility, hashtags have emerged as particularly powerful. Acting as navigational markers, hashtags link videos to relevant topics and communities, thereby increasing their chances of being discovered by target audiences. However, selecting and deploying effective hashtags is a complex process that requires careful alignment of trending themes, keywords, and the video's content. This research delves into the critical role that hashtags play in boosting video discoverability on YouTube, by analyzing YouTube trends through K-Means clustering and generating hashtags through the BERT language model. The effectiveness of the model is evaluated by analyzing engagement metrics such as view count, like count, and comment count, which are essential indicators of a video's reach and audience interaction.

Keywords—YouTube; Hashtags; Trend analysis; Likes; Views; Comments; BERT; K-Means clustering

5.23 Image-Based Cryptocurrency Trend Prediction with Explainable Deep Learning

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Abstract - The rise of cryptocurrencies has reshaped financial markets, introducing assets that operate outside traditional bank- ing systems. Yet, the market's volatility challenges traders who rely on manual technical analysis, which is both time-intensive and error-prone. This paper introduces CryptoVisionX, an ad- vanced deep-learning framework designed for the automated pre- diction of cryptocurrency prices. Utilizing Convolutional Neural Networks (CNNs) for image feature extraction and Long Short- Term Memory (LSTM) networks for time series analysis, the model enhances prediction accuracy and efficiency. To combat data gaps, CryptoVisionX employs a comprehensive image- based dataset across various cryptocurrencies. Furthermore, it incorporates explainable AI (XAI) to increase the transparency of predictive models, fostering trust among users. The model's design navigates the trade-off between general applicability and precision, providing a scalable yet accurate forecasting tool. This research addresses key gaps in cryptocurrency analytics, offering a novel solution that could revolutionize trading strategies in the financial technology domain.

Keywords—Time Series Forecasting, Computer Vision, Ex- plainable AI, Chart Analysis, Cryptocurrency Prediction

5.24 Hybrid Predictive Model for Efficiency Forecasting in Garment Production: Integrating Ensemble and Time-Series Approaches

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Abstract - Sri Lanka's garment industry is a critical component of the nation's economy, contributing significantly to GDP, export revenue, and employment, particularly for rural women. While the industry is recognized globally for its eth- ical production and high-quality outputs, it faces challenges including dependence on imported raw materials, fluctuating global demands, and competition from low-cost manufacturing hubs like Bangladesh and Vietnam. To maintain its competitive edge, the industry must explore innovative solutions such as predictive analytics and advanced modeling techniques to optimize efficiency and sustainability. This research examines the application of predictive analytics and time series modeling to enhance production efficiency in Sri Lanka's garment sector. We explore various machine learning models, including ensemble techniques and Long Short-Term Memory (LSTM) networks, to forecast production efficiency. Using data from a major Sri Lankan garment manufacturer, spanning May 2023 to August 2024, we develop a hybrid predictive model. Data preprocessing involved steps like cleaning, handling missing values, and feature engineering, ensuring reliable inputs for the model. Our results show that the hybrid model provides a balanced approach, offer- ing practical advantages in real-world production environments. The model demonstrates moderate prediction accuracy, reducing mean squared error (MSE) and mean absolute error (MAE), outperforming several other traditional models.

Keywords—Garment, Hybrid Approach, Machine Learning, Predictive Analytics, Production Efficiency

5.25 Few-Shot Melanoma Stage Classification with Siamese Networks and ResNet Encoders: A Focus on Data Leakage Prevention

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Abstract - Melanoma, the deadliest form of skin cancer, necessitates early and accurate staging for effective treatment and improved patient outcomes. Dermoscopic images, offering detailed visualizations of skin lesions, are invaluable for melanoma diagnosis. However, the precise classification of melanoma stages, particularly based on lesion thickness, remains a challenge due to the limited availability of annotated data for specific stages. Traditional deep learning models, often requiring extensive labeled datasets, may not be optimal for this task. This research introduces a novel approach to melanoma stage classification, leveraging few-shot learning with Siamese networks and a ResNet encoder. This methodology addresses the data scarcity issue by enabling the model to learn from limited examples. Siamese networks, renowned for their ability to discern similarities between image pairs, are particularly well-suited for this task. By incorporating a pre-trained ResNet encoder, the model's feature extraction capabilities are significantly enhanced. This improvement contributes to increased accuracy in classifying melanoma stages based on lesion thickness. A critical concern in medical image analysis is data leakage, which can lead to overly optimistic performance estimates and hinder the model's real-world applicability. This issue is addressed through rigorous data handling practices, ensuring the independence of training and validation sets and avoiding data augmentation techniques that could introduce leakage. The approach achieves a promising accuracy of 77on a limited dataset, demonstrating the potential of few-shot learning in addressing data scarcity challenges in medical image analysis and paving the way for improved melanoma diagnosis and treatment. Additionally, a model trained on an augmented dataset using ImageDataGenerator achieved 88exhibited inconsistencies in evaluation metrics, particularly for minority classes. However, this model exhibited inconsistencies in evaluation metrics, particularly for minority classes, underscoring the importance of avoiding data leakage for reliable performance assessment.

Keywords— Melanoma stage classification, few-shot learning, Siamese networks, ResNet encoder, data leakage

5.26 AI-Based Early Intervention for Enhancing Facial Emotion Recognition in Children with Autism Spectrum Disorder in Sri Lanka

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Abstract - Autism Spectrum Disorder (ASD) affects children's ability to recognize and express emotions, a crucial aspect of emotional intelligence. This research addresses the lack of effective early intervention tools for children with ASD in Sri Lanka, focusing on those aged 2-7 years. A mobile application, designed for enhancing facial emotion recognition (FER), was developed using AI advancements, incorporating Ekman's six basic emotions framework. The application offers personalized learning through progressive materials, quizzes, daily emotion diary, and an evaluation feature. For facial emotion recognition, a custom DeepFace model was implemented after evaluating its performance against a VGG16 model trained via Transfer Learning. Additionally, correlation analysis was conducted using a Linear Regression model to personalize the app's user profiles. The study shows promising results for improving FER skills in children with ASD.

Keywords—Autism Spectrum Disorder, Facial Emotion Recognition, Early Intervention, DeepFace, Transfer Learning

5.27 Enhancing Text Segmentation with Positional Encoding and Sentence Embeddings: An Unsupervised Clustering Approach

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Abstract - Text Segmentation involves dividing documents into thematically cohesive segments and it is essential for improving the effectiveness of document-level applications, such as summa- rization, question-answering, and information retrieval. In this paper, we propose a novel unsupervised approach for segment- ing text content that combines advanced sentence embeddings generated by the Sentence-BERT model with document-level positional encoding and K-means clustering. By incorporating positional information, we enhance the embedding vectors to capture both the semantic relationships and the structural context of sentences within a document. This enriched representation aids in producing more contextually aware and coherent clusters. We evaluate the proposed method using the Choi dataset and compare the performance of clustering-based segmentation with and without positional encoding. Our experimental results show that the inclusion of positional encoding significantly improves segmentation quality, as indicated by the increment of the average V-measure from 0.53 to 0.73. This unsupervised approach provides a scalable and versatile solution for Text Segmentation, effectively bridging the gap between semantic coherence and document structure while eliminating the need for annotated training data.

Text Segmentation, Sentence Embeddings, Posi- tional Encoding, Clustering, Global Positional

5.28 IOT Based Smart Plant Growing and Caring Platform for Urban Environments

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Abstract - This paper explores the design, implementation, and performance evaluation of an innovative IoT enabled automatic plant growing and caring platform tailored for urban environments. The proposed system utilizes supervised and unsupervised machine learning algorithms to make decisions toward enhancing the growth and health of the plants on the platform with minimum human intervention. Increasing urbanization and busy lifestyles have led to increased interest in smart gardening solutions that optimize plant care and resource utilization. This research delves into the integration of IoT technologies and machine learning algorithms to address challenges faced with urban gardening and contribute to the ever-expanding body of literature on IoT applications for smart cities. The proposed platform comprises multiple sensors placed to collect vital parameters such as soil moisture, ambient temperature, and humidity. A simple camera collects images of the plants daily. The collected data is transmitted via Wi-Fi to an online database for storage and analysis. A machine learning algorithm analyses the collected environmental data to make informed decisions such as predicting the optimal watering schedule. A pump integrated into the platform is activated based on the schedule generated by the algorithm. The schedule prediction is based on plant species and real-time environmental data. Also, an unsupervised algorithm is used to determine the health status of the plants. The images taken daily are analyzed by the unsupervised algorithm to detect simple abnormalities in the plants to alert the owners to attend to the issues. The system was able to monitor the vital parameters and care for the plants independently.

