Book of
Abstracts

21st International Conference on Advances in ICT for Emerging Regions

ICTer 2021

02nd & 03rd December 2021
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21st INTERNATIONAL CONFERENCE ON ADVANCES IN ICT FOR EMERGING REGIONS (ICTer) - 2021

BOOK OF ABSTRACTS

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MESSAGE FROM THE DIRECTOR UCSC

It is with great pleasure we welcome you to the 21st International Conference on Advances in ICT for Emerging Regions (ICTer 2021), which will be held on 2nd and 3rd December 2021. The ICTer conference is hosted by the University of Colombo School of Computing (UCSC) with the support of local and international partners. In the history of the last 23 years, this is the very first time that we are going to organize the ICTer Conference as a blended conference due to the prevailing situation in the world due to the Covid-19 pandemic, allowing some participants to attend the conference physically. Based on the last year experience, the organizing committee is planning to host the conference as an open conference, allowing public to watch the conference through YouTube webcasting. All the participants are invited to watch the last year conference proceedings at www.icter.org/conference.

The International Information Technology Conference (IITC), first held in 1998 was the predecessor of the ICTer conference organized jointly by the University of Colombo and Infotel organization. In 2008, the International Conference of Advances in ICT for Emerging Regions succeeded the IITC conference while integrating it with the IEEE Computer Society to make it a formal annual international event in Sri Lanka.

Last few years, we organized the conference at the Prof. V. K. Samaranayake Auditorium, University of Colombo School of Computing. Although we planned to have the conference in the same venue, these unexpected circumstances forced us to think about organizing the conference in an online mode. We believe that this is an opportunity to move forward irrespective of all challenges that we are facing in organizing an online conference even without going to our workplace during these days.

ICTer Conference has been a platform for dissemination of research work not only at the cutting edge of computing research and development at the UCSC but also research that addresses real problems in emerging regions carried out by other universities, including those outside Sri Lanka.

ICTer2021 has had a dedicated team organizing and supporting it. We take this opportunity to express our sincere gratitude to the conference co-chairs for their leadership and all committee members who belong to the young academic team at UCSC. Also, we would like to extend our gratitude to all reviewers, keynote speakers, paper presenters, and session chairs. We greatly appreciate the support provided by the University of Colombo administration, governmental institutions, and higher education institutions throughout Sri Lanka. Finally, we would like to thank all our sponsors, without whose support this conference would not be possible.

Prof. K. Priyantha Hewagamage, Director, University of Colombo School of Computing

MESSAGE FROM THE CONFERENCE CO-CHAIRS

As Co-Chairpersons of the ICTer 2021, We are delighted and honoured to bring this message to the 21st International Conference on Advances in ICT for emerging region (ICTer2021) held on the 2nd and 3rd of December 2021. This annual international conference is organized by the University of Colombo School of Computing (UCSC) in collaboration with IEEE Sri Lanka section and IEEE Computer Society, Sri Lanka chapter. Hence, the accepted papers of the ICTer2021 conference proceedings will be published in IEEE explorer after the conference, to disseminate it among a larger international audience.

The International Information Technology Conference (IITC) first held in 1998 was the premier IT conference in Sri Lanka. The International Conference of Advances in ICT for Emerging Regions succeeded the seminal IITC conference and is arguably the leading IT conference in Sri Lanka. Hence it is with great pride and pleasure that the UCSC is hosting the ICTer2021 at the new Prof. V. K. Samaranayake auditorium. ICTer Conference has been a platform for dissemination of research work not only at the cutting edge of computing, but also research that address real problems in emerging regions. Publications in ICTer have more than 2000 citations and an h-index of 19 and an i10-index of 57 according to google scholar.

The ICTer conference is renowned for its high standards. The UCSC along with other higher education institutions and the support of the IT industry of Sri Lanka has been improving on these standards over the years. This year, the number of submissions has continued to grow to 250, reflecting the continued growth in computing research in the region. After following a rigorous blind peer review process using more than 70 reviewers and cross checking all the papers for plagiarism, we were able to accept 40 as full papers, with around 16% acceptance rate. The best research work presented will be invited to be published in expanded form in the International Journal on Advances in ICT in Emerging Regions. Our technical program is rich and varied with six (6) keynote speeches and one (1) invited talk. In addition to the papers, there will are 10 poster presentations that will add value to the conference. We also expect to provide technical demonstrations and numerous opportunities for informal networking. As a conference chairs, we know that the success of the conference depends ultimately on the many people who have worked with us, in planning and organizing the conference. ICTer2021 has had a dedicated team organizing and supporting it. We take this opportunity to express our sincere gratitude to the Director, UCSC, Prof. K.P Hewagamage for his leadership and constant advise. Also, would like to extend our gratitude to all reviewers, keynote speakers, paper presenters, session chairs and experts conducting workshops. Finally, we would like to thank all our sponsors, without whose support this conference would not be possible.

We hope that you have a productive as well as an enjoyable conference.

Dr. Thilina Halloluwa & Mr. Viraj Welgama,
Conference Co-Chairs, ICTer2021

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➢ Ms. Yashodha Vimukthi, University of Colombo School of Computing, Sri Lanka

➢ Mr. Ravi Madanayake, University of Colombo School of Computing, Sri Lanka

KEYNOTE SPEAKERS

➢ KEYNOTE 1

Role of Metaphors in Information Visualisation
Prof. Prasad Wimalaratne
Head of the Department, Department of Communication and Media Technologies,
University of Colombo School of Computing, Sri Lanka

➢ KEYNOTE 2

Altered Reality: Designing Immersive Experiences Using Multisensory Approaches
Dr. Roshan Peiris
Assistant Professor, Rochester Institute of Technology (RIT), USA

➢ KEYNOTE 3

Today's students are tomorrow's workforce, So what?
Dr. Chathuranga Manamendra
Director Software Engineering, IFS, General Council Member, SLASSCOM

➢ KEYNOTE 4

Artificial Intelligence for Internet of Things Security and Forensics
Dr. Nhien-An Le-Khac
Lecturer/Assistant Professor, School of Computer Science, University College Dublin, Ireland

➢ KEYNOTE 5

Elephants and algorithms - how computer science can revolutionize acoustic monitoring
Dr. Daniela Hedwig
Research Associate, K. Lisa Yang Center for Conservation Bioacoustics, Cornell University, USA

➢ KEYNOTE 6

Making Smart Cities More Playable
Prof. Anton Nijholt
Human Media Interaction, University of Twente, Netherlands

Opening of the UCSC Research laboratory and ICTer2021 Inauguration

AGENDA – 1ST DECEMBER 2021

02:30 PM	Inauguration of the 21st International Conference on Advances in ICT for Emerging Regions (ICTer2021) Conference - Arrival of the Chief Guest
02:35 PM	Opening of the Research lab / Reception area / Museum Phase - II / Computer Laboratory
03:00 PM	Welcome Address by the Director of UCSC
03.05 PM	Address by the 21st International Conference on Advances in ICT for Emerging Regions (ICTer2021) Conference Co-chairs
03.20 PM	Address by the Vice Chancellor of University of Colombo
03.30 PM	Keynote 1 – -"Role of Metaphors in Information Visualisation" ***Prof. Prasad Wimalaratne***
04.15 PM	End of the Ceremony – Vote of Thanks

