UNIVERSITY OF PERADENIYA
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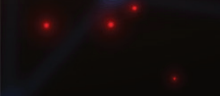
Proceedings of the Fifth Engineering Students' Conference at Peradeniya (ESCaPe) 2020

ESCaPe
ONLINE PROJECT SYMPOSIUM
2020

Organized by
Department of Computer Engineering,
Faculty of Engineering, University of Peradeniya.
29th May 2020



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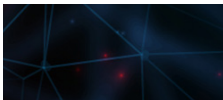

Message From the Dean
Faculty of Engineering

I am happy to learn that the Department of Computer Engineering is organizing its 5th annual student symposium "ESCaPe 2020" on 29th May 2020 and that a proceeding is being published on this occasion too. This year they will be organizing this symposium as a webinar with two keynote addresses, several research articles of the final year undergraduates and participation of many computer professionals.

With the COVID 19 pandemic, the whole world today is focusing more on online systems to run basic facilities, the thematic areas of this Webinar: software and systems, embedded systems and computer architecture, networking and machine learning and data mining, etc. are both timely and important. So I have no doubts that this webinar will be an excellent forum for both the computer professionals and the future computer engineers to clarify any issues they have on these selected themes. I take this opportunity to congratulate the organizers of this webinar for providing a platform for a discussion on these timely topics through this event. Finally, I wish the webinar a great success.

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

Message from the Head

Department of Computer Engineering

It is with great pleasure that I am writing this message to the 5th Annual Symposium ESCaPE 2020 of the Department of Computer Engineering. ESCaPE was started with the intention of providing a forum for computer engineering students to hone many of the skills they should possess for entering into the competitive computing industry. The researches presented in this symposium are the outcome of the final year research projects which spans across two semesters.

The skills that the students acquire through this symposium can be categorized broadly into four namely; research & development skills, report writing skills, presentation skills, and organizing skills. At the beginning of the project, the students conduct a thorough literature survey to understand what is already being done in the area of their research. Research topics are selected with the help of the industry or by considering the issues addressed currently by the research community. Based on the literature survey, students find gaps in existing work and plan the milestones of their research. Then the development work is carried out with appropriate fine-tuning under the supervision of the academic staff. In this process, the students carry out several intermediary activities. Project proposal writing and presentation, mid-term review, 7th semester report and presentation, 8th semester progress report and presentation, mid-term review, and 8th semester final report and presentation are the main activities. These activities will provide students ample opportunity to report what they have learned and discuss their findings. The presentations will help them to improve their presentation skills. In addition to all these, the organization of an event of this caliber provides a rare opportunity for the students to improve their interpersonal skills and other related soft skills.

As we did in the past, we were planning to conduct the symposium in a prime location in Colombo together with career fair and internship interviews. Due to the prevailing pandemic situation, we have decided to conduct it online. The event organization is lead by the Symposium Chair; Dr. Damayanthi Herath with the help of academic staff members of the Department. The Association of Computer Engineering Students (ACES) provided logistic support. I take this opportunity to thank Dr. Damayanthi Herath, academic staff, and ACES for making this event a success. Finally, I would like to thank the Vice-Chancellor and the Dean for helping us in numerous ways and for gracing this annual event.

Dr. Kamalanth Samarakoon,
Head of the Department/Senior lecturer,
Department of Computer Engineering,
University of Peradeniya.

Message from the Chair, ESCaPe 2020

With great pleasure, I welcome you to the 5th Engineering Students Conference at Peradeniya (ESCaPe) 2020. This year, the presented work by final year undergraduates of the Department of Computer Engineering, University of Peradeniya (DCE, UoP) covers the main disciplines of Computer Networking, Embedded Systems, Intelligent Systems, Computer Security and Computational Biology. We had 21 research articles submitted and after the review process, 13 articles were accepted for presentation at the symposium. There will be 3 presentation sessions and two keynote speeches are to be delivered. The symposium also includes a discussion session with professionals from industry and academia allowing the participants, especially the undergraduate students to interact with them. Abstracts of all the work presented at the symposium will be published in a proceedings booklet in citable format.

