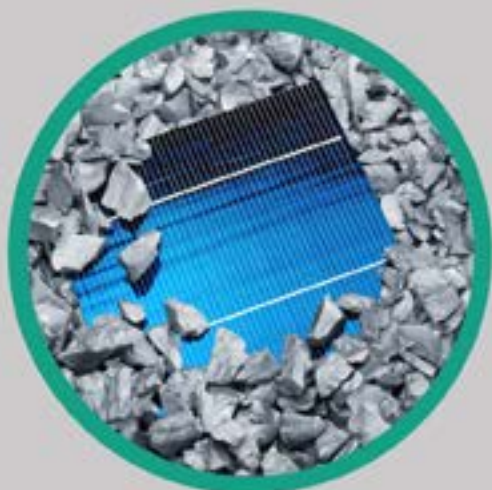


eCarrier

FEBRUARY 2015

OFFICIAL MAGAZINE OF E-CLUB



Eforum 2015



E-CARE



INTERVIEWS



ARTICLES



Leveraging technology to help you think differently about your business

Innovation is power



“DEVELOP A PASSION FOR LEARNING. IF YOU DO, YOU WILL NEVER CEASE TO GROW”

-Anthony J. D’Angelo-

The Department of Electronic and Telecommunication Engineering, with a unique history of nearly fifty years, molds the brightest Sri Lankan minds to be innovators, and technology leaders, who contribute in broadening the knowledge paradigms throughout the globe. The creation of innovators and leaders happen through the way our department’s faculty intrigues the undergraduate and graduate students in 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, biomedical engineering and many other related areas. It has managed to remain the most sought after engineering discipline in the Faculty of Engineering by facilitating students the exposure to cutting edge technologies. The department today is undergoing through a series of notable transformations in terms of academia as well as facilities

provided for students. UAV research laboratory established on 15th December 2014 in the department made history not only to the department but to the University and to Country as a whole. Apart from addition of new specialization stream under the department, Bio Medical Engineering, renovation of the laboratories and lecture halls along with study areas are of the most significant ones. All these efforts have been taken in order to make the department more enriching and eventually raising it up to be a home away from home. The official magazine of the department, eCarrier is the transcript of the revolutionary transformation having 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 exhibiting talents of undergraduates of the department among the industry and technology enthusiasts. As a final note, it is inevitable that the department will continue to triumph in every aspect as it has been in the past. Having all the necessary guidance, skills and expertise from academia to students end made these tremendous achievements a reality.



ELECTRONIC CLUB

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University of Moratuwa**

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Message from the Dean Faculty of Engineering

I wish to congratulate the Electronic Club, the student body of the Department of Electronic and Telecommunications Engineering, Faculty of Engineering, University of Moratuwa, for publishing of the e-Carrier Magazine 2015, and for E-Forum 2015 to culminate an year of innovative projects completed at the Department.

The E-Forum is expected to be the platform to bring together the alumni, the staff and the students of the Department, for sharing their views on the status of the Industry and the role of the Department in the Industry. The e-Carrier Magazine 2015 is a collection of technical articles written by Industry Professionals, Academic Research Personnel, and Undergraduates of the Department of Electronics and Telecommunication Engineering.

The Department has taken many steps in the recent

years to venture into many new areas, setting up a pioneering trend for the benefit of the whole country. It was among the first Departments to set up Industry-sponsored Research & Development Laboratories at the University of Moratuwa. In addition, the staff and students are consistently involved in many state and private sector programmes of national importance.

The Electronic Club has a rich past spanning across two decades, during which it had taken effort to mould its undergraduate members into competent and socially responsible engineers for the country. For several years, the Club organised an annual exhibition to portray the abilities and innovations of the undergraduates to the industry and society at large, and since 2011, the Expose Forum has been organised in place of the exhibition.

I take this opportunity to thank the Electronic Club

for the publication of the e-Carrier 2015 Magazine in conjunction with E-Forum to discuss the topics of Bio-medical Engineering, Industrial Engineering, and High-Performance Computing, to set the stage for interaction with the Industry into the future. I also express my sincere appreciation to the pioneers, and the current staff of the Department for 43 years of excellent track record, making the discipline the most sought after in the Faculty of Engineering today. I wish the Department and the Electronic Club great success with all their events.

Professor U.G.A. Puswewala
30 January 2015



Message from the Head of the Department

Department of Electronic & Telecommunication Engineering

It is with great pleasure that I am issuing this message to the e-Carrier, the official magazine of the department published by its student body - eClub. e-Carrier is truly a window to what is happening in our broad field of Electronic and Telecommunication Engineering. Activities at the Department, those within the local Electronic & Telecommunication industry and the key developments globally are all captured in one volume. Last year, e-Carrier was launched at the flagship annual event of the department which had the theme "Facilitating new directions for Industry and our graduates". We can all be happy that activities conducted during 2014 have really facilitated new directions and to sustain that momentum we are continuing with the same theme at this year's e-Forum as well. This year e-Carrier has chosen the same thematic areas we are using for e-Forum, namely, Biomedical Engineering, Internet of Things, UAV (Robotics) and Semiconductor Intellectual Property. The articles in the e-Carrier will reflect these thematic areas to different extents.

e-Carrier will once

again be launched during the e-Forum this year clearly making it a tradition. Even in today's context, where all information is virtually online, printed material has a profound impact on the readership and this is very much true for e-Carrier. This year the online version of e-Carrier will be made available via the department web site and efforts will be made to make the past versions go online.

e-Carrier provides an opportunity for the staff members of the department to present their views on activities they conduct, their interaction with the industry and also what the future hold with reference to their own niche field of specialization. Similarly students present their views about the latest developments in technology and most importantly their final year projects. These blending of ideas from staff and students in one magazine provide insights which are hard to come by and I am sure the readership will immensely benefit from such thoughtful views. Some of our initiatives during last few years to expand the boundaries of the local industry are slowly being realized and

e-Carrier is highlighting these developments through the startup space. This information will surely provide a different perspective of the emerging new areas of the industry to the undergraduate students.

In addition to the technical matters, e-Carrier also provides information about various non-technical activities conducted by the student body of the department - eClub. All these activities show the diversity of the experience a student gains during their stay at the department.

I wish to congratulate the editorial team of e-Carrier, patron and staff advisor of eClub for this wonderful effort that provides a unique insight into our fascinating field. I hope, e-Carrier would be soon looked up to as a guiding light showing how our broad field of study is driving the technology renaissance in Sri Lanka.

Dr. Ajith Pasqual
15th February 2015.



Message from the Patron

E-Club
Department of Electronic &
Telecommunication Engineering

E-career is the official magazine of the department published by the student body 'e-club'. The student body of e-club now includes those specializing in (a) Electronic & Telecommunication Engineering and (b) Biomedical Engineering. I congratulate the editor and the editorial board of e-club for their time and effort in producing the e-career magazine for the fifth successive year and I am happy that it is launched on 19th February at the E-Forum 2015. As in the past, this year also the magazine carries several articles written by the undergraduates on a variety of current topics. This year E-Forum will once again bring the students, academic staff and the industry closer to each other and strengthen the mutual relationships. The industry inputs have greatly helped to improve

the quality of the graduates and as such the industry interaction has a special place in the department annual event calendar. The e-Forum event and e-career go hand-in-hand. Through e-career, the students have acquired a variety of valuable skills including technical writing, editing, interviewing professionals in the academia and the industry. In addition to publishing the e-carrier, the e-club organized several other activities. One such event is the 'e-care' annual program where in 2014 the e-club visited Balangoda Hatharabage Kanishta Vidyalaya and helped in painting and repairing school infrastructure facilities in addition to conducting some revision classes in Mathematics and Science.

I wish to place on record, my deep appreciation on the dedication and efforts of the e-club

in all their activities, the e-Forum and e-career in particular. I wish every success at this year e-Forum.

I J Dayawansa
12 Feb 2015



Message from the President

E-Club
Department of Electronic &
Telecommunication Engineering

It is an honor as the President of the Electronic Club to issue this message for the E-Carrier magazine. Being the official publication of the Electronic Club of the Department of Electronic and Telecommunication Engineering, E-Carrier has played a vital role in linking the department to the world outside. One of the founding objectives of E-Carrier was to create a platform for the students of the department to showcase their talents through articles. Evolving since then, the magazine has now become an annual publication equipped with the highest standards and high quality articles. When we look at the E-Carrier magazines of yesteryears, we can see the drastic change of the goal of the main event, E-Forum as well. It was recently designated with the ISBN numbering, raising its standards to even higher grounds.

