eCARRIER

JANUARY 2019

THE OFFICIAL MAGAZINE OF E-CLUB

Special Edition

50 Years of Excellence

of Department of Electronic and Telecommunication Engineering

- Articles
- Our Achievements
- Startup Space
- Final Year Projects
- Interviews

EXPOSE EXHIBITION 2019

Department of Electronic and Telecommunication Engineering | University of Moratuwa

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2019

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of Department of Electronic and Telecommunication Engineering

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EDITORIAL

2019 marked the 50th anniversary of the department of Electronic and Telecommunication engineering at the University of Moratuwa. Since its inception, Department of Electronic and TelecommunicationEngineering (ENTC) has paved the way for bright Sri Lankan minds to be innovators, and technology leaders, who contribute in broadening the knowledge paradigms throughout the globe.

Being in an era of rapid technological advances, department recognizes the need of adapting the industrial requirements and evolves accordingly by introducing curriculum changes. This allows engineers produces by the department to be more competent in their fields and build up an exceptional career.

The official magazine of the department, eCarrier, is the transcript of the revolutionary transformation being made in the department. Turning out annually since its inception in 2008 under E-Club, it has managed to secure its position as the precursor of showcasing the talents of undergraduates of the department among the industry and technology enthusiasts.

In closing, we sincerely believe that the Department of Electronic and Telecommunication Engineering will continue to produce technology leaders with the strength in character to balance their academic and professional lives who would contribute in reshaping the technological landscape of Sri Lanka.

"Knowledge is of no value unless you put it into practice"

-Anton Chekhov-

ELECTRONIC CLUB

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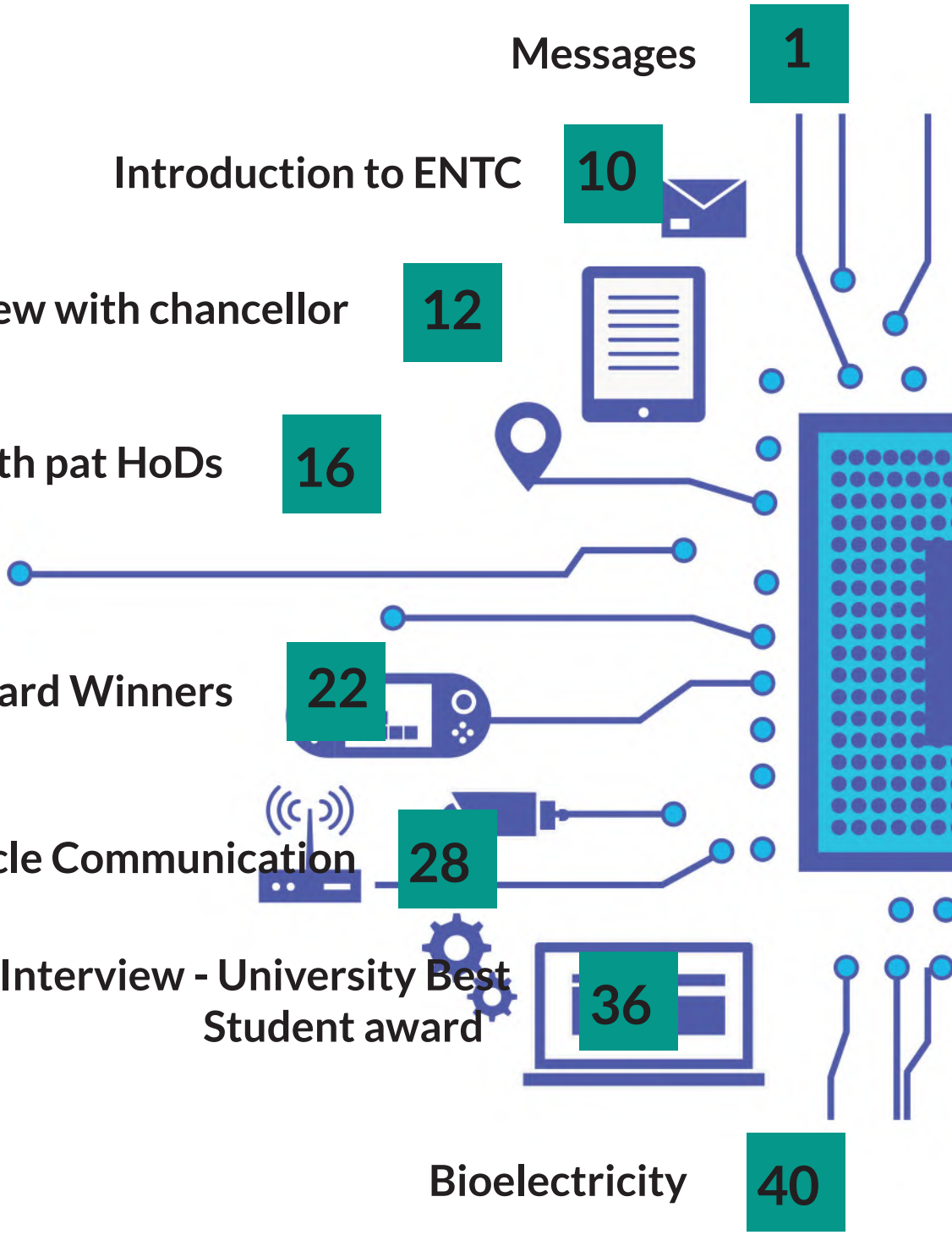

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Message from the Vice Chancellor, University of Moratuwa

Producing nationally relevant and world class graduates with a view to contribute to national development is one of the broader objectives by the University of Moratuwa. Events such as "Expose" organized by the Department of Electronics and Telecommunications provide opportunity for the society to judge the achievement of the nationally relevant and world class graduate status. The quality of the projects displayed is of very high standard and is in par with the cutting-edge technologies. The creativity displayed by the graduates in designing and developing different projects in the field of Electronics and Telecommunication that are on display at "Expose" will not only justify skills of applying the knowledge and skills acquired during their undergraduate period but also the investment of the public funds in them. Training and the other skills developed through the opportunity of participation by the students at this evet will help them in their future professional carriers.

While extending all the best wishes for the event, the guidance given by project supervisors in carrying out the research projects and organizing the event is greatly appreciated and acknowledged

Vice Chancellor

Prof. Kapila Perera

> *"'Expose' organized by the Department of Electronics and Telecommunications provide opportunity for the society to judge the achievement of the nationally relevant and world class graduate status."*

Message from the Dean, Faculty of Engineering

I am indeed proud to be writing these few words of felicitation to the e-Carrier Magazine of the Department of Electronic and Telecommunication Engineering of University of Moratuwa. The Department is celebrating 50 years of excellence in serving the nation this year. The Golden Jubilee is an occasion that any institution could be proud of, yet the Department of Electronic and Telecommunication Engineering has many more reasons to feel honoured than of being merely in existence for the last fifty years.

University of Moratuwa initiated a separate and altogether new field of engineering for the country when it decided to establish the Department of Electronics and Telecommunications when neither of these areas played a significant role on the lives of people at the time. The telephone was a luxurious rarity and electronics meant a radio set with valves to most of the people. In the end, the bold decision to start the new field was proved to be timely and prescient. The Department went on to produce generations of expert engineers in the two allied areas of electronics and telecommunications contributing immensely to the exponential growth of the industry since then. The strong and unfailing demand by the industry for its engineers year after every year is a fitting tribute to our forbearers who took the then courageous decision to start this new field of engineering in the country.

The E-Club of the Department, being the official organisation for the students to get-together and develop their social interactions and team skills, hosts both the Expose 2019 and the e-Carrier Magazine. The E-Club provides a valuable extracurricular dimension to the lives of undergraduates in the Electronics & Telecommunication Department. .

E-Club is populated by creative young minds who develop and innovate products that encompass our lives so comprehensively today. Expose 2019 is the platform for exhibiting the innovative talents of those students

I have no doubts that just like its past, the next fifty years of the Department would be strewn with success and stellar performance by its graduates who help develop the nation in equal measure.

I wish all the very best for the success of their efforts and do hope that its benefits will last a lifetime in the minds of its most enthusiastic membership of E-Club.

Prof. N. Wickramarachchi

07th January 2019

MESSAGES

Message from the Head of the Department, *Department of Electronic & Telecommunication Engineering*

I am writing this message with great pleasure to the e-Carrier magazine, the annual official magazine of the Department of Electronic and Telecommunication Engineering. The e-Carrier has been the platform for our undergraduates to express their ideas on latest development of technologies in areas of their interest. My congratulations and greetings to the editorial team and writers for their valuable contributions.

This year is particularly important to us as we are celebrating the 50 years of excellence at the Department of Electronic and Telecommunication Engineering (ENTC). Established in 1969, the department is unique in Sri Lanka, currently offering two B.Sc. Engineering specializations in Electronic and Telecommunication Engineering, and Biomedical Engineering. Our graduates have been in the forefront of national and global innovations and developments for years. The department is going form strength to strength on the influence of dedicated staff and highly talented students who ensure that quality of the programmes is maintained at the highest level.

The department has expanded its reach across emerging application areas such as robotics, biomedical, internet of things (IoT), unmanned aerial vehicles, machine vision, machine learning, renewable energy, and underwater vehicles over the last fifty years. Having incorporated theses emerging fields into the curriculum, the department has made our students gain a wide range of experience in the emerging technologies as presented in this magazine. One of our most significant recent initiatives has been the establishment of the Advance Electronic Design Facilitation Centre to support the private sector to start electronic product development and manufacturing in Sri Lanka.

This year, the e-Carrier magazine is published to coincide with the Expose exhibition of the department. This exhibition provides an insight into the talents and capabilities of our students. The Expose will help the future employers to plan strategies of their institutions to use our young engineers effectively to get the most out of their capabilities, for the growth of their institutions and the national economy.

Dr. Nuwan Dayananda

January 2019

Message from the Patron, E-Club, Department of Electronic & Telecommunication

As the Department of Electronic and Telecommunication Engineering is celebrating its Golden Jubilee this year it gives me great pleasure to write this message to the e-Carrier, the official magazine of the department published by the student body E-Club, on this special occasion of the Expose Exhibition-2019.

E-Club is setup to provide a broader platform for nurturing the special talents and skills of the undergraduates of the department for more effective contribution towards the betterment of the society. It started almost 28 years ago under the adroit patronage of Prof. (Mrs.) Indra Dayawansa. Over the years, slowly but steadily, it grew from strength to strength. The annual event calendar is now populated with a variety of interesting and enjoyable activities such as the Expose exhibition, E-Forum, E-Care, Tronic Premier League, Tronic Shuttle fest, Tronic Padura, Sri Lanka Robotics Challenge (SLRC), and donations/assistance to schools.

This year the Expose exhibition has been promoted to be the main annual event of the E-Club. This event is organized to showcase the outcomes of various undergraduate projects to the industry, the general public and the school children. It will enhance the bonds between the department, the industry and the general public. I am sure it will be a very special occasion that brings about plenty of challenges and opportunities to the members of the Electronic Club. These interactions will be a very useful experience for the budding ENTC undergraduates in shaping up to drive the industry in future. The e-Carrier magazine is expected to improve the writing and editorial skills of the undergraduates.

I guess the articles are useful but at the same time request the readers to pardon for any shortcomings as it is the work of the undergraduates and not the experts.

I wish to place on record, my deep appreciation on the dedication and efforts of the E-Club executive committee and all members, the staff advisor Dr. Ranga Rodrigo, and all staff of the department in organizing the event.

I wish every success to the Expose exhibition and all future endeavors of the Electronic Club.

Kithsiri Samarasinghe

18th January 2019.

MESSAGES

Message from the Staff Advisor, Department of Electronic & Telecommunication

The student association of the Department of Electronic and Telecommunication Engineering, Electronic Club, annually publishes the e-Carrier magazine, a compendium of articles on the current trends and applications. These articles focus on themes such as electronics, telecommunications, robotics, computer vision, machine learning, reconfigurable computing, biomedical engineering, and related applications. This year's e-Carrier marks the Expose exhibition and the 50th anniversary of the department. I hope the magazine would be useful to the readers and initiate discussions.

I thanks those who contributed with articles, the head of the department, the academic staff, the sponsors, the editorial team, and the officials of the Electronic Club who made the magazine possible.

Ranga Rodrigo

18th January 2019.

"articles focus on themes such as electronics, telecommunications, robotics, computer vision, machine learning, reconfigurable computing, biomedical engineering, and related applications."

Message from the President, E-Club, Department of Electronic & Telecommunication Engineering

It is with great pleasure that I am issuing this message to the eCarrier magazine. This is the official magazine of the Department of Electronic & Telecommunication Engineering (ENTC) which is published by its student body. One of the main objectives of publishing eCarrier was to create a platform for students to showcase their talents in article writing and editing. This will be a special edition of eCarrier magazine focusing the Golden Jubilee of the department and it will showcase the journey of ENTC throughout the last five decades.

The Electronic Club (E-Club) is the official student body of the Department of Electronic and Telecommunication Engineering, University of Moratuwa. It was established two decades ago with the vision of 'Serving Humanity through Electronics'. Year by year, growing its strengths, the E-club has aimed to mold its undergraduate members into proficient and socially responsible citizens of the country.

Expose is a flagship event organized by the E-Club with the intention of demonstrating final year projects and a selected set of other projects of undergraduates and post graduate students of the department to industry experts, investors, school students and general public. "Expose 2019"is organized for the 3rd time with the theme "50 Years of Excellence" to mark the Golden Jubilee of the Department of Electronic and Telecommunication Engineering, University of Moratuwa.

It will showcase the trends and developments related to industrial electronics, software hardware codesign, telecommunication, robotics and automation, bio-medical engineering, digital system design and many more interesting fields of electronics and telecommunications. Organizing Expose exhibition and launching of eCarrier in this magnitude is not an outcome of overnight work. It is the result of tireless effort for months and many sleepless nights. I would like to express my sincere gratitude to the staff of Department of Electronic and Telecommunications Engineering for their incessant support and guidance in making this publication a success. I extend my special appreciation to the secretary and the editors of E-Club along with their team for their great commitment in making eCarrier a success. Immense gratitude goes out to our sponsors and well-wishers who support us and encourage us to make this a success. Finally, I must especially thank all the students who made the Golden Jubilee edition of the eCarrier magazine one of the best magazines.

Hasitha Wellaboda
President
Electronic Club 2018/19 /1
8th January 2019

INTROCUCTION TO ENTC

By Manthila Wickramasooriya

The Department of Electronic and Telecommunication Engineering at the University of Moratuwa also known as ENTC, is one of the leading Engineering departments in the country. In fact, it is the only department in the country which offers an undergraduate degree in Electronic and Telecommunication Engineering, which marks the uniqueness and identity of ENTC in Sri Lanka. Apart from the undergraduate degree program, M.Sc., M.Phil., and Ph.D. programs are also offered by the department.

Currently, nearly 450 promising students follow the undergraduate degree program at ENTC. The academic staff consists of a well-qualified and distinguished panel of lecturers. ENTC also facilitates three industry sponsored research laboratories (Dialog, Zone24x7, Premium) on communication, electronic systems, and biomedical engineering in order to maintain a strong link with the industry.

The major areas of research include electronic devices, circuits, signal processing, digital systems, VLSI, reconfigurable hardware, computer organization, computer architecture, electromagnetics, quantum electronics, microwave systems, photonic systems, communication theory, communication systems, wireless systems, MIMO, OFDM, pattern recognition, machine learning, vision, medical imaging, robotics, intelligent machines and biomedical engineering. Research is conducted through the main research groups; intelligent machines, reconfigurable digital systems, machine vision, telecommunication and biomedical engineering.

Throughout the rich history of 50 years, ENTC has been molding the young engineering minds of the country to be innovators, achievers, professionals and leaders in technology. ENTC also provides consultancy for national projects. Over the past five decades, ENTC has been able to create a worldwide impact with its graduates following various disciplines of electronics and telecommunication all around the globe.

Thus, while contributing to its mission of "reshaping the technological landscape of Sri Lanka while contributing to the body of knowledge", ENTC is in fact a pioneer in the field of engineering in Sri Lanka.

DEPARTMENT HISTORY

Anticipating the quick growth of the electronics industry, the Department of Electronics was established in the University of Moratuwa in 1969.

It began with around ten undergraduates in each batch, Professor K.K.Y.W. Perera and Professor Sam Karunaratne alone took on the responsibility of handling lectures for the entire department. Initially, the curriculum followed that of the Electrical department and branched out into the specialization of each department in the final year.

It was in 1972 that some significant changes were brought about. Telecommunication was introduced as a field of specialization. This led to a change in the name of the department, and the acronym ENTC was coined, for "Electronic and Telecommunication". The department was also shifted to the Sumanadasa building, where it remained until 2003. The ENTC department, and its reputation, continued to grow, and the good performance of the pioneering graduates in the industry, quickly secured a firm niche in the job market.

By the 1980s, one senior lecturer alone remained in the department, aided by visiting lecturers from SLT and SLBC. Significantly, the specialization had also been moved forward and students were being extracted to the department from the second year. A new subject – "opto-electronics" was introduced.

With time, the department grew to offer the best curriculum of its kind in the country, and the student body grew gradually until it reached its current size.

On the 26th of July 2001, the foundation was laid in ceremony for a brand new building with state of the art facilities, with the collaboration of the Japanese and Sri Lankan governments. The new building was declared open on the 8th of April 2003. With the simultaneous enhancement in laboratory facilities, the annual intake of undergraduates to the department increased immediately to 80; and subsequently to 100.

Along its journey, the "Electronics Club" was initiated in 1998, which provided countless opportunities for the department undergraduates to both improve their skills and contribute to the community. Currently, most of the department events are organized and carried out via the E-Club.

The introduction of a specialized Biomedical Engineering program in 2014 was a remarkable milestone in the department history. Today it has an intake of 15 students and has joined hands with several local medical institutes to provide the best undergraduate training.

The dedicated effort of the ENTC family throughout the years has brought the department to the pinnacle of success.

An Interview with Chancellor

- Interviewed by Chirath Diyagama

Vidya Jyothi Professor K.K.Y.W.Perera is the current chancellor of University of Moratuwa. He was the founder and Head of the Department of Electronic and Telecommunication Engineering at the University of Moratuwa. This interview reveals the humble beginnings of Department of Electronic and Telecommunication, Prof. Perera's personal experiences, his thoughts about "Expose" and his suggestions for the future.

e-Carrier: You were the first Head of Department of this Department of Electronic and Telecommunication Engineering, and you have seen this place from its start. What can you tell us about the journey ENTC has taken over the years?

At that time, we had to start very small, with less than 10 students. The staff of the department in the beginning consisted of only myself and two others. We were fortunate to get ten students even, since at that time even the word electronics was not properly understood and students did not know whether they will have jobs at the end of the course. Other traditional departments such as civil engineering, mechanical engineering and electrical engineering attracted more students. At the beginning, we got our old equipment which were basic experimental tools from Maradana Technical College. As you mentioned, I was the first Head of the Department of Electronic and Telecommunication Engineering. Not only that, I was the first Dean of the faculty of Engineering and Architecture which was a single faculty at that time. So, I have seen this place from the very beginning, from its birth. About the journey the department has taken, we had only two rooms in the old Sumanadasa building to begin with; we didn't have this electronic engineering building. Anyway, now we are doing really well because we have earned a name. Earlier, students were actually reluctant to join the Electronic Engineering Department, whereas now it is the most competitive department to enter at the first year level.

e-Carrier: Student innovation and research is highly promoted through events like "Expose". How important are these for aspiring young electronic engineers?

Yes, there is a fair amount of innovation which is exhibited, in this event. Now, for the people who do these innovations, there has to be a motive as to why they want to do the innovations. This is a good opportunity to showcase what students and staff have done and are capable of doing. That gives motivation to do further and better work. This has a big impact as it will show what has been done, what can be done, and show it to the other students and staff as well as to the public. So, it has a great impact, not only to the researcher or the innovator but also to the public because they get the opportunity to know what Moratuwa university electronic engineering department can do.

e-Carrier: If we revisit your university life - a long time ago I guess - what were the memories you cherish the most to this day?

It is a difficult question, because my undergraduate days were a very long time ago, from1950 to 1954. I think none of our students were born even (slight laugh)! The university I completed my undergraduate education was the University of Ceylon housed at Thurstan road Colombo. Its laboratories were at Maradana, in the Maradana Technical College. It was very interesting because we were exposed to things that we never dreamt of at that time. I played table tennis for the university and I was quite happy with that. I remember, one time, we had a visit to Jaffna when the cement factory was being constructed in KKS - Kankesanthurai. We went by train, practically most of the students plus staff had to see this civil and mechanical engineering construction being done. That was also a very important and interesting experience. On another occasion, we assembled an audio transmitter, at that time transmitters were only for the broadcasting people in SLBC (Sri Lanka Broadcasting Corporation) and so on. We had it at Thurstan road on a balcony and transmitted our waves to the far end of the ground. We had another transmitter receiver there hooked up, made by us, to which we replied back. So that was very interesting at that time. Television was not there at that time, just radio, and even these equipment was very limited and was used only by the government broadcasting people!

Other normal events were of course there: usual student activities which were interesting, such as stage plays and things like that done by the students when we got together.

e-Carrier: What type of student would you say you were at campus? Studious, sporty, activist?

I think all three combined! I was mostly studious of course, because I ended up with a first class - the only first class in that batch of Electrical and Electronic students. Also, as a sport, I played table tennis, it was limited to that mostly. I was not an activist in the sense of political activist! However, I took part in various other activities: lot of things which made dull campus life more interesting.

e-Carrier: You have reached a zenith of achievement in life. What aspects of your university life played a substantial role in this journey?

Firstly, zenith of my life, I don't know how you count it. That depends on your attitudes. Actually, I have been telling this story at various places. I first went to a Sinhala school in the village Kannimahara and there was a colleague of mine called Dhaniyel (????????), not Daniel – plain Dhaniyel. Both of us were seated together and I have come up in the education ladder and also in the administrative ladder and had become head of the university at Moratuwa plus head of a government ministry, ministry of power and energy where I was secretary. However, I consider Dhaniyel to have equally achieved, because he could climb coconut trees faster than anybody else! So he is my equal. Achievements are not limited to just one field, in any field you can achieve. So I kept my friendship with my good friend Dhaniyel. About the university life, what helped me was moving with students and of course, running with them and fighting with them. No harm in fighting, doesn't matter how much you fight, doesn't matter how much you argue, in the end of you can come to a consensus. This is what we should do, that is the real victory. That is what I have to say about university life. University life trained me to do this, not my teachers etc. but automatically the way we moved and behaved, the classes, courses and practicals. In the lab work, particularly, there were four in a batch at that time. We had to talk to each other and arrange: you do this, I'll take the readings, I'll take the observations, and without fighting we had to do it or else we can't complete those.

e-Carrier: Expose attracts crowds from across the country, including thousands of school students. What impression, do you feel, Expose has on them?