AGENDA – 2ND DECEMBER 2021

08:00 AM	Registration	
08:30 AM	Keynote 2 – Designing Immensive Experience Using Multisensory Approaches *Dr. Roshan L Peiris*	
09:30 AM	Platinum Sponsor Speech	
10.00 AM	Tea Break	
10.10 AM	*Sponsor Advertisement*	
	Session 1-A	**Session 1-B**
	Open Track	**Machine Learning Track**
10:20 AM	9	8
10.40 AM	22	97
11.00 AM	108	36
11:20 AM	137	102
11:40 PM	144	103
12.00 noon	Technical Session on 5G innovation - Powered by Dialog	
	Session 1-C	**Session 1-D**
	Machine Learning Track	**Human Computer Interaction Track**
12.15 PM	110	85
12.35 PM	162	91
12.55 PM	232	222
01.15 PM	Poster Session 1 – 133, 6	217
01.25 PM	Sponsor Advertisement	
01.30 PM	Lunch Break	
01.50 PM	Sponsor Advertisement	
02.00 PM	Keynote 03: Today's students are tomorrow's workforce, So what? *Dr.Chathuranga Manamendra*	
	Session 2-A	**Session 2-B**
	Applications of IT Track	**Physical Computing Track**
03.00 PM	49	25
03.20 PM	58	26
03.40 PM	96	Poster Session 2 – 73, 224, 223
04.00 PM	Tea Break	
04.10 PM	Sponsor Advertisement	
04.20 PM	Keynote 04: Artificial Intelligence for Internet of Things Security and Forensics *Dr.Nhien-An Le-Khac*	
05.20 PM	Sponsor Advertisement and End of the first day of the Conference	

AGENDA – 3ᴿᴰ DECEMBER 2021

	Session 3-A	Session 3-B
08:00 AM	Registration	
08:20 AM	Keynote 5 – Elephants and algorithms – how computer science can revolutionize acoustic monitoring ***Dr. Daniela Hedwig***	
09.20 AM	Sponsor Advertisement	
09.30 AM	Tea Break	
10.20 AM	*Gold Sponsor Speech*	
	Session 3-A	**Session 3-B**
	Machine Learning/NLP	**Applications of IT/NLP**
10.00 AM	112	98
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10.40 AM	93	19
11.00 AM	152	206
11.20 AM	Sponsor Advertisement	
	Session 3-C	**Session 3-D**
	NLP	**Machine Learning**
11.30 AM	Poster Session 3 – 129,143.160,211	Poster Session 4 – 226,230,231
12.05 PM	Sponsor Advertisement	
12.15 PM	Panel Discussion – Research in Computing	
01.15 PM	*Sponsor Advertisement*	
01.25 PM	Lunch Break	
02.00 PM	*Sponsor Advertisement*	
	Session 4-A	**Session 4-B**
	Machine Learning/NLP	**Applications of IT/NLP**
02.10 PM	70	3
02.30 PM	214	153
02.50 PM	186	18
03.00 PM	192	159
03.40 PM	Keynote 6 – Making Smart Cities More Playable ***Prof. Anton Nijholt***	
04.40 PM	*Sponsor Advertisement*	
04.50 PM	Awarding of the Best Paper	
05.20 PM	*Sponsor Advertisement*	
5.30 PM	Vote of Thanks by Conference Co-Chair	

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2. TractNet: A Deep Learning Approach on 3D Curves for Segmenting White Matter

3. A Comparative Analysis of Clustering Techniques with Feature Selection for Breast Cancer Recurrence Prediction

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4-A)   Machine Learning/NLP

4-B)   Applications of IT/NLP

KEYNOTE SPEAKERS

Role of Metaphors in Information Visualisation

Prof. Prasad Wimalaratne,

Head of the Department,
Department of Communication and Media Technologies,
University of Colombo School of Computing, Sri Lanka

3D metaphoric information visualization visualizes abstract data & information using spatial metaphors. Interactive information visualization systems employ a variety of metaphorical devices to make abstract, complex, voluminous, or otherwise difficult-to-comprehend information understandable in graphical form. Due to its ability to explain new concepts in terms of familiar ones, metaphor is used at all levels of interaction with computers. It has been observed that a system is intuitively usable if the users' unconscious application of prior knowledge leads to effective interaction. This talk will focus on metaphorical information visualization in 2D & 3D and discuss some of the research carried out at UCSC in metaphorical information visualization in large data sets using Pandemic data as a case study as well as visualization of software systems together with security vulnerabilities, code evaluation etc.

Altered Reality: Designing Immersive Experiences Using Multisensory Approaches

Dr. Roshan Peiris,

Assistant Professor,
Rochester Institute of Technology (RIT), USA

Our senses help perceive and make our own realities of the world. 'Altered Reality' is the notion of altering our perceptions through various technologies such as virtual reality and haptics to present enhanced and immersive alternate realities. Here, we explore various multi-sensory approaches to achieve these Altered Realities through research themes that range from basic human perception studies to creating new technologies and experiences for applications in the industry, entertainment, and various social communities. In this talk, I will highlight some of our recent works that especially focus on new experiences around the head and the face. Through works such as ThermoVR, FacePush, and LiquidReality I will discuss the process of creating new interactions in this domain and creating realistic effects such as feeling the water from a virtual shower or punch from a virtual boxer directly on the face! Furthermore, I will introduce my new research direction of Immersive Accessibility and discuss its future directions.

Today's students are tomorrow's workforce, So what?

Dr. Chathuranga Manamendra,

Director Software Engineering,
IFS, General Council Member, SLASSCOM

Societies have been immensely impacted by the technological advancements which have caused us to comprehensively transform our way of working, travelling, buying, fulfilling minimum requirements, interacting & socializing and many more. It's need not to say that the speed of the changes will continue to increase by altering many of our current practices. So what? How do we enable students to succeed in the workforce while it evolves to both create and eliminate jobs?

Artificial Intelligence for Internet of Things Security and Forensics

Dr. Nhien-An Le-Khac,

Lecturer/Assistant Professor,
School of Computer Science, University College Dublin, Ireland

Today is the era of Internet of Things (IoT), millions of machines such as cars, smoke detectors, watches, glasses, webcams, smart blood pressure monitor, etc. are being connected to the Internet. The number of machines that possess the ability of remote access to monitor and collect data is continuously increasing. This development makes, on one hand, the human life more comfortable, convenient, but it also raises on other hand issues on security, privacy. Some challenges can be listed as the multiple locations and networks; the management and automation features of an IoT network; the survival period and visibility nature of IoT devices; huge amount of IoT data collected. Due to the un-standardized nature of IoT devices, the cybercrimes can exploit security vulnerability of these devices as well as of their eco-systems such as the insecure web, backend API, cloud, or mobile interfaces, etc. Attacks such as sniffing, surveillance, DDoS, etc. on IoT networks and IoT devices are normally difficult to detect.

Recently, Artificial Intelligence (AI) have made tremendous progress in many areas such as computer vision, pattern recognition, natural language processing, cybersecurity, etc. Many AI-based approaches, using machine

learning and deep learning models have been developed as a key solution to secure IoT eco-systems. Hence, in the first part of this talk, I am willing to present achievements of using machine learning and deep learning for IoT security and forensics.

On the other hand, such AI-based approaches themselves could also raise issues in privacy and security. It is more severe if these approaches are black-box to end-users or investigators. For example, deep learning models are trained on very large amounts of data from potentially untrustworthy sources, providing opportunities for adversaries to manipulate them. In recent years, many sophisticated adversarial attack techniques have been exploited to compromise deep learning based systems. Therefore, in the second part, I share my thought on how to provide the robustness and safety to AI-based models against these adversarial attacks.

Elephants and algorithms - how computer science can revolutionize acoustic monitoring

Dr. Daniela Hedwig,

Research Associate,

K. Lisa Yang Center for Conservation Bioacoustics, Cornell University, USA

Passive acoustic monitoring (PAM) is an emerging non-invasive method that allows for the continuous, long term and large-scale monitoring of populations of elusive, yet, acoustically conspicuous terrestrial species as well as anthropogenic disturbance at reasonable cost. As such, PAM can serve as an excellent evaluation tool that enables information-based decision making and adaptive management in wildlife conservation. However, challenges associated with retrieving, storing, and analysing vast amounts of sound recordings from remote locations still impede data acquisition and interpretation, and slow down the turnaround time from sound to actionable data for conservationists. The Elephant Listening Project at Cornell University is at the forefront of developing and implementing PAM tools to support protected area managers across Central Africa in monitoring forest elephant populations and illegal gun hunting. This talk will illustrate applications of PAM in forest elephant conservation, challenges on the ground and in the analysis lab, and how innovative computer technology and engineering solutions offer opportunities to contribute to effective conservation strategies.