I make this an opportunity to thank the panel of editors, and the program committee for their immense support in the review process. Further, I am grateful to the Association of Computer Engineering Students (ACES) for their dedication in making this event a success. A special note of thanks to ACES editor, Ms Kaveesha Dilshani for her assistance in handling the event logistics. I am also thankful to Prof. Roshan Ragel, DCE, UoP, and Dr. Kamalanath Samarakoon, the Head of Department, DCE, UoP for their encouragement. This event which is held in the form of a webinar would not have been possible if not for the support from the Lanka Education and Research Network (LEARN). Thank you all.

We are delighted to have the presence of Prof. Upul B. Dissanayake, Vice-Chancellor, University of Peradeniya, Prof. Gemunu Herath, Dean, Faculty of Engineering, University of Peradeniya, Prof. C. Pandu Rangan, Professor at Department of Computer Science & Engineering, Indian Institute of Technology Madras, India, and Mr. Mano Sekaram, CEO and Co-Founder at 99X, at the symposium this year.

Finally, I thank all the participants of ESCAPE 2020. Your active participation made this event a reality.

We hope to see you in future editions of ESCaPe.

Dr. Damayanthi Herath,
Chair,
ESCaPe 2020.

Agenda

Engineering Students Conference at Peradeniya 2020 (ESCaPe'2020)

29th May 2020

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

08:30 a.m.: Commencement of the conference
08:35 a.m.: Welcome Speech by Dr. Kamalanth Samarakoon, Head/Computer Engineering Department
08:45 a.m.: Speech by Prof. Gemunu Herath, Dean/ Faculty of Engineering/University of Peradeniya
08:55 a.m.: Speech by Prof.Upul B.Dissanayake, Vice-Chancellor/University of Peradeniya

09:05 a.m.: Presentation of the research articles

- A Retinex based GAN Pipeline to Utilize Paired and Unpaired Datasets for Enhancing Low Light Images
- Multi-Agent Reinforcement Learning in Sparsely Connected Cooperative Environments
- SwarmLib- Programming Framework for Robot Swarms
- Dynamic Difficulty Adjustment (DDA) in FPS games using Strategy Analysis

10:05 a.m.: What is Computer Science?
Prof. C. Pandu Rangan Professor at Department of Computer Science & Engineering, Indian Institute of Technology Madras, India.n

10:35 a.m.: Presentation of the research articles

- Nanopore DNA Sequencing Data Processing on Android Smartphones
- miRNAFinder: An accurate plant pre-microRNA classifier with an analysis of feature impact
- Data-driven discovery of nucleotide sequences belonging to species in a metagenome
- BAT: Bock Analytics Tool Integrated With Blockchain-Based IoT Platform
- House Price Prediction using Random Forest

11:50 a.m.: End of EscaPe'2020 Session 1

12:30 p.m.: Start of the EscaPe'2020 Session 2
12.30 p.m.: Startups, Entrepreneurship and the Ecosystem
Mr. Mano Sekaram CEO and Co -Founder at 99X Technology

1:00 p.m.: Presentation of the research articles

- Keystroke Dynamics Based Biometric for Remote User Authentication Schemes
- Exploiting univariate and multivariate LSTM models for stock price forecast: The case of Colombo Stock Exchange
- Stock Market Prediction using SVM, LSTM, and Linear Regression
- Real-Time Dynamic Object Tracking with a Pan and Tilt Camera Setup

2.00 p.m.: Panel Discussion with the industry professionals
2:30 p.m.: Awards for the Best Research Article and Best Presentation
2:35 p.m.: Vote of Thanks
2:40 p.m.: End of the Conference

Keynote Speech:

“What is Computer Science”

By

Prof. C. Pandu Rangan

PROFESSOR AT DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING,
INDIAN INSTITUTE OF TECHNOLOGY MADRAS, INDIA

Prof. C. Pandu Rangan is a Professor of the Computer Science and Engineering Department at Indian Institute of Technology - Madras (IITM), India. Prof. C. Pandu Rangan has published over two hundred research papers in the following areas of Computer Science and Engineering:

- Restricting the problem domain
- Approximate algorithm design
- Randomized Algorithms
- Parallel and VLSI Algorithms
- Applied Cryptography
- Secure Multi-Part Computation
- Game Theory and Graph Theory

His main research focus is on the design of pragmatic algorithms. He is interested in looking for pragmatic alternatives for the problems of practical interest in Graph Theory, Combinatorics, and Computational Geometry.