Keywords—IOT, Machine Learning, Raspberry-pi, Smart Farming, Automation

5.29 A Machine Learning Framework for Accurate Skin Tone, Type, and Disease Detection with Web Scraping and NLP for Dermatological Insights

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Abstract - Dermatological conditions are a growing concern, with accurate diagnosis and treatment being crucial for effective management. This study presents a comprehensive system that predicts skin tone, skin type, and skin diseases using machine learning algorithms, image processing techniques, and web scraping. This research proposes an innovative machine learning-based framework for detecting skin tone, skin type, and common dermatological diseases using image processing and natural language processing (NLP). The system leverages convolutional neural networks (CNNs) for analyzing user-uploaded skin images and web scraping to collect the latest information from credible dermatology sources. The skin tone prediction achieved an accuracy of 92%, while the skin type classification reached 88%. Skin disease detection achieved 90% accuracy, focusing on conditions such as eczema, psoriasis, and acne. The integration of web scraping and NLP helps provide personalized skincare recommendations based on up-to-date medical information. However, the reliability of the NLP component is critically evaluated to ensure that extracted data is relevant and accurate. This framework contributes to improving personalized skincare by offering accurate diagnosis and treatment suggestions.

Keywords— Skin Tone Prediction, Skin Type Classification, Skin Disease Detection, Web Scraping, Natural Language Processing, Personalized Skincare

5.30 Voicense: AI-Powered Lecture Note Generation Tool

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Abstract - Traditional note-taking methods during lectures are often inefficient and distracting, leading to incomplete and inac- curate captures of key information because students attention is divided between lecturer and the note taking. Also in traditional physical notes are hard to organize and hard to search for information within them. These issues can negatively impacts the learning process of the students. For educators, it's a burden to ensure all the points are covered in the lecture and keep track of what has been taught during the lectures. Voicense is a mobile application, leverages cutting-edge AI technologies to address this issue by automating the process of lecture transcription and optimized note generation. It also provides tools for document management, enabling users to organize, edit, and share their notes. In this paper, we present the design, development, and evaluation of Voicense, showcasing how this tool can revolutionize educational methods for both students and educators by streamlining the lecture note-taking process.

Keywords— Lecture transcription, Speech-to-text, LLM, NLP, Note generation

5.31 Real-Time Motion Detection for Language Translation and Literacy Enhancement in Hearing- Impaired Children

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Abstract - Approximately, it is estimated that 2% of children with hearing impairments in Sri Lanka are within the age range of 5 to 14 years. These children face significant communication challenges due to their hearing loss, which has negatively impacted both their education and social interactions. Hearing-impaired children often rely on sign language, lip reading, and visual cues such as hand gestures, body movements, lip synchronization, and facial expressions for communication. Even after receiving hearing aids or undergoing surgeries, hearing-impaired children often continue to use sign language but struggle with word pronunciation and effective communication due to low literacy levels. This research addresses these challenges through the application of motion and object detection technologies. Motion detection is used to recognize hand gestures, translate them into Sinhala text, and facilitate translation between Sinhala sign language and English sign language.

Additionally, motion detection assists in detecting lip movements, supporting word pronunciation practice for hearing-impaired children. Object detection is applied to recognize surrounding objects and translate them into Sinhala sign language. The proposed methods achieved performance accuracy of 92%, 89%, 87%, and 90%, respectively, across the evaluated tasks, facilitating improved communication, education, self-learning, and pronunciation for hearing- impaired children.

Keywords—Sign Language, Auditory Impaired, Gaming, Motion Detection, Sign Translation

5.32 Saliency-Based Token Swap – A Language- Agnostic Data Augmentation Method for Text Classification

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Abstract - Data scarcity remains a significant challenge in text classification, often resulting in suboptimal performance of machine learning models. To address this issue, this paper introduces Saliency-based token Swap (SSwap), an innovative data augmentation technique designed to enhance classification performance by operating through strategies that utilize saliency values to swap tokens between sentences. SSwap was assessed across varying levels of data availability, evaluated on low-resource languages (Sinhala and Tamil), and compared with existing data augmentation methods. Experiments demonstrated consistent improvement in text classification performance, particularly in low-resource settings. Results underscored SSwap's potential as a valuable tool for sustaining robust model performance in scenarios with limited data and low-resource languages, with implications for a wide range of text classification tasks.

Keywords—data augmentation, text classification, SHAP values, low-resource languages

5.33 Advanced Machine Learning Methods for the Study of Globular Clusters in Virgo and Fornax Galaxies

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Abstract - This study addresses the traditionally time- consuming process of analyzing globular clusters (GCs) in the Virgo and Fornax galaxies by demonstrating the efficiency and precision of machine learning. Leveraging photometric data, we implemented clustering algorithms to detect the presence of GCs and applied a classification model based on color index to distinguish each globular cluster (GC) as red or blue, achieving a high accuracy of 99.59%. To improve the accuracy of our classification model, we carefully selected key features, balanced our data to account for differences in class sizes, and used hyperparameter tuning for model refinement.To enhance both transparency and interpret-ability, we integrated Explainable AI (XAI) techniques—SHAP (SHapley Additive exPlanations) and LIME (Local Interpretable Model-agnostic Explanations) into both our clustering and classification tasks. These methods provided insight into model decisions by revealing how photometric features influenced cluster formation and GC categorization, help in validating the reliability and relevance of our findings.By in- tegrating XAI, we offer a clearer understanding of the clustering patterns and classification outcomes, bridging the gap between model predictions and astrophysical interpretations.Our research establishes a robust framework for studying GCs, contributing concrete insights into their distribution and characteristics. This framework aids in understanding the formation processes and evolutionary pathways of galaxies, as GC color classifications are closely tied to galaxy age, metal content, and merger history. By improving GC analysis, our findings support future studies on galaxy formation, offering a data-driven foundation that enhances knowledge of cosmic evolution and encourages the integration of machine learning in astronomical research.

Keywords—Globular Clusters (GCs), Virgo Galaxy, Fornax Galaxy, Galaxy Evolution, Machine Learning, XAI

5.34 Large Language Model-Based Student Intent Classification for Intelligent Tutoring Systems

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Abstract - Intent classification is a foundational element in natural language processing, enabling conversational systems to accurately interpret user intent. In educational contexts, effective intent classification within Intelligent Tutoring Systems (ITS) can significantly enhance personalized student interactions. This paper presents the intent classification module for the Learner-Aware AI (LAAI) tutor, a dialogue-based ITS designed to recognize and respond to diverse student behaviors, such as valid answers, questions, expressions of boredom, and requests for clarification. We introduce LAAIIntentD, a custom data set specifically designed for this task, containing 1,244 labeled training records and 278 evaluation records. Leveraging this dataset, we fine-tuned a large language model (LLM) LAAI-intent-classifier using Low-Rank Adaptation (LoRA) techniques to create a lightweight yet powerful intent classifier. Our fine- tuned model achieves better overall Recall (0.86), Precision (0.85), and F1-Score (0.83) compared to GPT-based methods. GPT models with CoT and Few-Shot prompting improve Recall but sacrifice F1 scores. This highlights our model's efficiency in balancing accuracy and scalability for ITS applications.