Making Smart Cities More Playable

Prof. Anton Nijholt,

Human Media Interaction,
University of Twente, Netherlands

Digital technology can make cities smart. City management can make use of information that can be extracted from databases in which data is collected about energy consumption, traffic behavior, waste management, human behavior in public environments, and opinions of the general public, for example as they can be collected from social media. But can this digital technology and the data collected from it help to make living in a city more enjoyable? How can digital technology and information provided by digital technology make cities playful, allow citizens to engage in playful and entertaining activities that help to enjoy their daily and sometimes boring activities such as commuting, working, career and social obligations, housekeeping? In this talk, we investigate how sensors and actuators in an urban environment can be introduced and used to design playful applications. We discuss how ideas about playable cities have developed and pay attention to the criticism of the concept of playable cities that has emerged in recent years.

Generalization of LSTM CNN ensemble profiling method with time-series data normalization and regularization

Disni Rathnayake, Pasindu Bawantha Perera, Heshan Eranga, Manjusri Ishwara

Department of Statistics, Faculty of Science, University of Colombo

University of Colombo School of Computing

Colombo, Sri Lankaa

This study concentrated on generalizing an anomaly detection method of time series data using ensemble LSTM CNN network with time series data normalization and regularization. Considering the relevant conditions must meet for time series normalization, an algorithm was proposed for time series normalization. Checking the stationarity and normality of time series data is fundamentally included in the proposed algorithm. Afterward, different types of time series data are visualized with different normalization methods, and the impact of each of these methods is discussed. Normalization techniques like Min - Max, Sigmoid and Tanh are used. When sigmoid normalization used with a dataset where the original data is almost in the range of zero to approximately one was able to normalize well. For the data which is not in the range of [0,1] this method cannot be used since it tends to overlap data that is not available in original data. The study reveals that a smooth, non-linear sigmoid function performs a better transformation for many anomalous time series data as a normalization factor. The prediction errors of the LSTMCNNkeras (LSTM CNN ensemble neural network was implemented using Keras is called LSTMCNNkeras.) model are discussed and compared with and without proposed normalization approach. Also, the gross effect of both normalization and regularization steps to the prediction errors of the LSTMCNNkeras model is discussed. For the time series data where the range lies somewhere between 0 to 1, produced better predictions in LSTMCNNkeras model along with Sigmoid normalization and Dropout regularization techniques. The gross effect of Layer weight regularization with Tanh normalization was able to produce a foreseeable growth in the performance of LSTMCNNkeras model with more accurate predictions for many time series data.

Keywords: anomaly detection, time series, lstm, cnn, ensemble networks, generalization, normalization, regularizationt

A Novel FPGA Architecture of Commentz-Walter Algorithm using Bit-Split String-Matching Enginess

Sugandima M. Vidanagamachchi, Shirley D. Dewasurendra

Department of Computer Science, Faculty of Science, University of Ruhuna, Sri Lanka.

Department of Computer Engineering, Faculty of Engineering, University of Peradeniya, Sri Lanka

This paper describes a reconfigurable hardware implementation of CommentzWalter algorithm with bit-split string matching engines to match multiple protein sequences. It is reported that multiple pattern matching using the most widely used Aho-Corasick algorithm for different applications has been carried out on graphics processing units and field programmable gate arrays to accelerate the matching process. Commentz-Walter algorithm, is a multiple pattern matching algorithm and more complex than Aho-Corasick. There are no reports of it being directly implemented in any hardware platform except as software implementations on general purpose processors. In this work, a specific architecture for our target application using CommentzWalter algorithm has been developed and tested with a simulator for hardware description languages. This architecture can match multiple patterns of proteins efficiently when implemented on a Field Programmable Gate Array. Finally, we compare a previously developed hardware architecture of bit-split Aho-Corasick with our bit-split Commentz-Walter architecture. Using the Intel Stratix IV GX EP4SGX230KF40C2 FPGA chip as the target device, the compilation results with Quartus II show that the synthesis logic utilization is 5% with 2203 total number of registers, 64896 FPGA block memory bits and 4 DSP block 18-bit elements. The simulation and practical experimental results show that the proposed architecture can effectively improve the performance of the Commentz-Walter algorithm..

Keywords: Commentz-Walter, FPGA, Reconfigurable, Bit-split, String-Matching

Movie Recommendation System Using Concurrent Hybrid Variational Autoencoders

Mathangi Krishnathasan

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University of Moratuwa
Katubedda, Sri Lanka

Movie recommendation is a fundamental user requirement for online movie streaming platforms. This research proposes a robust hybrid pipeline that uses two variational autoencoders which can run parallelly to capture the user's movie preference and genre preference from past data separately. This research uses a stable 1M Movielens dataset for training and testing. This research further explores the impact of the latent space dimension, the impact of the output layer activation function in movie recommendation tasks, and a suitable prediction matrix based on the activation function we used. Our proposed methodology was evaluated against AutoRec Model and was able to achieve 1.3939 in root mean squared error evaluation.

Keywords: Recommendation Systems, variational autoencoders, Hybrid Filtering, MovieLenz

A Decision Making Aid for Organizations during Epidemic Situations

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Colombo, Sri Lanka

An epidemic is a widespread infection within a population at a particular period. COVID-19 is one such epidemic which is turned into a pandemic by mid-2020. COVID-19 had an enormous impact on people's livelihood, health, economy, and social life. In Sri Lanka, we have faced the dreadful side of the COVID-19 during its second, third, and fourth waves. Some of these waves were propagated by the behavior of individuals in organizations. During this period several intervention strategies have been introduced in order to stop the disease spread globally and as well as locally using. Many different epidemic models built using techniques ranging from statistical prediction to simulation. For this research we used Agent-Based modeling to simulate the spread of a contagious disease in different organizations. Several parameters have been introduced in the development process of these models considering some important aspects of contagious disease spreads. Two common interventions practiced in countries were implemented to evaluate their effectiveness, namely social distancing and face mask. Agent-based simulation models were generated from these computational models and evaluated using parameter sweeping. The effectiveness of the two interventions in mitigation of the spread of the disease were compared. Flattening the curves of the graphs of infection spread can be achieved by timing the interventions early. The simulation clearly shows the impact of parameters these and their importance in the control of disease spreads.

Keywords: Agent based modeling, Epidemic modeling

IOT-Based Intelligent Assistant Mirror for Smart Life & Daily Routine Using Raspberry PI

SPSS Sirinayake, DKAK Dasanayake, TMLU Rodrigo, WUY Perera, MDJT Hansika Mahaadikara, Surath Kahandawala

dept.computer systems engineering Faculty of Computing,
Sri Lanka Institute of Information Technology Malabe, Sri Lanka

Humans start their day by looking in the mirror at least once before leaving their homes every morning. In addition, they waste some considerable time of their busy workload in front of the mirror. To make this time more productive and useful, there ought to be a system that can be readily conducted, user-friendly, and smart according to the constant progress on the Internet of Things. The intelligent mirror is a new addition to the smart device family, which is a straightforward concept. There will be a screen placed behind a two-way mirror, and this Intelligent Mirror turns our room or bathroom mirror into a personal assistant with artificial intelligence. The purpose is to develop a smart mirror that can automate working humans' busy daily routines and manage their tasks when they spend their time in front of a mirror. To make the most of this moment, users can securely access all the relevant details of the day by looking in the mirror simultaneously. The intelligent mirror, which a single voice command can activate, will significantly help disabled persons and the general. Raspberry Pi has been used to build the proposed intelligent mirror, linked to the digital world via the Internet. The mirror can communicate with the user through voice commands and reply appropriately. The monitoring of emotions and health measuring function will provide a distinctive experience to the users. The mirror will reflect important elements such as weather, date & time, covid-19 situation reports, local news, To-do list, water reminder, home workouts, and meal plans. The mirror can also handle specialized functions such as automating and controlling home IoT devices.