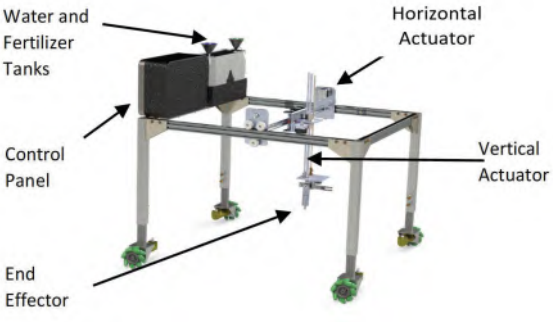
Expose is a great event if you look at it that way, because it will give an idea what engineering, particularly what electronic engineering can do. Actually, now in many countries attraction to do engineering is diminishing. They like to do all sorts of other things, business, trade, commerce etc. That's also good but at the same time, I think, in the state of development of our country, we must attract the best students to engineering and to electronic engineering from the point of view of our electronic engineering department. If I speak from the point of view of my position as chancellor we must attract them to all engineering and architecture and other things that we teach. Attraction to engineering will increase with this type of exposition, because they will come to know what it is. Mostly for general public, electronics is just a television or something like that. Yet, what is inside that, what shall we do with that, what can we do with the information technology, and what can you do with the programming and what can you do with engineering systems? Those things will attract younger people, that is those of 16, 17, 18 years of age, and if we can get the best of them into the department, it is good for the department. In addition to that, I see that practically every graduate in electronic and telecom engineering being employed without waiting for long, some even before they graduate. So that means there is a huge demand for this. Therefore, it's a very good thing to inform to the public that there's a big demand and it's an interesting area, from the point of view of those who like to enter university to select the field. Furthermore, it is good from the point of view of their parents and others to know what these things really mean and what their children will do by joining the University of Moratuwa.

e-Carrier: What suggestion do you have for Expose, as an event, to go forward?

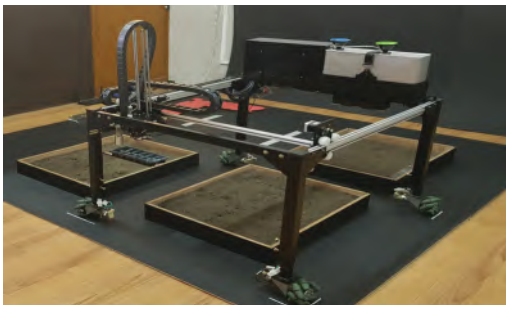
I observe that Expose is doing a lot to showcase what has been done to research, innovation and so on. Also public get to know what is in the department and labs and so on. To add to this, I believe that if you can organize something particularly for science teachers, an event for science teachers particularly by our lecturers and so on, showcasing to them, what our labs are, what we can do in the labs, how you can develop. That will be of interest to the teachers and they may go and relate these things to their students as well.

A Scalable Autonomous Farming Robot

The latest addition to the long record of innovations by University of Moratuwa, the university pioneer in technological innovations and advanced engineering implementations in Sri Lanka, is the farming robot –SAASbot (Scalable Autonomous Agronomical Smartbot). SAASbot is a fully autonomous robot which is capable of maintaining home gardens to medium scale farms from the point of planting seeds, up to the point of harvesting. The robot was designed and developed by three undergraduate students, Achala Athukorala, Kosala Herath and Nipuna Ranasinghe, from the Department of Electronic and Telecommunication Engineering of University of Moratuwa, under the guidance of Dr. Peshala Jayasekara and Dr. Thilina Lalitharatne, senior lecturers of University of Moratuwa, from the Department of Electronic and Telecommunication Engineering and the Department of Mechanical Engineering, respectively.



Dr. Peshala Jayasekara, the one who is behind the idea of "Scalable Farming Robot", states that "the focus is not on the automation of farming activities, but on changing the whole culture of agriculture". Present day world is heavily dependent on large scale farms to fulfil agricultural product requirements for daily consumption. Almost all the agricultural products are grown in remote large-scale farms, which are then transported to markets, to be purchased by consumers. With the rapid increase of world population in the past decades, centralized supply chain of agricultural products forces remote large-scale farms to increase their supply continually. As a result, the artificial chemical (insecticides, pesticides) usage in farming has been increased drastically with the aim of increasing the yield. Furthermore, the use of chemical preservatives has also been significantly increased to reduce the wastage occurring during transportation and storage of agricultural products. Due to these factors, the agricultural products in present markets pose a serious threat to the health of consumers. Moreover, despite the use of chemical preservatives, there is a significant wastage of agricultural products presently, due to inefficiencies in large-scale farming, transportation and storage.



According to the belief of the young innovators from University of Moratuwa, the solution to this crisis lies in the decentralization of agricultural product supply, through motivating consumers to engage in personal or medium-scale farming. However, people are demotivated to engage in farming, mainly due to the time constraints as well as the tiresomeness of conventional farming activities. This is the core problem SAASbot was built to solve, thereby facilitating anyone to engage in farming without additional effort or time, thus changing the whole culture of agriculture, as envisioned by Dr. Jayasekara.

Currently, there are only a very few agricultural robots available for purchase for consumers, for personal farming or medium scale farming in the world. However, all of these available robots have either fixed farming areas (max. ~ 8 square meters) or can only perform a specific farming activity only (seeding, watering, fertilizing). SAASbot provides functionalities such as planting seeds, watering and fertilizing, surveillance, automatic weed elimination with the added unique feature of scalability. The SAASbot can be used in a farming field of any size or shape, making it superior to all the presently available commercial robots for personal to medium scale farming. Looking at the sales data of currently available personal farming robots in the market, it is evident that

SAASbot is capable of securing a huge market share globally, if commercialized.

The whole mechanical system of SAASbot was

developed from scratch in Sri Lanka, under the supervision of Dr. Thilina Lalitharatne, at a fraction of the cost of existing commercial robots for personal farming. SAASbot system consists of not only the SAASbot mobile farming robot but also a stationary home station and its mobile application. The robot comprises a CNC (Computer Numerical Control) gantry and a mobile platform with Mecanum wheels. The CNC mechanism allows the robot to carry out farming operations within its dimensions, which is called as a 'Cell', whereas the mobile platform allows the robot to move to another cell. The use of the hybrid actuation system of Mecanum wheels and the 3-axis CNC mechanism allows precise and faster end effector movement while facilitating scalability. Additionally, the actuation architecture used in SAASbot allows the robot to plant different plants in the same farming field, and treat individual plant separately; a unique feature which is not present in mobile farming robots. The robot has onboard seed, water and fertilizer storages and an onboard rechargeable battery.

The SAASbot mobile app developed by the team provides an easy and powerful interface for the users to control the robot. The mobile app can be used to perform all the aforementioned robot functions (planting seeds, watering, fertilizing), and also it can be used to create custom profiles for each plant type (i.e. the daily water/fertilizer requirement for a specific plant, crop harvesting time etc.). SAASbot will automatically carry out watering and fertilizing daily, according to the profiles created by the application.

"University of Moratuwa undergraduates are diversely skilled. Our engineering graduates possess general engineering knowledge relevant to numerous engineering disciplines, not only constraining themselves to their majoring field. All three members of our team majored in Electronic and Telecommunication Engineering, however, we developed the whole SAASbot system from scratch in Sri Lanka including the mechanical design, electrical and electronic design, control system design, networking and mobile app development. Nevertheless, we had to face many difficulties regarding the mechanical system design implementation, due to the lack of access to manufacturing technologies and resources in Sri Lanka. Looking back, we recall the immense support and resources provided by Dr. Thilina Lalitharatne in implementing the mechanical design. Furthermore, we must thank Dr. Peshala Jayasekara and Professor Rohan Munasinghe, the former Head of the Department of Electronic and Telecommunication Engineering, for their immense support throughout the development of SAASbot." – Achala, the team leader expressed his thoughts.

The methodology and the results of the SAASbot have been presented at the 14th International Conference on Mechatronic and Embedded Systems and Applications of the American Society of Mechanical Engineers (ASME) and Institute of Electrical and Electronics Engineers (IEEE), which was held in Finland this year. SAASbot system is undergoing further developments currently, to increase its effectiveness in different environments and to make the robot compatible with a wider variety of crops. "We are inviting researchers in agricultural robotics as well as potential investors to join us." , the team leader added.

Interviews with Past HoDs

- Interviewed by Sandali Jayaweera and Chamidi Bandaranayake

After few years of silence, Expose 2019 will take place with the joy of celebrating 50 years of excellence of the department. This article reveals the humble thoughts and ideas of some of the past heads of the department about the Expose 2019 despite their busy schedules.

Prof. Kapila Jayasinghe

Prof. Kapila Jayasinghe is a senior professor of department of Electronic and telecommunication engineering and also the chairman of Intellectual Property Advisory Committee (IPAC). He has a vast knowledge and research experiences in Traffic Control Systems, Medical Electronics, Mechatronics, Motion Controllers, Image Processing, Signal Processing, Agriculture related Electronics. He humbly shared his thoughts about Expose with us as this.

e-Carrier: You're an expert in the industry, with your own company established. What things in your university life helped you come where you're today?

Being a university academic, I was fortunate to get my Post Graduate studies linked to Philips in the Netherlands and saw the importance of commercialization of research far back in late 19980's. I resumed duties in 1991 with PG qualifications and worked toward commercialization of research. The introduction of locally developed Traffic Signal Systems by the Department of Electronic and Telecommunication Engineering in collaboration with Department of Civil Engineering was a significant achievement for my carrier. In 2000, I took the leadership to commence the Engineering Design Centre and in 2009, I took the leadership to introduce the Intellectual Property Policy for the University. These are some important events happened in my university life which helped me to come to where I am today.

e-Carrier: What should be the main focus of a university student? Where do self-projects and research fit in?

The university student main focus should be first understand the principles behind the engineering and then develop analytical skills and practical skill to solve real life engineering problems. The self-projects and research should come in towards the third and final years after you grab the principles, analytical and practical skills under proper supervision. Getting involved in self-projects during your early years has a danger of developing hobby type work styles.

e-Carrier: As a past Head Of the Department, what are the improvements you see in the department?

When I returned to the department we had only 2 permanent staff members and a today I see we have a very strong cadre with more than 20 Phd's. This is one of the significant improvement I see in the department.

e-Carrier: To the general outsider, does Expose have any value? What more do you feel can be done to connect to them more?

There are two types of outsiders. The AL students and Industry. What you are presenting is of high value to school children, but in my opinion we need much more to get the real attention of the industry.

Eng. Kithsiri Samarasinghe

Eng. Kithsiri Samarasinghe is a senior lecturer of Department of Electronic and Telecommunication since 2001. He was also the head of the same department for 3 years from 2006 to 2009. Mr. Samarasinghe has a vast industrial experiences gained from working an an Electronic Engineer in Airport and Aviation services , Sri Lanka , as a Director Engineering of Sri Lanka Rupavahini corporation and as a member of the director board of Sri Lanka Broadcasting Corporation. His research interests are Technology Management, Industrial Automation, ICT Policy, Telecom Policy, Wireless Applications, Radar and Navigation, Satellite Communication, Broadcast Technologies, Meditation and Stress Management. He humbly shared his thoughts about Expose with us as this.

e-Carrier: You've had years of experience in the industry. From the many things you learnt back in university, what do you think helped you most in your journey?

I think that the analytical skills and the knowledge I gained of several areas, through the engineering course helped me most in my carrier.

e-Carrier: What should be the main focus of a university student? Where do self-projects and research fit in?

In my opinion, developing the skill set needed for the engineering career ahead should be the main focus of our students. Projects, assigned or self-initiated, are very effective for this purpose because they help to integrate different pieces of knowledge and skills to solve practical engineering problems. Research can help engage an inquisitive analytical mind to train the thought process towards generating new ideas and fostering them towards culmination of an engineering innovation/invention.

e-Carrier: As a past Head of the Department, what are the improvements you see in the department?

Staff strength has immensely improved over the recent years and that has promoted our contributions to research. The department has continued its legacy

of attracting brilliant students and that student community also contributed significantly for the development. Introduction of Outcome-Based-Education (OBE) techniques for the undergraduate curriculum is also a very significant improvement.

e-Carrier: Over the years, you've seen multiple editions of Expose. What contribution do events like this make to student development in your opinion?

Events like Expose were introduced to increase the visibility of the talents of our undergraduates to industry and the general public. We empower our students to take lead in these events. Therefore, events like Expose help develop organizing skills and public relation skills of the undergraduates. These events train them to be socially responsible as well. I have seen Expose serve these purposes very well over the years.

e-Carrier: To the general outsider, does Expose have any value? What more do you feel can be done to connect to them more?

It is the general public who invest their hard-earned money in educating our undergraduates. They should be given the opportunity to see whether their intentions are well nurtured, and goals achieved. That cannot be fully satisfied by just citing the number of undergraduates produced annually. They need to see the quality of the work as well. Expose give them an opportunity to visit the department and observe the work of the undergraduates. School workshops organized in Expose also provides a good learning and motivational opportunity for their children.

Prof.Rohan Munasinghe

Prof.Rohan Munasinghe was the Head of Department of Electronic and Telecommunication Engineering from 2016 to 2018. He specializes in Robotics, Drones , Control systems, Mechatronics and many other fields.

e-Carrier: As an expert in the industry, what things in your university life helped you come where you're today?

Everything in me has eventually come from my university life started at 1996 through learning new things and putting them into practise. I just don't learn from knowledge but I learn through practise and I think this is a fundamental concept which all engineers should keep in mind. Not only in student life even when I joined the staff I learned many things, not only knowledge but how to communicate with different people and how to connect with them.

e-Carrier: Where do self projects and research fir in a life of a university student?

I think self projects and research is a crucial part of university students. University itself is a wide and open place for different ideas and full of enormous amount of knowledge. I think the all the students should try to make a change to the world they live in. Our university has introduced many research

and projects to students as a part of curriculum but that is not the ultimate objective as university try to make you a responsible, mature and knowledgeable professionals. At present we are changing our course modules and curriculum into outcome based education and it will help students to design solutions and implement them using electronic or any other means and then try to solve real world problems.

e-Carrier: Over the years, you've seen multiple editions of Expose. What contribution do events like this make to student development in your opinion?

I think it is very important to have this kind of exhibitions, specifically expose where you show what you do in this department to the rest of the university and to the public. Having seen some very interesting, very special projects, main thing we expect to happen is inspiration. Some of the projects go way beyond final year senior level and those students should get credit for what they have done. So I think it is extremely important to have exhibitions like expose to inspire students and showcase their work to the public.

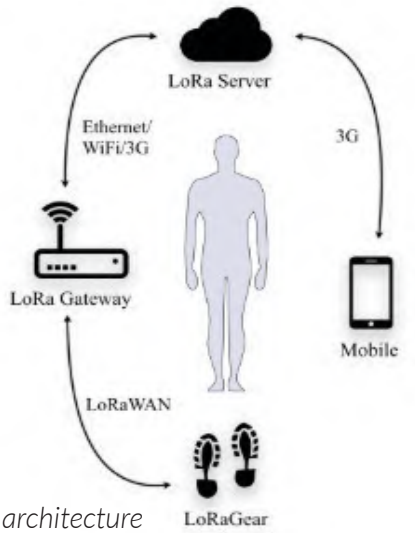
e-Carrier: Many school children visit Expose. Do you think it is important for them to visit to exhibitions like this?

It is extremely important. Advance level students at present are the future of the country and we want the best students to come to this place. We want to show our projects to them and inspire them to engage in those projects later. At present they may not fully understand the technical knowledge and complexity of the projects , but they try to understand the flow of projects and they can resonate what they know about those areas. When school children visit exhibitions like this, these memories remain for a long time and they make these projects their life's benchmark and try to achieve that excellence. So I think it is very important to populate this exhibition within the school children.

LoRaGear: A LoRaWAN based low power wearable for fitness monitoring and location tracking

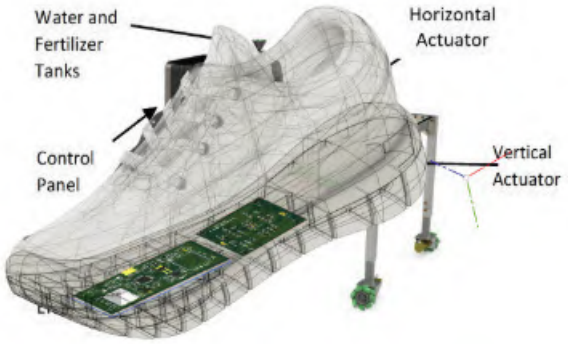
The number of smart devices worn and carried by users such as smartphones, smartwatches and smart-shoes is growing faster than ever before. Recent advancements in technology has enabled an incredible amount of computational power to be compacted into smaller footprints, facilitating a variety of attractive services through these wearables such as precision health and fitness. These applications require continuous monitoring of human activities through Inertial Measurement Units (IMUs) and regular communication with cloud-based services for further data processing. Continuous monitoring makes most wearables extremely resource hungry, leading to higher power consumption and shorter battery life.

Moreover, the battery technology is not keeping pace with the demand due to small form factor requirements of wearables. Having to charge multiple devices frequently makes the problem even more acute. If direct low-power secure communication can be provided on wearables, the repertoire wearable applications and user quality of experience can be further improved. Especially, in the case of precision health and fitness activities that in which carrying a smartphone is inconvenient and mission critical applications that require continuous network connectivity.



System architecture

We introduce LoRaGear, a novel low power smart shoe based on LoRaWAN that provides long range secure direct always-on connectivity through the LoRaWAN communication protocol with fitness monitoring and location tracking capabilities. The device is partially powered by an Electromagnetic energy harvester, which is further utilized for step-counting.



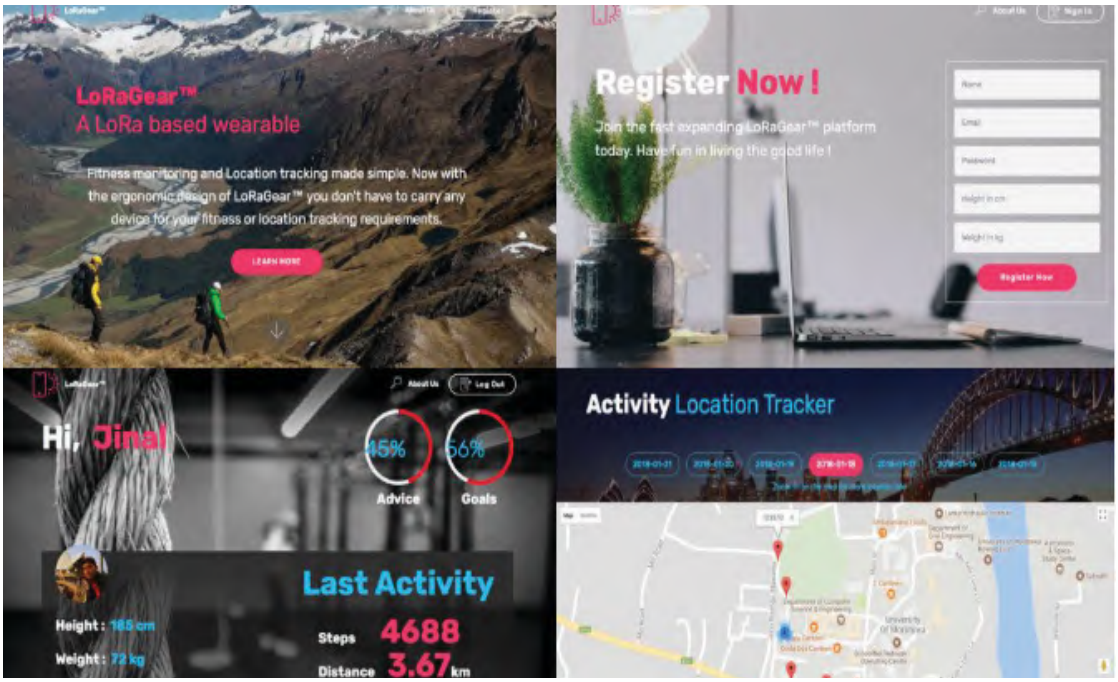
The technology used for communication, LoRaWAN is a low-power-wide-area communication technology for low-power Internet-of-Things (IoT) devices that operates in unlicensed frequency band. With the proliferation of IoT devices, LoRa networks are currently getting deployed around the world. Nonetheless, LoRaWAN has not yet been exploited for wearable device communication and this is the first demonstration of the performance of LoRa based wearable.

LoraGear comprises of a LoRa radio, a GPS module and an electromagnetic energy harvester. The energy harvester is made using two sets of magnets mounted on two vibrating arms which ensures harvesting energy on the go. Several design phases were involved for energy harvester as miniaturizing it to house inside a shoe was a crucial task.

A Web based user application for LoRaGear provides users the fitness and location tracking services . Since,

fitness data such as traveled distance, burnt calories depend on height and weight of a person in addition to step count, we developed a profile based application where each user can manage a personal account. Based on user preference, daily recommended fitness expectations and targets can be personalized.

methodology published on ISWC '18 Proceedings of the 2018 ACM International Symposium on Wearable Computers held in Singapore, and full paper [2] presenting the complete system is under review at ACM/IEEE International Conference on Information Processing in Sensor Networks.



User interfaces of the web application

LoraGear was tested for the range of communication, location and step accuracy within the university premises and some areas in Colombo. This device claims a 98% accuracy for step counting and line of site connectivity upto 1km. Furthermore, the results show that LoRaGear has a power consumption of 6.61mW and power generation of 0.5mW. Furthermore, LoRaGear can be used up to 274 days on a single charge of a 100mAh battery for a typical user with recommended activity hours by World Health Organization.

In conclusion, LoRaGear achieves a longer battery life compared to existing wearables

by reducing power consumption for communication and processing while generating a portion of energy requirement. This is the first consumer wearable that uses LoRaWAN for communication and Electromagnetic energy harvesting signal for step counting, as to the best of our knowledge.

A short paper [1] elaborating the novel step counting

[1] Kahatapitiya, K., Weerasinghe, C., Jayawardhana, J., Kuruppu, H., Thilakarathna, K., and Dias,D., 2018, October, \Low-power step counting paired with electromagnetic energy harvesting for wearables", In Proceedings of the 2018 ACM International Symposium on Wearable Computers (pp.218-219). ACM. https://dl.acm.org/citation.cfm?id=3267291&dl=ACM&coll=DL

[2] Kahatapitiya, K., Weerasinghe, C., Jayawardhana, J., Kuruppu, H., Thilakarathna, K., and

Dias, D., Submitted in 2018, October, \LoRaGear: A LoRaWAN based Low-Power Wearable for

Fitness Monitoring and Location Tracking", Submitted to ACM/IEEE International Conference on

Information Processing in Sensor Networks (Awaiting reviews).

LSS AWARD WINNERS

Excellence in academia will not alone be the single most vital factor of perfection in one's personality. Here, at the Department of Electronics and Telecommunication Engineering, we value not only one's academic achievements but also his/her leadership qualities and potential to serve the community. Therefore, The ENTC awards the prestigious 'LSS Award' to its most outstanding graduate in leadership, scholarship and service. It's the first honor society of the department with a national scope to give recognition and honor for meritorious leadership and service to the university and to encourage development of general university studentship.

Let's explore some of the personalities, who was awarded this prestigious award.

2016- Nadee Senevirathne

"For me, LSS award was an impeccable milestone as an undergraduate of the department and I wish to be a responsible individual who would do their part to make this world a better place to live for the future generations."

Currently being a PhD student at University of Maryland-College Park (UMD), her research work is focused on incorporation of deep learning techniques in speech and audio signal processing. Prior to beginning her graduate studies, she served as a Lecturer-on-contract in the Department of Electronic and Telecommunication Engineering (ENTC), University of Moratuwa, her alma mater.

With immense gratitude she recalled how ENTC motivated her to pursue a career in research, exploring the unknown.

"I am grateful for all my teachers at ENTC for laying the foundation in the subject fields and at the same time providing opportunities to improve my knowledge and skills. ENTC helped me to balance my undergraduate life by encouraging to engage in extracurricular activities while performing well in academic work."