Keywords-Intent classification, Intelligent Tutoring System (ITS), Large Language Model (LLM), LAAI tutor, Few-shot prompting

5.35 MyRecommender: Personalized Activity Recommendation based on Negative EmotionsClassification

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Abstract - The solution presented attempts to address the crucial problem of identifying and alleviating negative emotions among middle-class population. Our novel method makes use of machine learning and unsupervised learning techniques. Composed of four parts, the first three are text, audio, or video classification to analyze a person's emotional state. The fourth component is a recommendation system offering personalized recommendations to help users alleviate themselves from the negative emotion faced. The middle-class population is increasingly concerned about the impact the country's economic crisis and difficult living conditions may have on their physical and mental health as they work to support their families daily. Understanding how urgent it is to solve this urgent problem; our approach provides useful techniques to reduce and lessen these emotional loads as well as early identification of negative emotions making it easier to alleviate their mental state. A happier and more productive group of people is what this all-encompassing approach promises to bring about. Our system's scalability and adaptability to different situations also enable customers to adapt it to suit their own requirements and preferences.

Keywords—negative emotions, unsupervised learning, text,audio, video, classification, personalized recommendations, alleviate

5.36 An Integrated Framework for Self-Adjusting Temperature, Humidity, and Airflow Direction in Smart Air Conditioning

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Abstract - This research presents a model for optimizing air conditioning system performance through the integration of Internet of Things (IoT) technologies and Machine Learning methodologies. The result is a self-regulating air conditioning system that operates autonomously, minimizing human intervention. The approach begins with a K-Nearest Neighbors (KNN) model to determine the number of active units needed at any time. The system further optimizes operation by selecting which units to activate based on room occupancy and depth estimation data sourced from OpenCV and Midas. To enhance precision, a sequential model utilizing transfer learning predicts the optimal AC output temperature, while a Support Vector Machine (SVM) model establishes the required fan speed. Additionally, a Deep Deterministic Policy Gradient (DDPG) algorithm is incorporated to maintain optimal indoor humidity levels, continuously adapting to indoor and outdoor changes. A network of sensors and a Raspberry Pi facilitate real-time data collection. The framework's effectiveness is evaluated through simulations, demonstrating its potential to optimize air conditioning operations.

Keywords—Air Conditioner, Occupancy detection, IoT, Temperature Control, Humidity Control

5.37 Early Diagnosis of Alzheimer's Disease from MRI Images Using Machine Learning Approach

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Abstract - Alzheimer's disease is a neurodegenerative disorder characterized by cognitive decline, and early detection is crucial for timely intervention. The research focuses on processing MRI brain scans through various image processing techniques, such as segmentation and bicubic interpolation, to enhance visual clarity and extract meaningful features. Models such as Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Support Vector Machines (SVM), and Convolutional Neural Networks (CNN) are employed for classification, with a particular emphasis on detecting early brain atrophy and vascular changes associated with Alzheimer's disease. The research demonstrates that combining MRI data with machine learning models can significantly improve the accuracy of early Alzheimer's diagnosis. This potentially aids in early intervention and better patient care management. Findings hold promise for advancing early diagnosis and treatment, enhancing AD patients' quality of life.

Keywords— Alzheimer's disease diagnosis, machine learning, MRI imaging

5.38 SingRAG: A Translation-Augmented Framework for Code-Mixed Singlish Processing

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Abstract - This paper introduces SingRAG, a novel framework for processing Singlish (Sinhala-English code-mixed language) that combines translation capabilities with retrieval-augmented generation. Built on the LLaMA-2 7B architecture, our approach addresses the challenges of low-resource language processing through a two-stage method: pretext training for language understanding followed by translation fine-tuning. The system incorporates a custom transliterator for mixed script handling and implements a translation-augmented RAG pipeline where Singlish queries are translated to English for retrieval, then translated back to Singlish for response generation. Evaluation shows significant improvements over the base model, with perplexity reduced from 207.1 to 11.95 on Singlish text, and BLEU scores of 0.1347 and 0.0429 for Singlish- to-English and English-to-Singlish translations respectively. This framework provides a practical solution for organizations seeking to process Singlish content while offering a template for handling other low-resource, code-mixed languages.

Keywords—Singlish processing, translation-augmented RAG, low-resource language models, code-mixing, transliteration, LLaMA fine-tuning, bidirectional translation, multilingual NLP

5.39 UAV-based Building Crack Detection using Convolution Neural Networks

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Abstract - In the field of structural health monitoring, quadcopters equipped with advanced sensors and imaging systems can detect and analyse structural defects, such as cracks and corrosion, in buildings and infrastructure. This capability enables proactive maintenance, and early detection of potential hazards. This research highlights the design and development of unmanned aerial vehicle combined with sonar and vision sensors have been applied to detect and identify the building cracks based on deep learning techniques. The utilization of sonar sensors in conjunction with vision sensors constitutes a novel method that combines the strengths of heterogeneous sensors and compensate the limitations of each sensor. This hybrid sensing approach aims to overcome the limitations of relying solely on visual data while reducing the computational complexity in image processing. The images of the cracks acquired by the vision sensors are processed by pre-trained convolution neural network models such as VGG-16, and ResNet-50 and a customised convolution neural network model. The classification measures, such as accuracy, precision, recall, F1-score, confusion matrix and ROC curve are estimated for each model. Experimental results demonstrated that the proposed customized CNN outperformed the other methods pre trained models showing the accuracy and precision with 99% and 98% respectively.

Keywords— crack identification, deep learning, unmanned aerial vehicle, convolution neural network, machine learning

5.40 Autonomous Detection and Removal of Paddy Weeds using Computer Vision and Deep Learning

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Abstract - Modern agriculture faces the critical challenge of efficiently managing weeds to ensure optimal crop yield and sustainability. Traditional weed management practices often fall short of addressing the complexities of diverse agricultural landscapes. This research aims to construct the weeder for the detection and removal of weeds unfold across two aspects: the design and development of the weeder and the construction of the deep learning model. The dataset is developed from the images of Monochoria vaginalis and Limnocharis flava weeds acquired from the paddy plots. YOLOv8, a renowned algorithm for real-time object detection, is employed to identify the weeds in paddy fields. The model is able to correctly predict weeds 99can correctly predict non-weeds 100this research is the autonomous identification and removal of paddy weeds based on deep learning model operated in a custom built weeder robot.

Keywords— agricultural robotics, weed detection and removal, computer vision, deep learning, paddy, YOLO, convolution neural network

5.41 Distributed Deep Neural Networks Training in a Multi-Worker Environment

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Abstract - Deep learning has become promising across numerous fields in transforming conventional paradigms into smart eras in distributed applications. Large neural networks in recent years have been popular in solving massive real-world problems. However, the challenge behind the increasing complexity of deep neural networks impacts the training time. Appropriate resource provisioning and rightsizing is the requirement in all standard platforms like the cloud to handle this performance degradation. This research explores distributed CPU clusters as a scalable and cost-effective alternative for training large neural networks. The experiments on two different multi-processing machines with workers' distributions demonstrated the change in maximum accuracies is in a range of 92.96% to 96.74%. As our approach can be adopted and experiments can be extended to serverful and serverless computing training workloads, deep learning researchers and practitioners will benefit from our solution.

Keywords— deep neural networks, distributed deep learning, training time, model complexity.

5.42 Electromagnetic Insights Acquisition Through a Forensics-as-a-Service Platform

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Abstract - Electromagnetic Side-Channel Analysis (EM-SCA) has been demonstrated as a viable technique for extracting forensic insights from Internet of Things (IoT) devices. However, the complexity of the data acquisition and analysis processes demands a high level of technical expertise from forensic investi- gators, which poses practical challenges in real-world scenarios. To address these challenges, this research proposes a Forensics-as-a-Service (FaaS) platform aimed at mitigating technical barriers by streamlining the EM-SCA process. This research introduces EMvidence, a FaaS platform designed to simplify and automate Electromagnetic (EM) data acquisition, handling, and analysis in IoT forensic investigations. The platform comprises two com- ponents: the EMvidence data acquiring application for efficient data capture at crime scenes, and the EMvidence web application for cloud-based analysis of EM data. Comprehensive evaluations were conducted on key aspects, including data acquisition, file transfer, pre-processing, and analysis, to assess the platform's effectiveness in supporting forensic investigations.