The modern electronic and telecommunication engineering is developing at an unimaginable rate, with the emergence of superior hardware, automation and innovation. The core objective of the E-Forum is triggering and facilitating a continuous discussion between industry and university. The discussion is based on how the Sri Lankan industry has adapted to the latest technological developments and how the university should re-focus its strategies to produce finer engineers capable of providing solution adhering to aforementioned technologies. A forum of this nature is especially important to the department at a time of attempt towards producing job creators over job seekers.

This time the E-Carrier 2015 is- the opportunity to expose the sue is launched in parallel with skills and talents

of the undergraduates to the industry and the public. The final year undergraduate projects with national and commercial importance are showcased today, giving the flavor of innovation and the cutting edge technologies that are currently being deployed. In conclusion, I wish to extend my sincere gratitude to the staff of the department, the sponsors and all students who made this E-Carrier issue possible. An especial appreciation goes to the editor of the Electronic Club and his team for their great commitment in making this E-Carrier a success.

Pradeep Sanjeewa
1st February 2015

The Department of Electronic and Telecommunication Engineering is housed in the majestic four storied building towards the east-side of the University of Moratuwa. With a legacy of nearly 50 years, the department continues to prosper from the heritage of excellence together with exceptional teaching and laboratory facilities. In keeping with the department's policy of "teaching you to learn", nine laboratories equipped with modern facilities are offered for students to carry out laboratory experiments and project work. Furthermore, the department has forged strong links with the industry to promote collaborative work. As a result there are three additional industry-sponsored laboratories setup as joint ventures.

At the department, the students balance their academics with many other activities. Students can be seen walking down the corridors, filled with smiles, for the life at ENTC is an enjoyable experience for all. Throughout the year, the department is filled with co-curricular events as well as music, drama and adventures.

The department fosters innovative thinking and encourages hard work. These together with the heritage of excellence enable the enthusiastic students to become highly sought after engineers, innovators, researchers, and technology leaders both locally as well as internationally.



3D ICs: A Brief Introduction to the New Dimension

N. P. S. C. Nugawela

In the Electronics industry, innovation has always played a major role in advancing the efficiency and the functionality of products. Since the replacement of the vacuum tubes by the transistors, the industry has grown by leaps and bounds, introducing new technologies at least one per decade. ICs have taken the center stage in miniaturization, with various fabrication technologies and various packaging methods. But till now, the development in the IC designing and fabrication methodologies had been limited to only 2 dimensions. Needless to say, it was found that this is inadequate to accommodate the requirements of the modern world. Therefore, a new technology emerged, and it is the topic of discussion of this article.

Motivation for development

A 3D IC can be simply described as a stack of 2D circuits. It is reminiscent of another method in a completely separate portion in Electronics, which is PCB fabrication. But why is such a method necessary in the first place?

In the modern devices, interconnect structures are responsible for a large portion of the power consumption and the

delays. So to minimize these structures, the solution put forth is increasing the number of "nearest" neighbours seen by each transistor using the 3D fabrication method. It will allow power savings and also limit parasitic capacitances due to its shorter interconnections. Heterogeneous integration, that is, integrating different layers of components together, is another objective. It would allow for better optimization than when they would simply be in separate layers. Also circuit security can be achieved by distributing a functionality-sensitive circuit across layers as to thwart the attempts at reverse engineering.

Major Design Approaches

All 3D ICs can be categorized into two major types, according to the development approach.

1. Monolithic approach
2. Stacked approach

In the monolithic approach, the whole structure is derived from a single semiconductor wafer. This approach has the advantages of needing no thinning, aligning, bonding or Through-Silicon Vias (TSVs), since there is only a single substrate.

The stacked approach can be further categorized into wafer-to-wafer, die-to-wafer, or die-to-die stacking methods. Wafer-to-wafer has the devices implemented on two or more separate wafers and then they are aligned, bonded and then diced into 3D ICs. The vertical connections are either formed before or after the bonding. These connections are called Through-Silicon Vias (TSVs). Thinning of the wafers can be carried out before or after the bonding.

Die-to-wafer approach implements electronics components on a wafer and a die, with one wafer being diced. Then these dice are aligned with the die sites on the other wafer and then bonded.

Die-to-die is similar to wafer-to-wafer in that two or more dice with electronic component implementation are aligned and bonded. The same goes for thinning as well.

There are two major design styles in 3D IC design. They are, gate level integration and block level integration. When designing, it is more feasible to go for block level integration designing approach than

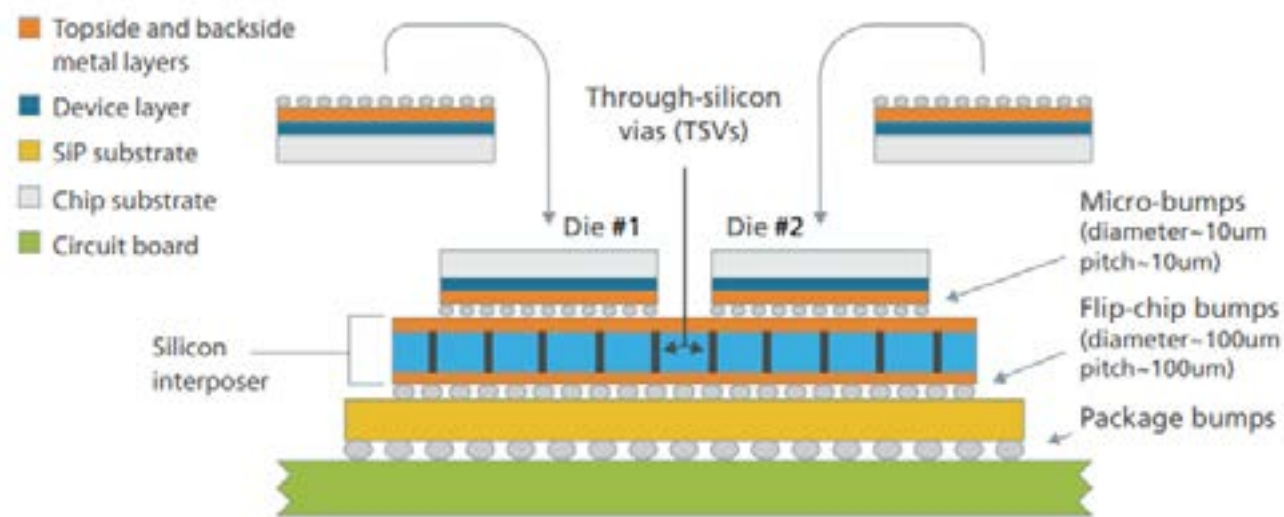


Figure 1: 3D IC realized through TSV

gate level integration. Gate level integration allows for the placement of standard cells in different dies and this promises savings on wire length and greater flexibility, but at the expense of having more TSVs. Also this approach calls for 3D place-and-route tools, which are not currently available. So the block level integration, where a single functional block is placed into a single die is currently used.

Manufacturing Technologies available

Depending on the requirements of the circuit to be built, the technology for fabrication can be determined. Here follows a list of such technologies.

i. Beam Recrystallization-Deposit Poly Silicon and fabricate TFTs

Only high performance TFTs can be used as Poly Silicon used in the method has a high

melting temperature and due to low carrier concentration.

ii. Processed Wafer Bonding-Bond two fully processed wafers together

Similar Electrical Properties on all devices can be obtained. Good for applications where chips do independent processing. However Lack of Precision (Alignment) restricts interchip communication to global metal lines.

iii. Silicon Epitaxial Growth-Epitaxially grow a single crystal Si

High temperatures cause significant degradation in quality of devices on lower layers. Also, the process cannot yet be used for manufacturing.

iv. Solid Phase Crystallization-Low Temp alternative to SEG

Offers flexibility of creating multiple layers and is also compatible with current pro-

cessing environments. Useful for Stacked SRAM and EEPROM cells.

