

6th ENGINEERING STUDENTS' CONFERENCE AT PERADENIYA



PROCEEDINGS OF ESCAPE 2021

ORGANIZED BY
DEPARTMENT OF COMPUTER ENGINEERING
FACULTY OF ENGINEERING



UNIVERSITY OF PERADENIYA
SRI LANKA

24TH OF JULY 2021

ISSN 2806-5050



9 772806 505003

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**Message From the VC
University of Peradeniya**

I warmly extend my best wishes for the 6th “Engineering Students Conference at Peradeniya” (ESCaPe) 2021 of the Department of Computer Engineering, Faculty of Engineering, University of Peradeniya. Research is the link among Universities, Industries, and Research Institutes. The collaboration among them is mutually beneficial for both parties leading to the sustainability of collaborative programs. It also has a clear potential to make a significant contribution to the quality of higher education. Therefore, this symposium would provide a platform to present and publish research work carried out by final year undergraduates under the guidance of academic staff and outside subject experts.

In line with this year's theme “Empowered with AI ”, the research conducted this year is related to developing intelligent engineering solutions for forsaken issues arising from computing to cross-disciplinary fields. It is evident that the quality of the research and symposium proceedings have reached a commendable level showing the commitment of the academic staff and the students to develop the research culture in the University.

I would also like to extend my sincere gratitude to Prof. Gamunu Herath, Dean of the Faculty of Engineering; Dr. (Eng.) Kamalanath Samarakoon, Head, Department of Computer Engineering; Dr. Upul Jayasinghe, Chair of the symposium; all academics and non-academics of the Department for the immense support, commitment, and cooperation for making this event successful. Finally, I extend best wishes to those who present their research findings at the 6th Engineering Students Conference at Peradeniya, 2021.

Prof. Upul B. Dissanayake,
Vice Chancellor,
University of Peradeniya.



Message From the Dean Faculty of Engineering

I am delighted to convey this message on the occasion of the 6th “Engineering Students Conference at Peradeniya” (ESCaPe) 2021 of the Department of Computer Engineering, Faculty of Engineering, University of Peradeniya. ESCaPe Symposium is an annual event in the academic calendar of the Department of Computer Engineering and has been a great success in the last several years with high quality presentations, publications and participation of academics, industry personnel, undergraduates, and scientists from different research institutions. The ESCaPe has great importance to the Faculty mainly because the research outcomes of the graduating students are disseminated to the public after one year of research work. I sincerely believe the experience that students gain, and the partnership strengthened in participating in the research session will brighten their path to the challenging future.

This year’s theme of the symposium; “Empowered with AI”; timely and vital in modern day applications in any field. Moreover, with the COVID 19 pandemic, today’s world is focusing more on online systems to run facilities and I’m sure knowledge that will be disseminated in this year’s symposium will add great value to such domains.

As the Dean of the Faculty, I also wish to convey my sincere gratitude to Dr. (Eng.) Kamalanath Samarakoon, Head of the Department, Department of Computer Engineering; Dr. Upul Jayasinghe, Chair of the symposium; council members of the Association of Computer Engineering Students (ACES), and distinguished staff members of the department for their tremendous effort for the success of the symposium. I wish the ESaPe 2021 would be a great success.

Prof. Gamunu Herath,
Dean, Faculty of Engineering,
University of Peradeniya.



Message From the Head Department of Computer Engineering

Since its inception, the Department of Computer Engineering has been true to its name. We have been striving to produce “engineering” graduates as opposed to software engineers or just coders. Our graduates have a deep understanding of entire computer system; from software to hardware. If the solution requires designing a piece of software, our students are capable of doing that. If the solution is about developing hardware, our students are capable of doing that as well.

The capacity of our students to solve real-world problems was exemplified during the pandemic situation as well. For examples Keshara and Kasun developed a centralized patient monitoring system which interfaced with individual patient monitors and decipher standard and proprietary health monitoring data protocols. The system was developed within a few days and deployed it in Kandy and Peradeniya hospitals which and has drawn the attention of the Prime-minister of Sri Lanka.

Chathurangi won the Investment Prize at the COINS Grand Challenge global competition in the UK; the largest cash prize won by an undergraduate in Sri Lanka and became the only undergraduate to win the Investment prize in its history. The device includes the hardware and the software required to measure the quality parameters of soil samples in the field itself without taking it to a laboratory which would save lots of money for the construction industry.