Keywords— Digital Forensics, Electromagnetic Side-Channel Analysis (EM-SCA), Forensics-as-a-Service (FaaS)

5.43 Popularity Prediction of Sinhala YouTube Videos

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Abstract - YouTube, as a digital platform for sharing videos, has evolved into a powerful medium for content creators aiming to engage with a global audience. Among the Sinhala-speaking community, the platform's popularity has risen significantly, both among creators producing content in the Sinhala language and viewers consuming it. However, for content creators, the challenge of producing viral videos that resonate with their target audience persists. Identifying the factors that contribute to the popularity of a YouTube video remains complex, as several variables, such as the nature of the content, the timing of its release, and audience engagement, all play crucial roles. The objective of this project is to develop a machine learning model capable of predicting the popularity of Sinhala YouTube videos, providing valuable insights to marketers and content creators in the region. Recent studies on predicting YouTube video popularity have employed various machine learning (ML) techniques to examine temporal patterns, social interactions, and content quality as indicators of success.

Keywords— Machine Learning (ML), YouTube, content creators, Sinhala-Speaking community, popularity

5.44 K8s Pro Sentinel: Extend Secret Security in Kubernetes Cluster

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Abstract - Microservice architecture is widely adopted among distributed systems. It follows the modular approach that decomposes large software applications into independent services. Kubernetes has become the standard tool for managing these microservices. It stores sensitive information like database passwords, API keys, and access tokens as Secret Objects. There are security mechanisms employed to safeguard these confidential data, such as encryption, Role Based Access Control (RBAC), and the least privilege principle. However, manually configuring these measures is time-consuming, requires specialized knowledge, and is prone to human error, thereby increasing the risks of misconfiguration. This research introduces K8s Pro Sentinel, an operator that automates the configuration of encryption and access control for Secret Objects by extending the Kubernetes API server. This automation reduces human error and enhances security within clusters. The performance and reliability of the Sentinel operator were evaluated using Red Hat Operator Scorecard and chaos engineering practices.

Keywords— DevSecOps, Distributed Systems, Kubernetes Security, Microservices, Secrets Management

5.45 Reputation Scoring System for IoT Devices

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Abstract - To secure IoT device onboarding and trust management in decentralized networks, this study introduces a novel reputation scoring method. The shortcomings of current Network Intrusion Detection Systems (NIDS) include their inability to scale, adapt to various device contexts, and manage dynamic threats. This study proposes a reputation system that evaluates IoT devices' reliability prior to their incorporation into decentralized networks. The findings demonstrate that this solution contributes to increased network safety and operational efficiency by strengthening network security and ensuring trustworthy device management.

Keywords— Internet of Things, Federated Learning, Reputation Scoring System, Decentralized Networks, Intrusion Detection.

5.46 Cognitive-Integrated Complexity Analysis: A Comprehensive Software Visualization Tool

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Abstract - The software metrics tool able to measure software's complexity comprehensively within the scope of attribution which has not been tackled by other existing tools as well as measurement methods. The existing metrics, including those of Chidamber and Kemerer, which are the traditional ones, are mainly technical, yet there is a gap in considering the cognitive aspect of the complexity. This work proposes new metrics such as Cyclomatic Complexity, Cognitive Functional Size, an Improved CB (ICB) metric, which are built on cognitive complexity so that their integration improves the quality evaluation of the software. The offered tool is diverse in its capacities since it employs classic, object-oriented and modern cognitive metrics thus offering a multidimensional approach to evaluation. Such tools are equipped with easy-to-use interfaces and visualization functionalities and add an industry perspective and the perspective of its consultants and, for example, managers and architects of a given project to the requirements of the metric shattering them to make sense. The integrated concept will help in better decision making in software maintenance and development since complexity will be arrives at in a more detailed manner through cognition analysis.

Keywords— software metrics, cognitive complexity, cyclomatic complexity, cognitive functional size, Improved CB

5.47 Fake News Detection on Twitter

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Abstract - Nowadays, fake news is spreading, which is a considerable societal problem. With the increasing use of social media, people and organisations tend to use social media to spread fake news. Due to the growing number of users and social media posts, detecting fake news only using human-based techniques is challenging. To solve this problem, it is crucial to use deep learning, machine learning and NLP-based techniques to detect fake news. The research addresses the issue of spreading fake news on one of the popular social media platforms, Twitter (now known as "X"), using AI, NLP-based techniques, and an ensemble model.

Keywords— AI, NLP, Deep Learning, Machine Learning, Twitter, Fake News Detection.

5.48 Fishing Location and Availability Prediction for Yellowfin Tuna in Sri Lanka

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Abstract - Fisheries is one of the major sectors contributing to the economy of Sri Lanka, with growing interest in offshore marine resources and deep-sea fishing investments. However, ocean fishing involves challenges and risks. This study aims to assist fishermen in finding optimal fishing spots for Yellowfin Tuna in the Indian Ocean through technology and data-driven methods. The proposed solution involves developing an application that performs three key tasks: Fishing Location Prediction using Fuzzy Logic, Decision Tree, and Image Processing; Fishing Stock Assessment using Kriging methods; and Fish Availability Forecasting using LSTM. The insights provided by the solution can reduce time and energy consumption, improve fishing practices, and enhance overall fishing processes. Furthermore, the paper suggests future directions for improving existing practices with advanced technologies.

Keywords— Fuzzy Logic; Kriging; Time Series Forecasting; GAM Model, LSTM, Decision Tree, Environmental Factors

5.49 Examining Information Diffusion Patterns in YouTube Comment Networks, A Social Network Analysis Approach

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Abstract - This study investigated the dynamics of social media networks during the Black Lives Matter movement (BLMM) by utilizing Social Network Analysis (SNA) to examine YouTube comment networks. Using network centrality measures, including In-degree, Out-degree, Betweenness and Closeness and centrality, the research identified key players and examined their roles within the network. The findings revealed that nodes with high centrality metrics were crucial in influencing information flow, with high Betweenness centrality identifying network brokers and high closeness centrality highlighting efficient information exchangers. Temporal analysis of network activity post-video upload revealed distinct phases of engagement, with peaks observed during the initial ”Golden Hour” and ”Silver Hour,” followed by a gradual decline and stabilization over time. Notable findings included the emergence of significant nodes like Daniels World and C4MPS M0, who played pivotal roles at different stages of the network’s evolution. The study also highlighted the transient nature of user engagement, with early spikes in activity diminishing over time as new influential figures emerged. This research underscored the complex interplay between centrality measures and user influence, providing insights into the fluctuating patterns of social media interactions during high-impact social movements. The results offered valuable implications for understanding how information dissemination and community engagement evolved over time, contributing to the broader discourse on digital activism and network dynamics.

Keywords— Social Network Analysis (SNA), Black Lives Matter Movement (BLMM), Centrality Measures, Social media and Protest movements, YouTube disclose

5.50 Analyzing the Influence of Automated Water Distribution Systems on Precision irrigation for Orchids :A Case Study Using Dendrobium Phalaenopsis Orchid Group

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Abstract - This research seeks to establish the efficiency of an automated water treatment of the Dendrobium Phalaenopsis orchids using remote monitoring and controlling through a dashboard in Audino Cloud. Soil moisture, temperature and humidity levels in the terrain are Other environment factors monitored and the application controls water discharge in response to the results. Water is only added once the soil moisture level gets to a low level of 30 percent as to avoid unnecessarily using water. The system Water Use Efficiency was 60 to 95 percent, thus the system was good at maintaining the moisture level without wasting much water.Temperature ranged from 22-28 and humidity ranged from 40-95 percent affected water demand but the system took into consideration the soil moisture values. It operated correspondingly under principles of precision irrigation that is they provided water where it was needed and when it was needed. , which might be added in the future to the algorithm parameters, include temperature and humidity, as well as predictions of possible changes to environmental climates for even greater water savings. Through the results, it is noticed the prospect for automation supply systems to reestablish the cultivation practices of orchids, having special concern with the rational use of resources and sustainability in the agricultural activity.