EDA Tools

Most of today's electronics chip designs call for computer based design tools due to their complex nature. As such, it is undoubtedly expected that 3D ICs will require EDA (Electronics Design Aid) tools as well. EDA tools are expected to take into account matters such as heat dissipation, EMI, power consumption, timing and routing. Unfortunately as of now, there are no 3D place-and-route tools available.

Being a relatively new field, there are not many EDA tools available in this area. Most of the tools present today are academic. An example of such a tool would be 3D MAGIC developed by MIT.

Synopsis provides tools for Interconnect Simulation, Test

Automation, Physical Verification, Circuit Simulation, etc.

3D EDA from Romania is a research organization focused on developing 3D circuit design tools using the existing 2D design tools. R3Logic is a company focused on developing 3D IC designing tools.

Although there is a number of EDA tools available, they are not still completely adequate to satisfy the needs of this growing industry. This can be noted as an area where further development is much welcome.

Challenges faced by 3D ICs

These include,

1. Cost

Although cost efficient compared with scaling, it is still an issue. But with the maturity of the technology, this will become less of a problem.

2. Yield

In 3D ICs, if even a single layer is faulty, the whole IC would have to be discarded and this, if not properly managed, will affect the yield greatly.

3. Heat

There will be a large amount of heat generated within the stack due to layers' proximity to each other electrically. So, the design must account for heat dissipation from these areas.

4. Design Complexity

3D designs are highly complex

and must be carefully designed in order to exploit the benefits of the 3D structure.

5. TSV introduced overhead

TSVs have a larger footprint compared to gates. (Comparable to 50 gates) Therefore they end up taking a large area in the design.

6. Testing

Testing of individual dies is necessary to reduce costs and to increase yield. But this is difficult due to optimized interconnections between the layers, making it difficult to isolate single layers.

7. Lack of standards

Although the issue has been pointed out, there are only a few prevalent standards for 3D IC manufacturing, packaging and design.

8. Heterogeneous integration supply chain

9. Lack of clearly defined ownership

Applications of 3D ICs

In 2004, Intel presented a 3D version of the Pentium 4 CPU. The chip was manufactured with two dies using face-to-face stacking, which allowed a dense via structure.

The Teraflops Research Chip introduced in 2007 by Intel is an experimental 80-core design with stacked memory. Due to the high demand for mem-

ory bandwidth, a traditional I/O approach would consume 10 to 25 W. To improve upon that, Intel designers implemented a TSV-based memory bus. Each core is connected to one memory tile in the SRAM die with a link that provides 12 GB/s bandwidth, resulting in a total bandwidth of 1 TB/s while consuming only 2.2 W. [3]

There are 3D FPGA designs available from Xilinx. The boards using this technology, as noted in the Xilinx site are, Kintex and Virtex Ultrascale designs and Virtex-7 T, HT and XT boards. [4]

3D IC manufacturing has been used to implement SRAM, the latest addition to the memory technologies. In 2014, European scientists developed a 3D stacked hybrid SRAM cell. [5] Memory technologies are to benefit mostly from the advancements in 3D IC implementations.

Also there are ongoing projects to adapt 3D IC designing technologies for more devices. Tezzaron has developed a microcontroller based on 3D technologies. [6] As time progresses, we will come to see many more devices adapting this novel technology, as this is still a relatively new technology, with a lot of opportunities for expansion.

Emergence of High Level Synthesis in VLSI Design

Aditha Rajakaruna

Introduction

High Level Synthesis (HLS) is an automated process which interpret an algorithmic level description of a digital system in to a hardware description level design. The current researches and commercial applications have claimed the ability to accept ANSI C/C++/ SystemC synthesizable subsets, analyze, constrain and schedule to create a Register Transfer Level (RTL) Hardware Description Language (HDL) code which can be synthesized by the logic synthesizer tools.

At the early stage of the VLSI design, designers manually place the transistors to create hardware components. Then in the early 90's EDA vendors introduced the behavioral compilers which accepted Verilog and VHDL as input languages. After ten years later in the 2004, HLS tools were introduced but the adaptation was slow. Due to the exponential increase of design complexity and requirement of a fast design process have caused the HLS to become a hot topic in the ASIC and FPGA design.

Advantages of HLS

HLS has number of advantages

and the most significant are discussed below. The root cause of the problem addressed by the HLS is creating an error free RTL from an abstract specification.

Reduced design and verification effort

In HLS the designer only deals with the abstract description. He does not need to worry about the implementation details such as hierarchy, processes, clocks and technology. This description is easier to write and easier to verify for the expected results.

In general VLSI design process, verification consumes a greater percentage of the time allocated to the project. But in HLS the designer can verify the abstract description instantaneously and the tool will create a required error free RTL code which is more efficient and productive.

So with HLS the correct RTL can be obtained more rapidly, and in return the verification time and the debugging overhead will be reduced.

More effective reuse

Reuse of existing IP cores is a widely adopted design methodology

to address the problem of high design complexity. But reusing the RTL based IPs always have limitations such as specific clocks and technologies. Small change to the code can result unexpected complexities.

But in contrast with the HLS the designer only creates the abstraction and the specific clocks, technologies and micro architectures are added in the HLS process. Hence the problems arise in the traditional methodology can be rectified by using HLS.

Another benefit is the HLS tool can be used to generate different RTL models for the same abstract description. So the performance, power consumption, and area allocation can be estimated to choose the optimum design required.

Investing R&D resources where it really matters

Writing a RTL code is not a value added activity in the design process. If the HLS is used properly it can save the months of the R&D process. Instead of worrying about the implementation level details designers can pay more attention

to the algorithm development, architecture optimization and system level power optimization. So by using HLS, more time can be invested where it matters the most than mundane design tasks.

Seizing the opportunity

In the modern world time to market is one of the most critical factors. HLS allows the designers to complete the implementation and verification faster.

HLS Process

Data Flow Graph Analysis

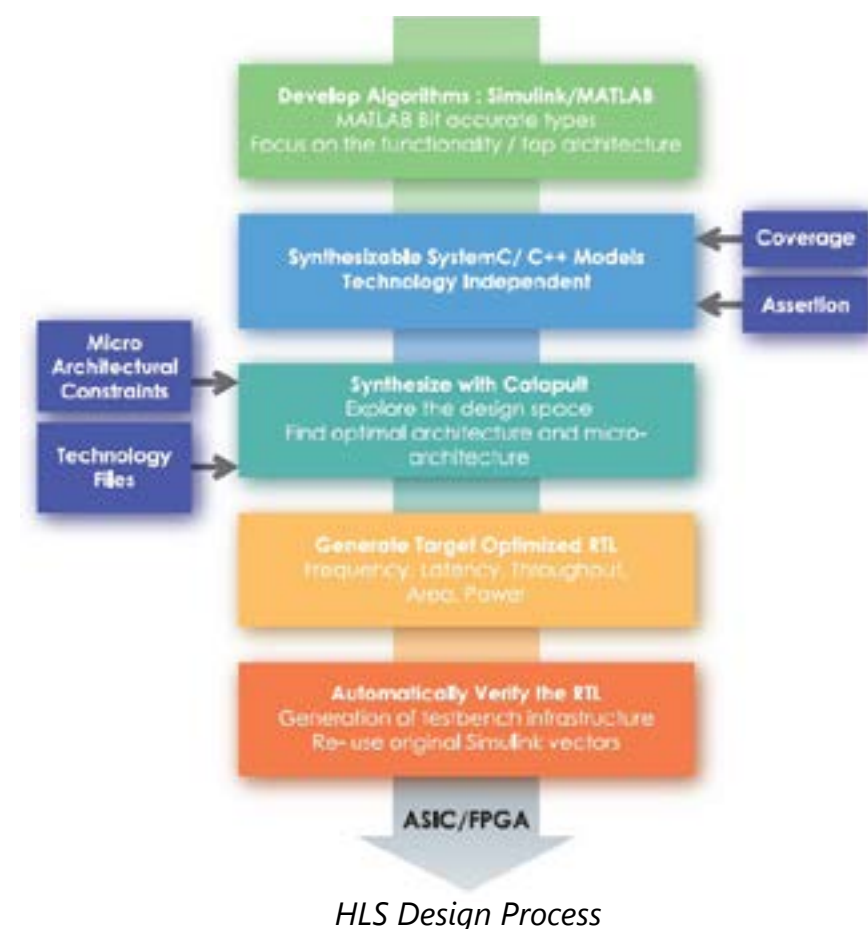
The HLS process starts by analyzing the dependencies in the code. The dependencies lead to the creation of Data Flow Graphs (DFG). The parts of the code which do not have any dependencies can be executed in parallel.