The research conducted by our final year students will be presented in two themes, accelerated AI and data-driven AI. The accelerated AI track will present research that looks at running typically computationally intensive AI applications on resource-constrained devices. As an example, Suneth, Pubudu and Wishma, is working with the Garvan Institute of Medical Research in Sydney to develop a low powered handheld device for DNA sequencing so that, DNA sequencing can be done in the field itself without transferring the samples to a laboratory. The DNA analyser is developed by Oxford Nanopore and our students are developing an FPGA based system for doing the sequencing in the field itself.

The research conducted by our undergraduates has resulted in publications in a number of reputed journals including the coveted Nature’s Communications Biology. On average, 50% of the research papers presented at ESCaPe in the past years have produced publications in at least International conferences.

Recently SLASSCOM coined the term “AI Nation” with the aim of transforming the Sri Lankan IT sector to embrace AI and Data Science as one of its main Pillars. As a country, are we ready to embrace the full potential of AI? That would be the topic for the panel discussion. Continuing the discussions we will initiate today, we hope to work together with SLASSCOM and ICTA to make “AI Nation” a reality.

Dr.Kamalanath Samarakoon

Head of the Department/Senior Lecturer,
Department of Computer Engineering,



Message from the Symposium Chair ESCaPe 2021

As the chairperson of the organizing committee, I am delighted and honored to bring this message to the 6th “Engineering Students Conference at Peradeniya” (ESCaPe) 2021 of the Department of Computer Engineering, Faculty of Engineering, University of Peradeniya under the theme of “Empowered with AI”. The ESCaPe research symposium focuses on the dissemination of research problems, problem solutions, and insights on new challenges facing Computer Engineering and related disciplines. The event will be delighted by two keynote speeches from the industry, twelve oral presentations, nine 3MT presentations, and a panel discussion with professionals from industry and academia allowing the participants, especially the undergraduate students to interact with them.

I would like to express my profound gratitude to Prof. Upul B. Dissanayake, Vice Chancellor, University of Peradeniya, Sri Lanka and Prof. Gamunu Herath, Dean of the Faculty of Engineering, University of Peradeniya for their guidance and fullest support in organizing this important event. I am also thankful to Dr. Kamalanath Samarakoon, the Head of Department, Department of Computer Engineering as well as Prof. Roshan Ragel, Dr. Dhammika Elkaduwe, and Dr. Asitha Bandaranayake for their guidance and encouragement. Moreover, I make this an opportunity to thank the symposium editors and the program committee for their immense support in the review process. This event held in the form of a webinar would not have been possible if not for the Lanka Education and Research Network (LEARN). Further, I’m grateful for the financial support given by the Faculty of Engineering, University of Peradeniya and Peradeniya Engineering Faculty Alumni Association (PEFAA) to make this event successful.

Association of Computer Engineering Students (ACES) have done a wonderful job in organizing this symposium successfully. Therefore, my heartfelt appreciation also goes to all the council members including Mr. Malitha Liyanage, President, ACES; Mr. Devin Gallage, Vice President, ACES; and Dr. Suneth Namal, Senior Treasurer, ACES. I also express my sincere thanks to the keynote speakers, Mr. Jeevan Gnanam, Founder/Group CEO of VeracityAI, and Mr. Thushera Kawdawatta, CEO Axiata Digital Labs for accepting our invitation to deliver the keynote speeches despite busy schedules. Nevertheless, my heartfelt appreciation also goes to distinguished panelists of ESCaPe 2021, Mr. Jeevan Gnanam, Founder/Group CEO VeracityAI; Mr. Thushera Kawdawatta, CEO Axiata Digital Labs; Mr. Anura de Alwis, Chief Digital Economy Officer ICTA; Mr. Dr. Romesh Ranawana, SLASSCOM; and Mr. Miller Rajendran, CEO at SenzAgro for their wise advice and suggestions.

Further, I would like to extend my appreciation to all authors and presenters at the 6th annual symposium of the Department of Computer Engineering who are the major contributors to this event. I would like to congratulate all of them for completing their projects and wish them all the best in their future endeavors. Finally, I thank all the participants of ESCAPE 2021 and I wish a successful symposium.