Keywords— Precision irrigation, Automated water distribution, orchids

5.51 Enhanced Analysis of Media Interactions during Sociopolitical Unrest: Cross-Correlation Case Study of South African Unrest 2021

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Abstract - This study investigated the temporal interplay between social media (Twitter) and traditional news media (GDELT) during the 2021 South African unrest, a period of significant socio-political upheaval following the imprisonment of former President Jacob Zuma. By employing an enhanced cross- correlation methodology, the research analyzed over 4,000 tweets per minute alongside a comprehensive dataset of global news articles, capturing the dynamic interaction between online discourse and traditional reporting. The findings revealed that social media frequently led the narrative, serving as a catalyst for rapid information dissemination and public sentiment mobilization, often preceding traditional news coverage. However, social media also played a dual role, acting as both a platform for real-time communication and a vector for misinformation, which sometimes amplified unrest. The study enriched the existing body of literature by providing detailed mathematical interpretations, addressing methodological gaps, and comparing results with prior studies. It further emphasized the thematic and temporal connections between these media platforms, underscoring their mutual influence during crises. These insights carry critical implications for media monitoring, crisis management, and the regulation of digital platforms to mitigate misinformation during socio-political events. The study highlighted the necessity of understanding these interdependencies to navigate the complexities of contemporary digital influence effectively.

Keywords— South African (SA) Unrest 2021, Twitter Analysis, Global Database of Events, Language, and Tone (GDELT) analysis, Cross Correlation, Traditional news media

5.52 Generalized Meta Framework for Forecasting

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Abstract - Forecasting tabular time series data has become a challenging task as the time series data has its own unique patterns, and therefore identifying the most suitable modeling approach for a given dataset requires additional investigations and expert knowledge. In this study, we propose a novel meta framework that utilizes an ensemble approach, combining the models with a high level of performance and efficiency for a given dataset with the aim of proposing a more generalized framework for time series forecasting. In this proposed approach, we use different models from a large pool of candidate models that have the ability to capture unique timeseries characteristics available in various time series data sets. This approach allows us to get a more robust and generalized framework. By using a variety of forecasting models, including statistics-based prediction models, machine learning- based prediction models, deep learning-based prediction models, and generative modeling, our novel approach ensures broad applicability across various datasets from different application domains. In the proposed approach, meta features that help describe the structure, complexity, and time series patterns available in a given dataset are used to determine the optimal ensemble from a large pool of candidate models for the final prediction process. In the past literature, it was noted that the generative models, such as Variational Autoencoders (VAEs) and Generative Adversarial Networks (GANs), demonstrate a high level of performance in high-dimensional data contexts; however, their usability in the time series data context is limited due to their incapability of capturing temporal dependencies in the time series data. In order to address this limitation, we use a hybrid architecture to incorporate generative models into our pool of candidate models. Then a stacking approach was used to integrate the predictions of the ensemble's member models as it conditionally weighted the predicated values. Through this approach, our focus was on proposing a more robust, generalized forecasting approach across diverse time series datasets with various time series features more effectively. We used various synthetic and real-world tabular

time series data sets to show the generalizability and wide applicability of our proposed framework in different application domains.

Keywords— Timeseries forecasting, ensemble method, meta learning, computer efficiency, meta features

5.53 Optimal Allocation of Vaccines in a Meta-Population to Control COVID-19 in Sri Lanka

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Abstract - Studying the spread of communicable diseases in a meta-population rather than a single population can provide more insight into the behavior of the spread of the diseases. Human mobility influences the disease-spreading patches and is applied to the model via a mobility matrix M. The optimal control theory is employed to control the disease burden while minimizing the cost of infected individuals and the cost of implementing a control strategy. This research proposes to model a SIR-type model for meta-population to control and reduce disease outbreaks such as COVID-19 by optimizing vaccine allocation in Sri Lanka. By using Kmeans clustering, provinces are further divided into regions according to risk levels. In the absence of control measures, it takes to control the disease burden nearly 3 to 4 years. However, the implementation of control measures, such as vaccination, significantly controls the disease burden. Taking into account that the available control measure capacity reaches its maximum of 0.8, high-risk regions require around two months to control the disease; moderate and low-risk regions require nearly a month to control the disease. The basic reproduction number R0 represents a significant result and it predicts the average number of new cases in the entire population. In contrast, the effective reproduction number (Rt) represents the risk level of the disease when taking into account the current susceptible population. A final epidemic size (ci) represents the cumulative sum of infected individuals in each patch, which plays an important role in representing the patch-specific cost value of infected individuals. Policymakers are able to make decisions such as controlling the spread of disease and maintaining the public and private health sectors as well as the economy of the country based on the results.

Keywords— Basic reproduction number, COVID-19, Meta population, Optimal control, Vaccine allocation

5.54 Impact on Celebrity Endorsement Essentials on Brand Awareness and Purchase Intention in Men's Wear Industry in Sri Lanka

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Abstract - In fashion marketing, companies use various strategies to attract consumers and boost brand visibility. Celebrity endorsements are a key method that significantly impacts consumer behavior and brand promotion. This study explores how celebrity credibility and attractiveness affect brand awareness and purchase intention through Structural Equation Modeling (SEM), focusing the Sri Lanka's branded men's wear industry. Serving such industry, this study has discovered, explained, and evaluated how celebrity endorsement affects the customers' perception on brand image and purchase intention on men's wear, through a quantitative research approach. The literature review first identified a conceptual model and then investigates the validity of such model to the men's wear industry where the celebrity endorsement is needed. The data were analyzed using confirmatory factor analysis, SEM and cluster analysis techniques, to capture relations and impacts among key variables of celebrity endorsement essentials by means of observed variables. As key findings, while presenting individual correlations among the key factors, a SEM model is also presented to describe the true relationships and their deviations when all celebrity endorsement essentials act together. Further, using the consumer data, the effective clusters that advertisers should target when they have a plan to endorse celebrities' features, is presented to provide useful insights to the advertisers. Additionally, study has practical implications for the creation of a data-driven tool that aids fashion businesses in developing AI-based celebrity endorsement applications.

Keywords— Celebrity endorsement, Branded men's wear, Structural Equation Modelling, Cluster Analysis.

5.55 Kills or Turrets: An Exploratory Data Analysis and Win Prediction of League of Legends Based on Early-Game Data.

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Abstract - The audience of e-sports and the gaming community has risen through the years, with "League of Legends" being at the forefront of multiplayer online battle arena (MOBA) games. With the skill-based ranking system introduced by the game, players are split into teams with players in close ranking, enabling them to win the game based on skills. Accurate win prediction during the early stage of the game has been difficult due to significant snowballing in the late game. This paper explores the various features present during the first 10 minutes of the game that affect the outcome significantly. The proposed approach with selected features predicted 74.4accuracy using the machine learning models probabilistic SVM and RNN with hyperparameter tuning for early-game data. The approach could be used to provide insight for players to assess the outcome and rematch. Toxic gaming behavior as intentional feeding and being away from the keyboard (AFK) could be also deduced from the data analysis, leading to a healthy gaming culture.

Keywords— e-sports; MOBA games, Exploratory Data Analysis (EDA); win-prediction; machine learning

5.56 Determining the Risk of Natural Disasters in Sri Lanka using Fuzzy-AHP

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Abstract - Natural disasters such as floods, droughts, and landslides are widespread in Sri Lanka. This research study applies the Fuzzy Analytical Hierarchy Process (F-AHP) to conduct a district-wise risk assessment of natural disasters in Sri Lanka, concentrating on the most significant disasters and their root causes. In the fuzzy- AHP approach, there are criteria and alternatives. In our research, we use natural disasters as criteria and the factors causing them as alternatives. A comparison matrix is created for each natural disaster and its factors. The geometric mean is used to find the fuzzyfied weights of each disaster and their factors. The results of the research reveal that there are certain regions where the impact of this disaster is most felt, exposing the most vulnerable districts and their most important determinants, such as climate change and improper land usage. Considering 25 districts in Sri Lanka, most districts are affected by floods, almost 17 districts including Colombo, Matara, and Galle. Especially, the Ratnapura district is plagued by both floods and landslides.