Keywords: Smart mirror, Raspberry Pi, Artificial intelligence, IoT (Internet of Things)

Ensemble Methods based Machine Learning Approach for Weather Prediction for Precision Agriculture

J.S.A.N.W.Premachandra, P.P.N.V.Kumara, M.D.P.P. Goonathilake

Department of Computer Science
General Sir John Kotelawala Defence University, Sri Lanka

Agriculture sector in developing countries including Sri Lanka has been highly affected by recent climatic variabilities. Expected raining might not occur at the expected time, due to recent changes happened in the rainfall patterns. This research mainly addresses the problems occurred due to the difficulty in identifying the mismatch between current rainfall and traditional seasonal cultivation schedules. Even with the advance technologies, weather prediction has become challenging task. This paper presents an Ensemble method based machine learning approach for predicting rainfall for precision agriculture. For predicting daily rainfall occurrence, six correlated weather features including wind speed, wind direction, humidity, temperature, O3 concentration and solar radiation were selected and improved with proper data preprocessing. 80-20 cross validated data were initially trained and tested with four ML algorithms where SVM, and Random Forest, KNN and Decision Tree achieved 88%, 89%, 89% and 90% accuracy levels respectively. Then several ensemble methods including Averaging, Voting and Bagging were used, where accuracy levels were 92%, 89% and 89%. Boosting method which combined AdaBoost with Decision Tree recognized as the best fitted model with 94.12% accuracy. The results depict a significant accuracy in this Ensemble methods based approach for Sri Lankan weather prediction.

Keywords: Precision Agriculture, Machine Learning, Ensemble Method, Weather Prediction

Machine learning approach for predicting career suitability, career progression and attrition of IT graduates

B.M.D.E Bannaka, D.M.H.S.G Dhanasekara, M.K Sheena, Anuradha Karunasena, Nadeesa Pemadasa

Department of Information Technology, Faculty of Computing, Sri Lanka Institute of Information Technology, Sri Lanka

The IT industry in Sri Lanka is associated with a massive work force consisting of skillful professionals and it also provides many job opportunities for fresh graduates at the present. For a fresh graduate entering the IT industry there is a wide variety of job opportunities available and in order to have a satisfactory and rewarding career they should identify the most suitable career for them. On the other hand, employees change their careers and regularly seeking for career advancements and more benefits while the employers struggle to retain employees. Under such circumstances, this research focuses on developing a career mentoring system which comprises of the prediction of career suitability, career and salary progression, and employee attrition to assist IT employees to achieve career goals by overcoming barriers in their career path. For this purpose, data are collected from IT employees, and several models were implemented using classification algorithms such as XGBoost, Random Forest, Support Vector Machine, K-Nearest Neighbors, Decision tree, Naive Bayes, and their performance are compared using accuracy, precision, recall, and F1-Score to select accurate models. XGBoost resulted with higher accuracies for prediction of career suitability, initial salary, career and salary progression with values of 92.31, 90.35, 86.45 and 88.76 respectively. Furthermore, for the prediction of professional courses and employee attrition, Random Forest resulted higher accuracies of 93.52 and 89.70. The ultimate goal of this research is to guide IT graduates and employees to have better performances and to assist them in embracing responsibilities throughout their career life.

Keywords: attrition, career path, classification algorithms, pro-gression, suitability

Human Gut Microbiome Data Analysis for Disease Likelihood Prediction Using Autoencoders

Dinithi Wickramaratne, Rupika Wijesinghe, Ruvan Weerasinghe

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University of Colombo
Colombo, Sri Lanka

The community of microbes including bacteria, viruses, fungi etc. living in and on our body is known as the human microbiome. The human microbiome plays an important role in life helping in digestion, developing immunity and synthesizing vitamins. Advancements in Next-Generation Sequencing technologies have enabled profiling of microbial communities fast and efficient. Studies have shown that the gut microbiome is linked to many diseases such as type 2 diabetes, colorectal cancer and inflammatory bowel disease. Application of modern machine learning algorithms is proven to be beneficial in predicting disease likelihood. However, the high number of dimensions in microbial datasets compared to the number of samples, is causing machine learning approaches to perform poorly. Traditional approaches of feature reduction cause a loss of important information. Therefore, efficient dimensionality reduction methods should be employed in microbiome-related classification tasks. In this paper, we explore a model to perform disease likelihood prediction, using autoencoders to minimize the information loss in traditional approaches of feature reduction.

Keywords: autoencoders, dimensionality reduction, metagenomics, microbiome

Minimize Traffic Congestion with Emergency Facilitation using Deep Reinforcement Learning

Dulmina Kodagoda, Dushani Perera, Gihan Seneviratne, Prabhash Kumarasinghe

University of Colombo School of Computing
Colombo, SriLanka

In intelligent traffic light control, matrices derived from real-time traffic data are paramount for efficiency and performance. The rewards and state representations in previous studies could mislead a Reinforcement Learning agent in some cases. This paper examines the effectiveness of considering the Standard Deviation of vehicle's Waiting Time (SDWT) on Deep Reinforcement Learning based traffic congestion control with emergency facilitation. The proposed method was self-evaluated by only considering average waiting time under both synthetic and Toronto real-world dataset. It has demonstrated that the proposed method was able to gain a significant impact on performance by considering the SDWT. Moreover, the proposed method was able to reach zero waiting time for emergency vehicles.

Keywords: Machine learning, Reinforcement learning, Traffic light control, Emergency vehicle prioritization, Deep learning

Suspicious Human Crowd Behaviour Detection– A Transfer Learning Approach

Peshala Liyanage, Pumudu Fernando

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Informatics Institute of Technology
Colombo, Sri Lanka

Video surveillance systems play an important role in the public security sector. These systems are used to detect a variety of activities such as suspicious human behaviours, analyze crowd behaviours, manage road traffic and track vehicles. Due to the difficulty in manual monitoring of such activities, several research attempts were carried out to automate information extraction from surveillance systems using machine learning and deep learning approaches. The unavailability of large video data sets for processing purposes, is one of the common barriers in this research domain, since the majority of the existing videos are untrimmed, unannotated, and may contain ambiguous data. The purpose of this research is to propose a machine learning based transfer learning approach, to solve the limitations with the datasets specifically for accurate detection of violent crowd behavior via surveillance systems. Four state-of-the-art models were tested with varied configurations and the proposed prototype achieved highest model accuracy of 97%.

Keywords: Suspicious crowd behaviour, Video surveillance, Transfer learning, Anomaly detection, Computer vision

Prediction of Student Satisfaction on Online Learning during the COVID-19 Pandemic - A Case Study on Sri Lankan Universities

Senthan Prasanth, Kuhaneswaran Banujan, BTGS Kumara, Hiruni Rupasingha

Department of Physical Sciences and Technology
Department of Computing and Information Systems
Department of Economics and Statistics
Sabaragamuwa University of Sri Lanka

With the sudden upsurge of the Corona Virus (COVID -19) epidemic, higher education institutions around the globe have been engaging in untiring efforts to provide continuous learning opportunities for the students and to safeguard their welfare. This research is done to investigate the true experiences of university students in Sri Lanka using e-learning facilities throughout this period of the epidemic situation and forecast the adaption of e-learning in the universities after this epidemic situation. For this purpose, an online survey was designed and a formal questionnaire was circulated. In the end, after a thorough survey, a satisfactory result was obtained. Out of the 909 responses, 189 were not interested in involving in the e-learning process in the future whereas 460 were identified as satisfied with the adaption of e-learning. In addition, the rest of the 260 was satisfied with both the cases. Furthermore, the dataset fed into selected supervised machine learning techniques like Support Vector Machine (SVM) and Artificial Neural Network (ANN) to develop the prediction model on forecasting the likelihood of students with the adaption of the method of e-learning in the days to come. As per the results obtained, ANN outperformed against SVM and resulted in an accuracy of 76.19%. Immense inconveniences were experienced in the course of the students' academic activities, because of the sudden upsurge of the pandemic. They are namely inaccessibility of technological devices, poor connectivity of the internet, and unsuitable surroundings for learning. This attempt also pinpoints the characteristics of the prevailing technological procedures in the making of distance learning theory. It was concluded that additional funding and feasible plans would be necessitated for the enhancement of an effective teaching-learning process towards the aforesaid method of the educational framework all over the country.