During her first year of graduate studies itself, she was awarded the distinguished teaching assistant award by the Department of Electrical and Computer Engineering at UMD for the year 2016/17 and she believes the experience I gained by being at ENTC was extremely helpful to achieve such an accomplishment.

It is with humble pleasure she thanked ENTC again for awarding her with the prestigious LSS award in 2016. She also stated that she believes that the LSS award recognizes the versatile personality of an ENTC graduate who would not only focus on academic work, but also works for the betterment of the community they live in.

"It is about what you give-in to the society while growing yourself as a professional."

2017 - Hasantha Malavipathirana

"LSS is the highest honor I have received so far in my life. I feel a humble pride for receiving this honor, and I'm truly indebted for the department for awarding me with LSS."

Primary Education: Telijjawila Royal college

Secondary Education: Sujatha Vidyalaya, Matara and Devi Balika Vidyalaya ,Colombo 08.

Passing A/Ls with 3 As securing the 11th place in the Colombo district and 31st in the Island, Hasantha entered University of Moratuwa in October 2011. Meeting a bunch of new friends and teachers, and gathering a whole of new experiences, she also became the batch first at the field selection exam in the first semester.

'On my 1st day at ENTC, I was inspired by the welcome speech given by the then president of E-Club, Mr. Lakshitha Chathuranga. I wanted to be a part of it.'

Powering herself from that inspiration, she started her career in the E-Club by volunteering at SLRC 2012. It was a lot of responsibility as she was also the batch representative in the same year. Her career as a volunteer at the E-club ran as follows;

- **Event day organizer for SLRC 2013**
- **Volunteered for TPL, E-care and E-forum**
- **Member of the organizing committee of the first Abhina show of the department (Abhina 2014)**
- **Appointed as the vice president of the E-Club in 2014**
- **President of the E-Club in 2016**

LSS AWARD WINNERS

"I must thank all the ENTC family members who laid the steps to re-initiate Expose exhibition in 2016 after 9 years, specially for the guidance of the staff adviser of E-club, Eng. Kithsiri Samarasinghe, the HoD prof. Rohan Munasinghe, staff members and the E-Club alumni."

In 2015, she got the opportunity to work as a Research Assistant at Augmented Human Lab in Singapore University of Technology and Design. Hasantha graduated in April 2016 with a first class and joined Synopsys Inc. Sri Lanka as a Corporate Application Engineer. She worked there for one year and joined the department back again as a lecturer on contract in 2017. Currently she is a PhD student at Florida International University.

Her Final words for this achievement was uttered with a mouth full of smile:

"ENTC gave me knowledge as well as a lot of experience to shape my life. I'm who I am now because of what ENTC gave me. I was fortunate enough to work with giant figures in the department. I must thank all the staff members for their guidance and support. I specially mention Dr. Ranga Rodrigo, who guided me in balancing academic and extracurricular activities. Also I must thank my batchmates and all the ENTC family. Any of the achievements at ENTC would not have been possible without them. I must thank my parents and teachers who guided me throughout my life.'

2018- Tharindu Kaluarachchi

"The LSS Award wasn't just any award, but an unforgettable part of my life that awakens memories and reminds me of the responsibilities that await me in the department to ensure that ENTC is always becoming better to create great Engineers for generations ahead."

His journey from Anuruddha Central College to Royal College, and then to the University of Moratuwa had prepared him enough to be able to select the Department of Electronic and Telecommunication Engineering.

As it stated in every LSS winner's mind Tharindu also stated that ENTC family, includes the best and friendliest academic staff he has ever seen in the University and also claimed that it was made up of the most excellent and intelligent people coupled with their various skills which made it easier for anyone to be good at many things.

"ENTC made me a person who can proactively solve problems and accept challenges in the industry and society."

Some of the achievements of this proud recipient of LSS is as follows;

Member of the champions team at the International Robotics Challenge 2015 of Techfest, held in Mumbai, India.

Served as the assistant secretary and the vice president of the E-Club

Batch Representative of the department

Received the University colors for table tennis twice.

Graduating with a First Class.

Finally making the eight year old dream a reality Tharindu's last words of success was;

' I remember vividly well, always ending essays on 'myself', with the sentence "My ambition is to be an Electronic Engineer." Despite having no idea who an engineer is then, I held on to my dream and ambition to become one. It was a life goal, "I must be an Electronic Engineer." '

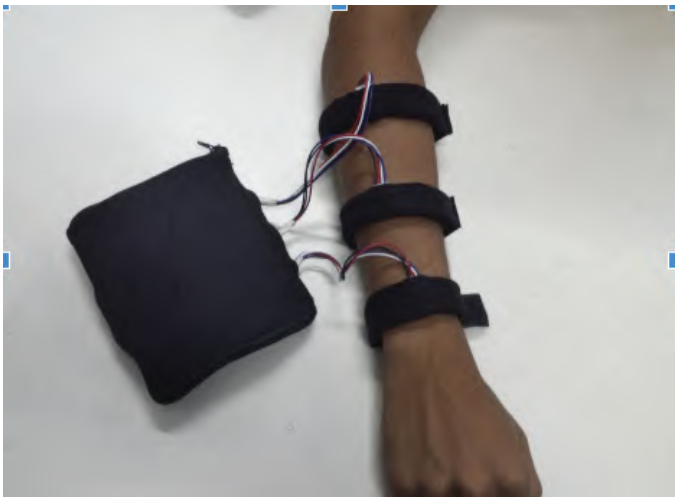
BrailleBand – You don't need eyes to see the world

By Savindu Herath

Sight is the main human sense which possesses the main influence on perception of all sensations, in collaboration with other senses such as hearing. Therefore, the lack of sight is the greatest challenge the visually impaired population face in performing their daily tasks such as navigation, information access, interpersonal interactions and safety.

Moreover, as per the World Health Organization's fact sheet on "Visual Impairment and blindness", the global completely blind population is estimated to be 40 to 45 million and nearly 135 million are estimated to have low vision as at 2014. Unfortunately, the blind population is expected to double by 2020 while further recent studies project the blind population to triple by 2050.

However, visually impaired people are neglected from many modern communication and interaction procedures.



Assistive devices developed through assistive technologies have become the key applications of biomedical engineering which lead to the enhancement of quality of life of people with physical and sensory disabilities and abnormalities. Assistive technologies such as text-to-speech and braille displays are the most commonly used means of connecting such visually impaired people with mobile phones and other smart devices. But unfortunately, both these solutions face usability issues. Therefore, this study was focused on developing a user friendly wearable solution called the `BrailleBand' with haptic technology while preserving affordability. The `BrailleBand' enables passive reading using the Braille language. Connectivity between the BrailleBand and the smart device (phone) is established using Bluetooth protocol. It consists of six nodes in three bands worn on the arm to map the braille alphabet, which are actuated to give the sense of touch corresponding to the characters. Three mobile applications were developed for training the visually impaired and to integrate existing smart mobile applications such as navigation and short message service (SMS) with the device BrailleBand.

BrailleBand uses the sense of touch of the arm to transfer information to a blind person using a wearable band having six vibration nodes in three bands, two nodes per each band, corresponding to the standardized braille dot code. These nodes are actuated to give the sense of touch corresponding to the characters which are being transferred from the phone to BrailleBand.

Wearing a band on the arm is similar to wearing a wristwatch, hence does not hinder the use of the hand for other essential tasks. Moreover, wearable assistive solutions are preferred than the portable assistive solutions such as braille displays and mobile phones (text to speech) as they provide hands-free convenient interactions.

The main focus areas of assistive technologies are,

1. Information Transmission

2. Mobility assistance and Navigation

3. Computer and Smart Device Accessibility

The BrailleBand caters the needs of all the above three areas and its scope of applications are broader and can be customized according to diverse user needs.

Three mobile applications were developed for the BrailleBand:

1. BrailleBand Teacher - Used to get the blind person familiarized with the device and to teach the method of reading braille from BrailleBand. Since blind people are deprived of their sight, the other senses are stronger and hence they catch up the system really fast.

2. BrailleBand Messenger - Enables the user to read text messages received to the mobile phone through the BrailleBand.

3. BrailleBand Navigator - This application can navigate a blind person to a destination by giving haptic feedback about the direction and the distance to travel through the BrailleBand. However, the accuracy of navigation still needs to be developed.

The existing social media and utility mobile applications such as Facebook, Twitter, Linkedin and Google Maps can be integrated with the BrailleBand application and is readily usable with the BrailleBand device since the information from these applications can be conveyed to the blind user through the device.

BrailleBand caters a wider range of blind support needs and it has many applications such as reading, navigation and smart device accessibility. It is a complete package of the device and the mobile applications for smartphones.

The adaptability, usability and efficiency of reading was tested on a sample of blind users which reflected progressive results. Even though the reading accuracy depends on the time duration between the characters (character gap) an average Character Transfer Rate of 0.4375 characters per second can be achieved with a character gap of 1000 ms.

The blind community uses the sense of hearing and sense of touch to interact and understand the surrounding environment. Hence, the sense of touch becomes the primary sensory modality to communicate non-audible information to and from a blind person.

Conclusively, the `BrailleBand' haptic wearable blind support device connected to smartphone applications helps the blind community to lead an independent quality life. This assistive technology enables information transmission, navigation and smart device accessibility through the sense of touch. With the development of the BrailleBand we have successfully implemented a new mode of communication to the blind using haptic technology.

Project Members:

Achintha Iroshan (BME)

Savindu Herath (BME)

Charith Panangala (ENTC)

Wishwa Perera (ENTC)

Hareen Udayanath (CSE)

VEHICLE TO VEHICLE COMMUNICATION

An Interview of Dr. Tharaka Samarasinghe

Interviewed by: Shenali Kariyawasam

Dr. Tharaka Samarasinghe is a Senior Lecturer at the Department of Electronic and Telecommunication Engineering, University of Moratuwa. His specializations and research interests include Wireless Communication, Information Theory and Vehicular Communication. While giving insights into Vehicle to Vehicle communication, this interview reveals his contributions in this area.

e-Carrier: Vehicle to Vehicle Communication is identified as a novel development that reduces motor traffic related problems. To begin with, we would like to know what Vehicle to Vehicle Communication is?

Vehicle to Vehicle Communication allows a vehicle to initiate wireless communication with another vehicle or with any related stakeholder of a vehicular network, such as a roadside unit or a pedestrian. Generally, the communication is divided into two categories as Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I). The main objective of V2V communication is to reduce accidents and to make roads a safer place.

e-Carrier: What are the applications of V2V communication and how will this technology address the prevailing problems seen today in motor traffic?

The applications of V2V communication can be divided into a few categories, with the main one being safety applications. Safety applications focus on notifying the driver when there is something to be alert of. It can be sudden braking, a not safe to overtake message, a blind spot warning, a red light warning, a hazardous road condition notification, notification of an incoming train or any other message that ensures safety. These messages can alert the driver in form of a display on screen, a seat vibration or a noise, so that the driver can be more aware of his surroundings.

Similar to your mobile phone, the vehicle will have its own transceiver, using which it will transmit messages autonomously without the involvement of the driver. Mostly, there will be periodic beacons, so that the neighboring vehicles are notified of your parameters of interest, which may be updated in a map.

What kind of information is transferred between the vehicles? It can be position which can be a GPS coordinate, the speed, the direction, braking etc.

The second category is applications related to traffic management. Traffic management is a key factor in Intelligent Transport Systems (ITS), which is a buzzword these days. A driver can be notified of alternate routes if there's a traffic congestion lying ahead.

Vehicle platooning is another well-known application of V2V. A platoon is a group of vehicles that can travel together by maintaining a close distance between each other. All the vehicles in the group will have a synchronized speed and will probably travel to the same destination. This enables another key factor

in transportation and ITS, which is improved fuel efficiency. V2V communication can be considered a necessity for platooning.

On top of these, V2V communication can be used for ridesharing, public transport – to easily track public trains and busses, fleet management etc.

e-Carrier: What is the technology involved in V2V communication?

The main technology involved in V2V communication is called Dedicated Short – Range Communications (DSRC). This is the accepted or the widely used method at the moment, and operates in the 5.9 GHz band in the USA. It has a dedicated frequency spectrum and is based on IEEE 802.11p, which is a modified version of the well-known standard used in Wi-Fi.

Cellular Vehicle to Everything (C-V2X) introduced by 3GPP, which takes an important part in 5G (the next generation mobile wireless technology), can be considered to be the key competing technology to the US promoted DSRC. A main drawback of DSRC is the necessity of installing a dedicated transceiver in every communication node, which makes it prohibitively hard to connect stakeholders such as pedestrians and cyclists on to the network. The requirement also hinders the penetration of ITS. The advantage of cellular V2X over DSRC is that cellular coverage is already available and stakeholders can be easily connected. In general, anyone carrying a mobile phone can be connected to the network.

Europe originated Cooperative Intelligent Transport Systems (C-ITS) can be considered to be another alternative technology to DSRC.

e-Carrier: How far have the Engineers worldwide reached in practically implementing the technology? What are the factors that slow the pace of development?

Requiring a costly DSRC transceiver is a limitation in V2V communication. For V2V applications to operate at full swing, all vehicles in the network should have their own transceiver. Majority of new cars are DSRC equipped, but it will take a long time for all vehicles on the road to be V2V ready.

Limitations can arise due to spectrum issues as well. At the moment, the US has dedicated the 5.9 GHz band for DSRC. Due to the safety critical nature, a dedicated spectrum is essential. A transmission in the same frequency band will cause interference, which will lead to reliability issues. However, the next generation wireless communication is also eying the 5 GHz portion of the spectrum (e.g. mmWave) due to the requirement of higher bandwidth. This may lead to conflicts in the future.

e-Carrier: How is V2V communication and Autonomous driving linked?

There are two well-known autonomous cars at the moment- the vision based Tesla and the LiDAR based Google car. The problem associated with fully automated cars is the requirement of a near perfect driving environment. In most cases, autonomous car crashes have occurred due to irregular traffic conditions that the machine has failed to understand and react.

Improved communication among the nodes in the network is the most likely solution to this problem. Therefore, V2V can be considered to be a vital component of autonomous driving.

e-Carrier: Are there any research projects related to V2V communication that you are involved in at the department, including undergraduate and postgraduate?

Yes, we have done both undergraduate and postgraduate research projects in the last couple of years. One objective of our projects and research here was to look at alternative methods to DSRC which in turn will speed up the penetration of ITS. Wi-Fi

VEHICLE TO VEHICLE COMMUNICATION

Direct came in as an alternative. We have identified limitations of Wi-Fi Direct, and further research has been done to alleviate these limitations. Theoretical, simulation based as well as experimental studies have been completed and published.

We have also done few simulation based projects on DSRC to simulate the communication aspects of different applications of ITS, which included car following, lane changing, emergency vehicle traversal, intersection traversal and vehicle platooning. We have also started work on the promising C-V2X technology. To this end, a Ph.D. project is currently underway on MAC layer modeling of C-V2X, jointly with University of Oulu, Finland.

e-Carrier: How do these research projects benefit the economy of Sri Lanka? Are the facilities available sufficient for these improvements?

Apart from the research projects that I mentioned earlier, we have been able to form a center on ITS. Six departments in the university, namely: Civil, Electronics and Telecommunication, Computer Science, Mechanical, Chemical and IT have collaborated to form the center. We have succeeded in attracting a World Bank grant which we will have to deliver in the next three years.

A main focus of this project is to find out how we can implement applications of V2V in Sri Lanka for the betterment of the country. We have put thought to some useful applications including safety of railroads, pedestrian safety and traffic management.

The main project will lead to several final year projects, and there will be ample opportunities for postgraduate students as well in the next three years.

e-Carrier: What is your advice to undergraduate students who are interested in Telecommunication Engineering, to involve in V2V communication related research projects?

ITS will be a key component in smart cities in the future, and V2V is definitely an enabler of ITS. In the next few years, there will be plenty of activities at the department, and also at the university thanks to the ITS center. I strongly encourage the students to get involved in these activities.

Forensic Video Analytic Software FYP shines with NBQSA GOLD Award, APICTA Nomination, IEEE SMC Paper Publication and BSc Thesis Grant Award.

By Sahani Goonetilleke

Law enforcement officials heavily depend on Forensic Video Analytic (FVA) Software in their evidence extraction process. However present-day FVA software are complex, time consuming, equipment dependent and expensive. Developing countries struggle to gain access to this gateway to a secure haven. The term forensic pertains the application of scientific methods to the investigation of crime through post-processing, whereas surveillance is the close monitoring of real-time feeds.

Under the supervision of Dr. Ranga Rodrigo, a Final Year Project (FYP) group from 2013 batch, comprising of Ms. Sahani Goonetilleke, Mr. Anton Ratnarajah, Mr. Dumindu Tissera and Mr. Kapilan Balagopalan as team members, undertook the FYP titled "Forensic Video Analytic Software" with the principle objective of developing an efficient and effective FVA Software, addressing the shortcomings through a stringent and systematic review of scholarly research papers, online databases and legal documentation.

The scope spans multiple object detection, multiple object tracking, anomaly detection, activity recognition, tampering detection, general and specific image enhancement and video synopsis. The final output is a deployable software efficiently integrating all the above-listed functionalities, operable on workstations with a user-friendly GUI connected to a CCTV camera. Along with this, deliverables achieved include GPU implementation of common and frequent processing steps with optimization of machine learning techniques as well as conference publication.

Technologies

Methods employed include many machine learning techniques, GPU acceleration and efficient, integrated architecture development both for real-time and postprocessing. Latest technologies such as C++ and Matlab programming languages, OpenCV 3.4.0, Cuda 8.0 and CuDNN 5.1 libraries, x64 Visual Studio, NVIDIA 940MX and NVIDIA GTX 1050 Ti Graphics Processor Units (GPUs), Intel® core™ i7 CPUs, Microsoft Windows Operating System, upto 16GB RAM, CNN, GMM and multithreading were integrated into the system to overcome present-day FVA software bottlenecks in complexity, time intensity, exorbitant pricing and equipment dependency.

IEEE SMC 2018 Paper and IEEE BSc Thesis Grant

Video Synopsys is a novel summarization technique of generating shorter videos by exploiting the spatial and temporal redundancies. The team also has a publication under their belt for their innovative research paper titled "Moving Object Based Collision-Free Video Synopsis" which was accepted by all 4 reviewers for oral presentation at IEEE International Conference on Systems, Man and Cybernetics (SMC) 2018, held at Seagaia Convention Center, Miyazaki, Japan, from 7th to 10th October 2018. It is the flagship conference of the IEEE Systems, Man, and Cybernetics Society. Concurrently, the team was

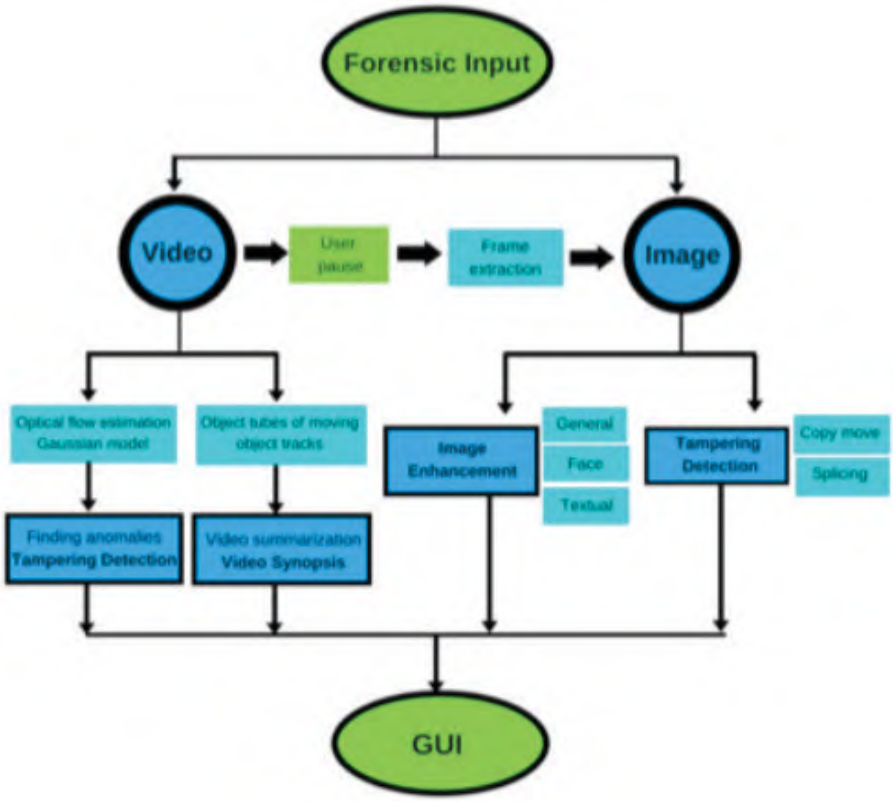
awarded the BSc Thesis Grant for Outstanding SMCS BSc Thesis Work at the IEEE SMC Conference. This was sponsored by the Thesis Grant Initiative of the IEEE Systems, Man and Cybernetics Society.

NBQSA 2018 and APICTA 2018

The team submitted their working prototype of the Forensic and Surveillance System for evaluation for the National Best Quality ICT Award (NBQSA) 2018, under the Tertiary Student Project (Technology) category in August. After two rounds of presentations, the team won the GOLD Award in the aforementioned category. Through NBQSA streaming, the project was selected to represent Sri Lanka at the 18th Asia Pacific ICT Alliance (APICTA) 2018 as an APICTA nominee. The FYP was demonstrated at the event held from 9th to 13th October in Guangzhou, China under Tertiary Student Project (Technology) category. APICTA provides the region's ICT entrepreneurs with valuable networking and product benchmarking opportunities, fosters ICT innovation and creativity, promotes economic and trade relations and facilitates technology transfer.

Testing of online datasets and self-recorded videos both in indoor and outdoor scenarios with variations in illumination, duration, object density, etc. were performed to justify the practicality. The links for forensic (https://www.youtube.com/watch?v=vsZIYKQxSkE&t=24s) and surveillance (https://www.youtube.com/watch?v=QrTLyJp65yU&feature=youtu.be) demonstrate the extent of feasibility of our FVA software through pilot trials in the market.