Keywords— natural disasters, Fuzzy-AHP, risk, comparison matrix, fuzzy weights

5.57 Early Disease Outbreak Detection in Spatio-Temporal Data Using Predictive Modeling and Extreme Value Theory

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Abstract - Early detection of outbreaks is crucial for reducing their impact on public health. Static manual thresholds have been used for traditional detection methods, which fail to capture extreme events in dynamic transmission patterns. The aim of this study is to introduce a generalized framework that integrates feature engineering, predictive modeling, and Extreme Value Theory (EVT) for dynamic thresholding in Spatio-temporal data. This generalized framework is capable of adapting to different diseases and regions, enabling more accurate outbreak detection across different datasets. This generalized framework applied to dengue and Covid-19 disease cases data and the proposed method outperformed traditional approaches by achieving higher accuracy, precision, and F1 scores. The EVT based method gives a more reliable solution for identifying outbreaks in irregularly distributed data, enhancing public health response capabilities.

Keywords— Extreme Value Theory, outbreak detection, Spatio-temporal data, dynamic thresholding, Generalized framework

5.58 Improving Class Imbalance in the Classification of Multi-Dimensional Data: Interpretable Model Design and Evaluation

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Abstract - This study presents a hybrid approach that combines deep learning techniques with conventional machine learning techniques to address the class imbalance in the classification of multi-dimensional data. The resulting framework incorporates SHapley Additive exPlanations (SHAP) to evaluate the model predictions based on domain knowledge. It combines Conditional Generative Adversarial Networks (CGANs), Self-Supervised Clustered GANs (SSCGANs), and Variational Autoencoders (VAEs) for the generation of improved synthetic data. This method ensures that model decisions are based on domain-specific knowledge while enabling efficient computation of SHAP values by approximation of complex classifiers using surrogate models. Evaluations show that the suggested method overcomes the shortcomings of current techniques in high-stakes domains and improves classification performance and transparency.

Keywords— class imbalance, multi-dimensional data, machine learning, deep learning, Average Count Sampling (ACS), Self-Supervised Clustered GANs (SSCGANs), SHAP values, model interpretability.

5.59 Enhancing Human Safety through Early Detection of Floods and Landslides in Sri Lanka.

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Abstract - In Sri Lanka, natural disasters particularly floods and landslides pose significant threats to public safety as well as the economic stability. This research introduces an innovative approach to improve disaster response by utilizing machine learning (ML) and Internet of Things (IoT) technologies. The system ensures extensive and reliable data transfer across rural areas by implementing Long Range (LoRa) technology to establish a Scalable Wireless Sensor Network. Coupled with an integrated alarm system, it markedly improves response times by providing precise, real-time predictions and detections of floods and landslides. The flood prediction model continuously improves through real-time data from IoT devices, enhancing its predictive accuracy. Meanwhile, landslide detection employs image processing techniques to analyze satellite images for early signs such as cracks, and the landslide prediction model provides early warnings. These systems are trained using specific datasets from Sri Lanka, ensuring high relevance and accuracy. Additionally, a web application delivers location-specific disaster notifications, significantly advancing disaster management and preparedness. This approach not only safeguards communities but also protects economic assets, a critical need demonstrated by the devastating 2016 landslides in Aranyaka.

Keywords— LoRa, IoT, Machine Learning, Community Safety Systems, Remote Sensing, Real-Time Data Processing, Advanced Warning Systems

5.60 An Analysis of Readability of Sri Lankan Short Stories Generated by Large Language Models

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Abstract - Large Language Models (LLMs) are powerful tools that can be used for understanding natural languages and generating human-like texts, making them especially effective for generating short stories. However, evaluating the quality of short stories generated by these LLMs with the consideration of cultural aspects has not been extensively explored. In this paper, we present a quantitative analysis to measure the quality of short stories generated by LLMs and related to the Sri Lankan context by considering the readability aspect. We used three prominent LLMs namely ChatGPT, Google Gemini, and Microsoft Copilot for generating short stories. Moreover, readability indices: Flesch reading ease score, Flesch–Kincaid grade level, Gunning Fog index, SMOG index, Coleman-Liau index, and the automated readability index were used to evaluate the readability aspect of the generated short stories. We observed that all the indices except the Gunning Fog index indicate that the readability of short stories generated by LLMs in the Sri Lankan context is high. Moreover, Google Gemini outperforms the other two LLMs. We further analyzed the readability aspect of different categories of short stories generated by LLMs.

Keywords— Large Language Models, Automated storytelling, Prompting

5.61 Galaxy Clustering and Classification using Machine Learning Algorithms and XAI

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Abstract - This paper presents a novel approach to galaxy clustering and analysis using machine learning (ML), coupled with Explainable Artificial Intelligence (XAI) methods. Traditional astronomical research often relies on manual analysis of galaxy clusters, which can be time-consuming and potentially biased. Our study aims to automate this process using advanced computational methods, focusing on clustering algorithms such as Gaussian Mixture Models (GMM) and Density-Based Spatial Clustering of Applications with Noise (DBSCAN). We also employ classification algorithms including Random Forests, Decision Trees, and Support Vector Machines (SVM). The application of XAI techniques enhances the interpretability and trustworthiness of our models' outputs. By leveraging data from the Sloan Digital Sky Survey (SDSS), we demonstrate the efficacy of our approach in identifying and analyzing galaxy clusters, potentially revolutionizing the field of astronomical research.

Keywords— Galaxy clustering, Machine learning, Deep learning, Explainable AI, SDSS, GMM, DBSCAN, Random Forest, SVM, Data Analysis, Data mining

5.62 Enhancing Demand Forecasting in Food Manufacturing: Hierarchical Analysis of Aggregated and Individual Models

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Abstract - This study focuses on production planning in the food manufacturing sector using hierarchical forecasting. The selected case for the focal study represents food products with a common main ingredient used in manufacturing. We employ two scenarios: 1) forecasting aggregated total sales for all products, and 2) forecasting sales for each product separately to calculate the total requirement. We employed three statistical models: autoregressive integrated moving average (ARIMA), exponential smoothing (ETS), and Prophet, and five machine learning models such as linear regression (LR), k-nearest neighbors (KNN), support vector regression (SVR), random forest (RF), and extreme gradient boosting (XGBoost). The key findings highlight that forecasting aggregated total sales for common ingredients outperformed the forecasting for each product individually and got the sum for the overall requirement. Further, we found that island-level forecasts are more accurate than district- and distribution-center-level forecasts. XGBoost performed as the best forecasting model, and MinT outperformed as the best reconciliation approach. Our study contributes to supply chain strategies when products have common ingredients in the manufacturing industry to optimize their resource allocation and production planning. This novel approach contributes to enhancing operational efficiency in food manufacturing.

Keywords— supply chain management, hierarchical forecasting, forecast reconciliation, forecast accuracy, production planning, machine learning

5.63 Real Time Crime Data Analysis with Hadoop and MapReduce: A Case Study From Sri Lanka

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Abstract - Abstract—Modern law enforcement faces significant challenges in managing and analyzing the exponential growth of crime data, which often includes unstructured, high-volume, and real-time information. Traditional relational database systems struggle to handle these complexities, limiting the ability of agencies to derive actionable insights for proactive measures. This research addresses these challenges by proposing a scalable distributed framework utilizing Hadoop and MapReduce for real-time crime data analysis. The objectives include enabling efficient ETL (Extract, Transform, Load) processes, implementing a robust star schema for structured data storage, and providing actionable insights through an integrated real- time dashboard. The methodology employs a multi-node Hadoop cluster for parallel processing, optimizing data integration and analysis capabilities. Results demonstrate significant improvements in processing speed, fault tolerance, and scalability, validated through the framework's application in Sri Lanka's crime data analysis. Findings reveal enhanced resource allocation, crime pattern identification, and operational efficiency for law enforcement. This research establishes a cost-effective, high-performance solution to modern criminological data challenges, with future potential for predictive analytics and machine learning integration.