Resource Allocation

In resource allocation, each operation in the assembled DFGs are mapped onto a relevant hardware resource. This mapping is annotated with both time and area information which are going to be used in scheduling.

Scheduling

HLS adds the timing during the scheduling process. It takes the DFG operations and decides when they are performed. The registers are added at required places according to the given clock frequency. A Data Path



State Machine is created to control the scheduling activities.

HLS Good Practice

HLS requires a good coding practice to generate the RTL design which give the expected functionality. The HLS tool should be able to recognize the designer's intention without an uncertainty. So best coding practice is essential. The other important thing is not all the algorithms are suited for hardware implementation.

Encourage to use SystemC

SystemC is a set of macros and

a class library developed using C language for provide bit accurate data types and event driven simulation interfaces. Hence using SystemC a designer can save a lot of troubles by simply using the predefined classes and macros. The HLS tools also can understand the code clearly without any doubts.

If anyone use plain old C language they have to rewrite all the codes require to model the hardware system from the scratch or use the proprietary libraries provided by the particular HLS tool Vender.

Operation Strength Reduction (OSR)

OSR is replacing an expensive operation using a less expensive one. As an example multiplication can be replaced by shift operator as following.

$2 * 2 == 2 << 1$

Some tools automatically do this optimization but manually doing this can save considerable amount of hardware resources.

Do not use System Calls and Packages

The system functions such as "printf" or "scanf" are not synthesizable. Some tools will synthesize math functions such as "sine" and "cos" but the designer will encounter problems when run the verification for post-synthesize netlist. Because the fixed type conversion for floating point numbers.

Avoid recursive functions and function pointers

It is best not to write any recursive functions in your HLS code. The reason is recursive functions are normally unbound and it should be completely unrolled for synthesis. The tool will try to do this but this can create a code with unexpected results. Functions pointers are not supported in most of the HLS tools.

Dynamic memory allocation is not supported

Dynamic memory allocation is

strictly not synthesizable. Designers should use static memory allocation in their codes.

Do not use unbounded loops

When the loop's stop condition changes in the run time it is called as an unbound loop. Hence the tool can't create a specific logic circuit for the description in the code. This is a common problem in the RTL modelling as well.

HLS Tools

There are number of both commercial and open source tools available for High Level Synthesis. But the designer should carefully choose the tool according to the requirement.

LegUp (Open Source)

LegUp is an open source HLS tool developed by University of Toronto. This tool allows the designer to C to Verilog synthesis without building an infrastructure from scratch. Their goal is to reduce the design complexity of FPGA development.

Catapult

Catapult is a commercial tool which was originally developed by Mentor Graphics but later acquired by Calypto Design Systems. Catapult claims to generate quality RTL from C++ or SystemC code with power optimization and area optimization.

Vivado HLS

Vivado HLS is the HLS tool developed by Xilinx. This tool generate RTL code which can be synthesized for implementing on Xilinx FPGAs. They provide custom libraries for mathematical functions and video processing functions using OpenCV.

C-to-Silicon

C-to-Silicon is the HLS tool developed by the Cadence Design Systems. This also claims to provide RTL code for delivering performance, power, and area (PPA) results that meet or beat those of handwritten register-transfer logic.

GAUT (Open Source)

GAUT is an open source HLS tool developed by University de Bretagne. GAUT generates a register-transfer level VHDL file from C code which can be synthesized by the general purpose logic synthesizer.

What Bluetooth Low Energy means to the Internet of Things

Sanduni Premaratne

Remember the days when Bluetooth was just a connectivity mechanism to share files from one phone to another? The days when Bluetooth annoyed us, asking to enter pairing passwords? Those bad old days of Bluetooth are now behind us.

A decade has flowed past from that era, but Bluetooth is still in play, newer and more sophisticated than ever. Because the Bluetooth Special Interest Group wasn't idle for the past decade but rather have strengthened Bluetooth technology, to enable connectivity between devices and the world around them, rather than just between two mobile phones. Introduction of Bluetooth Low

Energy AKA Bluetooth 4.0 is what that brought forth the drastic changes about Bluetooth technology that we see today.

Bluetooth Low Energy vs. Bluetooth classic

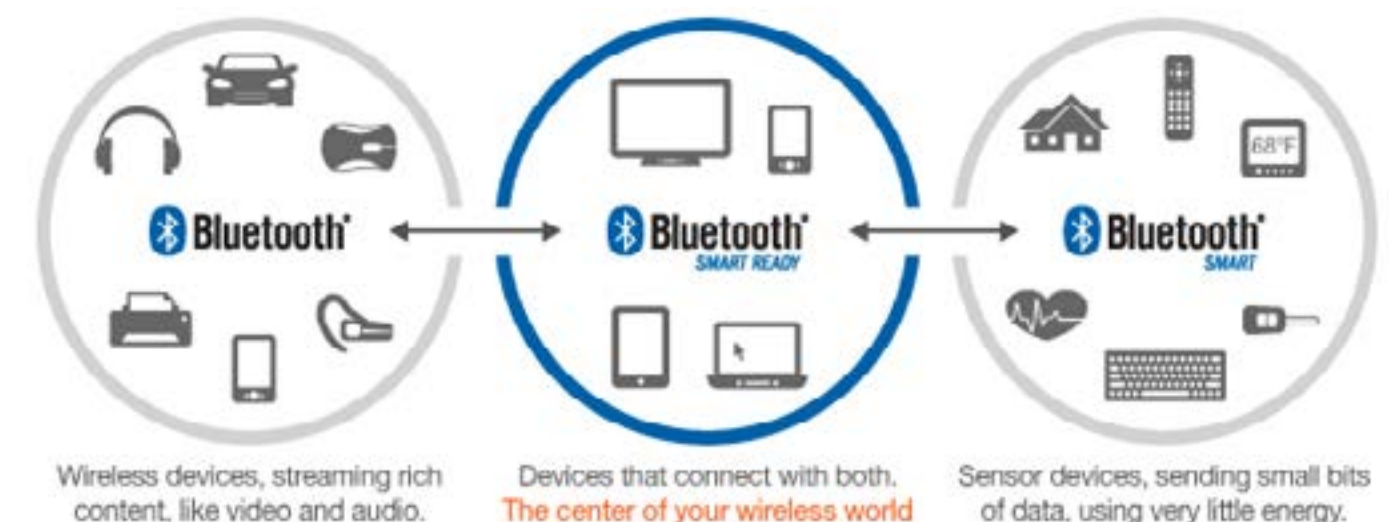
As the name implies, Bluetooth Low energy is none other than a version of Bluetooth technology that focuses on low energy consumption than high data throughput. But why so much hype about BLE?

The challenges Bluetooth classic faced were fast battery draining and frequent loss of connection, requiring frequent pairing and re-pairing. Being able to successfully face those is the reason why BLE has be-

come quite the discovery of the decade.

So, how does BLE do the trick? It's the design of BLE that has enabled it to be more intelligent in managing connections while preserving energy. While Bluetooth 3.0 focuses on higher data rate functionality, Bluetooth 4.0 emphasizes less on maintaining constant bit streams of information, but rather sends small chunks of data when necessary and puts the connection to sleep mode during idle periods.

Bluetooth 4.0 is further divided into two categories; Bluetooth SMART and Bluetooth SMART READY, also known as single mode BLE and dual mode BLE.



The intelligent functionality of managing connections while minimizing energy consumption, is the reason why Bluetooth 4.0 is called "SMART".

Bluetooth SMART READY or dual mode devices are those that can communicate with both Bluetooth Classic and Bluetooth Low Energy devices. The implied power saving can rarely be gained in these devices because they support both the implementations. The PCs, tablets and smartphones that come with BLE are all examples to Bluetooth SMART READY devices.

Bluetooth SMART or single mode devices can only connect with SMART READY counterparts. These are stand-alone, small battery operated gadgets that focus on power consumption as low as possible. Smart watches, car key fobs and heart rate monitors are few of the famous Bluetooth

SMART applications around the world today. But the opportunities of Bluetooth SMART applications have proved to be endless, given the concepts of "smart home", "smart city" and the "Internet of Things".