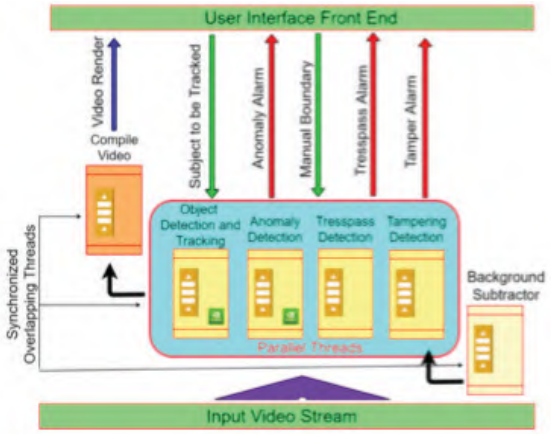
Forensic Analytic Software can ease the work for Sri Lankan police officers and security force in detecting any forensic activities in real time and also help them to collect evidences for criminal activities. Features like video synopsis will save the time of the authorities in finding evidence for criminal activities and surveillance. Tampering detection enables the police to identify whether the produced evidence is being

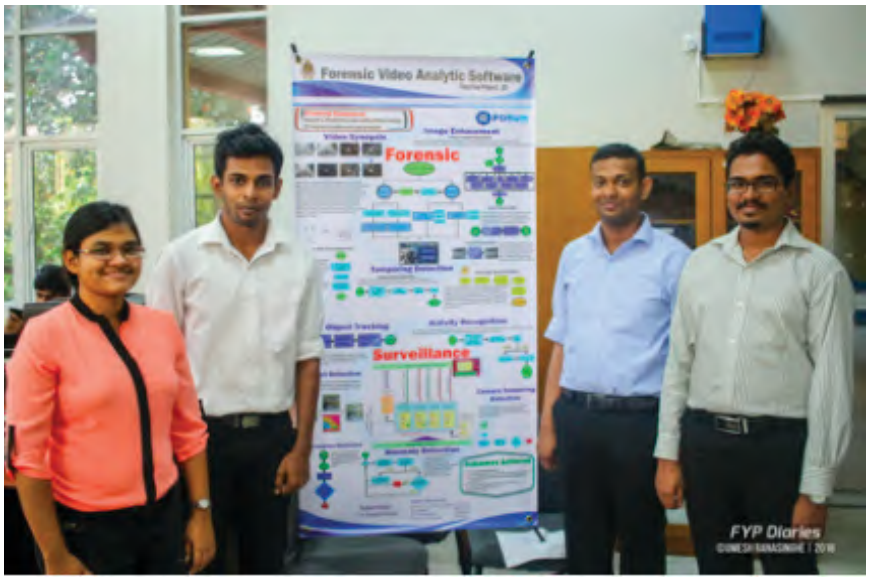


tampered or not. Activity recognition and anomaly detection enables real-time detection of activities which can cause crime and allows security officers to focus more on those scenes. Tracking multiple people in a video makes it easier to track the activities of a specified person. As the Sri Lankan police officers lack this technology, they are seeking help from lecturers in the Engineering Faculty of University of Moratuwa by sending their evidence video to extract some vital information. This Forensic Analytic Software will

be an appropriate solution for their needs, as it is a user-friendly software they can enhance a region of interest (e.g. face or number plate) and collect the evidence that they require.

The results include forensic and surveillance panel outcomes with emphasis on video synopsis and Sri Lankan context. Principal conclusions include the optimization and efficient algorithm integration to overcome limitations in processing power, memory and compromise between real-time performance and accuracy.





ELECTRICAL & ELECTRONIC COMPONENTS

TO BE AN EMERGING LEADER IN THE ELECTRICAL AND ELECTRONICS MANUFACTURING SECTOR TO MEET SRI LANKA'S NEEDS AND EXPORT TO THE GLOBAL MARKET

The Electronic and Electrical Components (EEC) sector is an up-and-coming sector for Sri Lanka, with the potential to stimulate innovation, research and development (R&D) and investment in the country. The EEC sector is well positioned to benefit from the electronic and electrical component industry's steadily increasing levels of manufacturing in Asia, and can contribute to the diversification and technological upgrading of Sri Lanka's exports.

Globally, the electronics industry has grown from US $ 1.75 trillion in 2008 to US $ 2.1 trillion in 2015, and is estimated to grow to US $ 2.4 trillion by 2020. During the past two decades, the industry – which encompasses consumer appliances, information and communication technology, industrial electronics, aerospace and defence – has experienced a steady expansion that has been driven by both demand and industrial infrastructure. The exponential growth of the Internet and its use for both personal and business data management and communications continues to be the sector's main driver.

Despite the immense global growth in the electronics industry, Sri Lanka so far has had limited participation in the sector. The country has great potential to develop a competitive electronics industry thanks to skilled labour, relatively well-developed infrastructure and preferential access to key destination markets through trade agreements. Interestingly, the compound annual growth rate (CAGR) for the electronics industry between 2012 and 2016 was 2.57 % for Sri Lanka, while the global CAGR was –1.20 %.

Global trends and opportunities for Sri Lanka

Electronics is a highly dynamic, globalized industry in which change is a constant ; adaptations and upgrades continue to be key enablers and disruptors for the industry. Many trends that evolve from the EEC sector are linked closely with the software and hardware sectors. The main trends are 'digitization', 'automation', 'miniaturization' and, importantly, affordability. Nothing will remain untouched by electronics, in which hardware and software combinations as embedded technologies will continue to deliver disruptive solutions at more affordable prices at an even faster pace. Several new areas such as security, healthcare, transportation, defense, agriculture, lighting and lifestyles are being digitized and automated at various levels.

Pressing issues for the sector in Sri Lanka

Many rounds of consultations with public and private stakeholders were held in Colombo and regions across the country to understand the sector, and many issues were highlighted in the value chain. This Strategy targets issues affecting the value chain and makes an informed selection of the most important targets that need to be addressed. Two main criteria were used to assess importance : the level of disturbance (perceived by national stakeholders) and the ease of resolution (both in terms of cost and time involved). The following are the most pressing issues that need to be addressed

- Limited recognition of Sri Lanka's EEC sector locally and internationally
- Limited availability of skilled and semi-skilled labour
- Substandard products entering Sri Lanka's markets
- Limited access to contemporary and innovative technologies
- Inadequate strategic partnerships to integrate with global value chains
- Absence of sector-specific promotion and branding and limited participation in international trade fairs
- Limited services for product testing and standardization for exports.

Article By:
Akila Dishan De Zoysa
Assistant Director
Export Services Division

NATIONAL EXPORT STRATEGY (NES)

The National Export Strategy (NES), a flagship development project, spearheaded by the Ministry of Development Strategies & International Trade and the Sri Lanka Export Development Board (EDB) together with the public private partnership, has started implementation in high waves after obtaining the Cabinet approval and the launch with all the stakeholders of NES. Sri Lanka now has the opportunity to catch up with fast-growing Asian exporting countries.

The NES is a comprehensive and carefully structured five-year strategy aimed at increasing exports and generating enhanced revenue for Sri Lanka's exporters including SMEs. The implementation of this endeavor will witness the increasing of Sri Lanka's export revenue to USD$ 28 Billion by 2022.

The National Export Strategy is well aligned with, complements and operationalises other national initiatives such as Enterprise Sri Lanka and Vision 2025.
The NES priority sectors have been selected to ensure a balanced export expansion from visionary, emerging and mature sectors which provide a good mix of industries with different growth trends, yet ensures the NES remains focused to achieve the key objective of export diversification during its 05 year implementation period. Using quantitative and qualitative information, the national stakeholders have selected the following industries:

- IT-BPM
- Spices & Concentrates
- Wellness Tourism
- Processed Food & Beverages
- Boat-Building
- Electrical & Electronic Machinery

The NES will improve the business environment for all Sri Lankan enterprises. While the NES provides the conditions to enable diversification by strengthening emerging sectors, all export industries of Sri Lanka will benefit from the increased performance of key Trade Support Functions. These include

- Logistics
- National Quality Infrastructure
- Innovation and Entrepreneurship
- Trade Information & Promotion

The NES aims to empower the emergence of new champions while supporting growth of traditional export industries. Major systemic issues hindering the rapid expansion of Sri Lanka's exports will be corrected to favour growth of higher-technology and knowledge-intensive exports, which are less vulnerable to cost shifts. The Advisory Committees, established by the EDB have already commenced the implementation while the NES Management Unit which was established under the Ministry of Development Strategies and International Trade leads the co-ordination, follow up and monitoring of the NES.

Article By:
Ms. Rukshanie Vidyaratne
Assistant Director
Policy & Strategic Planning

The Most Outstanding Graduate of the University of Moratuwa

An interview of Savindu Herath

- Interviewed by Kithmini Herath

The Vidya Jyothi Professor Dayantha S. Wijeyesekera Award for the Most Outstanding Graduate of the year is awarded to a chosen graduate from all faculties of the university who has proven to be an all rounder – someone who has excelled in academics (First Class Honors), with excellent sportsmanship skills, recognized as a leader and who has made significant contribution towards community service and service to the university. This prestigious award was recently awarded to Savindu Herath, a graduate from our very own Electronic and Telecommunication department. This was the interview that followed.

e-Carrier: Can you tell me a little about yourself?

I am Savindu Herath, the eldest son in my family. I have a brother and a sister. Prior to entering St. Antony's Nursery School in Borella, I spent my childhood with my parents and grandparents in Panadura. Since my father is a dedicated Old Anandian, I entered Ananda College, Colombo in 1999 to Grade 01. I was constantly encouraged by my parents – especially by my father who was a skilled sportsman himself – to get involved in sports and other extracurricular activities. Therefore, this motivated me to engage in extracurricular activities such as hockey, chess, football, swimming, gymnastics, scouting, cricket, rugby and long-distance running. Parallely, I obtained Distinctions (A passes) in all my subjects at the G.C.E. Ordinary Level Examinations and at the G.C.E. Advanced Level Examinations in the Physical Science stream (Mathematics stream) and obtained entrance to the Faculty of Engineering University of Moratuwa. After graduating from the university, I worked as a software engineer for London Stock Exchange Group, and I am now continuing in the same domain in Switzerland.

e-Carrier: Mark saying your journey towards entering the University of Moratuwa?

My journey began with a promise I made to my mother at the age of 13. Seeing a senior having won the Most Outstanding Anandian award at the prize giving that year, my promise to her was to bring that trophy to her someday.

However, as I began my journey with determination, it was not smooth as it sounds to be. In Grade 11, my school expected an island rank from me at the O-Level examination, but I could not achieve my goal. Determined to bounce back from my failure, I reflected upon myself and realized my ability does not lie in focusing a 100% on academics, but rather, in balancing everything with my involvement in sports and other extracurricular activities. I then joined the Prefects' Guild of Ananda College as an Assistant Prefect, while continuing to be part of the college hockey and chess teams and studying for A/Ls in the Mathematics stream. With time, I found the perfect balance between all my activities, and I really enjoyed doing them. Facing A/Ls in the Mathematics stream and making it to University of Moratuwa for a Prefect at Ananda is assumed to be a very hard task due to the time and effort the Prefects sacrifice for the school. However, I wanted to prove that nothing is impossible if you have the courage to challenge the status quo. I humbly say, as per school records, I was the only Head Prefect of Ananda College to achieve "A" passes for all subjects at the A/L examination in the Physical Science stream, in the 132 years of my school's history. As Head Prefect, I chaired 23 projects during my tenure. I represented Sri Lanka Schools under 21 team in Hockey and was the Vice-

Captain of the under 20 college chess team, while securing numerous achievements to my alma mater. I was then awarded the Fritz Kunz Memorial Challenge Trophy for the Most Outstanding Anandian, the highest honor a student at Ananda can ever achieve. And with that, the door to the Faculty of Engineering at the University of Moratuwa opened.

e-Carrier: Tell me your experience at the University of Moratuwa.

I'd say it was a great paradigm shift as in university, you find yourself in a great amount of freedom and meet many new people every day. The university has great culture, and I can guarantee that some well-known menaces that tend to harm and hinder the performance of universities are not present, so you find many opportunities for students to showcase their talents and reach their fullest potential. I joined AIESEC, the Rotaract Club, the hockey team and served as a student representative of the Faculty of Engineering, while pursuing my degree in Biomedical Engineering.

e-Carrier: Electronics and Telecommunications department (ENTC) is known to be a rather tough department. So how was your stay at this department and what did you gain from this department?

Yes, I agree with you. ENTC is tough and requires extreme effort, dedication, and commitment for studies. Earning good grades is arduous and strenuous not only because of the inherently convoluted nature of subject matter but also because you need to grasp and apply theoretical knowledge in projects and practicals to demonstrate your pragmatic competence. Fellow batchmates are the best brains of the island with the highest level of intelligence, diverse talents, and exemplary student profiles. Batchmates of such caliber with the erudite academic staff engender the ideal environment needed to nurture adept engineers for future generations.

Beside the knowledge acquired, I learnt from experience that perseverance is the key in achieving your dreams. Drawing an example from my 4 years of stay at ENTC, my academic performance of first 4 semesters were not exceptional. Yet, I held on to my dreams by intensifying my effort and bouncing back during the last 4 semesters which undoubtedly paved my way for the award. One should have the courage to put in more "effort" without presenting "excuses" for failing to achieve the set targets. Moreover, I remind my dearest batchmates whom I met at ENTC, and I truly rejoice the time we spent together. I hereby wish all my colleagues all the success in the days to come.

e-Carrier: What qualifications made you deserve this prestigious award?

I graduated with a First Class from the Department of Electronic and Telecommunication Engineering, specializing in Biomedical Engineering. During my studies, I contributed to three research publications in the field of assistive devices (for the visually impaired) and diabetic related foot ulcer detection/ prediction. These research publications were presented at international conferences in Canada, Australia, Korea and Sri Lanka.

I Captained the hockey team and won university colors for hockey in all 4 years of my stay. I was awarded Sri Lanka Universities Sports Association (SLUSA) Colors in 2017 and the Prof. Patuwathawithana Challenge Trophy for the Best Hockey Player of University of Moratuwa. I further represented Sri Lanka Universities' Hockey Team for Sri Lankan National Championship in 2017. I was also elected President of the Sports Council of the university.

I took part in numerous community service initiatives as part of the Rotaract Club of the University. My most memorable achievements include being the Co-chairperson of the project "Hand in Hand 2015", which donated and renovated the Children's ward of the National Cancer Hospital, Maharagama, and being the Co-chairperson of the project "Grama Prabodhaya" which developed the rural village of Ranugalla, Monaragala as a self-sufficient economic unit. For the project "Hand in Hand" we received the "Bronze Award for Most Outstanding Fundraiser" in the Rotaract District 3220 Sri Lanka and Maldives. Furthermore, the project "Grama Prabodhaya", was given recognition with the awards for the World's Best Community Service project

by Rotary International in Atlanta USA, the Most Outstanding Community Service Project (Economic and Community Development– Platinum Award) and Award of Excellence. I was also Director of Community Service of the Rotaract Club of the Alumni of the university for the term 2017/18 and Director of Finance for the term 2016/17. At AIESEC, I was adjudged the "Best Emerging Leader" in 2015 and was ultimately promoted as the Vice President for Talent Management.

As I entered the Faculty of Engineering in 2014, I was appointed as the Deputy Batch Representative for the Faculty of Engineering for all 4 years of my undergraduate studies, thus being responsible to cooperate with a batch of nearly 1000 students and the university administration.

I was also a part of the teams which developed two innovative products called the "BrailleBand" and "MindHome". BrailleBand was a blind support wearable device to help visually impaired people to use smart devices. We received the Peoples' Choice Award for the Best Innovation at Disrupt FutureX 2.0 Technopreneur Challenge. MindHome is a home automation system for immobile patients and it emerged as winner of the SMC Brain Hack 2017 in Canada.

e-Carrier: How did you overcome the challenges during your journey to achieve this award?

My story was built on many failures than on my success. I failed to achieve my desired result at O/Ls, and I wasn't always scoring well in academics during the first two years of university studies. Even though I represented many high-ranking teams, I have been on the bench during many tournaments. Life is not always a success story and if it is only success, then the story is not interesting either. What's important is to never give up and always keep your focus on your final destination despite your current situation. I've sacrificed many things during this journey towards receiving this award and spent many sleepless nights balancing everything in the best possible way. Not all dreams come true, but if you never chase your dreams you will never catch them. Despite all the doubts that may occur at certain circumstances, if you deliver your maximum effort, you should be brave enough to believe in yourself. What you have and don't have is irrelevant. What matters is what you do from what you have.

e-Carrier: Who helped you on your journey towards success?

My greatest strength was, most definitely, the extraordinary people around me. My parents, Chandrani Hewage and Dayananda Herath and family,

my school and university, teachers, coaches, captains, friends, my team, Rotaract Club and my AIESEC local committee, the sports council members, the Old Boys' group of Ananda College and all my seniors and juniors, and simply all of you. I was never outstanding, and it was you all who made me outstanding.

e-Carrier: What are your plans for the future?

I plan to continue my higher studies in Management of Technology and Corporate Leadership. My future plan is to become a corporate leader and serve the community in every possible way, to create a better tomorrow for us all and for the generations to come.

e-Carrier: How would you introduce ENTC to a fresh undergraduate?

First and foremost, I would rather prefer giving a general advice for all the juniors when choosing the engineering specialization subsequent to semester 1 exams. I would say choosing your engineering specialization is analogical to selecting your future life partner. You will have to live a life with it, hence it is a lifelong relationship. Therefore, choose what you like and what your heart says that's best for you. You should fall in love with the engineering specialization you choose, if not you will suffer. Don't let parents, seniors, salary scales, and other external factors decide your specialization. It is you who are going to live with it, so you should choose it. It's your life, hence it is your responsibility.

At the same time, for someone interested in choosing ENTC as his/her partner, it is a loyal partner with a classy pedigree, a sound academic background, in good shape and there will be a lavish pay back for investing your life in ENTC. These facts are evident if you analyze the academic profiles, research profiles, alumni profiles, industry trends, and the future plans of ENTC. So, if you see a brighter future with ENTC and if your profile matches ENTC, I presume starting a relationship with ENTC will be a wise decision.

e-Carrier: Finally, what advice would you give young undergraduates who are striving to achieve their own goals?

If you want to achieve anything, first you must have a "Dream" and you should transform them into "Burning Desires". This will direct you to perseverance. Have a "Methodical plan" accompanied by several "Backup plans". Then make sure to work out your plans with utmost "Dedication" and "Commitment". Failures will help you persevere. When you gain more in life, you should be more humble and thankful. Always strive, not to be a man of success, but rather, to be a man of value. You are the author of your destiny. The pen is in your hand and the outcome is whatever you choose. Make sure that your life story is the most inspiring.

Bioelectricity: The future of Cybernetics and Human-Machine Interfaces

By Kithmin Wickramasinghe

Ever since the 18th Century, we have used electrical conductors as the main medium for transmitting electrical signals. We can observe how electrical signals, ranging from the tiniest micro volts to mega volts, has ultimately transformed the world of technology we live in today. It was during this same time that preliminary work on biological conductors began as well. Many scientists devised mathematical models and theories to try and govern the behavior of biological conductors accurately. Today, we have made significant progress in the use of Bio-electricity as an alternative, and hopefully a replacement to conventional electric signals.

Our focus will move towards the significance of Bio-electricity in the field of Cybernetics and Prosthetics. Cybernetics is "the science of communication and control in animal and machine". This definition relates cybernetics closely with the theory of automatic control as well as with physiology, particularly the physiology of the nervous system. Some of the most common types of bio-electric signals used today would be EEG, ECG, and EMG. They refer to signals from bio-electrical activity of the brain, the heart and the fore-arm muscle contractions; all of which are very useful signals, applied in cybernetic technology. Hence, in the field of cybernetics today, automated control with respect to the bio-electric signals is a key area of research that is producing a lot of amazing and game-changing innovations. Further, human machine interfaces alongside cybernetics is playing a huge part in changing the quality of live for amputees, ultimately intending towards replacing normal function for missing body parts.

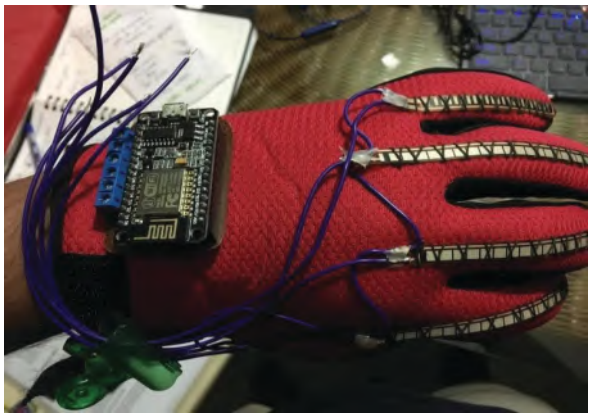
This study focuses on a technique of incorporating one form of bio-electricity, which is EMG signals from the electrical activity of the forearm contractions to create a technique of control for a prosthetic arm. To investigate the goals of the study, a 3D printed hand was constructed. The design chosen, known as the 'Parloma' hand designed by Gael Langevin, has the same physiological placement of tendons and muscles like the human hand.

High-torque DC servo motors were used as actuators for the bi-directional tendon system. Servo motors were used for both contraction of the fingers as well as abduction movements. Implementing the control mechanism to provide complete control of the bionic-hand was developed in two a two-stage mechanism.

FIRST STAGE: We implemented a glove with 5 flex sensors to read the bend angle from the flex sensors, and transmit the data into the main computer, which

emits PWM signals to the servo motors, controlling the angle of rotation. A machine learning technique using LSTM-RNN's was used to provide a more accurate model of individual finger control, removing any outliers of the range of motion of the flex sensor glove. The technique used here is simple, in which 5 inputs were modelled and mapped towards 5 outputs to simulate most accurate control over the system. The bionic hand acts as a finite state machine in this scenario, where the user can change the machine state of each individual finger by intuitively contracting his fingers in respective manner. This step was crucial in building the final control system.

SECOND STAGE: After building the initial control mechanism, the Thalmic Labs Myo, an armband with 8 electromyography (EMG) sensors and an



embedded ARM Cortex M4 120MHz processor for pattern recognition was used to implement the second stage. The classified EMG signals were used as the input stimulus into the neural network; that triggers the output variables governing the control of the hand. The machine state of each finger in this stage requires only to be adjusted towards the proper myo-electric signals of the forearm. The focus of the research project is in the efforts of creating an automated control mechanism that outperforms existing methods based on the function entirely upon myo-electric signals.

Further work is planned to be done into creating some custom user interfaces and investigating more AI techniques that can use bio-electric signals like EMG to provide continuous control mechanisms that can replicate human behavior as accurately as possible.

In summary, this project will ultimately be a Proof of Concept for hypothesis; through implementation of a Bio-electric Human-Machine Interface, it is possible to achieve better and more convenient continuous control mechanisms, the key factor here being the use of signals generated from the human body itself. It will also play a huge role in the control mechanism of the future, in the field Human-Computer Interfaces and Cybernetics.

Project Members

Kithmin Wickramasinghe

Samira Yasas Peiris

Emerging Concepts of Mind Engineering

An Interview of Eng. Kithsiri Samarasinghe

Interviewed by: Udara Mendis

Engineer Kithsiri Samarasinghe is a senior academic of the Department of Electronic and Telecommunication Engineering, Faculty of Engineering, University of Moratuwa. He is well recognized and renowned among the students and the public not only in the field of electronics and telecommunication, but also for his contribution towards developing inner peace and happiness among the young elites. This interview reveals his concept of Mind Engineering.

e-Carrier: What exactly is meant by Mind Engineering?

Mind is a process. It is a natural resource available to all of us that works in natural principles. Engineering focuses on harnessing the resources for the betterment of life. Therefore, in a broader sense, Mind Engineering can be described as a way of engineering this natural thought process for the betterment of life by reducing the level of suffering of humans and other living beings. Reduction of suffering may be understood at two different levels; internally, it means inner happiness/inner peace and externally, it means the level of happiness of a whole society.

e-Carrier: How can meditation and mindfulness be of use for an engineer?

An engineer is supposed to think of real-life solutions to problems of people and innovate/invent systems that will solve them. Engineers are a chosen lot who possess a very high capability to visualize and then engage the mind in mental volitional processes to arrive at solutions or new mental states. This ability is exercised in designing engineering solutions. Unfortunately, if the main focus is on the external world only, the engineer might be unaware about the internal process he/she is using to provide that particular solution. As such, the mind will not have an overall development. What I would define as a well-developed mind is a mind that can see its own internal processes as well. If the mind is blind on its own internal process, but can comprehend and tame the external worldly processes, then it becomes a handicapped mind. The solutions it develops might not be the best and moreover, the inner happiness index may actually reduce. Sometimes, such minds may even develop unethical engineering solutions that can be damage the values of humanity as well. If the mind can see and monitor its own process, then the energy of the visualization and mental volitional processes can be channeled in a most effective manner for the betterment of life of the engineer as well as the society. That is where mindfulness meditation techniques come in to play, especially to help understand the inner mental process and the mental factors involved at any given time. Once the mindfulness is achieved, these mental processes can be re-engineered to increase happiness and reduce the suffering, internally and externally.