Dr. Upul Jayasinghe,
Chair,

Engineering Students Conference at Peradeniya 2021 (ESCaPe'2021)
24th July 2021
Department of Computer Engineering, Faculty of Engineering, University of
Peradeniya

Agenda of the Symposium

08:30 am	Commencement of the conference
08:35 am	Welcome Speech by Dr. Kamalanth Samarakoon, Head, Computer Engineering Department, University of Peradeniya
08:45 am	Speech by Prof. Gemunu Herath, Dean, Faculty of Engineering, University of Peradeniya
08:55 am	Speech by Prof. Upul B. Dissanayake, Vice-Chancellor, University of Peradeniya
09:05 am	Keynote speech I by Jeevan Gnanam - Founder/Group CEO of VeracityAI
09:35 am	Student presentations - Session I - Accelerated AI Track - Data Driven AI Track
11:05 am	Keynote speech II by Thushera Kawdawatta - CEO Axiata Digital Labs
11:35 am	Panel Discussion - Jeevan Gnanam - Founder/Group CEO VeracityAI - Thushera Kawdawatta - CEO Axiata Digital Labs - Anura de Alwis - Chief Digital Economy Officer ICTA - Dr. Romesh Ranawana - Chairman, Artificial Intelligence (AI) Centre of Excellence (AICx), SLASSCOM - Miller Rajendran - CEO at SenzAgro - Dr. Dhammika Elkaduwa - Senior Lecturer, Department of Computer Engineering, Faculty Engineering, University of Peradeniya (Moderator)
12:35 pm	Break
01:05 pm	Student presentations - Session II - Lightning Talks (3 Minute Presentations)
01:30 pm	Awards for the Best Research Article, Best Presentation, and Best Lightning Talk
01:45 pm	Vote of Thanks
02:00 pm	End of the Conference

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Abstracts of the Symposium

Using Near-Infrared Spectroscopy for Vein Visualization

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Abstract: Near-Infrared spectroscopy is used for better vein visualization to make the venipuncture process more efficient. While there exist a few models which use the said mechanism, these models are costly, have accuracy issues, and are limited only to certain types of skin tones. Hence, this paper proposes a low-cost mechanism of obtaining near-infrared spectroscopy by using the image-guided technique, low-cost hardware, optimized algorithms, and evaluate its efficiency and usefulness by a clinical trial. We have tested the prototype using different combinations of light sources with different intensities and have analyzed the results. To quantitatively analyze, we have compared the number of visible veins under high intensity and low intensity. The number of visible veins is either same or up to 5 veins higher when 18W is used compared to when an intensity of 60W is used. We have also observed that the darker skin tones that have zero visible veins at normal sight result up to 2-3 veins when the prototype is used. The number of veins increased from 1 to 5, when the device was used, on fairer skin as well. We plan to conduct a clinical trial and test the device on human subjects and get feedback from the end-users and improve the prototype accordingly.

Key Words: *Computer vision, Near-Infrared, Spectroscopy, Venipuncture, Vein visualization, Image processing*

Accelerating Adaptive Banded Event Alignment Algorithm Using OpenCL on FPGAs

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Abstract: Nanopore sequencing is a third-generation sequencing technology that can read long DNA or RNA fragments in real-time. Nanopore sequencers measure the change in electrical current as nucleotide bases pass through a protein nanopore. These signal level changes are utilized in various nanopore data analysis workflows (such as identifying DNA methylation, polishing and variant detection) to obtain useful results from nanopore sequencing data. Adaptive Banded Event Alignment (ABEA) is a dynamic programming algorithm used as a key component in many nanopore data analysis workflows. Prior investigations have shown that ABEA consumes 70% of total CPU time in Nanopolish, a popular nanopore data analysis software package. Thus, optimizing the ABEA algorithm is vital for efficient nanopore data analysis. A previous study has proposed an accelerated version of ABEA on GPUs using CUDA that improves the execution time, at the cost of higher energy consumption. With the advancements of High-Level Synthesis (HLS) tools, Field Programmable Gate Arrays (FPGAs) are becoming more and more popular as accelerators that are energy efficient. In this work, we explore the use of OpenCL for accelerating ABEA on FPGA. We propose a modified version of ABEA for FPGAs using OpenCL and apply various optimization techniques, leading to a few different implementations. We compare the performance of our implementations with other implementations on different hardware platforms in terms of execution time and energy consumption. We show that our best implementation achieves an energy consumption of only 43% of the previous implementation of ABEA on GPU, however, with around 4x increase in execution time.