Internet of Things

So far, successfully overcoming the challenges faced by classic Bluetooth was identified as the reason for the rush about BLE. But why is it so important to subdue those challenges? The reason is not as simple as it spells: The Internet of Things.

The name "Internet of Things" itself is speaking of a world where your devices will all be connected. Imagine you wake up to a world where the bedpost greets you good morning the moment you wake up, alerts the home devices, and gives you a weather report of where you're going to be today. You go for a bath, and the shower is ready to let you

listen to music or daily news broadcast while bathing. The moment you step out of the home, the home security system will be enabled, and monitor the home for the rest of the day until you return. You will alert the system about the time you return so that home automation system will heat up/cool down the air inside to make it comfy and welcome you home. That is just a simplified picture of how the "Internet of Things" will run your home in the years to come.

A vast range of monitoring applications, from home or office security, patient health and environment monitoring to industrial smart monitoring systems are on their way under the Internet of Things. Most of these sensing applications come with the requirement of portability, where low power communication protocols are an utmost necessity, to synchronize the monitored data with the user's mobile or pc while maintaining the battery power economically. Furthermore these applications do not require the ability to maintain an unbroken stream of data, but rather to send small packets of data from time to time. These characteristics are the reasons why BLE plays a key role in the Internet of Things and predominantly in the wearable devices.

The present, future and beyond

All this talk about the Internet of Things and its sub concepts; the smart cities, smart homes and smart grids, sound more like a fairy tale of a Neverland than real. But where actually are we now, in the Internet of Things? What is our potential to accomplish the dream world of Internet of Things? And how significant is BLE for that?

The truth is "smart devices" or "IoT devices" with BLE have already penetrated our lives than we may have imagined. The first to come with Bluetooth SMART READY support was Apple with their iPhone 4s. Since then, all of their devices iPads, iPhones, MacBooks and Apple TV too support BLE. Samsung Galaxy series, Sony Xperia series and Google Nexus also started providing BLE functionality with the release of Android 4.3 API that came with BLE support.

While mobile phone companies were thus getting ready for BLE connectivity, many other companies, researchers and freelancers came up with Bluetooth SMART enabled devices to connect with those SMART READY mobiles. Heart rate monitors, smart watches and fitness trackers are the most prominent wearable BLE devices we see today. These devices send their tracking details to smartphone app of the wearer or other necessary party such as a personal physician.

Excluding the wearable monitoring devices, other sensing applications like thermometers, proximity sensors, weight scales, and tire pressure sensors have successfully found their way to our everyday lives, and all of them function with BLE. Furthermore there are USB dongles, earbuds, door controllers, pool cleaners, LED outdoor lights, Treadmills, computer mouse, stylus, light



Earin: world's smallest wireless earbuds

bulbs and numerous other devices that use BLE to provide their smart functionality.

All of these devices that have successfully gained their market share, are enough proof to the endless possibilities with Bluetooth Low Energy. So far separate companies have designed and developed these smart devices in a discrete manner but nonetheless all of them together lead to smart homes and cities, and in turn to the boost of Internet of Things.

We are not there yet, to bring all the elements together into one global village, but we certainly are on the way. And Bluetooth Low Energy has already become a vital piece along that path, than any of the other wireless technologies around.

If your product bears this logo...	It's compatible with products bearing any of these logos...



Fitbit fitness trackers: Charge, ChargeHR and Surge

Behavioral Analysis in Computer Networks

H A D E Kodituwakku

Today, security plays a critical role in networks more than ever before. There are many instances where malware and malicious users have infiltrated networks to obtain sensitive data as well as alter and destroy existing data, sabotaging organizational assets and reputation. Sensitive data must be protected from being accessed by outsiders to protect their integrity. In order to do this, networks must be able to restrict the access of critical assets only to the authorized users and programs and, block and report attempts by non authorized entities. Encryption and authentication is used to make sure that only the intended parties can access the data and services. But, security loopholes, such as bugs in software, poor firewall configuration and user mistakes can be exploited by third parties to gain access these resources despite these measures. So as a last line of defense almost all modern network systems employ Intrusion Detection Systems (IDS) (An Intrusion Detection System is a software application that monitors network or system activities for the malicious activities) such as Snort and Bro. Their main drawback

is that they use predefined parameters to detect network attacks. This makes them unable to identify network intrusions that utilize methods that are not documented before. Even when new types of the attacks are added to their database they are still vulnerable until new software patches are applied in the client system. This article intends to evaluate and contrast behavioral analysis approaches that exist in order to overcome these drawbacks and improve the effectiveness of IDS and their accuracy.

Intrusion detection is primarily to two-fold i.e. Host-based IDS (HIDS) and Network-based IDS (NIDS). HIDS look for particular activity of the host system while NIDS monitors network traffic. Both of these approaches yield good results in detecting network threats.

In HIDS host activities such as super user login attempts, FTP file transfers of sensitive files or failed file accesses are logged and analyzed. Further more audit logs for signs of intrusive behavior or departures from normal behavior are examined to determine the source of the intrusion and the type of the attack. Machine learning mod-

els are generated from a training data set containing parameters such as number of files created and deleted each day, remote logins, software used by the user etc. Using this data, "user profiles" are created and are constantly reshaped to reflect the most recent changes. Such systems are adaptive in nature along with user behavior. But this technique is susceptible if the user changes their profile slowly to include intrusive activities.

Moreover monitoring the behavior of programs, that has significant impact on the system, i.e. software that execute system calls that require higher level of privileges, which can cause problems if misused, is a promising way to detect system compromise. One approach is to learn the frequency of emails sent and print jobs scheduled and FTP file uploads etc. They are found to be temporally located in clusters thus current systems that average the number of anomalies over entire execution trace dampens the effect of burst behavior, rendering them ineffective against slow attacks.

NIDS is broadly categorized into anomaly detection and

misuse detection. Misuse detection approach has advantages such as attacks are known can be detected easily and reliably, and has a low false positive rate, while having disadvantages such as high rate of missed attacks depending on the ingenuity of the attackers. In order for a misuse detection technique to be successful every signature must be known, which causes the slow performance and high resource requirement, because a large set of training data has to be utilized. Anomaly detection addresses these issues and provides reasonably good performance in detecting new forms of attacks but at the expense of high false alarm rate and its extensibility being limited to be training dataset. In other words the training dataset has to include all normal behavior, otherwise the model will cause false positive. And also it should not include any anomalous behavior, otherwise it will cause false negatives.

There are numerous approaches used in all of these categories and specifically this article addresses the use of learning approaches for intrusion detection. There is an increasing amount of research in Artificial Neural Networks (ANN) for such situations. ANN is comprised of units called neurons and they are grouped in several levels. Neurons are con-

nected to other neighbor neurons and these connections are weighted. The basic structure of an ANN has an input level one or more hidden layers and an output level. Either supervised learning or unsupervised learning can be used to train an ANN. In the supervised approach the network learns the desired output for a given input or a pattern. In the unsupervised approach the network learns without specifying desired output during the learning phase. The advantage of using a neural network is that, it is capable of analyzing computer network data even if there are incomplete or distorted records. There are several researches done in Back-propagation Neural Network (BPN) called Neural Network Intrusion Detector (NNID) which has become a promising are in the behavioral analysis.

One of the notable researches has proposed to use artificial neural network with support vector machine (SVM). The results show that SVM is better than NN. But overall it was found that NN is slightly outperforming than SVM. Using SVM it was possible to detect network probing attacks at 83.8% accuracy but when it came Denial of Service (DoS) attacks it fell down to 63.1%. As an improvement another research has to used Distributed Time Delay Artificial Neural Network for anomaly detec-

tion and has achieved percentage of successful specification above 96.2% for all major attack types. And for intrusion detection neural network IDS model based on back propagation neural network was used, yielding detection ratios in excess of 80.5% and shows a impressive false alarm rate of only 7.4%.

Recent research on Back-propagation Neural Network has achieved high rate of detection of new types of attacks and low failure rate. The predominant feature of these researches is that they consist of data collector, pre-processor, encoder and neural network classifier in their model. The network is trained first and then testing is done in two levels. In level 1 sample data is used whereas in level 2 a new testing data set is used. In machine learning using different data sets for testing purposes is vital to get a better understanding about the performance of the machine learning model and thus a realistic estimation of its accuracy can be made. While this research has yielded only 73.9% when used with new testing dataset it is a more representative estimate than the 95.6% success rate achieved by using the same training data set.