In other words, our undergraduates possess exceptional skills for visualizing. They also possess very strong mental volitional capabilities. Only thing is that they should be made aware that the very same capabilities, if properly disciplined through meditation, can make them the happiest engineers and the best citizens.

e-Carrier: Why do you think it's essential for the engineering minds of Sri Lanka?

It is applicable to anyone. However, engineering minds are special due to their high visualization capabilities

and superb mental volitional processes. Meditation techniques would make use of these two capabilities in full. Being Sri Lankans, especially, the meditation techniques are our heritage and they were prevalent here over a long period of time, blended with our ancient culture. We may have lost the connection between meditation and engineering due to various things that happened in between. We may perceive these abilities are not connected. In fact they are not. We have had these meditation techniques in our heritage and culture and we are very rich in that aspect. At present, we may perceive ourselves not as rich in hard engineering as the western world. However, my thinking is that if we join these two talents together, Sri Lankan engineers could again be very capable and unique.

e-Carrier: What impact have you been able to make so far through your programs and books?

I must say, that the real impact has not exactly been measured. We have introduced meditation to the engineering curriculum and many undergraduates learn these techniques now. From their feedback, it is evident that they see the relevance between engineering and having a proper control of their visualization and volitional capabilities through meditation. Obviously, It is difficult for you to design solutions that will bring happiness to other people while being internally unhappy yourself. Having this combination of engineering capabilities and meditation mind engineering tools will first improve the inner happiness. Next, it will lead to providing good solutions for others. That is our goal and I can see that the students seem to have taken that message.

My counseling experience also reveals that learning does not improve happiness by itself. I have seen educated people including many engineers become internally unhappy and stressed at certain vital times of their lives, and when that happens they do not have the correct tools/thought process to resurrect. They should have first learned to minimize their own suffering and generate inner happiness while contributing to the happiness of the society while they were undergraduates. We expect to plant the necessary mental tools in their minds while they are with us as undergraduates.

e-Carrier: What do you think is the reason behind our young undergraduates and engineers deviating from mindfulness?

When you look around, you may notice that our society is gradually moving towards gross gratification of all desires. More the desires become high in intensity and in numbers, more will be agony as well as the effort a person has to make to gratify them. Since the search is external, the person will overlook the simple mindfulness techniques that can alleviate the burnout. Our undergraduates are a part of such society, and they are subjected to this collective mental programming. That is why mindfulness is not generally practiced by undergraduates. You can not blame them for that. In such a society, the engineers can be employed as slaves for just profit maximization, by any means. However, in return they will not get the happiness of life for they are not aware of such slavery. Sacrificing true inner happiness to earn wealth will not balance the overall equation.

It is necessary to educate the young that; one cannot try to ratify every desire of the mind. There needs to be proper control and that control first comes from mindfulness. Mindfulness will help to lead a balanced and happy life. If the engineer is fully aware of his/her own inner mental process, he/she can learn to contribute to wealth maximization of a company without sacrificing own inner happiness.

e-Carrier: What final message would you like to give to our young undergraduates?

My advice is; Be very successful in this short life. Remember; the true success of a person is measured by the level of inner happiness of that mind.

By learning mind engineering techniques an undergraduate will be well equipped with the ability to see both sides; the internal mental process as well as the external worldly processes. My advice for them is to learn the basics of mind engineering and start practicing them early in life. Some other countries already have decided to pass on these techniques to school children and undergraduates. Start with mindfulness techniques first. Once mindfulness platform is established in the mind then the other high-level techniques of meditation can be developed on that platform easily.

Detection of Diabetes by Macrovascular Tortuosity of Bulbar Conjunctiva

A research paper titled "Detection of Diabetes by Macrovascular Tortuosity of Superior Bulbar Conjunctiva" was presented at the 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC) 2018 held in Honolulu, Hawaii, USA from July 17th to 21st. It was presented by Mr. Achintha Iroshan Kondarage and the manuscript was written by Mr. Achintha Iroshan Kondarage and Mr. Dulara De Zoysa.

This research was carried out with collaboration of three institutions, Department of Electronic and Telecommunication Engineering (ENTC) of University of Moratuwa, Department of Clinical Medicine of University of Colombo and The National Diabetes Center. Authors are focusing on implementation of computational methodologies to detect micro and macro vascular complexities. In this research work they have implemented several image processing algorithms and computational methodologies to quantify tortuosity of blood vessels in bulbar conjunctiva using a 2D image of sclera region. They have also identified a significant relationship between diabetes and macro vascular tortuosity of bulbar conjunctiva.

EMBC is the annual flagship conference of the IEEE Engineering in Medicine and Biology Society, covering a broad range of topics from cutting edge biomedical and healthcare technology research and development to clinical applications, biomedical education and entrepreneurship. It is the world's largest international biomedical engineering conference. This research was conducted as the final year research project of Mr. Achintha Iroshan Kondarage and Mr. Dulara De Zoysa under the Biomedical Engineering degree program at Electronic and Telecommunication Engineering department of University of Moratuwa.

Next phase of the project is developing a system based on deep learning, machine learning to produce an output based on the risk level of diabetes determined by the vessel tortuosity. The system is fed with the bulbar conjunctival image of the person along with details such as age, height, weight, and gender. Tortuosity measurement calculated from the image is fed to the system as another input.

Input image is preprocessed to reduce noise and to extract maximum useful information from the image. An improved vessel extraction algorithm is applied to the input image to increase the number of vessels extracted. The designed system is able to predict the outcome with an average accuracy of 90%. The system has been trained with 410 segmented images. The system was tested with 25 segmented images. Ensemble learning techniques are used to improve

the performance by decreasing variance and reducing prediction errors. The results show that further optimization of the system, can lead to a mobile based application with minimal errors.

Supervisors

Dr. Anjula De Silva (ENTC)

Dr. Nuwan Dayananda (ENTC)

Dr. Mahen Wijesuriya (National Diabetes Center)

Dr. Chamari Warnapura (National Diabetes Center)

Prof. Saroj Jayasinghe (Faculty of Medicine, University of Colombo)

Team

Mr. Dulara De Zoysa (ENTC 13-batch)

Mr. Achintha Iroshan (ENTC 13-batch)

Mr. Shatheesh Sohan (ENTC 14-batch)

Mr. S. Neerajan (ENTC 14-batch)

INTERNATIONAL COMPETITION WINNERS

Owing to the unfailing guidance and inspiration disposed by the lecturers of the Department of Electronics and Telecommunication resulting in the dedication and hard work of the students lead to the acquiring of multitudinal awards extending towards international capacities.

The winners of such awards are stated below;

1) International Mathematics Competition for University Students 2018 Blagoevgrad, Bulgaria

The International Mathematics Competition is an annual competition for university undergraduates. In 2018, International Mathematics Competition was held in Blagoevgrad, Bulgaria and the following students from the Department of Electronic and Telecommunication of University of Moratuwa have won medals.

M.A.M. Afham-Bronze Medal

P.M.N. Wijewardena- Bronze Medal

J.A.D.O. Jayasinghe- Honourable mention

2) International IAS Undergraduate Robotics Contest 2017

Vinoj Jayasundara was able to secure second place at this international robotics competition with his robotics based audio and video surveillance system for disaster response and relief.

3) Myron Zucker International Design Contest 2017

The Myron Zucker Undergraduate Student Design Contest, conducted by the IEEE Industry Application Society, is open to all IEEE undergraduate student members.

In the year 2017, First Place was received by Jathushan Rajasegaran, student of the University of Moratuwa for his invention of the "IoT based automated irrigation system".

4)Myron Zucker International Design Contest 2018

The Myron Zucker Undergraduate Student Design Contest, conducted by the IEEE Industry Application Society, is open to all IEEE Undergraduate student members.

INTERNATIONAL COMPETITION WINNERS

In the year 2018, Third Place was received by Tharindu Suraj, a student of the University of Moratuwa under the individual category for his invention of the "Improper posture detecting system for backpacks".

5) Innovate FPGA 2018 - Asia Pacific Region

The Innovate Asia, Nordic, and North America contests are held on a regional competition basis for engineers to display their inventions of embedded compute with Terasic and Intel. The competition is open to everyone including students, professors, makers, and the industry.

In the year 2018, an international competition was held – Innovate FPGA – where a team representing University of Moratuwa received 5th place for their invention of an "Automated Sewing Machine".

The team comprised of ;

Isuru Senevirathne

Kasun Imesha

Vinura Dhananjaya

6) Innovate FPGA by Intel Asia Pacific Region - 2017 - Regional Bronze Award

The Innovate Asia, Nordic, and North America contests are held on a regional competition basis for engineers to display their inventions of embedded compute with Terasic and Intel. The competition is open to everyone including students, professors, makers, and the industry.

The product, Deep Learning based System for Automatic Plant Disease Identification, developed by a team representing University of Moratuwa was awarded the Bronze Award in the Asia Pacific Regional Level.

The team comprised of ;

K. Ranasinghe

H. Perera

N. Karunanayake

K. Wickramasinghe

S. Munasinghe.

7) YES Bank Datathon

YES BANK conducted the finale of YES Datathon launched in September 2018 on December 22-23 in Bangalore.

This was India's first bank led Datathon aimed at augmenting YES BANK's embedded data analytics & ML units to drive rapid prototyping of AI/ML based products, optimize digital product suite, and enhance product/service design and delivery, in an accelerated 100 day period.

The initiative saw participation from over 6000 data scientists/engineers and developers who participated in diverse Machine Learning challenges.

INTERNATIONAL COMPETITION WINNERS

"Team Insight" from Sri Lanka was awarded the best student team for their model for 'predicting customer product and service affinity' and it was selected as one of the top 5 teams.

The team consisted of ;

Sutharshan Mahendran

Chathuri Jayaweera

Uththara Chandrathilake

Indula Munasinghe

8) IEEE SS12 International Project Competition & Maker Fair 2017 Held on 8th and 9th September 2017 at Vardhaman College of Engineering, Hyderabad

A team of University of Moratuwa has won the first place in 'IEEE SS12 International Project Competition & Maker Fair 2017' held on 8th and 9th September 2017 at Vardhaman College of Engineering, Hyderabad, India, for their exhibit an autopilot "Life Saving Drone".

The team members are;

Insaf Ismath -Department of Electronics and Telecommunication Engineering

Janith Kalpa - Department of Electronics and Telecommunication Engineering

Ama Kalpani - Department of Chemical and Process Engineering.

Biosignals for Objective Measurement of Immersion in Virtual Reality Environments

By Navodini Wijethilake

Virtual reality (VR) involves creating and implementing a simulated, realistic, three-dimensional environment. In other words, diverse virtual environments can be constructed in limited spaces by generating realistic images, sounds and other sensations. The idea of VR is tricking the brain into having a real environment. Virtual reality is considered to have begun in the 1950s and only came to the public's attention in the late 1980s. Since environments generated by VR devices are similar to the real world, they have been used in various fields, especially as treatment options in hospitals. For example, VR devices have been used for social-adaptation training for social phobias, as well as for treating post-traumatic stress disorder (PTSD). In addition, many researchers have utilized VR devices during their experiments to create environments and observe the corresponding responses.

Immersion is a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences. In this research study, several biosignals are acquired to obtain an objective measurement of immersion in VR environments.

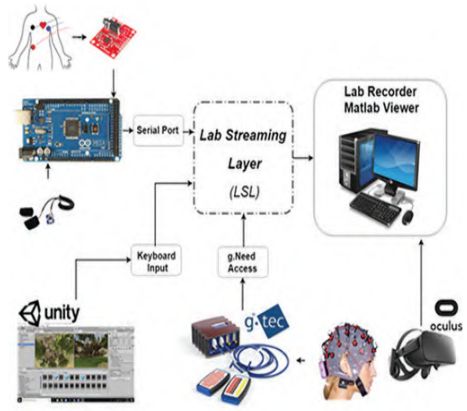
Several university students are recruited as subjects (>15) to conduct the experiment under strict control conditions. Subsequently, electroencephalogram (EEG, electrocardiogram (ECG) and electrodermal activity (EDA) signals are recorded while subjects engage in the VR scenarios.

The Oculus SDK, which is directly integrated with the popular game engines Unity 5, Unreal Engine 4 and Cryengine is used for creating VR scenarios. This allows for developers already familiar with these engines to create VR content with little to no VR-specific code. Moreover, UNITY VR platform is also used as a VR development platform.

Three modes of biosignals are acquired, electroencephalogram (EEG), electrocardiogram (ECG) and electrodermal activity (EDA). For measuring ECG, AD8232, which is an integrated signal conditioning block for ECG is utilized. As it has the ability to extract, amplify, and filter small biopotential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement. Electrical activity of the brain is monitored with a 32 channel EEG signal acquisition systems (gTech). The EDA is an electrical signal, measuring continuous skin-conductance (SC) changes. In general, changes in SC are associated with sweat gland activity. Whenever sweat glands secrete sweat through the

pores, SC peaks are generated. With Galvanic Skin Response(GSR) such strong emotions are identified by simply attaching two electrodes to two fingers on one hand.

Signal pre-processing and feature extraction algorithms are developed to identify patterns in these acquired signals that correspond to changes in the immersion of users in VR environment. Independent component analysis (ICA) based artefact reduction can successfully eliminate many sources of artefacts including eye blinks and muscle movement. Ultimately, biosignals are analysed and interpreted to identify the correlation between biosignals and immersion in virtual reality.

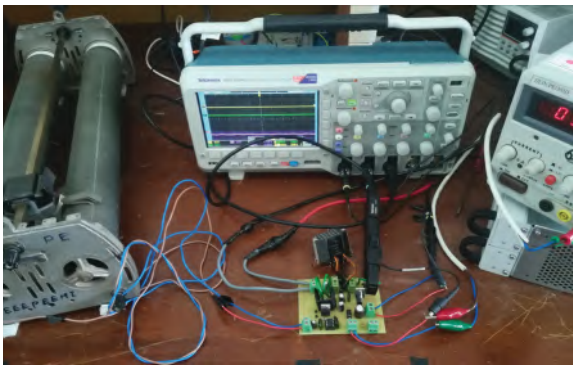


The adjacent experiment is conducted to design a glove for giving haptic (thermal/vibro-tactile) feedback to the hand. Artificial haptic sensations can present information to users, help them complete a task, augment or replace the other senses, and add immersiveness and realism to virtual interactions. In virtual worlds and robot teleoperation scenarios, this sense of touch must be artificially recreated by stimulating the human body (typically the hands) in a manner that produces the salient features of touch needed to enhance realism and human performance. To introduce the breadth of haptic device design and control, we consider three major categories of haptic systems: graspable, wearable, and touchable. Wearable systems are typically tactile (cutaneous) devices that are mounted to the hands or other parts of the body and display sensations directly to the skin. They can provide cues such as vibration, lateral skin stretch, and normal skin deformation. They may also be body-grounded devices, such as an exoskeleton, that provide a kinesthetic cue to the user by creating a reaction force on a less sensitive part of the body.

Haptics can largely be divided into two parts: (1) kinesthetic sensations that senses stimuli related with the motion and relative positions of the muscles and joints and (2) tactile sensations that are felt through the skin. In this experiment, thermal feedback is obtained as kinesthetic sensation, using Peltier modules and tactile feedback by using vibrotactile motors. A microcontroller is utilized to communicate with both glove and the VR scenario through the UNITY engine. The goal of glove development is integration of vibrotactile and thermal actuators to work according to the VR scenario and assessing its contribution in immersion.

High Step-Up Boost Converter Based on Coupled Inductor, Voltage Lift and Clamp Cells

By Ayodhya Kinkini Somiruwan
Supervisor: Dr. Dulika Nayanasiri



Introduction

Renewable energy is one of the most popular and important topics among the science community in this century. With the climate changes and other environmental concerns, using renewable energy instead of coal and other environmental polluting energy is becoming a trend. As these renewable energy sources which produces green energy are freely available in all around the world, most of the new researches and developments are done in related fields to maximize the usage of environment friendly energy. Even though the renewable energy is very useful, the major obstacle of using them practically is low terminal voltage characteristics of such energy sources. Thermo- Electric Generator (TEG), Photo-voltaic (PV) cells, wind turbines are such renewable energy sources and in which the output voltage typically is limited to few volts. In order to apply energy from such sources in practical application, voltage need to be highly increased or stepped up. High-step-up and ultra-high-step-up DC-DC converters are used to interface such sources having low terminal voltage characteristics.

Even though the basic Boost converter theoretically shows capability of achieving any finite gain larger than one, practically its efficiency considerably decreases with the gain. Switching stresses of such converters are also high. Therefore, it is essential to find new DC-DC power converter topologies which can achieve high gain, low switching stresses while maintaining a decent efficiency and a simplicity. For such converters, there are readily available voltage increasing techniques that are designed by prior researchers, to be used in combinations to achieve high gains. Among large number of different voltage-boosting techniques, coupled-inductor is one of the extensively studied approaches to obtain high-step-up voltage conversion. Almost all new DC-DC power converter topologies contains coupled inductor as a primary element where it can be used to multiply voltage as required, by varying its turns ratio.

Practically non-ideal coupling of the coupled inductor causes to a leakage inductance, which deviates the operation from ideal characteristics of a coupled inductor introducing performance degradations. Therefore, using other techniques in combination with coupled inductor is expected. The voltage lift and the clamp cells are such well-known techniques to mitigate that problem of recycling energy stored in the leakage inductor. Especially in low input voltage scenarios, recycling energy stored in leakage inductance is necessary as power losses due to voltage drops across diodes etc. plays a critical role in such applications. Using coupled inductor, voltage lift cell and voltage clamping cell as basic elements, a high step-up DC-DC power converter can be derived. The proposed circuit is derived by modifying circuit in [1] to utilize energy stored in magnetic device.

Proposed DC – DC Power Converter

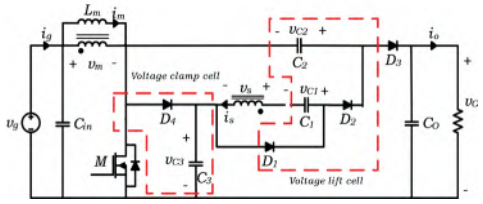


Figure 1: The proposed DC-DC Power Converter

Figure 1 shows the proposed boost converter topology which is based on coupled inductor, voltage lift cell and clamp cell. The energy stored in the leakage inductance is recycled using voltage lift and clamp cells to increase the gain and the efficiency of the converter. Figure 2 shows the equivalent circuits of the converter during active switch (M) ON and OFF sub cycles. Using small ripple approximation, and assuming perfect coupling between windings of the coupled inductor, voltage gain of the converter can be derived as in (1). However, in practical applications perfect coupling is hard to achieve.

HIGH STEP-UP BOOST CONVERTER

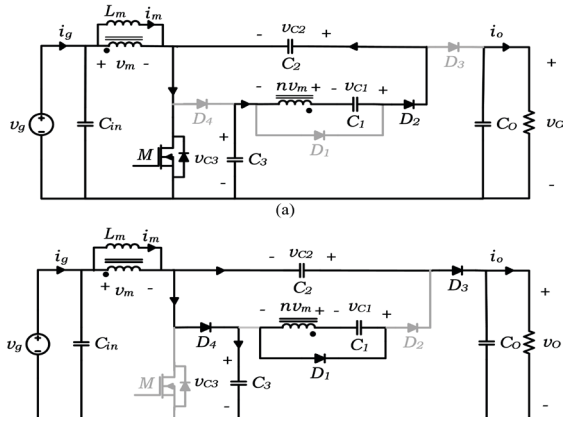


Figure 2: The equivalent circuits of the converter when the active switch (M) is (a) turned on (b) turned offr

V_o/V_g = (n+2)/(1-D) (1)

Simulation and Experimental Results

Operation of the proposed converter was validated using a simulation. Simulation was done performed considering the non-ideal characteristics of the semiconductor devices to analyze their effect on the output voltage. Figure 3 shows a comparison between calculated gain and simulated gains of the power converter. In simulation gain was lower than theoretically expected gain due to diode voltage drops, resistances of the switches, capacitor equivalent series resistance (ESR) and lower coupling coefficient (k). Even though, theoretical gain reach infinity when duty ratio (D) goes to 1, it is visible in the simulation, gain decreases after a maximum value due to non-idealities.

Operation of the proposed converter was further validated with experimental results. Figure 4, Figure 5 and Figure 6 shows the experimental results of the proposed converter.

Conclusion

In the proposed converter, voltage lift and clamp cells help increase the gain of the power converter and reduces stresses on the semiconductor devices by recycling energy stored in the leakage inductance as proved by theoretical analysis and verified by simulation and experimental results. The main advantage of the proposed converter is obtaining high gain using minimum number of components at low duty ratios. Imperfect coupling and other losses in magnetic devices and switching elements causes to reduce the efficiency of the converter.

References

[1] D. R. Nayanasiri and T. S. Ambagahawaththa, "Boost converter based on coupled inductor and voltage lift cell," in Proc. of the 2017 IEEE Region 10 Conference (TENCON), 2017, pp. 291–296.

[2] G. A. K. Somiruwan, L. H. P. N. Gunawardena, D. R. Nayanasiri and Y. Li, "High-Step-Up Boost Converter Based on Coupled Inductor, Voltage Lift and Clamp Cells," IEEE APEC 2019 (In press)

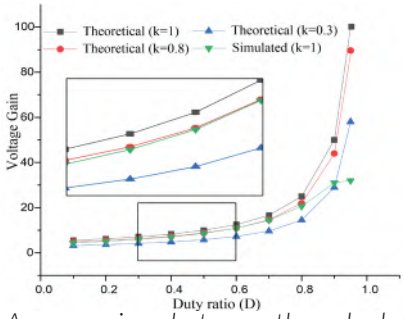


Figure 3: A comparison between the calculated and the simulated gains of the power converter

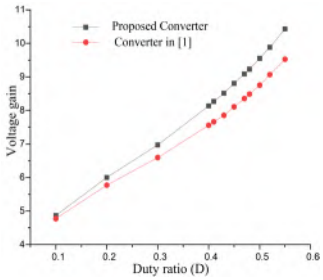


Figure 5: A comparison between voltage gain of the proposed converter and the converter proposed in [14].

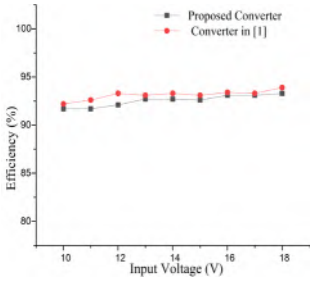


Figure 6: The efficiency comparison between the proposed converter and the power converter proposed in [14].

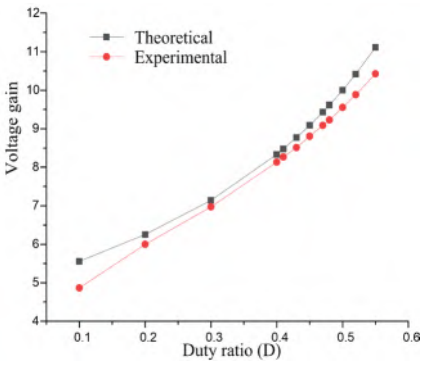


Figure 4 : A Comparison between the theoretical gain (ideal components and k = 1) and the experimental gain of the converter.