Key Words: *FPGA Acceleration, DNA Sequencing, heterogeneous processing, OpenCL*

Optimizing Chloroplast Genome Assembly and Annotation with Skim Sequencing Data

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Abstract: Chloroplast genes and genomes play an important role in plant phylogeny and species identification. Skim sequencing is getting low coverage genome sequencing data that has nuclear, chloroplast and mitochondria genome sequences. Since the fast development of high throughput sequencing technologies, it's low cost to urges the low coverage data of the whole genome (usually concerning 20-30GB data) that is enough to assemble a whole chloroplast genome. To date, there are several assembly processes/pipelines designed to assemble a whole chloroplast genome. However, what proportion of knowledge is required or really utilized in such analysis is a problem. Having such information can facilitate biologists to style their experiments properly and cost-effectively. Biologists expect a straightforward, quick and easy procedure to assemble and annotate a circular chloroplast genome from Illumina NGS data. In this project, we analyse the present procedures for chloroplast genome assembly and annotation, and work on developing the strategies to spot and choose the best set(s) of data and the procedure(s) to assemble a given chloroplast genome as accurately and efficiently, by statistical, computational and heuristic strategies.

Key Words: *genome, chloroplast, assembly, annotation*

Microservice based Edge Computing Architecture for Internet of Things

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Abstract: Distributed computation and AI processing at the edge has been identified as an efficient solution for delivering real-time IoT services and applications compared to cloud-based paradigms. These solutions are expected to support the delay-sensitive IoT applications, autonomic decision making, and smart service creation at the edge in comparison to traditional IoT solutions. However, existing solutions have limitations concerning distributed and simultaneous resource management for AI computation and data processing at the edge, concurrent and real-time application execution, and platform-independent deployment. Hence, first, we propose a novel three-layer architecture that facilitates the above service requirements. Then, we have developed a novel platform and the relevant modules with integrated AI processing and edge computer paradigms considering the issues related to scalability, heterogeneity, security, and interoperability of IoT services. Further, each component is designed to handle the control signals, data flows, microservice orchestration, and resource composition to match with the IoT application requirements. Finally, the effectiveness of the proposed platform is tested and verified.

Key Words: *Edge Computing, Distributed Computing, AI, Microservices, Fog, ROOF, Cloud*

Real-Time Data Processing and AI for Distributed IoT

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Abstract: Artificial Intelligence has influenced a variety of industries by leading the world towards evolutionary applications and services that are primarily driven by high-performance computation and storage facilities in the cloud. This is mainly due to the advantage of having higher computational power, larger storage capacity and scalability but with the increase of millions of IoT devices, a large amount of data is being generated. To process such data, the distributed end devices have to communicate with the cloud servers. It is difficult to generate real time decisions though it consumes a lot of resources including bandwidth, processing power, and storage facilities in the cloud. On the other hand, Edge computing architectures enable a distributed way to process data near the sources which leads to facilitate real-time processing. But with the limited resources in the end devices, it is quite challenging to perform complex AI algorithms. To facilitate such services and to enable real time processing at the edge, We present an approach based on distributed computation, vectorization, computation offloading, parallelization, and federated learning techniques.

Key Words: *FL, multi threading, vectorization, Edge computing, Federated learning*

Mixed Reality Environment for Swarm Robotics Simulations

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Abstract: The term “Swarm Intelligence” is the collective behavior of a combination of many simple individuals, where they operate autonomously. “Swarm Robotics” is the application of swarm intelligence used in collective robotics. This has been a new approach to the coordination of mass of robots which are capable of local communication, decentralized control and autonomous operations based on biological inspirational senses.

Virtual Reality has been used to achieve higher effectiveness of swarm robotics applications. Mixed Reality is typically correlated with Virtual Reality by the solutions that have been made to address the problems related to the robotic applications. Mixed Reality implementations have been identified as more promising than Virtual Reality implementations by their flexibility, scalability, and availability. Experimentation and testing of robotic applications could be made far easier than using Virtual Reality by a significant increase of control over various environmental constraints and limitations.