He obtained his MSc from the University of Madras in 1977 and completed his Ph.D. from the Indian Institute of Science, Bangalore, India in the year 1984.

He was awarded the Fellowship, Indian National Academy of Engineering in 2006. He also acted as a member of the board of directors in the International Association for Cryptologic Research (IACR) from 2002 - 2005. He was a member of the board of directors in the Society for Electronic Transaction and Security (SETS) from 2005 - 2007. He was in the editorial board for Lecture Notes in Computer Science Series (LNCS Series), Springer-Verlag, Germany, from 2005 - 2011, and for the Journal of Parallel and Distributed Computing during 2005 -2007. In recognition for professors “who have distinguished themselves and been recognized by their peers for their research and/or technology development, and who have excelled in teaching and service to the institute/ nation/profession” Prof. C. Pandu Rangan has been awarded the Institute Chair Professor at IIT Madras in the year 2018.

Keynote Speech:

“Startups, Entrepreneurship, and the Ecosystem..”

By

Mr. Mano Sekaram

CEO AND CO-FOUNDER AT 99X TECHNOLOGY
AND FOUNDER AT STARTUP X FOUNDRY

Mano Sekaram is a serial tech entrepreneur and is the Chief Executive Officer (CEO) and Co-Founder of 99X Technology Ltd., an award-winning, high-quality digital product engineering company that specializes in delivering digital services to European markets. This company, under his stewardship, has been listed among the top 25 ‘Best Companies To Work For’ in Sri Lanka for seven consecutive years and has also been ranked among ‘Asia’s Best Workplaces’ for 2019.

He is also the founder of Startup X Foundry, one of Sri Lanka’s first tech start-up accelerators, which aims at taking Sri Lankan start-ups to the global stage by providing necessary guidance and support. He further influences Sri Lanka’s start-up ecosystem through the Lankan Angel Network (LAN), of which he is Chairman.

Mano was appointed recently to the Board of the Information and Communication Technology Agency (ICTA) of Sri Lanka, which drives Sri Lanka’s digital transformation strategy as a catalyst for economic growth. He is also the past Chairman of the IT/BPM sector’s apex body, the Sri Lanka Association of Software and Service Companies (SLASSCOM).

He was listed on LMD’s 100 Club for 2019, the A-List of Sri Lankan business people who continue to drive the nation’s engine of growth.

Considered to be an industry thought leader, Mano was awarded the ‘Lifetime Achievement Award’ at the National Best Quality Software Awards (NBQSA) 2014, by BCS, The Chartered Institute for IT, for his vast contributions to the ICT industry.

Table of Contents

A Retinex based GAN Pipeline to Utilize Paired and Unpaired Datasets for Enhancing Low Light Images

Harshana Weligampola[1*], Gihan Jayatilaka[1], Suren Srithraran[1], Roshan Godaliyadda[2], Parakrama Ekanayaka[2], Roshan Ragel[1] and Vijitha Herath[2]
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Abstract: Low light image enhancement is an important challenge for the development of robust computer vision algorithms. Classical approaches for this problem have been unsupervised whereas the deep learning approaches have mostly been based on supervised learning using either paired or unpaired dataset. This paper presents a novel deep learning pipeline that can learn from both paired datasets and unpaired datasets. The proposed model employs CNN and GAN to optimize and minimize the standard loss and the adversarial loss respectively. Cycle consistency loss and a patched discriminator are utilized to further improve the performance. Finally, the paper presents an ablation study on the functionality and the performance of different components and hidden layers in addition to the analysis of the full pipeline by a broad collection of visual examples.