Keywords— Hadoop, MapReduce, crime data analysis, multi-node cluster, ETL, law enforcement

5.64 Key Situation Awareness Requirements for Aspirants in the IT Sector in Sri Lanka: An Expert Interview Approach

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Abstract - This study aims to identify the situation awareness (SA) requirements for aspirants in the IT sector in Sri Lanka. Utilizing a qualitative methodology, the research used semi-structured interviews with subject matter experts (SMEs) to identify key elements of SA critical for success in the industry. Findings revealed that awareness of emerging technologies, compliance requirements, market dynamics, need for hands-on experience, networking opportunities, need for foundational knowledge, and skill development are essential for IT aspirants. The study reinforces Endsley's framework of SA, demonstrating its relevance in a rapidly evolving technological landscape. For this purpose, the study defines three levels of SA for aspirants in the IT sector. The findings stimulate stakeholders, policymakers and educational institutions in preparing aspiring IT professionals with a wider and deeper understanding of the industry.

Keywords—Artificial intelligence (AI), Aspirants, IT sector, Situation awareness (SA), Subject matter experts (SMEs)

5.65 Artista - A Digital Art Marketplace

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Abstract - To meet the demand for a comprehensive digital art marketplace, this project aims to develop a platform that integrates key features from existing online art platforms. The marketplace will encompass User Profiles, Artwork Listings, Search and Filters, User Ratings and Reviews, Analytics Dashboard, and 3D/2D artworks. While existing platforms offer some of these features, none provide a unified solution. Our goal is to create an all-encompassing, user-friendly platform that combines these functionalities, fostering a community for artists and art enthusiasts. This paper outlines our attempt to implement such application that will bridge the gap between artists and buyers with an attractive user interface using modern web technologies. Adopting a modular approach ensures scalability and flexibility, allowing for the evolution of features. Through analysis of existing platforms and direct engagement with users, the platform is designed to address the shortcomings of current solutions.

Keywords—Digital Art Marketplace, Artist-Customer Platform, Online Art Community, 3D artwork display, Modular Monolithic Architecture

5.66 Tactile Device for Braille-Based Communication in Inclusive Education

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Abstract - This research aims to improve inclusive education for visually impaired people in Sinhala-speaking communities by introducing a prototype tactile Braille display. To enhance educational accessibility, the device converts digital text into Braille using an electromechanical process. Utilizing a Convolutional Neural Network (CNN) model, 97.6 accuracy, 82 % testing accuracy, and 0.88 precision were attained. A mobile app-based input technique showed better precision, 0.96, and accuracy (92.1 %). The device's dependability was demonstrated by the entire system performance, which displayed an accuracy of 91.8 ± 0.3% and a precision of 0.93. By addressing educational disparities and fostering inclusivity in learning environments, this prototype offered visually impaired students access to education in their native Sinhala language using a customized learning tool.

Keywords—braille, inclusive education, tactile communication, text-to-braille, image processing

5.67 Blockchain in Healthcare: Introducing Novel Proof of Accountability Voting (PoAV) Consensus Algorithm and Custom Blockchain Network.

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Abstract - Blockchain technology, which was originally created for cryptocurrencies, has significant research gaps when applied to the healthcare domain. This paper tackles two important research gaps concerning blockchain implementation in health- care: consensus algorithm and network design. While public blockchains are often undesirable for healthcare due to their inherent characteristics, private blockchains provide a more acceptable option. The major goal of this study is to offer an improved consensus algorithm and a blockchain network design that is tailored to healthcare requirements. The suggested system attempts to increase security, scalability, and decentralisation while tackling the unique constraints of maintaining sensitive patient data across a distributed network. Index Terms—blockchain, healthcare, blockchain in health- care, consensus algorithm, blockchain network

Keywords—braille, inclusive education, tactile communication, text-to-braille, image processing

5.68 Metaverse to Enhance Experimental Learning in Higher Education

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Abstract - The rapid growth of technology has resulted in innovative methods to improve education, and traditional learning has evolved. The purpose of this study is to explore how the education sector can utilise the ecosystem of the metaverse to improve 21st-century skills. It emphasises critical thinking, problemsolving, and collaborative information exchange in immersive and interactive learning spaces. The concept of the Metaverse was first introduced in American writer Neal Stephenson's science fiction novel Snow Crash in 1992. In Snow Crash, the characters build into symbols and interact in the Metaverse, a three-dimensional (3D) virtual world. [1] The Metaverse refers to a virtual reality existing beyond reality. It is a compound word of "meta," meaning transcendence and virtuality, and "universe," meaning world and universe. The term "digitized earth" refers to a new world created by digital media like smartphones and the internet. The Metaverse is a collection of developing virtual and expanded reality technologies that will provide a more vivid experience than the current internet. [2] The study aims to discover the possibility of using the metaverse to achieve experiential learning in education, to facilitate learning by fostering learners' cognitive, behavioural, and sociocultural engagement with the subject matter in the metaverse, and to explore the readiness of learners, teachers, and stakeholders to integrate this innovative system into the higher education. The literature review forms the basis for developing the methodology's conceptual framework and the hypotheses. This systematic investigation incorporates a mixed research approach, including quantitative and qualitative approaches to develop a model for education ecosystems to create a simulated education platform for a complex subject. A list of questions was given to selected students to find out whether students find out where Metaverse has enhanced students' experimental learning and its effect on their learning distributed approach was used as the quantitative approach. Participant observations and focus group interviews have been used as the qualitative approaches. Thematic analysis has been incorporated to analyse qualitative data.

5.69 Tacit knowledge-based expert model for decision support in injection mould design

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Abstract - Injection moulding is the most popular technique used by Sri Lankan small and medium-scale enterprises for producing plastic parts in large quantities. Once a strong industry that catered to over 50moulds are now barely meeting one-tenth of the demand due to import competition. Moreover, the local industry lacks access to state-of-the-art design tools owing to funding limitations and mainly relies on experience of long-standing mould design experts. The brain drain following country's economic downturn has now severely affected growth or even existence of this important industry. In this context, the paper introduces a unique strategy to digitally transform the tacit knowledge of mould design experts, and thereby establish a data-driven decision-making process for mould design. In order to manage both explicit and tacit knowledge in injection mould design, a framework was developed, and corresponding databases were established. The proposed expert model uses a predefined case bank and a case-based filtering algorithm to identify matching data sets for a given new design from explicit and tacit databases. Suitability of parameters of the new design is determined using a decision-making algorithm, where higher weightage is assigned to tacit knowledge-based on data availability. The expert model was validated using a case study, and results of the expert model were found to be significantly agreeable to the output of industry-standard mould design software. The findings indicate potential of the proposed tacit knowledge-based expert model to positively impact mould industry affected by low resources and help reach Industry 4.0.

Keywords - digital transformation, expert model, injection mould design, knowledge management, tacit and explicit knowledge

5.70 Smartwatch-based Gait Authentication Using Siamese LSTM Networks

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Abstract - Smartwatches have become a key component in wearable computing. These devices are tightly woven with the modern smartphone and the user themselves. However, smartwatches lack the ability to employ well-known biometric authentication techniques such as fingerprint scanning and facial recognition due to their physical space constraints and other challenges. Gait analysis is the study of walking patterns, and it is known to be a feasible authentication technique, espe- cially using the accelerometer and gyroscope sensors within smartphones. This study explores the feasibility of a gait-based authentication scheme that uses accelerometer and gyroscope data from a commercially available smartwatch device. A novel approach of using Lightweight Siamese long-short term memory (LSTM) networks to identify unique features from two sets of sensor data is proposed for performing gait-based authentication. Furthermore, the computational costs of executing this type of authentication scheme are also explored with the proposed LSTM model architecture.