Keywords: COVID– 19, E-Learning, Machine Learning, ANN, SVM

TractNet: A Deep Learning Approach on 3D Curves for Segmenting White Matter Fibre Bundles

Kumaralingam Logiraj, Kokul Thanikasalam, Sittampalam Sotheeswaran, Nagulan Ratnarajah

Department of Mathematics
Faculty of Science, EUSL, Sri Lanka
Department of Physical Science
University of Vavuniya, Sri Lanka

Fibre tractography techniques generate a large number of fibre streamlines that are densely distributed throughout the brain. These 3D fibre curves are classified into a discrete collection of white matter bundles for tract-based quantitative analysis which is a modern effective methodology for clinical demands in brain development, aging and disease. Although several approaches have been developed to segment the 3D fibre curves into anatomically meaningful fibre bundles, it is still a challenging task due to the complex and large volume of 3D curve data representation. In this paper, we propose a deep learning architecture (called TractNet) to segment ten major fibre bundles and to segment the curves which do not belong to these ten major bundles. Proposed architecture consumes 3D fibre curves in their raw data format. Moreover, proposed architecture has two channel attention modules to boost the segmentation performance. We demonstrated quantitative and the visual evidence of significant performance of the proposed model. The TractNet showed strong performance that is comparable to or better than the state-of-the-art in terms of experimental evidence.

Keywords: TractNet, White Matter, 3D Curve Segmentation, Fibre bundles, Deep Learning

A Comparative Analysis of Clustering Techniques with Feature Selection for Predicting Breast Cancer Recurrence

K L H S Perera, M D R L Silva

Department of Computer Science
University of Sri Jayewardenepura, Sri Lanka

After recovery from breast cancer, chances are there for the recurrence of cancer where it comes back after initial treatments. Conventional methods to detect breast cancer(BC) recurrence such as watch for recurrent cancer during the follow-up examinations are done by oncologists take a longer time to reveal the threat. Thereby, early prediction and detection of recurrence cancer is the vital need of every patient since it is their greatest fear. Since prediction has to be fast and efficient, highly influenced features for the recurrence should be identified. This research aims to comparatively analyze the advantages of using feature selection on clustering algorithms in predicting BC recurrence. In this study, we have performed breast cancer recurrence prediction using clustering techniques namely, Kmeans algorithm, Complete-Linkage(CL) algorithm, Expectation-Maximization(EM) algorithm, and Hierarchical Kmeans(HK) algorithm and Information Gain(IG) as the feature selection. We studied the outputs from the clustering algorithms with IG feature selection and compared them with outputs from clustering algorithms without using feature selection. Finally, the results exhibited that the EM algorithm with IG feature selection outperformed the other clustering techniques.

Keywords: Breast cancer, recurrence, feature Selection, clustering, information gain, kmeans, complete-linkage, expectation-maximization, hierarchical kmeans

Finding Feasible Image Processing Pipeline Using Genetic Algorithm

J P B A Jayasinghe, A M R R Bandara

Department of Computer Science
University of Sri Jayewardenepura, Sri Lanka

Building an image processing system is a difficult and time consuming process that requires knowledge in both the application domain and computer science. The lack of this knowledge prevents using image processing in many potential applications. This study proposes a method to develop a system, which gets the image processing pipeline designed automatically based on the sample input and output image pairs. Hence the hard work that needs to be done by the developer could be reduced and a better and accurate pipeline can be created. As this is an optimization problem, a genetic algorithm-based technique is used in the proposed method. Several image processing operations were used as the genes in the chromosomes and performed all typical genetic operations to build the prototype and evaluated using color extraction with smarties, hand extraction, and blood vessel extraction in fundus images using morphological method and template based method where an accuracy exhibited around 95%, 75%, 80%, and 77% respectively.

An Investigation into UI generation compliant with HCI standards ensuring artifact consistency across SDLC

Shyam Reyal,Samanthi E.R.Siriwardana, Arhchana Kugathasan, Sapthaka Godage, Dumindu Nissanka, Shashoda Kalindu, Pathumi Uduwana

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"The Alter" eliminates software product inconsistency by adhering to SDLC best practices and ensuring that the final product complies with HCI principles with minimal supervisor guidance under the pandemic condition. This paper presents two surveys and an interview: A literature survey on current automatic UI generation tools and a user survey on why it is necessary to have a system that generates user interfaces automatically. The first survey reviews the underlying systems and software used to automate the user interface generating process. With the help of the SDLC process (Requirement gathering, UML diagrams generation, generating wireframes, web UI generation, evaluate the application of HCI concepts) and HCI practices, the second survey attempts to bridge the gap between manual and automatic UI generation. The focus of the interview is on the significance of artifact consistency.

Keywords: Unified Modeling Language (UML), HCI (Human-Computer Interaction), SDLC (Software Development Life Cycle), UI (User Interfaces), Artefact Consistency

A rule based approach to minimize false-positive declines in Electronic Card Not Present financial transactions using feature engineering techniques

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In this research paper, we are been proposing a rule-based approach to minimize false-positive declines ("Legitimate transactions are been declined falsely identifying as fraudulent") in electronic CNP transactions. Related to the increased popularity of digital payments FP declines are becoming a severe problem among merchants who provide digital payment solutions. It's estimated that nearly 10% of the transactions are been declined as fraudulent transactions but only very few of them have fallen into the fraud category. To address this problem we have proposed a feature engineering technique based on behavior analysis. Our research is conducted based on a real-life CNP transactional data set from one of the largest fintech service solution providers in Sri Lanka and we have generated 130 features for each transaction and have employed an XgBoost Classifier to learn the classifier. We found out that this solution can mainly benefit the merchants who provide electronic payment solutions which involve CNP transactions to minimize false-positive declines targeting legitimate frequent customers and by the same, it minimizes the fraud losses and protects the customer's interests.

Keywords: False-positive problem, Machine learning, Feature engineering, Behavior analysis, Rule-based approaches, Fraud detection

Criminal investigation and management system using CCTV footage - "Eagle Eye"

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Automated criminal identification is not a very popular topic in Sri Lanka. To identify criminals, the methods which authorities are using are unnecessarily time-consuming. To make this process immovable, identifying a wanted person using an automated system would be a better alternative rather than the current practices. Current practices and techniques such as gathering records from eyewitnesses are not highly reliable. Even though scanning through CCTV camera footage manually is again laborious. Using modern technologies such as biometrics would be the best way to achieve this task in terms of accuracy. We will also use abnormal behavioral detection accompanied by Threatening weapons. As biometric techniques, using face recognition and figure recognition will provide the most promising result. Along with the modified image enhancement method that we are suggesting, the system will be able to capture and process the task in a much better way. Although biometric systems have already been used in society, there is no such system which can be used to identify and verify criminals. we used algorithms such as CNN, DNN, LBPH and Deep learning. As a final result, the system will automatically identify the entire crime incident to improve the quality of the footage, detect the abnormal behaviors accompanied by threatening weapons, identity & recognize the registered criminals using faces and their figures automatically with a minimum amount of time and higher accuracy level.

Keywords: Face Recognition, Image Enhancement, Abnormal Behavior Detection, Closed-Circuit Television (CCTV), Figure Recognition, Convolutional Neural Network (CNN), Deep Neural Network (DNN), Local Binary Patterns Histogram (LBPH), Deep learning

Supervised Learning Approach for Detection of Sinhala Depressive Posts based on Twitter

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Depression is a common mental disorder and a treatable mental illness under a low cost if diagnosed at its early stage. But many of the affected people do not diagnose the disease at its early stage especially in Sri Lankan community due to the lack of awareness about the depression, having negative perception about the mental health services and social stigma. In serious stage, suicide could be a result of untreated depression. Therefore, early detection of depression plays an important role in psychology domain. Nowadays people are more open on social media platforms and tend to share personal information such as emotions, feelings, and problems. Also, they even expecting online help and guidance to overcome from their problems. As a result of that, social media has gained the attention of many researchers recently to detect depression using social media data. Even though this is a well-researched area using high resource languages like English. According to the author's knowledge this is the first study which has been done to identify depressive contents in Sinhala contents. From this research, system was developed naming "DepDetect" which is based on Twitter platform. Prediction model was built and tested with five supervised machine learning algorithms (SVM, Multinomial Naïve Bayes, Random Forest, Decision Tree, KNN) and KNN was used to develop 'DepDetect' which observed the highest accuracy score with 70%.