Finding Effective Solutions through Verification IPs

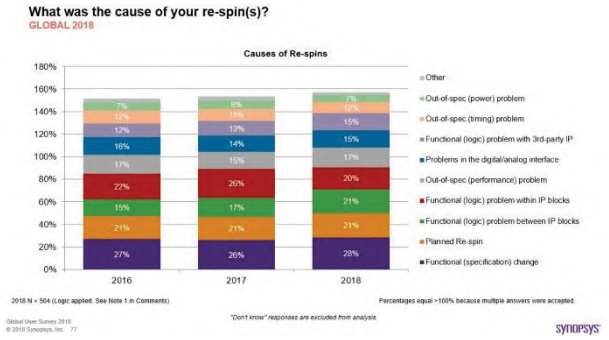
Article by Synopsys

The Challenge

The size and complexity of digital designs have grown significantly with the introduction of Hardware Description Language in VLSI. The Internet boom and advent of Artificial Intelligence (AI), have catapulted the growth in design size exponentially. This growth has eventually made the verification a difficult task. In a typical design lifecycle, verification consumes 65% of the total development efforts.

"Billions of gates were packed in a single die with best of the mankind's technology, but what if the whole SoC freezes in a FSM state?"

This may sound simple, but when the size of the design grows exponentially, it becomes a major challenge in VLSI design. The 2018 Synopsys Global User Survey (GUS2018) shows that around 80% of re-spins (ICs design bugs being corrected and re-fabricated) are due functional issues.



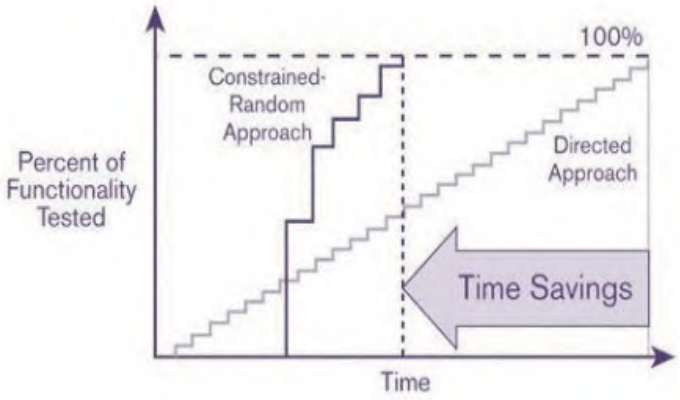
("Source: Synopsys Global User Survey YEAR(S) – used with Synopsys' permission")

Verification Methodology

Simple stimulus based approach to verification is difficult to perform and is not scalable for bigger and complex designs. There are exceptional cases that are either not possible to imagine and do a code test for them or they are missed during the verification. Further, visual inspection of the waveforms to trace a design bug is a tedious task.

The automation in verification process is the key to cover all scenarios efficiently. The results can be predicted automatically with the input stimulus. The generation of stimulus becomes a limitation because in a direct test approach the stimulus is manually generated.

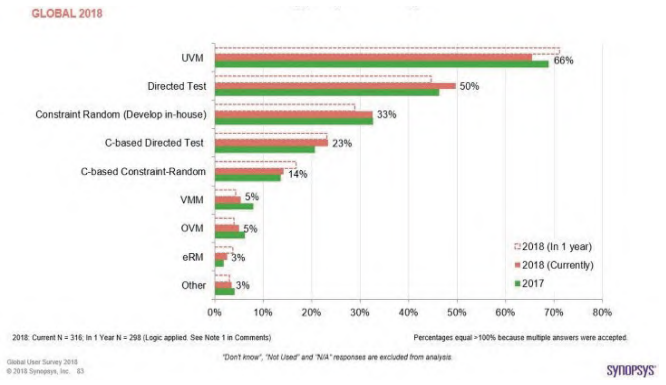
To overcome this limitation and improve verification productivity, constrained-random stimulus generation is used. Scenarios can be generated in an automated fashion under the control of a set of rules or constraints, specified by the user.



(source "www.learnuvmverification.com")

In December 2009, a technical subcommittee of Accellera — a standards organization in the electronic design automation (EDA) industry — voted to establish a universal methodology for verification. On February 21, 2011, Accellera approved the 1.0 version of UVM. Currently, almost a decade after its introduction UVM is the widely adopted verification methodology in the industry.

VERIFICATION IPs



("Source: Synopsys Global User Survey YEAR(S) – used with Synopsys' permission")

One of the key Features of UVM is its reusability and it modularity which enables the verification environment/component to be viewed as an Intellectual Property.

Growing Complexity

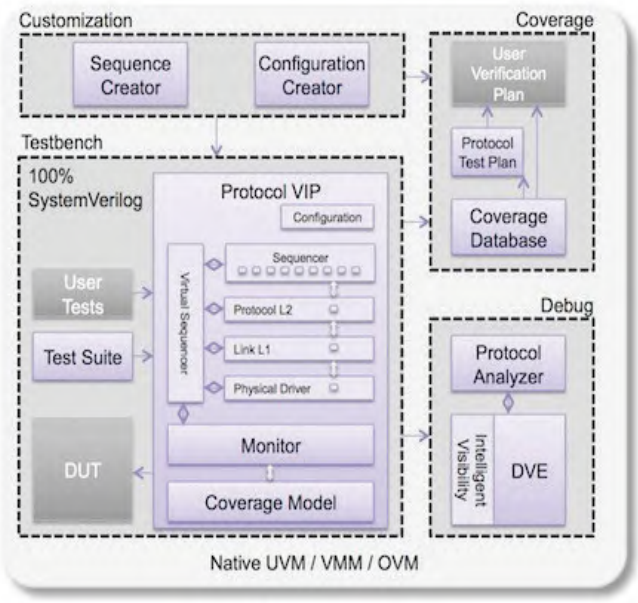
In the era of smart phones, an SoC has many complex interfaces such as USB, eMMC, UFS, DDR, LPDDR, SD, HDMI PCIe, etc. With the regular increase in the complexity of these specification, the compliance to the specification consumes more of the time to market.

In verification stage of the SoC, the external memory(such as Flash, RAM) is not accessible to the RTL which inhibits the verification capabilities. This requires the verification engineers to create a memory model for verification. The present data driven world has resulted in increased demand for high performance memory interfaces such as DDR, LPDDR, GDDR, HBM, ONFI, UFS, HMC, and so on. A typical SoC would have many of these BUS and memory interfaces. To verify the SoC, these interfaces must be modeled.

This has created the need for off the shelf models which are called Verification IPs.

Verification IPs

Verification IPs are reusable verification modules that typically consist of bus functional models, traffic generators, protocol monitors, and functional coverage blocks which provide verification engineers access to the latest protocols, interfaces, and memories required to verify their SoC designs. Due to the reusability and its modularity, UVM is widely used to create Verification IPs (VIP).



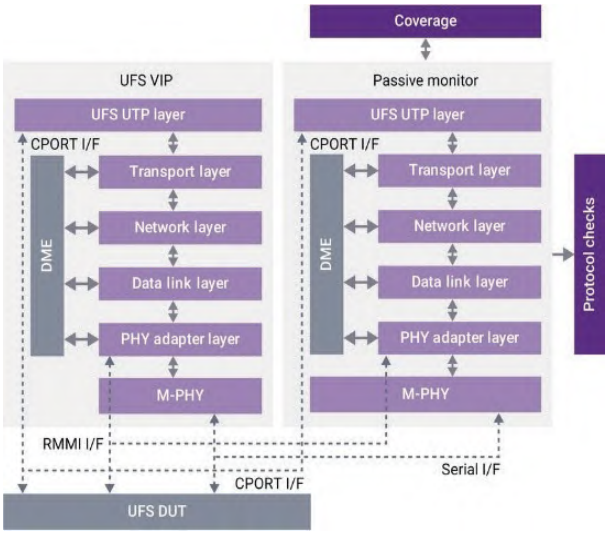
Typical structure of a Verification IP

(source www.synopsys.com)

The UVM separates the test and testbench. The verification IP is the reusable testbench and it can contain some sanity test to verify the connection. The verification engineers can write their own test on top of it to verify the DUT (Design Under Test).

Verification IPs have more features than a BFM, and it consists of thousands of checkers, and timers which guarantees the operation of the interface. The interfaces used or memories connected to the SoC may be a vendor dependent part number, which may be slightly different to the specification. The configurability available in the VIP helps the SoC to be verified based on the vendor specifications. This helps the verification engineer to ensure that the design works with the products available in the market.

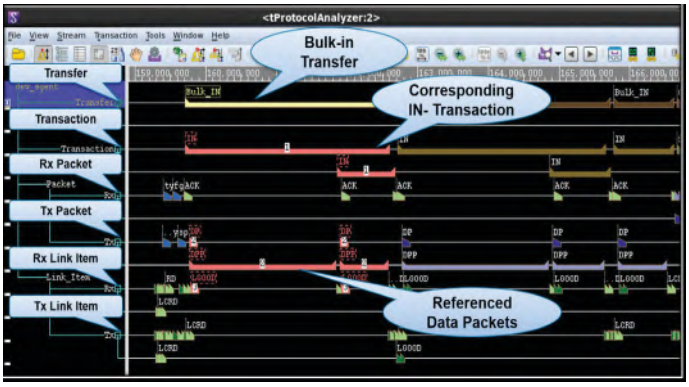
The philosophy of UVM is transaction level modeling. The user must provide the details of the transaction (such as data in the Ethernet packet) and the test bench handles the PHY level stimulus, which provides higher level abstraction.



Layered Structure of Verification IP

(source www.synopsys.com)

A major challenge faced by verification engineers is to debug the complex serial protocols. In a complex protocol, such as USB 3.0, there many types of packets that are active on the bus such as Link Command Packets, Protocol Command Packets, Low Frequency Periodic Signaling (LFPS). With the traditional verification using waveforms, log files are inadequate for productive debugging. Verification IPs provide new modes of protocol based debugging capabilities, because it is transaction based.



Protocol Based Verification

(source www.synopsys.com)

SoC performance is a key competitive advantage in the marketplace. The choice and configuration of protocol IP and the interconnects is aimed towards maximizing the performance of SoCs. The use of HBM (High Bandwidth Memory) technology and memory controllers is an instance of this case. Currently in its third generation, HBM boasts of high performance while using lesser power in a substantially smaller form factor than DDR. The VIPs enable the verification engineers to measure the performance through the metrics based on the protocol, and hence it ensures the validation of design to meet the performance requirements.

Performance Matrix of HBM

(source www.synopsys.com)

With the proven application of VIP, it is used in many verification projects. Verification IPs are growing very fast with several useful features which enables high performance, and highly complex SoCs to be delivered quickly without fear of re-spins.

Startup Space

Emerging startup from ENTC 15

Team gartor is one of the emerging startups from ENTC'15. Under the leadership of C.K.Pirunthan the team has been recognized with numerous achievements including winning the MQED challenge - held together with Yarl Geeks Challenge 2018, organized by MQED, Canada.

The startup mainly focuses on economical urban farming and automation in farming. Their customizable incubator gardening methodology for various types of plants have been an eye catcher for quite a lot of industrialists and urban farmers. The team has also developed their own sensor panel to achieve this task and their unique methodologies of controlling the basic parameters that plants need for their growth has received standing ovation in various platforms. The app which the team has created enables the user to change the parameters of the incubator whenever the user wishes and their big data analytics will enable them to set standard parameters for a vast set of plants in the future. The demo which was presented in the YGC platform consisted of environments for mushrooms and red roses separately in built in the mobile app. The incubator has the ability to be controlled from any part of the globe.

A greater proportion of the the team is comprised of ENTC undergraduates while the rest is comprised of some undergraduates from the IT faculty, University of Moratuwa.

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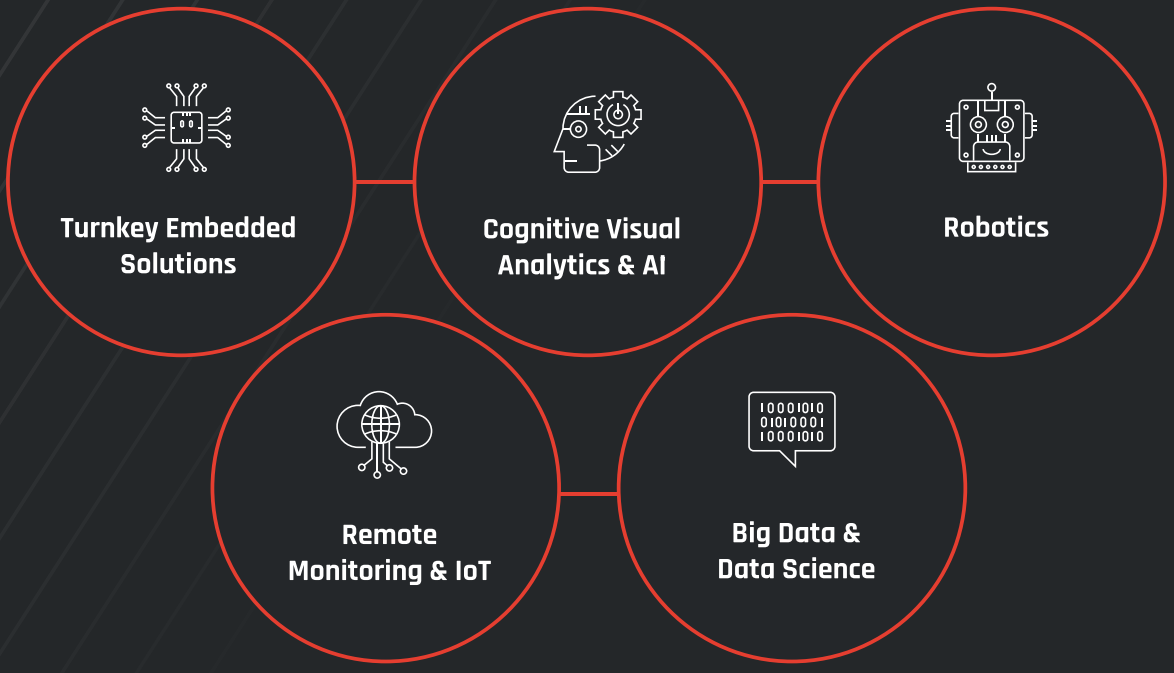

INSPIRING EMOTIONS

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FINAL YEAR PROJECTS

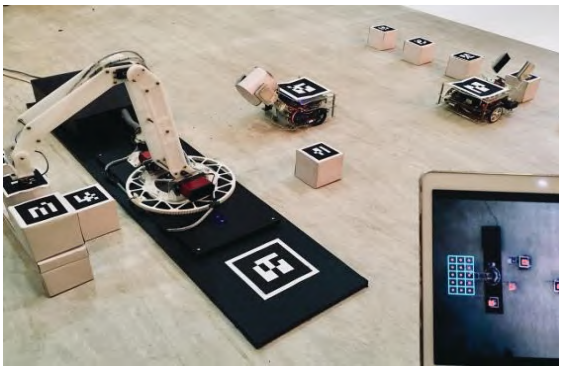
Group 01

Deep Learning through Augmented Reality based User Interaction for Collaborative Automation

Supervisors: Dr. Ranga Rodrigo, Dr. Peshala G. Jayasekara

Even though most of the industries are already automated, human interactions in construction are yet used a great deal. This is because all most all the machines used in this industry is still controlled by humans.

In this project we develop a multi-robot system to collaboratively do some task, without human control, learn through machine learning. This multi-robot system consisted of two mobile robots that can collaboratively transport objects and a robot arm which can construct a toy building. The machine learning environment was developed to track the block position changes to identify the high-level steps of constructing a toy building and later use this model to automate the system to control robots.

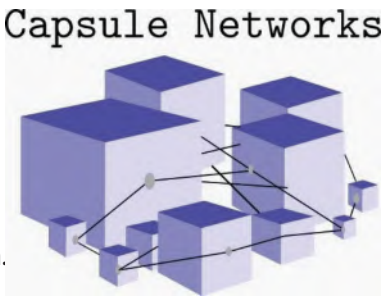


Group 02

Capsule Networks

Supervisors: Dr. Ranga Rodrigo, Dr. Suranga Seneviratne

The recently proposed concept of capsule networks is a revolutionary development in deep learning. Even with its true potential yet to be fully realized, it has already become the latest trend in both academia and the industry. Being a very young technique, capsule networks exhibit numerous theoretical lacunas and implementational drawbacks. Our work mainly aims to address these practical drawbacks, especially pertaining to few shot learning in the low data regime and computational efficiency, while attempting to fill the theoretical lacunas by means of cutting-edge research.

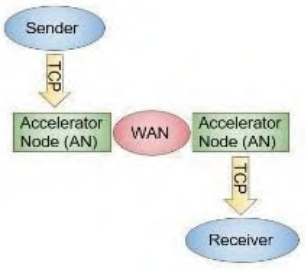


Group 03

TCP and Application Acceleration for WAN Links

Supervisor: Dr. Ajith Pasqual

With the rapid movement of internal computing infrastructure to cloud, there is an increasing need to manage the latency experienced in using cloud-based applications such as Office Productivity Suite. The acceleration over a WAN link can be achieved in two ways; TCP acceleration and Application acceleration. In both cases, TCP or application specific features are exploited by two hardware black boxes placed at the customer premises and at the data centre.

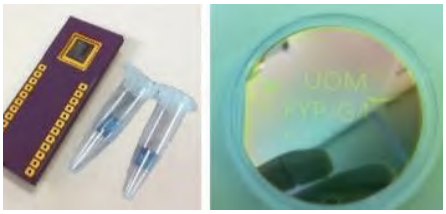


Our solution is a hardware implementation of those black boxes which

provides efficient algorithms for both TCP acceleration and Application acceleration. TCP acceleration is achieved by split TCP architecture and Application acceleration is achieved by Deduplication.

Group 04

Harsh Environment Wireless Communication

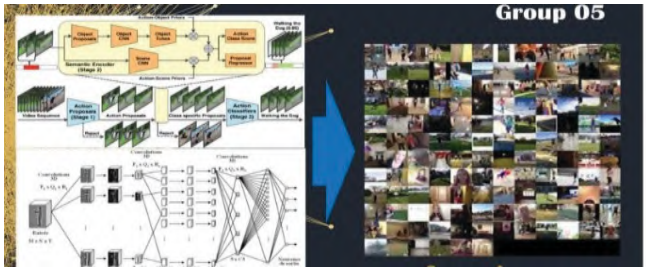


Supervisor: Dr. S. Thayaparan

Our project is dealing with the wireless communication that works in the harsh environment. Harsh environment is an environment that the physical conditions are in its extreme and is unable to retrieve data from outside. In here the high temperature environment is considered with the low power usage. Conventional microelectronics are impractical to use in high temperature due to excessive leakage currents above 150°C. The data is taken out of the harsh environment by using the integration of wireless and power line communication with the use of defined maximum operation limits and possibilities that suits in high temperature. A communication model which can work in low power and high temperature is developed in this project.

Group 05

Large Scale Activity Recognition



Supervisor: Dr. Ranga Rodrigo

In many Large-scale video analysis scenarios, one is interested in recognizing activities that occur within long untrimmed videos. Current approaches in this area still struggle to handle large-scale video collections and the task remains relatively unexplored. Thus, in this task, our workload expands along three key areas which are; identification temporal activity proposals within a given untrimmed video, localize the temporal activity actions, and finally use captioning method for describe each activity in the video. To gain the successfulness of the project, the breadth and depth of the workload, therefore, goes through shallow and deep learning methods, image and video processing areas, and ultimately machine learning processes with available ActivityNet dataset. At the end of this project, as a group, our opinion is to be implemented a novelty, independent, and faster off-line activity recognition system model with high quality and accurate outcome.

Group 06

FPGA Based Solutions for 40G Ethernet Applications

Supervisor: Dr. S. Thayaparan

High-speed Ethernet connectivity has a rising demand in the Digital communication industry and Gigabit Ethernet connections play an important role in that field. Therefore, the implementation of a high-speed ethernet channel is highly beneficial in industrial and academic perspectives. We designed a 40G Ethernet soft IP-core in order to provide an affordable and reliable high-speed ethernet channel using the Virtex-7 chipset. In addition to that, it is expected to make the IP-core commercially available as a product and provide 40G & other high-speed gigabit ethernet ASIC designs in the forthcoming phases according to the strategic plan of our project.

FINAL YEAR PROJECTS

Group 07

Personal Mobility System

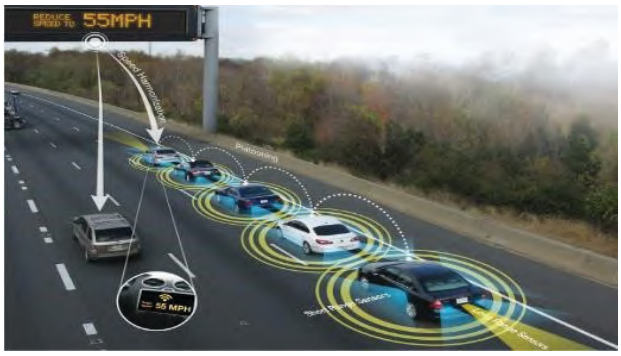
Supervisor: Dr. Peshala Jayasekara

Travelling along routine paths on foot is an exhausting and mundane task. As a solution to this problem, this project aims to develop a two-wheeled selfbalancing personal mobility device with autonomous navigation capabilities inside a predefined environment. The system will be lightweight, compact and usable by the average person (i.e. have low risk and short learning curve). The system will support manual (joystick), tele-operation and autonomous navigation modes. Autonomous navigation based on a pre-built map using laserscan data and obstacle avoidance based on 3D point-cloud data will be implemented using the Robot Operating System Navigation Stack.

Group 08

Vehicle Clustering System for Highways

Supervisor: Dr. Tharaka Samarasinghe



The rapid growth in the economy is coupled with increasing transport demand, traffic congestion and higher road capacity. One of the considered solutions to these problems is vehicle clustering with the aid of "Vehicular

Ad Hoc Networks" (VANETs). Vehicles with common interests can cooperatively form a platoon-based driving pattern, where a vehicle follows another one and maintains

a small and nearly constant distance to the preceding vehicle. Such platoons can significantly improve the road capacity and fuel efficiency. Furthermore, this creates the opportunity for the trailing vehicles to drive autonomously, thus, saving a great amount of human resources and time. This project focuses on developing and implementing a robust, fast vehicle clustering algorithm for vehicle platooning with the aim of increasing performance of a highway traffic system.

Group 09

ENTC Robot Receptionist

Supervisor: Dr. Peshala Jayasekara, Dr. Ranga Rodrigo

To overcome the shortcomings of human receptionists, several robot receptionists have been made and implemented around the world. However, the cost of available solutions are very high. Therefore, we have proposed a low-cost robot receptionist which will become the first ever human-like robot receptionist in Sri Lanka. The robot will have 5 degrees of freedom and will be able to show few motions. It will have the capability to detect and recognize faces, get to know new people through conversation and maintain a database of people, greet them, respond to basic questions using an NLP platform and show directions with hands. The robot receptionist will be an icon to the department of ENTC.

Group 10

Vision Based Digital Classroom

Supervisors: Dr. Ranga Rodrigo, Dr. Chamira Edusooriya

Many aspects of our lives have become digital. So, students expect classrooms also to have a presence in digital domain. There are existing digital classroom applications, but they suffer from limitations of textual information. This project aims to unlock new functionalities for digital classroom applications applying deep learning models for machine vision techniques such as face recognition and person reidentification. The students will be identified by face and tracked using person re-ID. This will create many new functionalities. The lecturer will be able to visually create groups on-the-fly by drawing lines on the video feed of the classroom on a tab for example.