Furthermore the research has indicated that it faced two major issues. A large amount of

training data was required to get accurate results and there was little correlation between increasing the classification levels and the detection rate. While it is recommended to have a reasonable amount of classification levels over-boarding with it can have negative impacts such as increasing the complexity of the model and making the IDS slow and more resource consuming. In worst cases having too many classification levels can reduce accuracy.

In conclusion it is observed that while research in this area has overcome some drawbacks of the existing techniques, over time, such as false detection, large training time, detection of low frequent attacks and classification of attacks, still there is no perfect solution for intrusion detection in computer networks. And for this reason it is highly researched area and new methods are constantly experimented. Given the importance of security in computer networks it is vital that a robust accurate technique to be found in order to eliminate network intrusion that is becoming a major problem in computer network systems. Driven by this need more robust approaches can be expected

How 5G will look in 2020? Massive MIMO

Prageeth Anjula

Every ten years of time a new generation of wireless system comes into play since 80s. First generation (1G) was introduced in 1981/1982, 2nd Generation (2G) came in 1991, 3G came in after 1998 and then set of requirements for 4G were formed in 2008 as WiMAX and LTE were competing together. But they are usually not backward compatible as they find totally different technology or spectrum. People can enjoy 5th generation for wireless systems in 2020 as predicted. Many research are currently going in this area and people are eager to see it in the future.

Requirements predicted for 2020

- Aggregate Data Rate - Network should handle 1000-fold gain in capacity to handle the growing internet usage, video streaming with connections at least 100 billion devices since smart phone and tablet penetration is growing very fast.
- Peak Data Rate - 10 Gb/s individual user experience capable of extremely low latency and response time.
- Round trip latency about 1ms (4G was order of about

15ms)

- Ultra dense cells covering small cell area serving 100s of terminals simultaneously in a cell.

- 100 times decrease in energy consumption (Joules per bit and cost per bit) per user

- Applications - two way gaming, novel cloud based technologies, growing social media, streaming high definition video, public safety applications, driverless cars communication, virtual and enhanced reality of Internet of things (IOT)

What technologies suggested for 5G

- Millimeter Wave Communication (new spectrum of 30GHz to 90GHz above Microwave spectrum) with unlicensed Wi-Fi (5GHz) spectrum to have a massive spectrum - Extreme Bandwidth
- Massive MIMO (100s of antennas at Base Station) to transmit data simultaneously to users in dense cell. - Extreme Base Station
- Extreme densification and Offloading - more active nodes

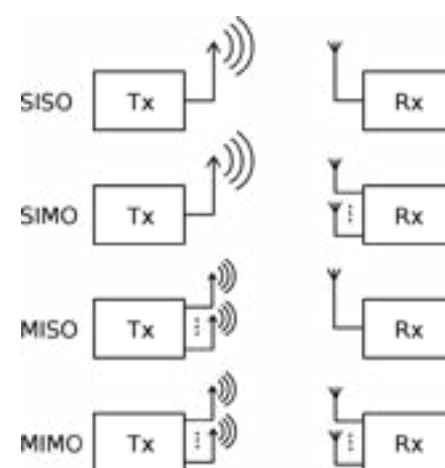
in a small cell area and Hz.

- Interference management (intra cell and inter cell) using base station cooperation

What is Massive MIMO?

Base station and terminals (Ex:-phones) having multiple antennas to support diversity gain and multiplexing gain were advanced smart antenna technologies used in 3G and 4G. SISO (Single input single output) antenna systems were now developed to few antennas at base station and as well as terminals. High Capacity gain can be obtained using this MIMO technology with pre and post processing algorithms.

MU-MIMO (Multi User - Multiple Input Multiple Output) antenna system was adopted to 4G - LTE and WiMAX recently. But only up to 8 antennas at the transmitter and the receivers (Ex: - phones) are placed in 4G. Researchers found that usage of large number of an-



tennas (100s of antennas) at the base station called Massive MIMO (Very Large MIMO) will give huge capacity gain with very less energy. So 100s of antennas simultaneously serving 10s of terminals in a small dense cell will help 5G to be realizable.

Precoding and Channel knowledge

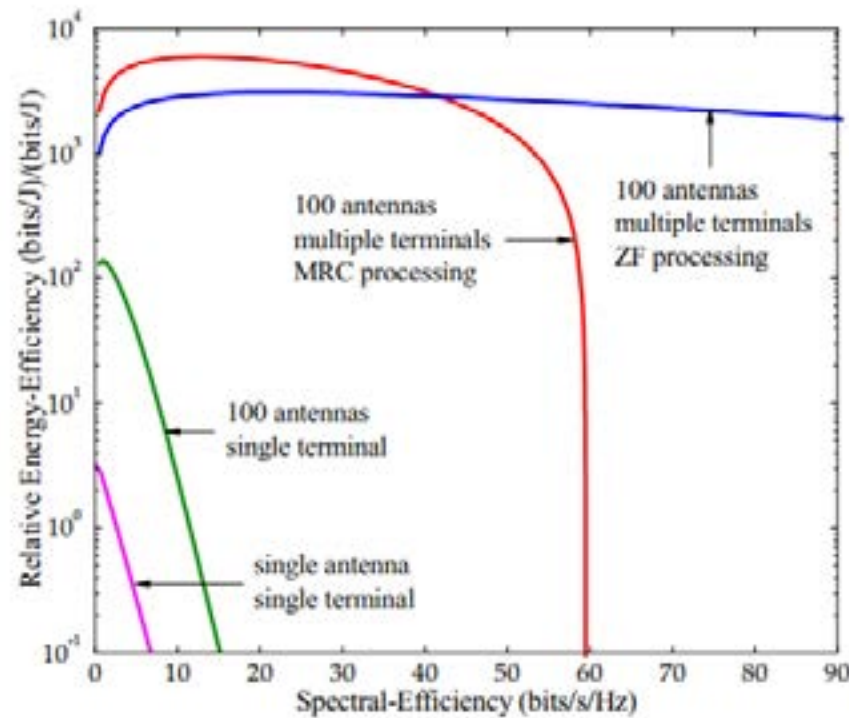
In order to achieve above array gain, diversity gains and energy efficiency some pre processing (precoding) has to be done at the transmitter side and as well as in receiving terminals. Precoding which exploits the usage of channel state information is basic processing required to eliminate interference caused by transmission of data simultaneously to several users in a cell and using several antennas at once. This known interference at the receiver has to somehow remove using a precoding method to achieve the theoretical capacity gain expected for massive MIMO. Simple linear Precoders like Maximum Ratio Transmission (MRC), Zero Forcing Precoder (ZF) and Regularized ZF, Minimum mean square error Precoder (MMSE) are on the process of research to become standard massive MIMO Precoder.

All these Precoders need perfect (or near perfect) channel state information at the

transmitter (CSIT) to work well. Most researchers suggested that Massive MIMO to work in Time Division Duplexing (TDD) mode. CSI will be taken by terminals transmitting pilot wave form and BS estimated uplink channel and calculate downlink channel by reciprocity technique in STDD mode. These downlink channel info will use to transmit data to terminals in downlink. For uplink, terminals again transmit pilots to BS before transmitting data on uplink, so then BS can estimate channel using received pilots and decode data coming just after using that channel knowledge. But there are some FDD mode Massive MIMO too for some applications and still research are going on in both area.

Massive antennas use Massive energy?

No. Intuitively you may think usage of 100s of antennas will consume of 100s of energy than normal single antenna case. But that is not the case in Massive MIMO more interestingly. If the number of base station antennas M grows without bound, system can reduce transmit power of each user proportionally to $1/M$ if the BS has perfect channel knowledge and proportionally to $1/\sqrt{M}$ if BS has only estimated CSI using uplink pilots. Spectral efficiency and energy efficiency can be achieved at once like the figure showing



here with massive MIMO (100s antennas, multiple terminals). Energy efficiency is very low in single antenna case (SISO) but massive MIMO with a simple ZF or MRC can have a huge energy efficiency than single antenna case. This is why massive MIMO is a leading technology for 5th generation as it can achieve both spectrum efficiency and energy efficiency once.