Key Words: low-light image enhancement, retinex theory, generative adversarial networks, cycle consistency

Multi-Agent Reinforcement Learning in Sparsely Connected Cooperative Environments

Pankayaraj Pathmanathan[1], Chandima Samarasinghe[1], Yuvini Sumanasekera[1*], Dhammika Elkaduwe[1], Upul Jayasinghe[1] and D. H. S. Maithripala[2]
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Abstract: In multi-agent systems, an agent's behavior is affected by the dynamicity of the environment as well as by the interactions among agents. Thus, in learning to cooperate to solve complex tasks, such considerations should be taken into account. Reinforcement learning has gained immense interest in this line of research as it allows agents to learn useful behavior by dynamically interacting with the environment and with one another. In this work, we exploit the inherent graph-like structure of multi-agent networks to facilitate the learning of more robust behavior strategies by capturing the spatial dependencies and temporal dynamics of the underlying graph. However, partial observability, as well as restricted communication can result in agents learning suboptimal strategies. We address these issues by allowing each agent to recurrently propagate information through its neighborhood, thus gradually increasing its receptive field. Finally, we demonstrate the effectiveness of the proposed model on a variety of cooperative control tasks.

Key Words - multi-agent, reinforcement learning, spatio-temporal dependencies, graph neural networks

SwarmLib- Programming Framework for Robot Swarms

Mahendra Bandara[1], Tharuka Bandara*[1], Nadun Priyankara[1], Roshan Ragel[1] and Isuru Nawinne[1]
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Abstract: SwarmLib is a generalized higher-level programming framework for robot swarms. This framework is designed to be comprehensible for anyone familiar with basic swarm robotics and robot programming principles. We process the data from the communication system, sensors from a robot and map them into a set of actuator functions also referred to as robot movements. These robot movements, combined with the functions to retrieve, manipulate input, and output data form SwarmLib. Programmers can make use of SwarmLib to program their swarm behaviors such as aggregation, pattern formation, and leader following effectively and efficiently. In this paper, our main focus is to present the layered architecture of our framework. SwarmLib makes use of a behavior-based bottom-up design approach in structuring and interpreting these layers. Moreover, the composition of each behavior is briefed. In the results section of the paper, we have included simulation results of a basic behavior component and a custom-built behavior to find and gather around a colored object. Custom behavior was tested with the object in the middle and the four corners. Results were recorded mainly considering the timing and scaling factors to test the robustness of algorithms with a maximum swarm size of 100. Custom behavior results deviated from the expected for the object in the corner scenario when swarm size increases. Furthermore, we discuss the probable causes and solutions to overcome. Finally, we discuss the challenges we have to face when migrating this framework into a real set of robots.

Key Words - robot-swarm, bottom-up design approach, virtual pheromone, behavior-based design ,swarm simulation

Dynamic Difficulty Adjustment (DDA) in FPS games using Strategy Analysis

Rahal Medawatte*[1], Mabeesha Wijekoon[1], Dinuka Hettiarachchi[1], Roshan Ragel[1] and Isuru Nawinne
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Abstrack: Player modeling and Dynamic Difficulty Adjustment (DDA) are widely studied areas that are proposed as solutions to increase the satisfaction of players in computer games. This research focuses on creating a DDA by using player modeling through strategy analysis on FPS games. After a thorough literature review and gaming community surveys, two main strategies were identified as (i) Aggressive and (ii) Passive and their characteristics were defined. As the first part of this research, we propose relevant features and a method to efficiently classify the players strategy using logistic regression with an accuracy of 89\% for a test data set. In the second part, we propose a fuzzy-based system to change the game parameters. The changing game parameters are weapon damage of the player, weapon damage of NPCs (Non player characters), Weapon shooting accuracy the NPCs, Ammunition count, total enemy count, maximum enemy count at one location, and health decreasing rate. Finally, we created a simple FPS game with the DDA system for testing purposes and it will be tested in the future.

Keywords - DDA, FPS, Strategy, Games, Difficulty

miRNAFinder: An accurate plant pre-microRNA classifier with an analysis of feature impact

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Abstract: MicroRNAs (miRNAs) are endogenous small noncoding RNAs that play an important role in post-transcriptional gene regulation. Several machine learning-based studies have been conducted for miRNA identification with the use of miRNA features. It is difficult to classify real and pseudo-pre-miRNAs in plant species than that in animals since plant pre-miRNAs are more diverse than the animal pre-miRNAs. Therefore, this study is focused on classifying real and pseudo miRNAs in plants. We have introduced a Machine Learning model based on a 280 feature set including compositional, triplet element, motif, and thermodynamic features. We tested and compared classification performances considering different feature sets and four different machine learning classifiers. Random forest classifier shows the best classification performance with all 280 features as it shows 97% accuracy for the training dataset.