Group 11

Meter Reading System for Existing Water Meters

Supervisor: Prof. Dileeka Dias

Existing water meters in Sri Lanka are mechanical and manually read. Water board requires to automate the existing water meter system without replacing them due to the high cost involved. Therefore, they require a low-cost method to read the existing water meters remotely. Hence our objective is to implement a cost effective and low power method to recognize the digits of the meter reading of existing mechanical water meters (Volumetric water meters) using a précised and efficient method along with two communication technologies known as 6LoWPAN (Mesh network connectivity) and NB-IoT (End to End connectivity) by developing a prototype. Since it is not practically feasible to deploy a mesh network, 6LoWPAN mesh network is simulated using contiki cooja to analyze the mesh network performance in terms of Packet loss, Throughput and the Number of packets received from each node. And also it is practically implemented using few TI CC2650 nodes for further evaluation of several network parameters.

Group 12

Lightweight Blockchains for Critical Network Traffic in Resilient Networked Control Systems.

Supervisor: Dr. Upeka Premarathne

Blockchain is a continuously growing ledger system which is linked together by the cryptographic technologies. Although Blockchain technology became famous with its usage in the bitcoin and other cryptocurrencies, blockchain has many other potential uses other than in using for digital money. The outstanding feature of blockchain technology is that it can be implemented as a decentralized system. It enables the security aspects that were not possible to achieve with a centralized system. Our project is to implement a lightweight blockchain for critical network traffic in resilient networked control systems. The meaning of the lightweight is to be compatible for use in constrained devices which consist of low processing power and storage facility. Critical network traffic means issuing a critical command in a network such as sending a turn off command to an electrical generator in a power plant. Therefore, a conventional blockchain cannot be used for this implementation and changes have to be made considering the facts that needs to be improved.

FINAL YEAR PROJECTS

Group 13

Communication Network Alternative for Smart Metering to Replace GPRS

Supervisor: Prof. Dileeka Dias

Our primary objective is to study the suitability of NB-IoT and Multihop mesh networks as alternatives for age old GPRS technology specifically for the smart metering applications. We would compare performance of both NB-IoT and multi hop mesh networks with GPRS by simulation and analytically methods. For the simulations work, we will be using OMNET++ an open-source network simulator based on C++. We will be using INET framework built for the OMNET++ simulator in which we could implement wireless communication. For multihop simulations we will be using IEEE 802.15.4 for physical and mac layers and Routing over Low Power and Lossy Networks (RPL) based routing protocols would be used at the network layer.

Group 14

Sparse Localization for Micro UAVs in Disaster Response

Supervisors: Dr. Peshala Jayasekara, Dr. Navinda Kottege, CSIRO, Australia

The main idea of our project is to introduce a micro sized UAV that is capable of assisting in rescue operations during a building collapse. This minimizes the direct human involvement in locating the trapped victims. Our approach is based on making a 3D map of the collapsed building using 'sparse sensing' where the UAV gets inputs from a limited number of fixed sensors and mark the positions of trapped victims and send them to rescue teams. Further, UAV has to navigate autonomously through an unknown environment while localizing itself without any external signals such as GPS.

Group 15

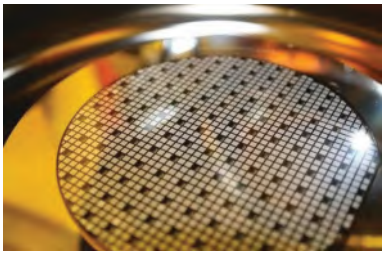
Hybrid Wireless Positioning with Wi-Fi and Bluetooth

Supervisor: Prof. Dileeka Dias

This Project deals with the implementation of a wireless positioning system using a hybrid model of Wi-Fi and low power Bluetooth (BLE) technologies for better indoor positioning. The use of GPS indoors is difficult and inaccurate, because the signals are affected in the indoor environment. Therefore, by designing a hybrid model that fuses the advantages of both Wi-Fi and BLE, it is possible to provide an accurate indoor positioning model that could cater the location-based services increasing day by day. The scope of the project is to analyze the system accuracy in static and dynamic environmental conditions and the immunity of the system for the malfunctioning of Access points for both existing Wi-Fi infrastructure and BLE beacons. They are to be deployed based on the signal characteristics which are studied in detail.

Group 16

Electronics for Harsh Environments



Supervisor: Dr. S.Thayaparan

Electronic systems that work under harsh environments is the key to achieve reliable and safe operations in aerospace, automotive and industrial applications. Existing temperature sensors do not satisfy these needs because they require physical contact and cannot withstand high temperatures. The availability of low power, cost-effective solution for temperature sensing is a major barrier for the evolution of small industries that work in harsh environments. To address problem this project provides a sensing and processing circuit that works under high temperature. The system initially is made using pre-built transistors by extending their existing limits. Through simulation and actual implementation, the parameters of the transistor are compensated to adopt functioning at higher temperature. Finally, the whole circuit is fabricated on silicon wafer that can simply measure and process high temperatures without wires or any human interaction.

Group 17

Legged Robot Navigation for Disaster Response

Supervisors: Dr. Peshala Jayasekara, Dr. Navinda Kottege, CSIRO, Australia

The goal of this project is to develop a robot that can navigate on a previously unknown complex disaster terrain. It is difficult for human beings to reach disaster areas to identify victims and send first aids for the them. Both tasks can be achieved using this platform. The robot is able to identify the survivors and give the location of them in a generated map of the area. It will be able to give an idea about the reachability and surrounding environment to the emergency response workers. Robot is a Hexapod platform with 3-DoF for each leg and LiDAR, depth camera and thermal camera are used as sensor payload. Automation of mapping and localization is another benefit of this project.

Group 18

Vision Based Autonomous Drone Landing

Supervisor: Prof. Rohan Munasinghe

Quadcopter drones have been widely used due to its small size and enormous capabilities to autonomous fly as take-off, hovering, and landing. It is a well-known fact that the landing is the most accident-prone stage for both manned and unmanned airplanes since it is a delicate process of dissipating the large amount of kinetic and potential energy of the airplane in the presence of various dynamic and operational constraints. Typically, autonomous UAV landing is done using GPS, where GPS based autonomous landing is not reliable and far from accuracy and more importantly it does not have ability to determine the obstacles.

Therefore, the main objective of the project and intention is to design and develop an autonomous landing system which can handle a precise landing on a pre-identified location. Once the drone is asked to land it is required to autonomously locate and recognize a helipad with the initial help of GPS, then align with it and land on it while keeping the drone stable.

FINAL YEAR PROJECTS

Group 19

Professional Video Over IP

Supervisor: Dr. Ajith Pasqual

Transmitting and receiving high resolution uncompressed raw video in real time at a high frame rate with low latency and high reliability are some of the strict quality of service requirements demanded by the professional video industry. The existing Serial Digital Interface (SDI) technology is no longer able to keep up

with future needs of professional video and has led to the

concept of Professional Video over IP. SMPTE ST 2110 is a newly introduced standard which enables professional video over IP. Our solution incorporates this standard in the design and development of FPGA hardware-based transmitter and receiver IP cores, to transmit and receive ST 2110 standard compliant IP packets in real time, supporting uncompressed video resolutions of up to 4K at 30 frames per second.

Group 20

Drone Based Package Delivery

Supervisor: Prof. Rohan Munasinghe

Package delivering is a day today necessity and with the development of the technology, there are different package delivery methods. In this project, we develop a hex copter drone which can carry packages to a given location and delivery it autonomously. This drone is capable of carrying a package of 500g weight to an operation range of 12km. Information about the destination of package will be given through a desktop application developed for this. For the delivery of the package to the land, a thread is used and after the package is landed, it will be released. After package is delivered, a photo of it

will be taken and send it in to the cloud. The drone gets back to the initial location after completing the package delivery.

Group 21

Framework for Imitation Learning in Mobile Robotics

Supervisors: Dr. Jayathu G. Samarawickrama, Dr. Suba Fernando

The Reinforcement-Learning (RL) becoming one of the major methodologies when it comes to complicated tasks solving robots and specific AI based solutions. Our work is to explore Imitation Learning, a RL method which actively teach a robot agent to learn faster and avoid unwanted consequences a robot could end up in. Here we're are proposing a framework which contains sensor to motor control of a rover and evaluating the novel Imitation Learning approach which boost the learning of similar task significantly with generality of the framework so that it can be applied on any mobile robot both industrial and scientific applications.

Group 22

Hardware Accelerated Vision Processor for Leaf Node

Supervisors: Dr. Ajith Pasqual, Dr. Ranga Rodrigo

In automated surveillance systems, the process of sending encoded video streams or extracted low level features of a video stream to a server through a Local Area Network (LAN) or a Wide Area Network (WAN) is a complex task with high power and bandwidth requirements. Our objective is to develop a hardware accelerated vision processor to support complex machine vision algorithms used in processing video streams in an embedded system at the leaf node- The final goal of this project is to develop a vision processor that could fit into small resource constrained leaf node cameras. The complex and large computations done by the processor will be accelerated by the Field Programmable Gate Array (FPGA).

Group 23

RISC-V Base ISA Processor

Supervisor: Dr. Ajith Pasqual

It is necessary to build a wide range of processors which has an efficient power-area-performance balance to meet the higher demands. Although there are many processors available in the commercial market, availability of patents, closed specifications and very high licensing fees have made those processors not affordable to academic purposes. UC Berkeley has developed an open source ISA, RISC-V with the intention of nurturing the researches related to processor architecture and making a free

computing framework for everyone. This project aims to develop a performance optimized implementation for the RISC-V ISA targeted towards FPGA and ASIC platforms. ENTC-12 started this project and we are continuing from where our seniors left.

Group 24

Vision based health monitoring of Pistia Stratiotes (Water Lettuce)

Supervisor: Dr. Upeka Premarathne

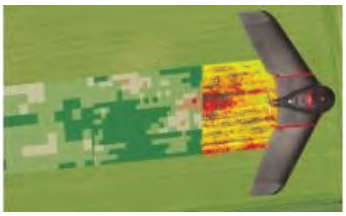
Pistia Stratiotes can be used to prevent Algal blooms. But, due to its ability for aids mosquito breeding and uncontrollable fast growth rate, farming the plant has become quite a danger. The project proposes a visionbased monitoring system of the plant by analyzing plant size, leaf color, and texture. This will enable effective monitoring of harvestable populations and efficacy of methods used to control the growth of the plant. Our outcome will be a handheld sampling tool which can be used outside the laboratory conditions which can capture images, estimate the biomass and the healthiness of the plant.

FINAL YEAR PROJECTS

Group 25

Drone Based Agriculture

Supervisor: Prof. Rohan Munasinghe

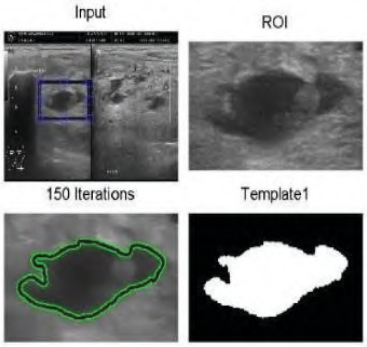


Design a fixed wing drone which is included with a Parrot Sequoia multi spectral sensor. The images obtained from the sensor will be used to identify the fertilizer needed areas and calculate the needed fertilizer amounts. The calculations on fertilizer amounts will be done according to the recommendations of the agriculture department. Inform the farmers with the needed fertilizer amount for the relevant places through a hand-held device. This is going to be done to avoid the practical issues which occur due to the less knowledge of farmers about the technology. The farmers may not know how to log into a cloud and access data. Therefore, they are informed with the required fertilizer level for the relevant places with a hand-held device which has a user-friendly interface. Predict the yield using a machine learning algorithm and upload the result into a cloud.

Group 26

Segmentation of Thyroid Nodules Using 3D Convolution Neural Networks

Supervisor: Dr. Nuwan Dayananda

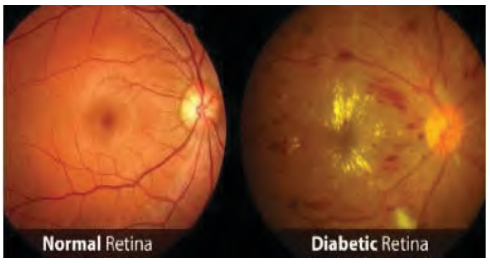


Delineation of thyroid nodule boundaries from ultrasound images plays an important role in calculation of clinical indices and diagnosis of thyroid diseases. However, it is challenging for accurate and automatic segmentation of thyroid nodules because of their irregular appearance and components similar to the background. In our project, we employ a 3D deep convolutional neural network (CNN) on 3D ultrasound images, to create a volumetric thyroid nodule segmentation. The method improves on existing 2D CNNs by addition of image preprocessing stages and combination of sweep images for constructing 3D nodules. The applications extend to detection of malignant (cancerous) nodules in the thyroid gland for early screening stages.

Group 27

Diabetic Retinopathy Project

Supervisors: Dr. Anjula De Silva, Dr.Nuwan Dayananda



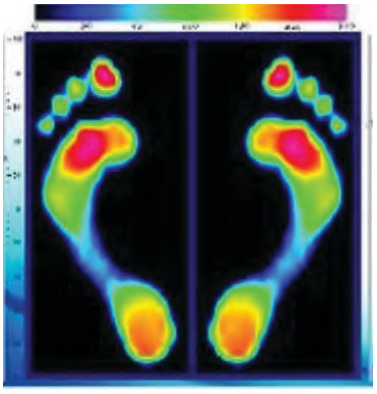
Diabetic is a non-communicable disease that has spread all over the world. Diabetes when left untreated can cause other complications in the body such as heart diseases, vision problem, kidney disease leading to kidney failure. Main purpose is to develop a robust system to diagnose and screen people with diabetic retinopathy at a very early stage.

- Using Deep learning and train it with the collected datasets for improved accuracy.
- Applying Graph based vessel separation to identify veins and arteries in retinal images.
- Statistical analysis of scleral vessel tortuosity with duration of diabetes.

Group 28

Develop Devices to Measure Plantar Temperature and Pressure to Detect Diabetic Foot Complications

Supervisor: Dr. Anjula De Silva



Diabetic foot complications can lead to ulceration and amputations. Plantar temperature and pressure abnormalities become visible at the early onset of foot ulceration. Our work, which is a continuation from the 2013 batch, focuses on further developing a Thermal Camera System for measuring temperature, which will be stationed in NHSL with Ethical Clearance to collect data over a prolonged period. It consists of a web application interface for the operator, a data analysis platform and a cloud storage for storing the data. A pressure measuring platform with a high frame rate data acquisition system will be developed to perform static and dynamic analysis of plantar pressure in future research.

Group 29

Biosignals for Objective Measurement of Immersion in Virtual Reality Systems

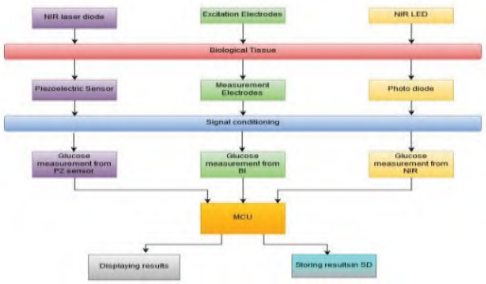
Supervisor: Dr. Anjula De Silva

Immersion is the psychological representation of how deeply a user is involved in a virtual reality (VR) environment. When novel methods are developed for sensory feedback in VR systems, developers need to evaluate the contribution of these developments in improving the users' immersion. This creates a need for objectively measuring immersion of a VR system. The traditional methods of measuring immersion (questionnaires and behavioral analysis) are not objective. This research proposes to investigate the suitability of bio signals (electroencephalography, electrocardiography and Electrodermal activity) to objectively quantify immersion in real time.

Group 30

Non-Invasive Blood Glucose Measurements

Supervisor: Dr. Nuwan Dayananda



Diabetes mellitus is a major cause of mortality and morbidity all over the world. Poorly managed diabetes may lead to serious complications. So, it is critical to frequently monitor the blood glucose level of diabetic patients and maintain it within the acceptable glucose level. The most widely used glucose monitoring devices are blood glucose meters which are minimally invasive and therefore they have lot of drawbacks.

To overcome these drawbacks, in this project we develop a non-invasive blood glucose monitoring system with comparatively high accuracy including three main techniques of photoacoustic spectroscopy, near-infrared spectroscopy and bio impedance spectroscopy. The methodology of the project is described in the figure below.

Sri Lanka – the emerging value hub for Design, Manufacturing & Branding Electronics

Confluence between software designs and manufacturing of hardware is the future of Sri Lanka's Electrical and Electronics sector. The country endows brilliant design talent and a small yet growing base of electronics manufacturing, catering into the global niche market. Expose 2019 organized by the Electronic Club of Department of Electronic and Telecommunication Engineering, University of Moratuwa will showcase these talents on January 19 – 20 at the university premises.

In 2017 Sri Lanka's Electrical and Electronics sector contributed $371 million to national export revenue, recording a 17% increase from 2016. The 80+ company's in the industry employs over 40,000 skilled workers producing an array of products including Automobile components and Cable Harnessing, Printed Circuits, Electrical Transformers, Switches, Lamp Holders, Boards and Panels. The sector also comprises manufacturers of machinery for the tea, power generation, healthcare and the packaging industries.

The industry constitutes about 15 Start-Ups steering the sector into the front-end of the value chain. The key driving force behind the birth of several of these entities was to preserve the talent pool in the economy. With the country producing around 600 electronic engineers annually, creating skilled employment opportunities, especially in Electronic Design Architecture has become paramount for Sri Lanka to leverage on her unique asset base.

At present however, Sri Lanka's Electrical and Electronics sector is dominated by contract manufacturers who are indeed today's sector strength with pockets of excellence in manufacturing that assure industry advancement. Lanka Harness; a leading electronics manufacturer for the international Automobile industry is an excellent example. The company is entrusted to supply seatbelts and airbags to global industry leaders with high quality requirements including Toyota, Hyundai and Chrysler. These Lankan products are said to have a failure rate specification of 1 part in a million, a standard which requires years of precision and evaluation. The company has now expanded its operations to feed the European manufacturers.

Exploiting the advantage of low cost labour in Sri Lanka was the driving force for many, if not all foreign contract manufacturers to set up base in the country. Overtime however, the cost structure has and continues to be uncompetitive in the global market mainly owing to the economy's increasing labour cost and the costly component sourcing from international markets.

In this front, to remain competitive requires unique value addition including product development engineering; in essence to renew country's Unique Selling Point in a dynamic fashion. Key industry players are doing exactly this; to maintain its competitive edge, the Swiss giant VARIOSYSTEMS has established strategic partnerships with local stakeholders including Sri Lanka Institute of Nanotechnology, Para Qum Technologies and the Institute of Fundamental Studies to add value to their own operations and also to create opportunities for the local sector. The European clients of VARIOSYSTEMS have built a reputation for high quality products catering their customers. Therefore the fact they trust Sri Lanka to produce their inputs is branding. With Sri Lanka acting as the hub for high quality electronics, emulating this to expand business operations over a chunk of the value chain will certainly facilitate a sector boom

Sri Lanka's Orel Corporation, famously known as Orange Electric is a pioneer in branding Sri Lanka's electronics sector in the world market. The company advocates the sector to immerse and capitalize from rear-end of the value chain. This leads to a much needed feature for country's electronics sector; the recognition of Sri Lanka's electrical and electronics excellence in the international market. With Branding in the driver's seat, Orel's business model embraces continuous Research & Development, that had led the company's innovative capabilities develop a portfolio of over 10,000 products branched under 4 areas of business operation. Although taking local products in to the global market is a natural barrier limiting growth in this sector, much focus was placed on developing products to one overseas market which can also be catered to another international space. Orange Electric was able to design a unique circuit base which allows the innovation team to assess how products from their wide portfolio could come together to work and cater to the different issues in demand. This invention came about as a business necessity when trading internationally – highlighting the extension of Sri Lanka's innovative capacity, an important charter to become a global player.

The key sector strength is the compatibility of mindset and business values among the industry players. They share one vision for Sri Lanka, which is convenient to enable the loudest voice for sector growth. A key opportunity to highlight is the platform to access international markets by leveraging international trade agreements. Activism of government bodies including Sri Lanka's Export Development Board that works proactively to reap the benefits of these agreements to the advantage of the sector is undoubtedly an added bonus. Inter-industry private sector synergies with the established Apparel and Tea industries and with the emerging ICT industry enable Sri Lanka to create global opportunities, in-house. With the rebooted industry alliance, Sri Lanka Electronic Manufacturers and Exporters Association is confident about the sector realizing the industry export revenue target of $1 billion by 2022, with unique design architecture, innovation-led manufacturing and renowned national branding.

Article by Sri Lanka Electronic Manufacturers and Exporters Association

SEMEA

E - CLUB

The E-Club works towards creation of competent, talented and responsible engineers, focusing on its core principle of serving humanity through electronics.

Serving humanity through electronics

Electronic Club, which is affectionately known as the E-Club by students, is the official student association of the Department of Electronic and Telecommunication Engineering, University of Moratuwa, guided by the staff members in the department. The E-Club works towards creation of competent, talented and responsible engineers, focusing on its core principle of serving humanity through electronics. The realization of the aspirations of the E-Club can be witnessed from the professional excellence, moral and the ethical conduct of the graduates of the department. It sheds its light on three major objectives namely acting as a platform to facilitate interaction between the undergraduates and the industry, identifying current trends in the technology and contributing to the development of the under development sectors in the society.

To achieve these objectives, there are various activities organized by the E-Club throughout the year. Among them, the E-Forum and Abhina are prominent. These activities ensure the creation of a platform for the undergraduates to showcase both their professional and aesthetic talents. This stupendous journey of the E-Club started almost 28 years ago under the guidance and patronage of Prof. (Mrs.) Indra Dayawansa. The grandeur of the E-Club shows evidence for her efforts in transforming the E-Club to its present state.

For this legacy to continue, the current executive committee and the patron of the E-Club performs a noteworthy service. The current patron of the club is Eng. Kithsiri Samarasinghe who is one of the senior most academic staff members of the Department and he was the former Director Engineering of Sri Lanka Rupavahini (TV) Corporation. Apart from the immense service he had rendered for the E- Club, he is well renowned as an excellent teacher who contributes significantly to engineering education as well as to the Telecommunication and Broadcasting industries.

The odyssey of the E-Club continues through its endeavours in shaping the lives of undergraduates to serve humanity through electronics.

E-FORUM 2018

E-Forum 2018 was an initiative by the Electronic Club to create a common platform for the industry, academia and future graduates of the department to be involved in a lively conversation aimed towards a friendlier collaboration with each other. The event was held on the 29th of January 2018 at the BMICH for the 5th consecutive time. The theme was to propel the national economy with electronics niche areas including Semiconductor IP core and EDA tool chain development, Robotics and Automation and Software hardware co-design.

The event was honoured with the presence of the Chancellor, Prof. K.K.Y.W. Perera; Vice Chancellor, Prof. K.K.C.K. Perera; Dean of the Faculty of Engineering, Prof. N. Wickramarachchi and former Head of the Department of Electronic and Telecommunication Engineering, Prof. Rohan Munasinghe.

The event provided an opportunity for the final year undergraduates to showcase some of the most brilliant final year projects which were up to international standards and gave solutions to some sensitive and important problems in the country. The presentations included Software Defined Networking (SDN) Switch for Core Networks, a LoRaWAN based wearable device, Scalable Autonomous Agronomical Smart Bot (SAASbot), a Kinect based gait analysis system, Diabetes related foot ulcer detection and Early detection of diabetes using tortuosity measurement of blood vessels in the sclera.