Key Challenges in Massive MIMO

- Plenty of research problems arise in massive MIMO to achieve the above called advantages.
- Pilot contamination – terminals will assign an orthogonal pilot sequence in Massive MIMO and these limited

pilots will be reused in other cells. When uplink training BS will receive pilots contaminated by pilots from other cells where same pilots are reused. This is considered the ultimate limit in massive MIMO. Even though this is not specific to this, this makes more problems in massive MIMO than traditional MIMO as receivers and BS more dependent on more accurate channel knowledge.

- Signal processing algorithms design - Simple and less energy consume processing algorithms. They can be linear or nonlinear.

- Low cost Hardware design and prototype development

Brain Computer Interfacing: Advances and Future Trends

Hasini Weerathunge

From Charles Xavier, better known as Professor X in the Xmen Series, who used the Cerebro to connect to Human minds to the robot surrogates in Avatar which were controlled by human mind, Brain Computer Interaction has played a major role as a popular Science fiction marvel.



As the understanding of the human brain improves along with the power of modern computers, Science has been able to make spectacular advances in making these science fiction concepts into reality.

Transmitting signals into a person's brain that allows visual, auditory and tactile sensory perceptions has made life convenient for the severely disabled communities. Research is being carried out for mind controlled prosthetic limbs to cognitive context based appliance control, where a person's thoughts are 'read' and utilized to manipulate computes and machinery in

various forms.

Thus, Brain Computer Interfacing a.k.a BCI, has become one of the most crucial technological breakthrough in decades. In this article, the novelties as well as present and future trends of BCI will be discussed, giving an incentive to the Biomedical Engineering communities and Researchers to carry out more research and application –specific developments in this truly 'mind-blowing' field of science!

BCI : How it works

Our Brains are formed from a mass collection of Neurons, individual nerve cells connected via dendrites and axons. Each time we think, move, feel or remember, the neurons emit small electric signals that are transmitted around the brain and the body in speeds more than 20mph. The differences in electrical potential carried by ion membrane on each neuron generate the signals of interest. The signals which

escape from the signal paths, which are insulated with myelin shields, are detected by scientists via a variety of electrodes.

These signals are interpreted and used to direct devices. For an example, a set of scientists from University of Minnesota has managed to identify the EEG signal pattern generated when the subject imagines using their hands left, right or both simultaneously and uses the findings to trigger control signals for a quadcopter motion right, left and upwards. The brain signals were recorded on a computer and transferred to quadcopter over Wi-Fi.

On the other way around, engineers have been observing various event-related potentials of EEGs generated at various scenarios and to synthesis the same signals in order to artificially generate the sensation. Researchers have been able to detect the signal pattern sent to brain when the 'red' color is detected



by the optic nerve and thus giving color vision to a blind person to 'see'. Movements such as Finger flexion activity and resulting EEG signal peaks are detected and analyzed to drive prosthetic limbs.

Brain to Brain Interface

The combination of Human Brain to Computer interaction and vice versa has resulted in Brain to Brain Interfaces (BBI) , where the control of another human or animal mind is given over to another human brain as predicted in the famous sci-fi movie 'Pacific Rim'. Researchers at Harvard University have created a BBI allowing a human to control the movement of a rat's tail. This is considered as a major step towards BBI that allows telepathic links between two or more humans.



The human is equipped with an EEG-based BCI, while the mouse is equipped with a focused ultrasound (FUS) computer-brain interface (CBI). FUS is a less invasive technology which lets researchers stimulate a specific region of neurons in the rat's brain with an ultrasound signal. Under the setup, the BCI detects the hu-

man looking at a specific pattern on a computer screen, and sends a command to the rat's CBI. The ultrasound signals sent to the region of the rat's motor cortex which deals with tail movement causes the action.

The researchers have stated that the Human brain-to-computer interface has an accuracy of 94 percent and the entire process usually consumes 1.5 seconds, from the human deciding to look at a screen , to the movement of the rat's tail.

Hands-on BCI Applications

Going into detail, a Brain Computer Interface is a two-part device. The hardware , which usually is a headset of EEG (electroencephalograph) electrodes, that are the sensors which rest on the scalp - and software, which processes brain activity to work out the wearer's thoughts.

Brain Computer Interfaces are generally used in a medical setting with very expensive equipment, but in the last few years, cheaper commercial offerings have emerged and many research communities have been working on open source platforms to bring down the costs of BCI research.

An Emotiv or Neurosky BCI can be brought at \$200-300 and trained to mind control the computer. Along with these commercial off-the-shelf BCI, the hardware and software

of BCIs are also available opensource via various projects and gives the technological knowhow for researchers who want to interpret EEG to drive applications. The openEEG project and openBCI kickstarter project are two examples which provide open ware solutions to BCI research communities worldwide. The number of projects built around these platforms increment each day. BCI has set the foundation for "bio-immersive" games, where games passively respond to thoughts, energy and emotions. Collecting brain signal data could also give people greater insights into their habits, struggles, diseases and addictions, pushing psychology and behavioral science forward.

Looking at the novelties and resources available in the field of BCI, the time has come for the Engineering communities in Sri Lanka to develop BCI applications in a truly Medical and Commercial scale.



Taking an example application of a music player, we can consider how simple or complex the BCI based application can be, based on the requirement. There could be simple applications where the Alpha , Beta, Gamma and Theta waveforms of EEG are detected and mapped onto Musical instrument sound waveforms, thus creating mind controlled music players. In a more advanced context, head movements and hand gestures can be tracked and the motor cortex signal features could be extracted to create a gesture-controlled

pitching and instrument selection enabled music players. By observing brain functionality when a person 'thinks' about or hums a tune, and with the use of Neural Networks, further advances can be made to actuate the musical instrument by the exact 'thought' of playing music.

From thought-controlled keyboards, prosthetic limbs and wheelchairs to new-



age, immersive video games that respond to bio signals, widespread use of BCI today indicates a whole new area of research and development in the fields of wearable technologies, cognitive

Analyzing Human Gait using Inertial Measurement Units

Charitha Saumya

Human gait can be simply described as the motion of human body from one place to another due to the movement of the limbs. Gait analysis is the systematic study of this motion. In a gait analysis system human motion is studied in terms of its different movements, body mechanics and activity of the muscles. It quantifies and interprets each of these aspects in a comprehensive manner. Lower limb motion plays a crucial role in performing most of the physical activities of human beings and it is quite complex considering the high number of joints and degrees of freedom. However there is a large population who cannot use their lower limbs properly due to various disabilities. Especially people with lower limb amputations find it very difficult to perform their day today activities. There are various solutions developed to assist those people in performing the low-

appliance control to Mobile app development. Some of these systems already exist, but there is a lot more work to be done before they become mainstream applications.

er limb motions accurately. Most popular ones are lower limb prosthetics and exoskeletons. To develop the control techniques of these bio robotic applications, analyzing the lower limb motion is extremely important. Another application of gait analysis system is to monitor the rehabilitation process of prosthetic or orthotic patients. Existing method is to monitor the motion of a patient with naked eye and do the diagnosis. But using a fully automated gait analysis system this monitoring process becomes more efficient and accurate. Apart from that lower limb motion analysis is important for most of the sports as well. In sports, Gait analysis systems help athletes to identify and practice optimal movements and avoid any posture or movement related injuries. In Cricket to identify the illegal bowling actions or to retest the bowling actions of bowlers, ICC (International

Cricket Council) has obtained the help of advanced human motion analysis labs. There they test the bowlers mainly using computer vision based methods.

In early days Gait analysis systems were mainly based on photographing (Chronophotography) or video capturing the motion. Recently several methods have been developed to analyze the lower limb motion including machine vision based techniques, video camera based methods and inertial sensor based methods. Avatar, the highest grossing movie in Hollywood used this marker based motion capture method to reconstruct the motions of actors in computer models. In computer vision based motion analysis systems active or passive markers are placed on the person's body and they are tracked by multiple cameras placed in different angles simultaneously. But the problem with this method is



Figure 1: Computer vision based motion capture in Avatar movie

that it requires very expensive high frame rate cameras and sophisticated facilities. Therefore a computer vision based gait analysis system is not affordable for any application in a country like Sri Lanka.