Keywords - microRNA, machine learning, microRNA classification, pre-miRNA, plant

Data-driven discovery of nucleotide sequences belonging to species in a metagenome

Kasun Vimukthi[1], Geeth Wimalasiri[1*] and Prabhath Bandara[1], Damayanthi Herath[1]
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Abastract: Metagenomics is one of the recent areas in microbiology, which helps to explore novel species and study about existing species and their dynamics in various environments. A key process in a metagenomics study is classifying nucleotide sequences related to species samples which is also known as ”Binning.” The classification can be done according to a reference or based on the mutual characteristics (data-driven) where multiple machine learning techniques are involved such as unsupervised learning. This paper focuses on optimizing data-driven binning by increasing the number of metagenomic sequences binned while maintaining reasonable binning accuracy. A dissimilarity-based approach is proposed to improve the number of contigs binned by an existing binning method. It is shown that the proposed method increases the number of contigs binned by 10% while having a reasonable accuracy compared to the original method. This work suggests that the effective use of observed data which may be discarded as outliers otherwise may result in improved performance binning.

Keywords: Binning, Metagenomics, Data-driven methods, Number of contig bins, outlier handling, Improve contig assignments, Mahalanobis distance

BAT: Bock Analytics Tool Integrated With Blockchain Based IoT Platform

Chathurangi Edussuriya[1*], Kasun Vithanage[1], Namila Bandara[1], Janaka Alawatugoda[1], Manjula Sandirigama[1] and Upul Jayasinghe[1]
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Abstract: The Internet of Things (IoT) is the current revolutionary paradigm of connectivity and driving force behind the state of art applications. However, the exponential growth of the number of IoT devices has increased the number of security and privacy concerns ranging from the risks of unauthorized data alterations to the potential discrimination enabled by data analytics over sensitive information. Hence to address these issues, an IoT platform based on blockchain technology is proposed. Built upon the tamper-proof architecture, the platform ensures the authenticity and integrity of data. Moreover, a novel approach called Block Analytics Tool (BAT) is introduced which enables the data analysis applications to be developed using the data stored in the platform. A pharmaceutical supply chain is used as the use case scenario to show the functionality of the platform. Furthermore, a model to forecast the demand for pharmaceutical drugs is investigated using a real-world data set to demonstrate the functionality of the BAT. Finally, the performance of the platform integrated with the BAT is evaluated.

Keywords - IoT, blockchain, data analytics, smart contract

House Price Prediction using Random Forest

Sankeerthan Kasilingam[1*], Anojan Satheesnathan[1] and Sampath Deegalla[1]
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Abstract: Housing price is influenced by multiple factors such as location, house size, number of bathrooms, and number of bedrooms. The traditional models used the statistics of these factors to predict house prices. The development of machine learning models to predict price as an alternative to the traditional model has been done in many countries. This had motivated us to do a study of houses located in Colombo district, Sri Lanka. The data set collected from the online house-selling platform is used for the study. The study focuses on removing outliers using K-means clustering and predicting price with Random Forest models. According to our results, after removing the outliers by clustering, the Random Forest model performance was improved and the RMSE of the best model was LKR 5.4 Million.

Keywords - house value prediction, machine learning, regression, random forest

Keystroke Dynamics Based Biometric for Remote User Authentication Schemes

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Abstract: Remote user authentication is a mechanism to access information systems via an insecure channel from any location. When communicating via an insecure channel, security is the main issue due to the intruders. Although researchers have invented many user authentication schemes to withstand security attacks still many schemes are vulnerable to various attacks.
Instead of passwords and smart-cards now many schemes use biometric features for their authentication due to the uniqueness of biometric features. In this research, a two-way authentication scheme is proposed. We have investigated the key requirement to fulfill the security and reliability on "Keystroke Dynamics Based Biometric for Remote User Authentication Schemes" referring to different authentication schemes. We have experimented mainly with three classification algorithms, J48, LMT, and PART, and compared each of the algorithms against its performance considering testing accuracy, training accuracy, and time. According to the obtained results, key-stroke dynamic biometric features and proposed multi-model classifier mechanism for authentication provide an acceptable level of accuracy.