Keywords: Depression, Supervised Learning, Machine Learning, Sinhala Scripts

English Language Trainer for Non-Native Speakers using Audio Signal Processing, Reinforcement Learning, and Deep Learning

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Lack of basic proficiency and confidence in writing and speaking in English is one of the major social problems faced by most non-native English speakers. Although the general adult literacy rate in Sri Lanka is above average by world standards, the English literacy rate is just 22% among the Sri Lankan adult population. Many individuals face setbacks in achieving their career and academic goals due to these language barriers. In a world where English has become a compulsory requirement to pursue higher education, career development, and performing day-to-day activities, "English Buddy" is a software solution developed to enhance the English learning experience of individuals in a more personalized and innovative way. The system provides an all-in-one solution while filling major research and market gaps in existing solutions in the e-learning domain. The system consists of a personalized learning environment, automated pronunciation error detection system, automated essay evaluation process, automated descriptive answer evaluation component based on semantic similarity, and real-time course content rating system. English Buddy is implemented using state-of-the-art technologies such as Audio Signal Processing, Reinforcement Learning, Deep Learning, and NLP. The LSTM, Sentiment Analysis, and Siamese network models have gained accuracy scores of 0.93, 0.92, and 0.81 respectively. Further, the UAT results proved that the personalized recommendations and pronunciation error detection processes are accurate and reliable. This research has been able to overcome the limitations of most existing solutions that follow traditional approaches and provide better results compared to the recent studies in the e-learning research domain.

Keywords: Audio Signal Processing, Deep Learning, Natural Language Processing, Reinforcement Learning

Non-Verbal Bio-Markers for Automatic Depression Analysis

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Detection of early depression risk is essential to help the affected individual to get timely medical treatment. However, automatic Depression Risk Analysis has not received significant focus in prior studies. This paper aims to propose an Automatic Depression Risk Analyzer based on non-verbal biomarkers; facial and emotional features, head posture, linguistic, mobile utilization, and biometrics. The analysis has shown that facial and emotional features can learn to identify depression risk better when compared with the head pose and emotional features. Moreover, the study shows that Depression Risk Analysis based on linguistic performed well with 95% accuracy for Sinhala content and 96% accuracy for contextual in English. Identifying the depression risk based on the biometrics, the sleep pattern analysis obtained 95% accuracy with the K Nearest Neighbour (KNN). Further, the mobile utilization analysis with the KNN model achieved 81% accuracy towards the Depression Risk Analysis. The accuracy of Depression Risk Analysis can be improved by extending analytic models to work as a single model. Furthermore, The models have been integrated with a mobile application that allows users to get a comprehensive Depression Risk Analysis based on each biomarker. These additional methods will function together to provide a more accurate on assessing depression risk.

Keywords: Depression Analysis, Facial Expression, Sentiment Analysis, Biometric Analysis, Phone Usage Analysis

Towards Developing a Simple Lumped Parameter-based State Estimator for PneuNets

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Soft actuators (SAs) are used for gripping and manipulating activities in various industrial applications and different designs of SAs are developed to improve their efficacy. In these designs, compliance materials are used to control the morphology of SAs to generate different movements. Specifically, PneuNets design is one of the popular designs and it uses the pressure difference in their internally networked chambers to control the movements. These chambers act as energy storing and releasing elements during pressurizing and de-pressurizing stages and play an important role in controlling motion output. These discrete chambers are usually networked and continuum therefore, they are difficult to model and integrate into control systems. The present paper attempts to use a hypothetical disc model to estimate the real-time states of PneuNets. The proposed second-order model has a single stiffness element (K) and a single damping element (B) that is assumed to be approximately equal to the change of bending angle of the PneuNet. These K and B values are obtained experimentally and the results were compared against finite element simulations. The model was tested for step/ sine inputs and resulted in an average root-mean-square-error approximately 4%.

Keywords: Soft actuators, State estimation, Hypothetical disc model, Control of soft actuators

Indoor Localization System Based on Bluetooth Low Energy with Inertial Sensor Assist for Resource Constrained Environments

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Indoor localization refers to locating people or objects inside indoor areas where conventional localization approaches fail to perform. This paper presents a novel methodology for indoor localization with Bluetooth Low Energy and inertial sensors for resource constrained devices. Authors approach uses a Kalman filter-based localization method that is running on the cloud, compared to previous work that utilized the end node for processing. The performance of the proposed system depends on factors such as the accuracy of inertial sensors, data broadcast frequency, and the quality of indoor infrastructure. Results show that our approach for indoor localization is well suited for devices with limited processing power.

Keywords: BLE, IMU, RSSI, Kalman filter

Period Prediction of Sinhala Epigraphical Scripts using Convolutional Neural Networks

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Inscriptions are important resources to know our history. The study of recognizing epigraphical scripts is a challenging task since the shapes of the characters were changed over the time and different sets of characters were used in different eras. Period prediction of epigraphical scripts is an important initial step in automated inscription character recognition systems, and also it helps archaeologists to find the era of an inscription in real-time. In this paper, we propose a novel approach to classify the era of Sinhala epigraphical scripts into five different periods using the images of Sri Lankan inscriptions. Since no previous studies were conducted, we have constructed a dataset for Sinhala ancient characters. Deep transfer learning techniques are utilized to train a CNN model with fewer numbers of samples. Moreover, a channel attention module is included to boost the character-wise features in classification. Based on the experimental results, the proposed approach showed 90.60% of average classification accuracy.

Keywords: Period Prediction, Inscription Classification, Epigraphical Scripts, Sinhala Character Recognition

Differential Diagnosis of Ringworm and Eczema Using Image Processing and Deep Learning

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Misdiagnosis of dermatological disorders is an ordinary incident among both doctors and dermatologists around the world. Among them, misdiagnosis of common dermatological disorders is exceptionally high since these types of common diseases appear visually similar on some occasions. Then these easily curable diseases can get devastatingly complicated due to the initial misdiagnosis and wrong treatments. Ringworm and eczema are two commonly misdiagnosed dermatological diseases that often display similar visual attributes as well as non-visual patient history questions. These two diseases were chosen after an investigation to differentially diagnose using an image-based system for this research. In the proposed system, the end-users are allowed to upload an image to the system, and using different image processing techniques; the lesion area will be detected. Then the image will be classified using a convolutional neural network that was trained using a dataset and will display the diagnosis result. To give a better experience, an android application was designed and developed as the frontend of the system. The proposed solution is entirely based on the visual aspects displayed on the lesion, which once trained, is capable of diagnosing with an accuracy of 82%.

Keywords: Image Processing, Classification, Deep Learning, Convolutional Neural Network

Detection of Wildlife Animals using Deep Learning Approaches: A Systematic Review

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The detection of animals, in particular wildlife animals, is important to monitor their distribution for the conservation of animal life and to address a broad range of questions of animal researchers, such as in the study of ecosystem function and behavioural ecology, analyse the growth and development of animals, understand population dynamics, and discover the factors influencing animal movements. Researchers use camera traps that are activated when an animal enters their field, allowing them to collect millions of images of animals without disturbing them. Machine learning methods, particularly convolutional networks, have quickly risen to prominence as the preferred way for detecting and recognizing animals in camera trap images. This paper examines the major deep learning ideas relevant to the detection and recognition of wildlife animals, as well as the contributions to the field, the majority of which have been published recently. We survey the use of deep learning techniques for automated animal recognition, segmentation, and detection and provide a concise analysis and comparison of these approaches. The open challenges and prospective research directions are discussed.