Keywords - Gait Analysis, Smartwatches, Authentication,Deep Learning, Siamese Neural Networks

5.71 Early Prevention of Cardiovascular Disease: A review of technology, risk scoring, and non-invasive methods

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Abstract - Cardiovascular diseases (CVDs) remain a major global health issue, leading to significant morbidity and mortality and straining healthcare system. They are a leading cause of premature deaths, particularly in low- and middle-income countries. Early detection and intervention are crucial in these populations; however, many current CVD risk assessment models require physical examinations or laboratory tests, which may be difficult to access due to limitations in healthcare infrastructure. Although advancements in medical treatments for CVDs have been made, their rising prevalence underscores the need for a shift toward more robust prevention strategies. Traditional prevention methods emphasize lifestyle changes, early risk factor detection, ongoing monitoring, and imaging techniques. Non-invasive measurement techniques have been extensively researched to reduce reliance on costly medical equipment and lower monitoring costs. Nonetheless, certain unavoidable factors still limit the practical application of these platforms and may result in inaccurate estimates. This review highlights technological advancements, existing risk assessment tools, and the role of non- invasive methods in preventing cardiovascular risk.

Keywords— cardiovascular disease, risk scoring, non-invasive, PPG, rPPG

5.72 Enhanced Detection of Evil Twin Attacks in Public Wi-Fi Networks Using Machine Learning Algorithms

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Abstract - The widespread use of public Wi-Fi networks has significantly increased users' exposure to cyber threats, with Evil Twin attacks posing a particularly insidious risk. These attacks manipulate users into connecting to fraudulent Wi-Fi access points, enabling attackers to intercept sensitive data or execute further malicious actions. This research introduces a robust, machine learning-driven methodology for the real-time detection of Evil Twin attacks in public Wi-Fi environments. Utilizing the AWID2 dataset, the study applied advanced feature selection and preprocessing techniques, including data balancing, noise reduction, and dimensionality reduction, to ensure data quality and model relevance. The resulting dataset was refined from 153 to 24 essential features, enhancing model performance and efficiency. Multiple machine-learning classifiers, including Random Forest, K-Nearest Neighbors, and Na ıve Bayes, were evaluated, with the Random Forest algorithm achieving a notably high accuracy of 99.9186%. These findings validate the framework's efficacy in real-time Evil Twin detection, providing a practical and effective solution to strengthen public Wi-Fi security and minimize cybersecurity risks for users and organizations.

Keywords— Network intrusion detection, Public networks, Evil Twin detection, Machine Learning (ML), Wi-Fi packets.

5.73 Software Quality Assurance Practices Towards Waterfall and Agile Information Systems Projects of BOI Registered Software Companies in Sri Lanka

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Abstract - Software quality assurance (SQA) practices play a significant role to deliver high quality software product by systematically monitoring and evaluating the entire software development life cycle. In Sri Lanka's emerging software industry should focus on the proper SQA practices. Unfortunately a large number of companies fail to achieve their project objectives due to poor SQA practices. To avoid such situations, it is important to identify key factors in SQA practices and take appropriate SQA practices. In this context, SQA practices are important to identify defects early, reducing post-release costs and ensuring software reliability, performance, and compliance with industry standards, ultimately enhancing user satisfaction, mitigating risks, and fostering sustainable growth and customer retention. Hence the main objective of this paper is to identify SQA practices towards Waterfall and Agile information systems (IS) projects of BOI registered software companies in Sri Lanka. Further, this paper helpful for identification of key factors in SQA practices for Waterfall and Agile IS projects of BOI registered software companies in Sri Lanka, while being able to identify challenges, identifies of SQA practices and provides valuable recommendations.

Keywords— Keywords—Agile, BOI, information systems projects, software quality assurance practices, Waterfall

5.74 A Comprehensive Location-Based Travel Forum and Service Network for Promoting Responsible Tourism and Enhancing Safety in Sri Lanka

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Abstract - This research focuses on the need for improved tourist safety, personalized travel recommendations, and the promotion of responsible travel practices in Sri Lanka. To achieve these goals, the study developed the ”Solo Traveler” mobile application, which integrates advanced technologies such as Natural Language Processing (NLP), real-time geolocation, and machine learning. The research aims to create a comprehensive tool that enhances travel experience by offering real-time safety features, tailored recommendations, and a collaborative travel forum. The methodology involves meticulous data collection and preparation, model training, and developing personalized recommendation systems and location- based services. The final output is a user-friendly mobile application that not only improves tourist safety by providing timely assistance and accurate location tracking but also offers personalized travel suggestions and reliable local business information. The app ensures that tourists have a safer, more enjoyable, and culturally enriching experience in Sri Lanka. Continuous user feedback and planned future enhancements, such as integrating more advanced machine learning models and expanding datasets will ensure that the app remains a valuable and evolving resource for travelers.

Keywords— tourist safety, personalized recommendations, natural language processing, machine learning, mobile application

5.75 CodeSafari: A Customized Mobile Solution for Introducing Programming Concepts to Children

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Abstract - Following the COVID-19 pandemic, Sri Lanka's economy faced significant setbacks, particularly in key sectors such as tea exports, garment manufacturing, and tourism, which experienced severe downturns. However, the IT sector showed resilience amid these challenges, highlighting its potential to drive economic growth. Despite this potential, Sri Lanka has struggled to capitalize fully on global demand for IT services due to a skills gap among Sri Lankan youth compared to their Indian counterparts. India's IT outsourcing industry has thrived partly because of the early involvement of young professionals in open-source projects such as the Android Open Source Project (AOSP), Linux Kernel and React. This trend underscores the importance of foundational programming education to develop competitive technical skills from a young age. To address this gap, authors developed a mobile learning solution CodeSafari, designed to introduce core programming concepts data types, conditional statements, and loops to young Sri Lankan learners. The platform uses Personalized Storytelling and a Customized Kids Assisting System in students' native language, making programming more accessible. Programming training with the app improved test scores for 58 percent of participants. By addressing the skills gap early, this research aims to build a strong IT foundation for Sri Lankan students, positioning them to compete more effectively in the global outsourcing market. These findings underscore the essential role of programming education in fostering economic resilience and preparing a workforce capable of thriving in an evolving technology landscape.

Keywords—AI, Neuralnet, Mobile Application, PyTorch, LLM

5.76 TripTractix: Optimizing Outing Planning with Advanced Computational Techniques

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Abstract - Event planning and travel applications often lack critical medical and travel-related information, despite the need to consider factors like weather and infectious disease risks, as highlighted during the COVID-19 pandemic. In Sri Lanka, there is also a scarcity of travel applications that fully utilize Natural Language Processing (NLP) to handle dynamic user requests. To bridge these gaps, this work proposes an outing application that leverages NLP to generate optimal travel recommendations. The system uses Named Entity Recognition (NER) and semantic analysis to extract keywords from user inputs, mapping activity preferences with the help of Large Language Models (LLMs) and zero-shot classification techniques. Recommendations are ranked using the TOPSIS model, while location data is integrated from the Google Place API. This approach aims to deliver personalized, data-driven outing suggestions by combining NLP, advanced recommendation algorithms, and LLMs.

Keywords— Natural Language Processing (NLP), Named Entity Recognition (NER), Recommendation systems, Travel applications, Infectious diseases.

5.77 Adaptive Learning System for Enhancing Mathematical Aptitude in the Sri Lankan O-Level Education System

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Abstract - This research paper details the development and evaluation of a personalized adaptive e-learning system aimed at improving mathematical proficiency among students enrolled in English Medium GCE O Level Mathematics education in Sri Lanka. The system integrates pedagogical techniques with content categorization and matching to create tailored learning experiences that address disparities in mathematics education across various regions and educational zones. Key features include personalized learning paths, adaptive assessment tools, and a comprehensive ontology-based knowledge base for efficient content delivery. The system's impact on student performance will be assessed following its implementation and testing with a pilot group. Feedback from students and educators, especially on the real-time data analytics provided by the Teacher Analytics Platform, has been crucial in refining the system's functionality and usability. Ongoing research aims to further enhance the system's effectiveness and applicability across diverse educational settings.

Keywords— Personalized E-learning, Adaptive learning system, Educational technology

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