The panel discussion which was moderated by Dr. Tharaka Samarasinghe was a much awaited session of the evening. The discussion was nurtured under the theme, Value addition in the Electronic and Telecommunication industry – Strategies for globally competitive products and services development. Distinguished professionals from University of Moratuwa, CodeGen, Zone 24x7, Dialog Axiata PLC and Paraqum Technologies (Pvt) Ltd presented their views and insights as panelists.

The launching of the 2018 edition of the e-Carrier magazine was a key highlight of the evening. The e-Carrier magazine is the official annual publication of the E-Club which showcases the technological advancement made by the department.

The prestigious LSS Award, which is awarded each year to the most outstanding ENTC graduate in Leadership, Scholarship and Service was awarded to Mr. Tharindu Kaluarachchi and Ms. Hasantha Malavipathirana for the year 2016 and the year 2017 respectively.

Thereby, the E-Forum 2018 marked yet another successful completion.

SLRC 2017 & School Workshops 2017

SLRC School Category Competition

The School category competition of SLRC 2017 was successfully held on the 13th of January 2018 with the participation of over 300 students across the country. There were around 75 teams registered for the competition from different schools all around the country. Despite being young, these students showcased quality innovative approaches when designing the robots.

All updates on the SLRC competition will be published on our official Facebook page. (URL: https://www.facebook.com/UoM.SLRC/) Tournament details and rules and regulations were published in our official SLRC website. (URL: https://www.mrt.ac.lk/web/competitions/slrc)

1st Place
Team Turbo
Mahinda College, Galle

2nd Place
Team Alpha
Bandarawela Central College

3rd Place
Team Zenith
Royal College, Colombo

SLRC University Category Competition

The University category competition of SLRC 2017 was successfully held on the 12th of January 2018 at the Civil Department auditorium, University of Moratuwa. There were more than 75 teams registered for the competition from different universities and institutes around Sri Lanka. More than 200 students participated for the event. It was evident from the enthusiasm of the competitors that they possessed both the passion and the technical maturity that one seeks from a tech-savvy undergraduate.

The competition comprised of two rounds. The preliminary round more than 50 teams battle for a place in the final and only 8 teams were selected to the final according to the performance of their robots in the first round. The winners of the competition were awarded cash prizes. The winners are as follows.

1 st Place
Team Kronos
University of Moratuwa

2nd Place
Team Nemo
University of Colombo

3rd Place
Team Circuit Breakers
University of Moratuwa

School Workshops

Equipped with the required theoretical and practical knowledge, the E Club having identified the necessity of spreading the emerging Robotics technology among school students, were able to launch four introductory Robotics workshops covering several areas of the island.

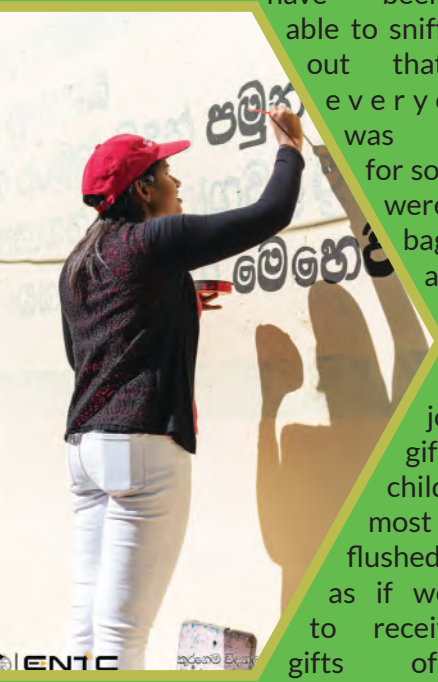
The first three workshops were held at Mathale, Kanthale and Dambulla with the average participation of around 50 students from different schools in the area. There were around 25 schools attended to these 3 workshops. Starting from fundamentals, these workshops featured a range of Robotics applications giving hands-on experience to the participants.

The second phase of workshops were organized in the months of October - December 2017 targeting the schools around Colombo, Kandy and Matara Districts. There were around 75 students in these workshops. There was really good positive feedback regarding these workshops from the participants as well.

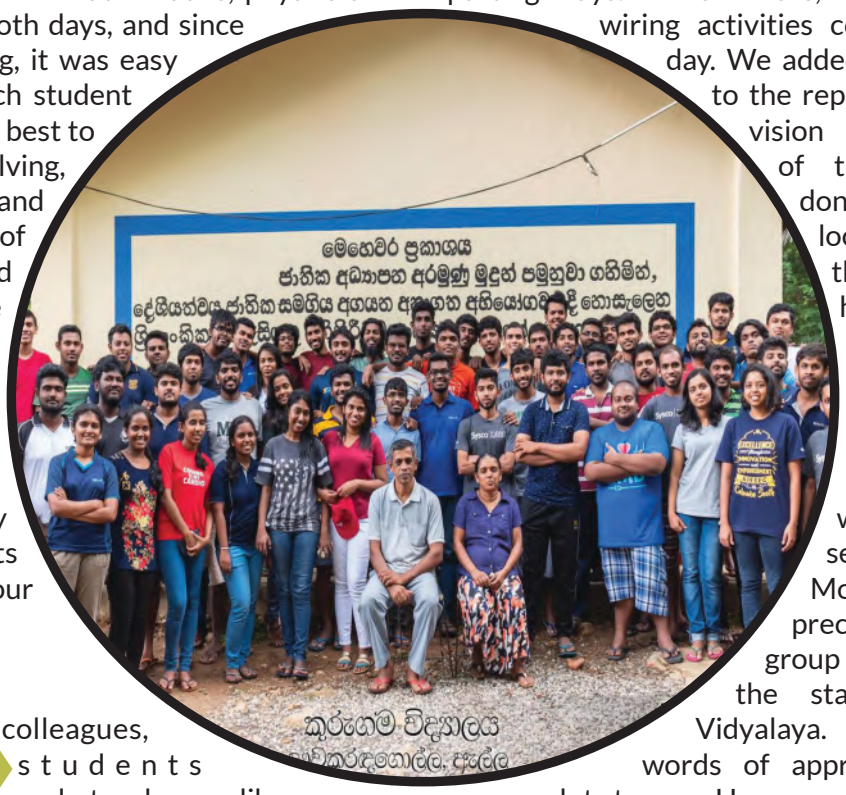
The final workshop known as “Robotics for Beginners” for school students and beginners was held on the 18th of November 2017 at the department premises. It was conducted as a full day workshop with the participation of around 100 students from more than 15 schools around the country. This was conducted by the third-year undergraduates of the Electronic and Telecommunications department.

E-Care 2018

E care 2018, the annual charity event organized by the E-Club of University of Moratuwa, was held on the 13th and 14th of October 2018, at Kurugama Vidyalaya, Ella. The event was a success and by the end of the second day, it brought smiles to everyone's faces; school children, their parents, the staff and ourselves alike. If you had visited ENTC before the 13th, you would have been able to sniff out that everyone was preparing for something. There were bundles of books, bags of stationery taken up and down the lift, not to mention the numerous paint buckets, brushes and whatnot. Everyone joined in getting the gifts ready for the school children, and of course, most of our faces were flushed with joy as if we were to receive gifts of new books, geometry sets, pens etc. The gifts were prepared, arranged and classified by the grade, but that was before they were tossed and mixed up after the bumpy ride they had at the backseat of the bus. We set off to Kurugama in the early hours of the 13th and reached the school at around 10 am. We hadn't expected the whole school to be at the gate, ready to welcome us, and this was a pleasant surprise. We entered the main hall amidst the clapping of students and teachers alike. Next, a brief introduction was given by Lahiru as to who we were, why we had come and what we planned to do. Mr. Rajapakshe, the Vice Principal and an experienced senior teacher of Kurugama Vidyala, gave a heart-warming welcome speech, and thanked us for choosing this school for the E-care project this year. Vinoj Jayasundara delivered a motivational speech to students from grade 6 to 11. This session was enlivened by several fun activities both Vinoj and Dickmendra Bandara had in hand. It was joyous to see the students deeply absorbed by the train of thought of shaping their lives towards a better future. Students were encouraged to study well, obtain university admission and lead successful lives. Meanwhile, the primary students were led to their classrooms for fun sessions and games. We played simple games with them to which they participated with much enthusiasm. Later, they took turns to sing a song or poem in front of the whole class. Some youngsters kept coming up to sing, their eager faces didn't allow us to refuse them the opportunity. The rest of the class joined the merry atmosphere of singing and clapping. As we drew closer to noon, the little ones were given gifts of books, colour pencils and stationery. They left for lunch, with the intention of returning for the campfire scheduled in the evening. After lunch, painting of the buildings was geared up. There was much to do, scrapping walls, sand papering desks and chairs



etc. The work was done steadily by our colleagues. The atmosphere was cheerful, and everyone was busy throughout the school, colour washing the walls, repainting the faded maps of Sri Lanka, painting the desks and chairs in blue. In parallel, the new science laboratory was wired by our batchmates. Students of grades 9, 10 and 11 participated in seminars held during the two days. Seminars for mathematics, physics and English were held on both days, and since the class size wasn't big, it was easy to pay attention to each student individually. We did our best to help them in problem solving, English grammar and theoretical concepts of physics. We concluded the seminars with the wish that all of them would soundly pass GCE O/Ls and pursue higher education successfully. As the day drew to its close, our colleagues, students and teachers alike prepared for the event everyone was waiting for; the campfire. By the time we reached the playground, it was packed with all the students, parents and teachers from the school. Nearly 500 people had gathered around the campfire. The Principal, who wasn't available in the in the first half of the day, welcomed us once more and expressed his gratitude towards our worthy cause. What followed next was showbiz! The campfire was an opportunity to showcase the exceptional talent these school children had.



They presented dances, songs and dramas which were well-rehearsed and entertaining. Each item was greeted with enthusiastic clapping. As hosts to the evening campfire session, we presented several entertaining items that left the spectators chuckling. Marking the close of the campfire, the villagers joined us in song and dance, before parting ways. The seminars, colour-washing and wiring activities continued the next day. We added finishing touches to the repainted mission and vision statements. Much of the cleaning was done and the school looked inviting, after the renovations it had gone through. The seminars on mathematics and English were completed by noon. After lunch, we got ready to set out back to Moratuwa, which was preceded by clicking group photographs with the staff of Kurugama Vidyalaya. The Principal's words of appreciation meant a lot to us. He expressed how blessed they collectively felt as a school, to be aided and cared for by us university students. Our E-club president, Hasitha thanked them in turn for their cooperation and facilities they provided for a large group as ours, for two days. We enjoyed every bit of those two days. It was evident by the high spirits we were in on our way back to campus. The event coordinator, Charith did a tremendous job in organizing the event, frequently contacting the teachers at Kurugama Vidyalaya and looking into what had to be done during the project. The residents of Kurugama provided exceptional meals for us all throughout our stay. The Principal and the staff should be thanked for their invaluable cooperation and support to the event, and for arranging accommodation for such large group. A big thank you goes out to batches 14, 15 and 16 for their dedication and will power to make this event a success. The ENTC family did it once again; it was the best E-Care we were a part of.

ENTC CAREERS FAIR

Department of Electronics and Telecommunication Engineering, University of Moratuwa together with E-Club, initiated a brand-new event "ENTC Careers Fair" on 8th of October 2018 at the department premises. The event itself meant to assist the final year undergraduates to organize their future careers as well as to introduce the prevailing career opportunities in Sri Lanka to the undergraduates.

Many prestigious companies in Sri Lanka, working in the fields of Electronics,

Telecommunication and Software Development were invited and over 25 companies participated in the event, willing to employ the undergraduates. Interviews and career-guidance programs were conducted by the companies which were very useful to the undergraduates to understand the requirements of the industry.

The final year undergraduates of batch'14 were the main beneficiaries of the ENTC Careers Fair 2018. They showed great enthusiasm in the event which benefited them in various ways. The undergraduates were able to acquire applied knowledge on industrial approach. Most of the final year undergraduates were able to find career opportunities through the program. Hence, the Careers Fair ended in a highly successful note.

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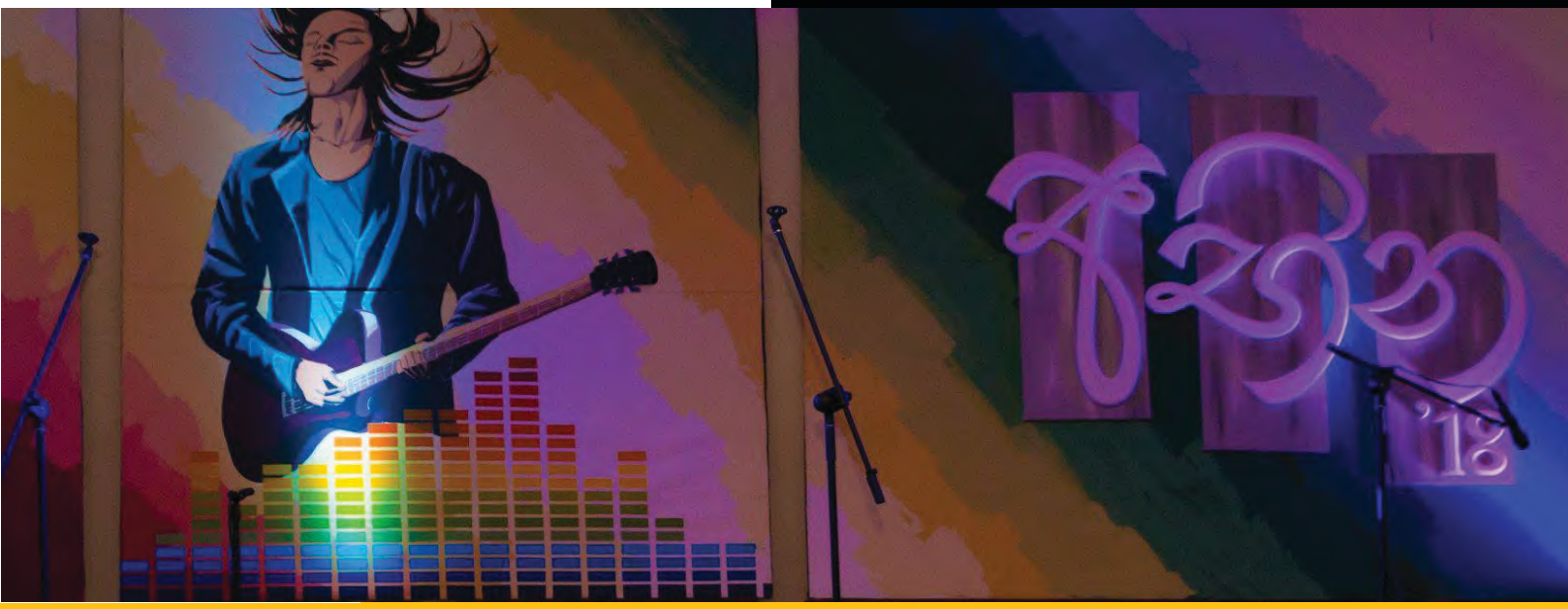
Abina-2018 the magical night was the most anticipated event of the year organized by the E-club of University of Moratuwa. The gathering was successfully held on 9th May 2018 at the Civil auditorium of University of Moratuwa. This is an event organized by the Electronic club of Electronics and Telecommunications department.

The vice chancellor of University of Moratuwa was invited as the special guest for the event. Even though there are many activities held throughout the year to showcase the talents of our students, this is the most prestigious of them all. The students studying at Electronics and Telecommunication Department, despite their high academic performances, also own much talent in aesthetic skills as well. This event gives them a platform to portray their talents in singing, dancing, acting and playing musical instruments. Most of the times, it is the hidden talents which are brought out at this stage.

Even though the students have a very busy schedule for the academic activities, they never fail to amaze us with their dedicated work for the event's success. There is a lot of effort put by the students to make this event a great success. Being the top most technological university in Sri lanka, we never fail to prove ourselves in aesthetic skills as well. Let it be a song, dance or a drama; our students do them with greater perfection. Not only the students, but also the academic staffs join hands with us; they also perform in the event. It is a great encouragement as well as inspiration for all of us.

Ultimately, amidst the heavy academic work schedule, this kind of an event is never a pressure, but a pleasure. The final day on stage is magical and colorful, but still, it is the effort and process to make it big is what makes it more important to each student's life. The sweat, the sleepless nights, laughter, and maybe quarrels; these all makes it special and memorable. We all work together, together as a batch; together as a department. Unity is our strength. And we overcome each other's weaknesses.



Tronic Premier League

The annual cricket encounter, Tronic Premier League organized by the Electronic club of the University of Moratuwa was successfully held on the 1st of November at the University ground. The most awaited sporting event of the E-Club calendar – it was a glowing event with the participation of all four batches of the department. With the great effort of academic staff, undergraduates and the Alumni of ENTC, TPL 2018 was a fun-filled event we will always remember. The day was made more colorful and fun-filled with the enthusiastic participation of cricket teams representing both the academic staff and the alumni members of the department.

Even though the weather was not favorable, the Tronic premier league started. Because of our Tronic family's' great luck the rain was over as soon as the matches started. The match was not only for males. The event was made radiant by including two girls per team. There were five overs for one round and one over was played by girls while the other four were played by boys.

This event was organized by all four batches dividing the work among batches. A splendid backdrop and posters were designed by the17 batch which added colour to the event. Refreshments were provided by the organizing committee.

The fans have been renowned as one the most fanatical supporters as they stick with their team through the ups and downs. Over the course of the cheerful chants and the words of encouragement boosted the team's spirits in the middle. The players played with a great spirit and talent. The announcers made the event more entertaining by unrolling the player's talents and special facts. It was a memorable day which was filled with joy. The photographers did a great job by taking photographs of radiant moments.

The batch of 2015 cricket team made their mark in history by emerging as the champions. Following the epic finale, this memorable day ended with a blast as the entire ENTC family celebrated together.

Tronic Avurudu 2018

With all the glamour and grandeur of the Sri Lankan culture, Tronic Avurudu was held on the 5th of May 2018, for the first time in the department history. The event was graced and made more colorful with the presence of the Head of the Department (HOD), Dr. Nuwan Dayananda, the former HOD, Prof. Rohan Munasinghe and the senior and junior academic staff of the department.

While numerous sweets and food items adorned the Avurudu table, the essence of the Sri Lankan heritage was held high with fun filled activities and games – where both the undergraduates and the academic staff enjoyed themselves while enhancing the bond of the ENTC family.

The most awaited event of the day was the crowning of the Tronic Kumariya and Tronic Kumara. Concluding a much competitive final session, Uththara from level 3 and Hasith from level 4 were crowned as the Tronic Kumariya and Kumara by Dr. Chamira Edussooriya.

Marking the end of the day, at the padura, the undergraduates made it an evening of music and songs which soothed their souls. The day was thus concluded, while the spirit and pleasure of the Avurudu season still hung in the air.

Shuttle Fest 2018

Shuttle Fest is an intra-department badminton tournament which brings together the undergraduates of all the levels and the academic staff members of the Electronic and Telecommunication department for a fun filled interactive day. Shuttle Fest 18' was held on the 13th of September 2018 at the Gymnasium of the university. It was indeed a memorable day for the shuttlers of the department to make known their talents.

There were separate categories for women and men, having 4 players per team, including 2 singles and 1 double. Twenty-four competitive teams participated under the men's category. Teams 'Swayaththa wichalya' – level 1 , 'Rockers' – level 2, 'Gahuwoth dalee' – level 2 and 'Net violators' – level 4 succeeded as semi-finalists. The confident team 'Net Violators' of Level 4 soundly beat the much talented team 'Gahuwoth dalee' and won the men's championship. It was an outright victory where ceaseless cheers of the audience filled the gymnasium throughout the match as both the teams played well.

Six teams participated under the women's category. The much talented players played headstrong throughout the tournament. The '14 batch' team faced off against the 'women's instructors' team at the finals. The '14 batch' team put up a valiant effort and won the women's championship.

Level 4 teams, both in the men's and women's categories became the undefeated champions of the 'Shuttle Fest 18'. Even though many teams competed head to head, Shuttle Fest 18' was a fun-packed day where everyone came together to cheer each other and build a strong bond between the students of all the levels of the department.

Hitech Solutions (Pvt) Ltd.
(www.hitech.lk)

The company was formulated by two undergraduates from University of Moratuwa, one from Department of Electronics and Telecommunications (DET) and the other one from Department of Mechanical Engineering (DEMECH). Both of them were working for there final year projects and helping others overnights at Research Lab at DEMECH and CAD lab at DET. They

collaborated both departments with each other for final year/Msc projects. This energy became an idea of commencing an Engineering Company with the slogan "Engineering Excellence" and the company was registered as Hitech Solutions (Pvt) Ltd in December 12th 2006 with the Vision "To become the leading Product Development and System Solution provider in the Asian region" driven by the mission "Develop the technical knowledge of the company and start a state-of-art production facility in the region" The first banking partner is Bank of Ceylon university branch.

At present Hitech Solutions is a leading Engineering and Research organization in Sri Lanka. We have contributed to medium to large scale industrial automation and small scale industry equipment development projects both locally and internationally. Further we have contributed to developments and scientific research of many organizations both

private and government sector including major universities. From 2013 we have expanded our export oriented projects, as we plan a significant growth in export sector. Our research and development capability gives our customers an added advantage of customization and application of latest technology for their betterment.

With the combination of Mechanical – Electronics knowledge, currently our product range expands from Machine Vision systems, Auto Guided Vehicle, IOT systems...etc upto Heavy Cranes.

Eng. Buddhika Marasingha

Founding Member

Eng. Kosala Jayasundara

Founding Member

Synopsys is Fueling the New Era of Smart, Secure Everything

Emerging and rapidly evolving trends like autonomous vehicles, artificial intelligence (AI), the cloud, and 5G are transforming everything we know about mobility, connectivity, and security from the way we consume and experience information to how we view data privacy and ensure our personal safety. These innovations are all possible because of complex silicon chips and powerful software code.

In any given device, billions of transistors and millions of lines of code must all work together, securely. As the interdependency between hardware and software grows and with the rise of safety-critical applications the full benefits of autonomous vehicles, AI, the cloud, and 5G can only be realized if security is designed-in from silicon to software.

To deliver Smart, Secure Everything, companies need to start software development earlier, in tandem with hardware design, to properly simulate how a device will work, to verify that the chip won't fail, and to ensure that the code can't be hacked. That's where we come in.

Synopsys technology makes it possible for leading companies to build smarts, security, and safety into their next-generation products. From silicon to software,we help our customers meet new goals for power, speed, connectivity, mobility, and reliability that are critical to the future of Smart, Secure Everything.

Build the Best Chips, Faster

Synopsys is the world's leading provider of solutions for designing and verifying advanced chips, and for designing the next-generation processes and models required to manufacture those chips. We help customers optimize chips for power, performance, and cost and cut months off their project schedules.

Integrate More Capabilities, Faster

Synopsys offers the world's broadest portfolio of silicon IP reusable blocks of logic, interface, and processor design to help customers integrate more capabilities, meet the unique requirements of their target applications, and get differentiated products to market quickly with reduced risk.

Build Secure Software, Faster

Synopsys static analysis, software composition analysis, and dynamic analysis solutions help customers build security and quality into their software code at any stage of the software development lifecycle and across the supply chain to minimize risks while maximizing speed of application development.

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