Keywords: Wildlife Animals, Detection, Ecosystem, Camera trap images, Deep learning, Review

A Rule Based Approach for Detection and Correction of Grammar Errors in Written Active Voice Sinhala Sentences

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Sinhala is the official language and major spoken language in Sri Lanka. The Sinhala language is one of the rare languages having diglossia, in which the written variety differs from the spoken variety. The written variety of Sinhala is very complex because it is defined by many grammar rules. Due to this complexity, there is not a specific tool to detect grammar errors in typed sentences as a web-based solution for grade five students to practice answering essay questions. This paper proposes a grammar checker module that helps primary school students who learn in Sinhala medium to identify grammar errors in input sentences. The proposed module also defines the type of errors and provides suggestions to correct errors in subject or verb or both. Therefore, this system enables to improve written competency in Sinhala learning and minimize grammar errors. A rule-based approach has been used for implementing the grammar module and the system is evaluated by the recall, precision, and accuracy, based on grammar error detection, error type identification, and error suggestion aspects. Precision, recall, F1 score for the grammar detection is 1, error type identification accuracy is 93.81% and suggestion accuracy is 83.85% within the defined scope.

Keywords: rule based, grammar error detection, error types, suggestions, Sinhala grammar

SMART Garbage Bin Kit: Expandable and Intelligent Waste Management System using Deep Learning and IoT for Modern Organizations

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According to published statistics, Sri Lanka produces garbage around 7000MT per day, and every organization directly contributes this national amount depending on the waste management practices. 'Waste contamination' is a critical issue that affects waste management, and it should be addressed during the garbage collection process. This has led to environmental hazards resulting in health and other social issues. Hence, it is a responsibility of an organization to separate the garbage during the collection process using a suitable technique. In this paper, we are proposing a smart garbage bin kit that automates the separation of garbage collection, which minimizes human error using AI based technologies. IoT-based devices connected to a smart garbage bin kit guide the user to the correct bin. At the same time, our proposed system can be easily expanded for new special waste categories as well. The other important issue of the current garbage management is improper time management of the garbage removal process in organizations. This happens due to the lack of real time data on waste bins, and collection is based on the fixed time interval irrespective of the status and location of garbage bins. In the proposed system of SMART Garbage Bin Kit, the group of all interconnected garbage bins is monitored in real-time to identify the optimum collection path considering the location and the status of garbage bins using an optimized algorithm. Hence, the study presented in this paper integrates several intelligent approaches together with IoT based network to build a cutting-edge device, declared as SMART Garbage Bin kit. The prototype system has been built as a part of the research study to demonstrate its feasibility and sustainability.

Party-based Sentiment Analysis Pipeline for the Legal Domain

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Since the advent of research to automate existing manual language workflows, legal domain has risen as a key area. When it comes to making the process of court cases more efficient with the said automation, legal information extraction is vital for legal professionals. In this study, we propose a unified pipeline to annotate party-based sentiment for court cases which reduces manual work. To achieve this end, we combined two state-of-the-art models into a single workflow. The first model extracts the entities which represent each party in a court case, while the second model analyzes the sentiment with respect to each party in a given sentence of a court case. In this study we propose two approaches for defining the pipeline which maps the output of the party extraction system into the party-based sentiment analysis system. Further, we propose improvements to the existing party extraction system.

Keywords: Natural Language Processing, Aspect Based Sentiment Analysis, Legal party identification, Legal Domain, Information Extraction

Seeking Sinhala Sentiment: Predicting Facebook Reactions of Sinhala Posts

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The Facebook network allows its users to record their reactions to text via a typology of emotions. This network, taken at scale, is therefore a prime data set of annotated sentiment data. This paper uses millions of such reactions, derived from a decade worth of Facebook post data centred around a Sri Lankan context, to model an eye of the beholder approach to sentiment detection for online Sinhala textual content. Three different sentiment analysis models are built, taking into account a limited subset of reactions, all reactions, and another that derives a positive/negative star rating value. The efficacy of these models in capturing the reactions of the observers are then computed and discussed. The analysis reveals that binary classification of reactions, for Sinhala content, is significantly more accurate than the other approaches. Furthermore, the inclusion of the like reaction hinders the capability of accurately predicting other reactions.

Keywords: NLP, sentiment analysis, Sinhala, word vectorization

Project Zone : An Advanced Undergraduate Project Management System For Software Development

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Project Management System important in large scale projects. There are existing project management tools such as Redmine, Microsoft Project, Jira. Most of the existing project management systems only configured for general purposes such as Project Management, Task management, Time line management. None of them capable of generating project groups, track student progress or track client meetings. These functions are very helpful in tracking project progress as well as individual member progress. Hence, the purpose of this research is to introduce set of new features to a project management system with accurate and effective project management capabilities. This system is capable of generating project groups using student's skills, Grade point average (GPA). Smart project tracking system where it uses project repositories and system generated timeline for the project. Using the project tracking system, Supervisors can manage groups remotely. Automatic peer review also added to identify each student's contribution to the project and finally a client portal where clients can request solutions for their requirements and students can use them as their module project. Client meetings will be tracked using voice-to-text algorithm and also emotional recognition where it will identify client's satisfaction. All These system modules will be used to calculate group performance.

Keywords: Project management system, Student grouping, Project contribution manager, Speech Recognition, Peer Review

Macroeconomic Event Base Expert Advisor for Forex Trades: Through Algo Trading

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An implicit foreign exchange trading decision is generally at the mercy of effective forex forecasting. Forex trade has been scrutinized using two sequestered approaches, technical and fundamental analysis. The fundamental data of the economy, correspondingly have a decisive influence on the forex. The idea of seeing the macroeconomic announcements turns progressively challenging due to the direction of the gigantic and variant figure of prices' determining factor and the rapid fluctuations in market dynamics. The main aim of this study is to develop a macroeconomic event base expert advisor to identify the patterns and provide a signal and automate trades based fundamental analysis to forex day traders. Moreover, the paper emphasizes the association between forex high-frequency dynamic forces and macroeconomic announcements that can be determined as events. The sensitive nature of the macroeconomic factors in the forex market must be considered in any system that efforts to deliver users with reasonable and effective insights into the market. The expected implication is to provide a novel methodology for the interested parties and provide a more accurate algo trading system for Forex Day traders. This expert advisor helps to address the gaps in fundamental analysis-based studies and helps to make successful and proper trading decisions as well. This study applies the Machine learning methodologies like linear regression, support vector machine to Random Forest optimizes indicators parameters in order to react straightway to slight variation in the marketplace status by producing swap signals driven fundamental analyses. Further main algorithm develops using mathematical modeling and Backpropagation Weight Decay Neural Network.

Keywords: Fundament analysis, Macroeconomic announcements, Expert Advisor, Forex, Algo Trading

Mammogram-Based Cancer Detection Using Deep Convolutional Neural Network

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Breast cancer is now a common health problem among most women. Breast cancer is the world's second-largest cause of mortality for women, and it affects mostly women over the age of 50. The major reasons are that most women do not have proper knowledge about breast diseases/conditions, and the inability to detect abnormalities in the initial stages. A mammogram is one of the best imaging modalities recommended by doctors to diagnose breast cancers. Consultant radiologists are necessary for the identification of those breast pathologies by mammogram images. For a human, it takes some time to read and have an opinion about the condition. Also, the pandemic situation makes the diagnosis processes even more difficult due to the unavailability of doctors and other medical staff. Deep learning approaches are applied for breast cancer detection, and it helps radiologists to identify breast pathologies quickly and accurately. In this work, the mammogram images are collected using MIAS, DDSM, and INbreast databases. The proposed system identifies the location of the lump within the breast, if the lump is malignant or benign, the size of the lump, and the state of the nipple (It is abnormal or not). Convolutional Neural Network (CNN) method for classifying screening mammograms obtained outstanding performance compared to the previous methods. This CNN method produces 96.5% accuracy for breast tumor classification and produces the 80% accuracy for nipple classification.