Keywords - Authentication, Keystroke dynamic, Biometric, Cryptography, Keystroke Dynamics

Exploiting univariate and multivariate LSTM models for stock price forecast: The case of Colombo Stock Exchange

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Abstract: With rapid economic growth, most entities focus on investing the money to obtain greater revenue. The stock market is the most accessible investment opportunity for almost everyone and therefore forecasting the trends of a stock market is of significant interest to researchers. Although highly volatile and chaotic nature of the trends makes such forecasting challenging, it can be done by considering all relevant information that affects the upward and the downward trends. All previous work on forecasting the trends of stock markets are performed for stable stock exchanges such as Newyork and Shanghai. However, such forecasting models would not capture stock exchanges which show high disruptive behaviours like the Colombo Stock Exchange (CSE). Further, stock exchanges such as CSE do not have trades on certain indexes on certain days making the data incomplete. In our work, we propose a forecasting model for stock exchanges with such disruptive behaviours and incomplete data. Our effort focuses on experimenting with univariate and multivariate Long Short Term Memory (LSTM) models to find the best-optimized model with the best set of features to predict stock prices and forecast the trend of indices in CSE, which is can be used for an automated trading platform. The multivariate LSTM model with the day of the week and trend for the past days along with past stock prices as features gave 54% accuracy with around 0.04 Root Mean Square Error (RMSE) score which is better than the compared baseline models.

Keywords - Stock market, Colombo Stock Exchange, LSTM, Time Series Analysis, Quantitative Analysis

Stock Market Prediction using SVM, LSTM and Linear Regression

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Abstract: The Stock market is a decisive section in the economy of a country. Using computer-based learning methodologies have become a prominent characteristic in modern stock trade.
Stock prices are highly volatile and are affected by economic, social & political factors. Businesses & investors are on a constant lookout for tools & technologies to get insights regarding stock variations to reap financial benefits. But existing stock prediction models have low accuracies in terms of prediction (confirmed through the literature review).
Through this research, different machine learning, statistical and neural network model performances are assessed regarding stock prediction. The problem (low accuracies) is approached as a classification and a regression. The models used in this research are Long Short Term Memory (LSTM) neural networks, Linear Regression (as a regressor), and Support Vector Machines - SVM (as a classifier). Detailed research performed through the aforementioned models is presented regarding multiple companies. Specifically, 10 years of historical stock prices of the most active 20 companies of the NASDAQ stock exchange have been used.
Through this study, it is evident that SVM is considerably under-performing while linear regression has proven to produce promising results. Results of LSTM are satisfactory, but not up to par with linear regression. One of the key findings is that SVMs failed to capture the pattern in time-series financial data with respect to the classification. As future endeavors, individual results of these models can be combined to develop an ensemble model and the prediction accuracy can be improved further.

Keywords -LSTM, SVM,Ensemble, Stock Market Prediction, Regression, Classification, Financial Forecasting

Real Time Dynamic Object Tracking with a Pan and Tilt Camera Setup

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Abstract: This paper presents the implementation and development of an action tracking camera. The final objective is to develop a pan and tilt camera platform which can control itself to follow and focus on a moving object automatically the same way any living creature watches a moving object through the naked eye. In this research, a pre-defined object is detected and localized from a video stream captured by a camera. Based on the relative position of the object in the image frame, pan and tilt commands are generated by a novel algorithm to track the object. A deep learning approach is used to detect and localize the object from the video stream. Based on its output, the camera is controlled so the object is brought closer to the center of the image frame as much as possible. Using the YOLO-v3 object detection algorithm, a football was tracked with a frame rate of 30fps on Tesla P4 GPU with an average precision of 54%. The camera controlling algorithm works at a frame rate of 7fps with camera movements.

Keywords - real time tracking , pan & tilt camera, moving object tracking, image processing, convolutional neural network,deep learning