The main focus of this research is the functionality of the mixed reality simulator which can mimic the behavior of swarm robots and how we can overcome the problems of reality integration in a modular and generalized methodology. We conclude this paper by proving that the traditional limitations of swarm robotics could be further realized with the help of Virtual Reality integration including virtual robot units, virtual characteristics, virtual environment, alongside with physical robots and environment to overcome the difficulties and to provide additional performances in more comprehensive and extended environmental configurations.

Key Words: *Swarm Robotics, Virtual Reality, Mixed Reality, Simulation*

Self Paced Non-motor Imagery Brain Computer Interface For Virtual Object Controlling

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Abstract: Non-invasive electroencephalogram (EEG) based Brain-Computer Interface (BCI) systems have been an interesting research area in many fields. However, most of the research done on this subject is synchronous, therefore, the state of the mind of the user at the time of application is different to its natural behaviour. As a solution to this problem in practical applications, self-paced BCI systems started gaining popularity in recent years. However, there are certain challenges yet to be addressed when following this method. Most of the research done on self-paced BCI systems are focused on motor-imagery control, whereas research on non-motor imagery mental tasks is limited. In this research, we analyse the possibility of using the techniques used in the motor-imagery method for non-motor imagery mental tasks to be fed into virtual object controlling applications. The research was done with 5 different classification models with the use of features from Fast Fourier Transform (FFT) and Wavelet Transform (WT). K-nearest neighbor model with features obtained with FFT sustained its performance continuously with a 0.56 cross validation value.

Key Words: *Brain Computer Interface, BCI, self-paced, EEG, sensorimotor rhythms, machine learning*

Ensuring Academic Integrity of Online Examinations

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Abstract: The need for invigilation is a must for examinations to maintain academic integrity. Though e-learning systems have grown rapidly, examinations are yet to conduct in a traditional setting where test takers are required to visit testing centers. In the context of online exams, proctors are yet to supervise a larger group of candidates through a live video stream during the examination. Often, online examinations require human invigilation either by live monitoring or inspection of recorded video to ensure academic integrity. This process is not feasible always since exams can be taken at any time and it involves high cost. This paper proposes an Online Proctoring System to automate invigilation processes by making use of inputs from a web browser, without using any external hardware or standalone application. The literature suggests not to depend on a single modality, rather make a decision based on several modalities. Their evaluation results imply that combining several models and creating a multi-model architecture produces better results. Processing the webcam video is one of the main aspects when deciding the abnormal behavior of the candidate. Head pose detection, eye gaze detection, liveness detection are several parameters that could be used for predicting abnormal behaviors.

Further, using the audio stream we can detect activities such as asking help from a person in the room. The system addresses a subset of misconduct such as frequent abnormal activities of the test taker's head pose, asking help from a nearby person, or inappropriate use of keyboard or mouse in the context. As a result, several misconducts during the examination can be identified and labeled as suspicious.

Key Words: *Online proctoring, invigilation, anomaly detection, unsupervised learning, behavior fingerprinting*

Real-Time Emotion Recognition using Electrocardiogram Analysis

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Abstract: Most of Electrocardiogram (ECG) analysis based emotion recognition studies use different machine learning techniques. Main problem with these methods is lack of accuracy and not having the ability to classify emotions real-time. The proposed method uses a large public dataset to increase accuracy and implements a Convolutional Neural Network (CNN) to identify emotions. First, the ECG data signals are preprocessed to increase the number of instances. Next, important features are extracted using feature extraction methods and finally the features are fed to a CNN. Three CNN models are trained to predict the valence, arousal and the dominance values of the ECG signal, which are used to finalize the emotion by mapping those values to the valence-arousal-dominance 3D plane. The CNN based classification models implemented in this proposed method results in a maximum accuracy of 81%.