Keywords: Breast Cancer, Mammogram, Deep Learning, CNN

EEG Based Real-Time System for Video Advertisement Recommendation

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Due to the innovative advancement in technology and competition in the business fields, video commercials are well known and extremely popular. As a result, analyzing the impact of these video commercials is critical before beginning marketing and promotion. Specifically, this study addresses a strategy for assessing the viability of movie commercials, which are essentially trailers, using Electroencephalogram (EEG) signals captured from a Brain Computer Interface (BCI). This allows the company to consider the impact of the commercial and its value. In addition, this has a recommend system that proposes movie adverts depending on the user preferences. The particular video will be evaluated from emotion, attention and enjoyment aspect of the user. Random Forest prediction algorithm with 91.97% accuracy was used for emotion analysis, Support Vector Machine (SVM) based c-Support Vector Classifier (C-SVC) algorithm with 91.70% accuracy was used for attention analysis while using statistical approach Central Limit theorem and Empirical rule was used for enjoyment analysis to isolate particular emotion state. The preliminary results confirm that the proposed framework is yielding promising results, which is encouraging. Research on film and entertainment has potential to be expanded to many other industries, despite its current concentrate on film.

Keywords: Electroencephalogram (EEG), Brain Computer Interface (BCI), Emotion Detection, Attention Detection, Enjoyment Detection, Recommend system

Human Tracking and Profiling for Risk Management

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Infectious viruses are conveyed via respiratory droplets produced by an infected person when they speak, sneeze, or cough. So, to combat virus transmission, the World Health Organization (WHO) has imposed severe regulations such as mandatory face mask use and social segregation in public spaces. The 'Human Tracking and Profiling for Risk Management System (HTPRM)' is an online application that identifies the risk associated with failing to follow proper health practices. This proposed approach, which is divided into four components, utilizes 'You Only Look Once (YOLOv3)' to detect face-mask danger, which would be determined based on two factors: wearing the face mask properly and the type of mask (Surgical,k95, homemade, and bare). The second phase is to use OpenCV and SSD-Mobilenet to evaluate the value of a one-meter space (Social Distance) between people. The system recognizes the maximum number of individuals that can be in the vicinity of the specific hall that uses YOLO(V3) and image processing as the third procedure. In the last processing, the system identifies each person's behavior, classifies it as uncommon or not, and calculates the risk associated with each category. Finally, the system computes the overall risk and generates a warning alarm to notify the user that they are in a dangerous scenario.

Keywords: YOLOv3(You Only Look Once, Version 3), SSD (Single shot detector), Mobile-net, Open-CV, Image Processing, Open pose, Tenser-flow

A Sinhala Natural Language Interface for Querying Databases Using Natural Language Processing

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In this paper, the author presents SinSQLFinder, a Sinhala natural language user interface for generating SQL queries. Data is the heart of the decision-making process in every business, every organization, every government office. But at the same time working with data stored in the databases require special technical skills like Structured Query Language (SQL). It is an identical problem that the non-technical people are facing difficulties while retrieving data from the databases. In Sri Lanka, the native language of the majority of people is Sinhala and a considerable amount of e-governance applications use relational databases. Therefore, to manipulate data from such database applications easily, non-technical users who are more confident with the Sinhala language, need a solution to agree with a simple sentence in Sinhala and generate a valid SQL query. Nevertheless, the main goal of this research has been to establish a strong link between the Sinhala language and structured query language. Because of the language's complexity, a unique method was developed to translate Sinhala language questions into structured query languages.

Keywords: Natural Language Processing (NLP), Sinhala, Relational Databases, Structured Query Language (SQL), Natural Language Interface for Databases. (NLIDB)

Navigate-Me: Secure voice authenticated indoor navigation system for blind individuals

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The majority of blind people require assistance when navigating through unfamiliar places due to a lack of information about the building structure and encounterable obstacles. To address this aspect of the problem, this paper presents "Navigate-Me" as an approach for indoor navigation with maximum accessibility, usability, and security, reducing the problems that the user might encounter while navigating through indoor environments. As the targeted audience of this paper is blind or visually impaired people, Navigate-Me utilizes voice-based inputs from the user. In addition, this paper includes Bluetooth beacon integration for localization, White Cane with sensors for obstacle detection, a machine learning model for voice authentication, and an algorithm protocol for a secure connection between server and application integration-driven architecture to assist the visually impaired in navigating known and unknown indoor environments.

Keywords: vision impaired, localization, indoor navigation, voice authentication

Hate Speech Detection in Sinhala-English Code- Mixed Language

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With the steady increase of user-generated content on the internet, the amount of hate content on the internet is also being rapidly increased. Social media sites, review forums, microblogging sites encourage users to convey their thoughts with minimum restrictions. This leads to expressing hate towards others who do not believe their beliefs. This study focuses on identifying hate speech texts that are written in Sinhala-English code-mixed language (Singlish) which is mostly used by Sri Lankans on the internet. Due to the unavailability of Sinhala-English code-mixed datasets, the dataset was created using comments on YouTube and Facebook. In this research, eight machine learning algorithms and three ensemble approaches were evaluated to detect hate speech in Singlish. Furthermore, their accuracy, precision, recall, and f1-score were evaluated. Afterwards, based on the performance of the considered algorithms, Support Vector Machine (SVM), Multinominal Naïve Bayes (MNB), AdaBoost Classifier, and Logistic Regression classifiers were used to develop ensemble learning-based solutions. In terms of ensemble learning approaches, soft voting, hard voting, and stacking were evaluated. The hard voting approach outperformed other baseline algorithms and ensemble approaches with 84% accuracy and f1-score.

Keywords: Ensemble Learning, Hard Voting, Hate Speech detection, Sinhala-English Code-Mixed Language

An Ontology-Driven Question Answering System for Computer Network Module

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The field of "question and answering" has become a popular area of research in recent years. The main reason for this is that the search through the "question answering" system is found to be more efficient than the normal search. The Question Answering (QA) Systems can be two types in general such as open-domain QA systems and closed-domain QA systems. Search engines are generally open-domain QA systems that are used to search and retrieve the data we need. However, instead of search engines giving accurate and precise answers to the user queries, they often returned the list of links. Then, the user clicks on each link one by one to get the answer. This method of searching can sometimes not give the precise answers to the user queries, or the user may have to spend more time searching for the answer, and hence the users may experience discomfort. This situation can be avoided by using the semantic concept. The normal web data are machine-readable and can be understood by humans, whereas the semantic web information is machine-readable and understandable. Ontology is the main component of the semantic web and it can be described as the structure of knowledge-representation of a particular domain or subject. It clearly describes concepts, roles, instances, and the relationships between them. The Question Answering (QA) system is one of the popular applications of ontology. Here, the QA system is used to extract the precise answer to the user queries from the data repository. The system can be developed using different techniques like NLP with IR, reasoning with the NLP, web-based QA System, ontology-based QA System, and more. This particular question answering system is developed using the ontology model. This ontology-driven question answering (QA) system provides the facility to the users to find accurate and concise answers for their queries in the Computer Network module of ICT Subject. The same questions that are asked in the ontology-based question answering system can be asked in the web-based system. The reason is that both of these methods are used in this system. This will make it easier for users to understand the difference between the two systems. The performance results of both these systems further strengthen the statement.

Keywords: Ontology, SPARQL, NLP, Computer Network

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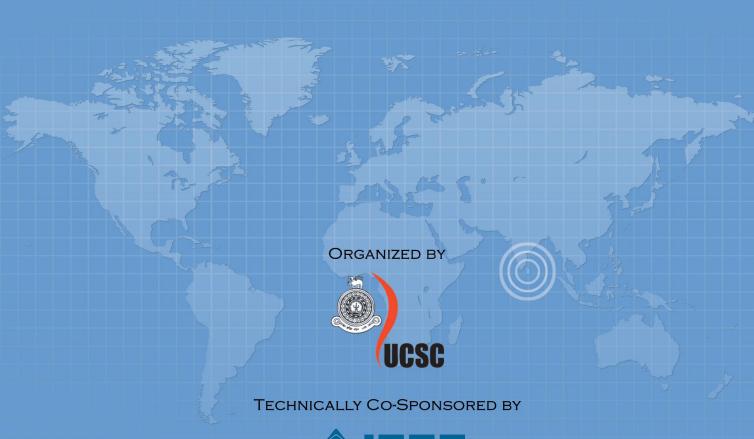
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