Key Words: *ECG, Neural Networks, Emotions, Classification, Feature Extraction*

Improved Gesture Recognition for sEMG based Human Machine Interface

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Abstract: Identifying hand gestures using surface electromyography (sEMG) signals is vital in the development of next generation human-machine interfaces (HMIs). sEMG based HMIs provide users with a more natural and convenient way to communicate with computing systems. sEMG signals recorded from muscle tissues give information about the intended muscle movements triggered by the brain waves. Identifying these movements allows developing interfaces that can control computing devices. In this research, we present an improved hand gesture recognition model that could be used in a real-time end-user human-machine interface, using an online open dataset of sEMG signals. First, sEMG signals were preprocessed using a bandpass filter and notch filter to remove noises in the signal. Then various time, frequency, and time-frequency domain features were extracted, and they were fed into machine learning algorithms such as random forest, support vector machines (SVM), K-nearest neighbors (K-NN), and recurrent neural networks to classify 8 class of gestures: idle, hand fist, the flexion of the hand, the extension of the hand, and four gestures of pinching fingers. All the results were validated using 10-fold cross-validation. Maximum accuracy of 90.03% was obtained using an SVM classifier with root mean square, mean frequency, and median frequency of the signal as features for 24 channel data. The same process was repeated for eight channel data using a signal acquisition device with fewer electrode configurations, which is known to give a better user experience and reduced signal processing delay, and achieved a maximum accuracy of 86.02% with the same classifier and features. Even though a good accuracy was achieved, precision and recall values for pinching gestures is significantly less than the values for idle, fist, flexion and extension gestures. In conclusion, the proposed model was more biased towards a particular set of gestures and therefore, further research needs to be done before adopting this analysis in a real-time end-user system.

Key Words: *Surface Electromyography, Gesture Recognition, Human-Machine Interfaces, Bio-Signal Processing, Machine Learning*

Adaptive People Movement and Action Prediction Using CCTV to Control Appliances

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Abstract: With the availability of high-performance processors and GPUs, the demand for Machine learning, Deep learning, and Computer Vision is growing exponentially and more complex but efficient systems are being developed. The application of computer vision algorithms on detecting humans can be identified as one such area and the success of these investigations has gone past human detection with a larger gap recently. However, standalone technologies like classical machine learning, neural networks, statistical approaches like Bayes theorem, Hidden Markov Models, Time series, etc are yet to produce optimum results for posture recognition, behavior predictions, and path prediction in the absence of rich data points. On the other hand, prediction algorithms are very sensitive to variations in tiny details and produce considerable deviations. Even the position of camera placement has a drastic impact on the final result in prediction scenarios. Hence this paper investigates a system that combines multiple models to control electric appliances through predictions. These predictions are deducted by analyzing CCTV footage of users using computer vision.

Key Words: *Computer Vision , Image Processing , Action Recognition , Path Tracing , Human Detection , People Re-Identification , Action Prediction*

Explainable Machine Learning for Resource Constrained Public Funding Platform

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Abstract: Machine Learning (ML) has contributed to many advances in science and technology. Recently a trend of applications in high-stake decision-making has been initiated. The advancement of ML made the decision-making process unclear with complex black-box models, especially the state-of-the-art models which have maximized the performance are more complex, inexplicable, and hard to explain. On the contrary, high stakes settings as healthcare, finance, and criminal justice, have strict ethical concerns that made a mandatory requirement to explain each decision or the model as a whole. Besides, the acts and regulations like General Data Protection Regulation (GDPR) make it obligatory to explain the decisions made by computer systems and created a social right for explanations. One of the most pressing problems in the field is the explainability and interpretability of artificially intelligent systems. Moreover, it is necessary to ensure the fairness and transparency of a decision to obtain the stakeholders' trust. The theoretical knowledge of explainable machine learning is not well-tested in real-world problems with direct social impact. In this paper, we have identified a quandary that reflects the characteristics of a high-stakes the machine-learning problem in the public sector. A solution of an early warning system to predict the projects that could be unfunded in an educational crowdfunding platform in a resource-constrained the environment has been presented.

Key Words: *black box models, explainable-AI, fairness, transparency*

Identifying Keywords in Legal Articles Using ML Techniques

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Abstract: Finding a satisfying e-resource that consists of legal documents in Sri Lanka is difficult. Making a platform to search and refer legal documents is a vital task. This paper presents a comprehensive analysis of keyword extraction in the legal domain. Assume that manual keyword extraction happens and there are ten thousand documents to upload to the system. If it takes ten minutes to extract core details manually for a document, then for a person who works eight hours per day, he needs two hundred nine days to complete this task. Thus, the system to analyze this legal knowledge will serve effectively for lawyers and law students. We face the challenge that the bulk of those documents are in natural language streams. Machine learning and deep learning algorithms are used for document classification. Legal document classification, translation, account, data gathering are part of the goals obtained from this research.

Key Words: *keyword extraction, Machine Learning, Text Rank, TF-IDF, Legal Articles*

Revealing MicroRNA Biomarkers for Alzheimer's Disease Using Next Generation Sequencing Data

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Abstract: Alzheimer's disease is recognized as one of the common diseases found among elders, which still has no successful cure. Different technologies such as microarray technology, Sanger sequencing, and Next Generation Sequencing have been used by various researchers for gathering samples. Out of these, Next Generation Sequencing has become more common nowadays, as it is a powerful platform which enables to sequence thousands or millions of DNA molecules simultaneously. A set of samples collected using Next Generation Sequencing technology is used in this study. The initial data set includes 70 samples and 2652 miRNAs. In this study, our goal is to determine the best set of microRNA biomarkers which are highly differentially expressed in samples with Alzheimer's disease. Initially, the data set is preprocessed with the aid of the Galaxy tool and python programming language. Significance value, fold change and area under curve analysis are the statistical methods used in this study. Random Forest algorithm and Principal Component Analysis are used for selecting the best set of biomarkers from the data set obtained at the end of statistical analysis. Using the statistical methods, followed by machine learning techniques, we establish 25 microRNAs as biomarkers for Alzheimer's disease. Furthermore, we provide an analysis of the selected 25 microRNAs with area under the receiver operating curve and classification algorithms.

Key Words: *Alzheimer's Disease, Biomarker, microRNA, Machine Learning*

Data Mining system for Selecting a winning Cricket Team

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Abstract: Cricket is a two-team game that originated in England around the 19th century. This world's second most popular game is played in 3 forms as twenty20, ODI, and Test matches. Due to the availability of ball-by-ball data of this game, researchers were able to do statistical analysis of data for pattern recognition, to find factors affecting the game, and for outcome prediction of a match. But due to the high uncertainty of the game, it has become very difficult to come up with a stable and accurate model for the predictions. The outcome model also depends on the number of overs, match type, considering the time, and player combination. This research focuses only on the ODI matches and considering only the ICC full members; Australia, West Indies, Sri Lanka, Bangladesh, New Zealand, Ireland, India, Zimbabwe, Afghanistan, England, South Africa, and Pakistan. This outcome prediction is based on players' performances in a team and some features specific to the team and the match. The individual performance of batsmen, bowlers, and fielders are analyzed separately considering all-time ODI data. The combined performance of batsmen and bowlers was analyzed and compared with individual performances using statistical methods. Association rule mining was used to find frequent winning player combinations. Match data from 2015 to 2020 was considered for the combined performance analysis and outcome prediction. For all these predictions we used data mining and machine learning techniques.

Key Words: *Cricket, ODI, Individual performance, Combined performance, Outcome prediction*

Isolation of genomic regions from skim sequencing data for phylogenetic studies

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Abstract: Internal Transcribed Spacer (ITS) region is vastly preferred among all genomic regions for phylogenetic studies associated with various plant species. Isolation of ITS regions from skim sequencing data results in more accurate inter-species as well as intra species diversity analysis. Most of the previous studies utilize the available tools and pipelines to isolate fungal ITS regions from Illumina sequences. Botanists find it much difficult to gather plant ITS regions from skim sequencing data due to the lack of an efficient existing workflow. Our study focuses on coming up with a workflow that comprises a user-friendly pipeline for the botanists to isolate plant ITS regions from Illumina skim sequencing data as accurately and as efficiently as possible for phylogenetic studies.

Key Words: *ITS, NGS, SPAdes, seqtk, BLAST, afterqc, fastqc*

Optimizing Mitochondrial Genome Assembly and Annotation with Skim Sequencing Data

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Abstract: There are several technologies that can be used to sequence the genome, and the modern method is next generation sequencing. Illumina sequencing is one of the most widely used next-generation sequencing methods. This method produces a large number of short, high-precision sequencing reads, while older methods produce longer reads. Therefore, the computational complexity of assembling such a large number of reads is high, but it is cost-effective. In next-generation sequencing approaches, skim sequencing is the method that uses low-pass, shallow sequencing of a genome (up to 5%) , to generate fragments of DNA. These fragments of DNA which are known as genome skims contain the information of a high- copy fraction of the sequenced genome. Since the genome skims are shallow sequenced and the data is only 5% of the original sequenced data, highly computational efficient tools are required to assemble the genome skims back to the complete genome. Here we mainly consider the assembly of mitochondrial genome and focus on how well the existing tools that are specifically dedicated for assembling mitochondrial genome perform the assembly by doing a comparative analysis with different combinations of skim sequenced data. The results obtained from the comparative analysis and the efficiency of assembly were analyzed, so that a guideline can be suggested to biologists on how to use the tools with the data they have. Furthermore, a pipeline is recommended for assembling a mitochondrial genome in a specific combination of data.

Key Words: *Genome Assembly, Mitochondria, WGS, Skim sequencing Algorithms, DNA, CPU utilisation, Assembly optimisation*

Anonymous and Distributed Authentication for Peer-to-Peer Networks

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Abstract: Well-known standard authentication mechanisms such as Public key Infrastructure (PKI) and Identity-based Public key Certificates (ID-PKC) are not suitable to integrate with the peer-to-peer (P2P) network environment. The reason is the difficulty in maintaining a centralized authority to manage the certificates. The authentication becomes even harder in an anonymous environment. We present three authentication protocols to solve the aforementioned challenges. Then the users can authenticate themselves in an anonymous P2P network without revealing their identities. Firstly, we propose a way to use existing ring signature schemes to obtain anonymous authentication. Secondly, we propose an anonymous authentication scheme utilizing secret sharing schemes. Finally, we propose a zero-knowledge-proof-based anonymous authentication protocol. We provide security justifications of the three protocols in terms of anonymity, completeness, soundness, resilience to impersonation attacks, and resilience to replay attacks.

Key Words: *p2p, anonymity, authentication, cryptography*

Wireless Software Defined Ad-hoc Network for Vehicular Communication

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Abstract: Software Defined Network (SDN) is a vastly evolving network architecture approach that physically separates the network control plane from the data plane. The interconnection devices take forwarding decisions solely supported by a group of multi-criteria policy rules defined by external applications called controllers. Vehicular communication has become a trending topic in transportation technology. Most of the researchers pay attention to the development of vehicular communication using wireless SDN in order to overcome issues such as lack of intelligence and scalability of the network. The recent developments in SDN have paved the way to control and manage wireless ad-hoc networks. Wireless ad-hoc networks are distributed networks that operate without fixed infrastructure and through which each network node is willing to forward network packets for other network nodes which reciprocally provides a reliable platform in vehicle-to-vehicle communication. The objective of this research is to review some benefits of wireless SDN and how SDN can be used to implement network on vehicle to vehicle communication.

Key Words: *adhoc mesh networks, Traingular Routing, Software Defined Network, Batman adv, vehicular communication*

Objectively Measure Player Performance on Olympic Weightlifting

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Abstract: In Olympic-style weightlifting, athletes attempt to lift the weight plates on a barbell and the scores are determined by a combination of the successful highest weight achieved in the snatch and the clean-and-jerk actions. However, the current method does not objectively measure the player techniques. In this paper, we introduce a novel method to objectively measure player performance in weightlifting through human action recognition applied on videos. We introduce a method to assess the player techniques in weightlifting by using skeleton-based human action recognition. In order to achieve our goal, we further introduce a new video dataset for action recognition in weightlifting which is annotated to frame level and introduce an automated scoring system through action recognition. We conclude our paper with qualitative and quantitative experimental results using non-Olympic players and 2016 Olympic medalist in different weight categories (both men and women).

Key Words: *action recognition, sports, skeleton-based, summarizing, scoring, weightlifting*

Doppelgänger Cartoon

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Abstract: Human face recognition and feature extraction allow a huge number of face images to be recognized in just a short amount of time and extract the face features very easily, rather than recognizing each image and its features individually through a normal human's eyes. Using these technologies, research is being carried out to find the look-alike features in humans. This research was conducted to find the techniques for face detection, feature extraction of a cartoon characters and recognize look-alike cartoon characters for a given human image. Landmark based comparison is the basic model on this research and gender prediction and hair extraction models are added to improve the performance. Alternatively, a classification model is also used to compare the performance of the basic landmark based model.

Key Words: *face detection, feature extraction, feature comparison, landmarks*

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