IMU (Inertial Measurement Unit) sensor based gait analysis has been subjected to a great deal of research in the last few years. Here multiple IMU sensors are placed on the body of the subject and IMU data is transferred wirelessly to a PC. IMU data can be used to derive many important gait parameters including real time joint angles, step lengths, cycle time etc. Using this method a reasonable accuracy can be obtained and also it is financially much feasible. And this method does not require sophisticated laboratories or facilities; so it can be set up easily in any place, hence appropriate for a country like Sri Lanka.

What an IMU Sensor can measure?

IMU (Inertial Measurement Unit) is a specialized sensor which gives us the information about the acceleration, angular motion and orientation of a point in the space. An IMU sensor can be described as combination of 3 sensors; Gyroscope, Accelerometer and a Magnetometer. These 3 sensors measure angular velocity, acceleration and magnetic field intensity respectively, relative to each sensor's local frame. To calculate the Euler angles of a particular orientation all these 3 sensors need to be used. Magnetometer data is used in calculating the yaw angle in this case. But the limitation of using a magnetometer is that the magnetic disturbances present in the environment reduce the accuracy of the reading. Ferro magnetic materials play a crucial role in distorting this magnetometer reading. Therefore in a robust orientation estimation mechanism, the use of magnetometer for angle calculation is avoided.

Human lower limb motion is often modeled by hinge joints and spheroidal joints. Normally the knee joint is assumed to be functioning as a hinge joint whereas the ankle joint is assumed to be a spheroidal joint. Under normal human motions like walking,

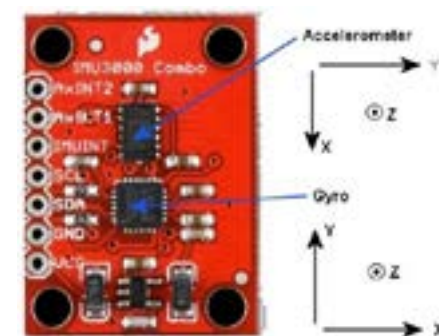


Figure 2: An IMU Sensor
Identification of the Joint vectors

running, stair climbing, these assumptions are considered to be reasonably accurate. To calculate the joint angle in a hinge joint, the joint axis coordinates must be identified. When two IMUs are placed in thigh and shank of the subject this axis needs to be identified with respect to each sensor's local coordinate system. One common approach taken is to perform precisely defined movements so that joint axis coordinates can be identified. This can include circular swing of the limb in sagittal plane because in that motion the two sensors will be rotating about the joint axis. Problem with this approach is that if the system is intended to be used in a clinical environment some patients might not be able to perform these calibration procedures accurately. Another approach is aligning the sensor's local axes manually with the joint axes so that the joint axes need not be calculated separately. But human body lacks even surfaces and

right angles; therefore the accuracy of such manual placement is very limited.

Recent researches going on this area has introduced a novel and more scientific way of calculating the joint axis coordinates. In this method the kinematic constraints of a hinge joint are employed rather than relying on precisely defined hinge movements or manual sensor placement. Due to the kinematic constraints, angular velocities of two points that are placed on the two segments of a hinge joint are in the following relation.

$$\|g_1(t) \times j_1\| - \|g_2(t) \times j_2\| = 0 \forall t$$

Here $g_1(t)$ and $g_2(t)$ are the angular velocities and j_1 and j_2 are the 3 dimensional joint axes coordinates in each sensor's frame. By expressing the unknown joint axes in spherical coordinates this becomes a four dimensional problem. So if there is a large data set $g_1(t)$ and $g_2(t)$ this can be solved in least square sense. Any least square optimization technique such as the Gauss-Newton algorithm can be used. Gauss-Newton algorithm considers the left hand side of the above equation as a multivariate function and finds the best direction to move so that it ends up in a desired global minimum. Advantage of using the Gauss-

Newton algorithm is that it converges very fast approximately in 5-10 iterations and doesn't require complex or time consuming mathematical computations. One key point to note is that the input data set for the algorithm must be carefully selected. The data set should have a sufficient variation pattern so that the joint axes could be identified. To capture gait patterns in normal walking, a minimum sampling rate of 50 Hz is more than enough. If the 50Hz data stream is fed directly to the algorithm it can produce incorrect results because in high data rates there is a very small variation between two consecutive data points. So best practice is to feed every nth sample to the algorithm where n is an integer greater than 1. By using this methodology the joint axes coordinates can be identified while the test subject is in normal motion. One limitation is that this will not give the desired results if the subject's knee or ankle is not functioning as a hinge joint which might be the case in some unique lower limb disabilities.

Sensor fusion algorithms If the joint axis is known for particular hinge joint, the joint angle can be calculated directly by integrating the difference of gyroscope outputs in the direction of the joint axis.

$$\theta_{gyro} = \int_0^t g_1(t) \cdot j_1 - g_2(t) \cdot j_2 dt$$

But this angle is subjected to gyroscopic drift. Drift means if we place the gyro sensor in static condition and integrate the output it will not stand at a constant level. The reason for this error is when gyro output is integrated the noise component also gets added up resulting a drift in the result. On the other hand the same angle can be calculated using the accelerometer by tracking the gravity vector. In normal motions we can assume that the accelerometer output is dominated by gravity. Therefore by tracking the direction of the gravity the orientation of the sensor frame can be calculated. This measure is not subjected to any drift because no integration is involved in the calculation. But accelerometer output is noisy because it is sensitive to any small force acting on it. These reasons make it's impossible to use the sensors alone. Therefore rather than using one sensor to measure the angles best practice is to fuse these two sensors' outputs and come up with a more accurate angle measure. This is the underlying principle of sensor fusion algorithms like Kalman filter and complementary filter.

The mathematical principles behind Kalman filter are a lit-

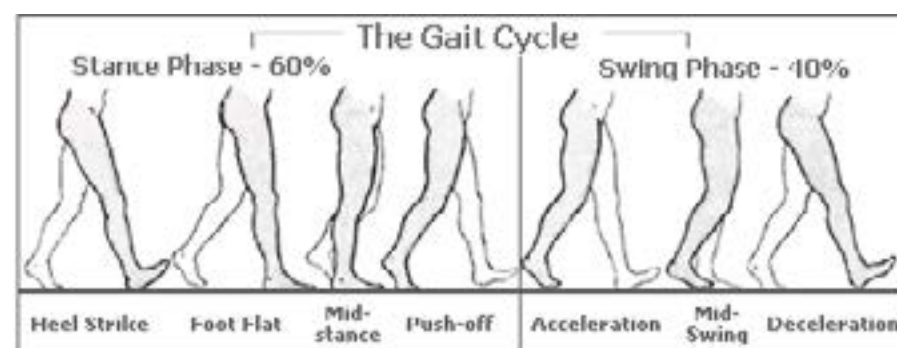


Figure 3: The Complete Gait Cycle

tle difficult to understand, but the concept it works on is very simple. What happens inside a Kalman filter can be summarized in to following equation.

$$\hat{X}_k = K_k Z_k + (1 - K_k) \hat{X}_{k-1}$$

Here \hat{X}_k and \hat{X}_{k-1} are the current and previous estimates of the angle, Z_k is the current measurement of the angle and K_k is Kalman gain. So simply it averages the measured value and the previous value to get the current value, but the tricky part is deciding the averaging factor K_k . Actually Kalman filter is all about calculating this averaging factor. It calculates the optimum averaging factor for each state. The complementary filter is really simple and straight forward. As mentioned before gyro angle is not reliable for longer duration of time due to drift and accelerometer angle is not reliable for short duration of time due to sudden variations. Therefore complementary fil-

ter applies a low pass filter to accelerometer reading and combines it with gyro reading. Even though the operating principle is quite simple complementary filter also works perfectly in most of the cases. Interpretation of the Gait signal.

The joint angle measurement alone doesn't give complete information about a person's gait patterns. The joint angle signal needs to be analyzed further to derive important gait parameters. These important gait parameters include step length, stride length, walking speed, cadence, double side time, single support time etc. And it is equally important to identify gait phases in the gait cycle. As described earlier the joint angle signal of a walking person is periodic. This periodic signal can be divided into different phases such as heel strike, foot flat, mid stance, terminal stance and toe off. Heel strike is the initial contact of the foot with the ground. In foot flat phase the total weight of the

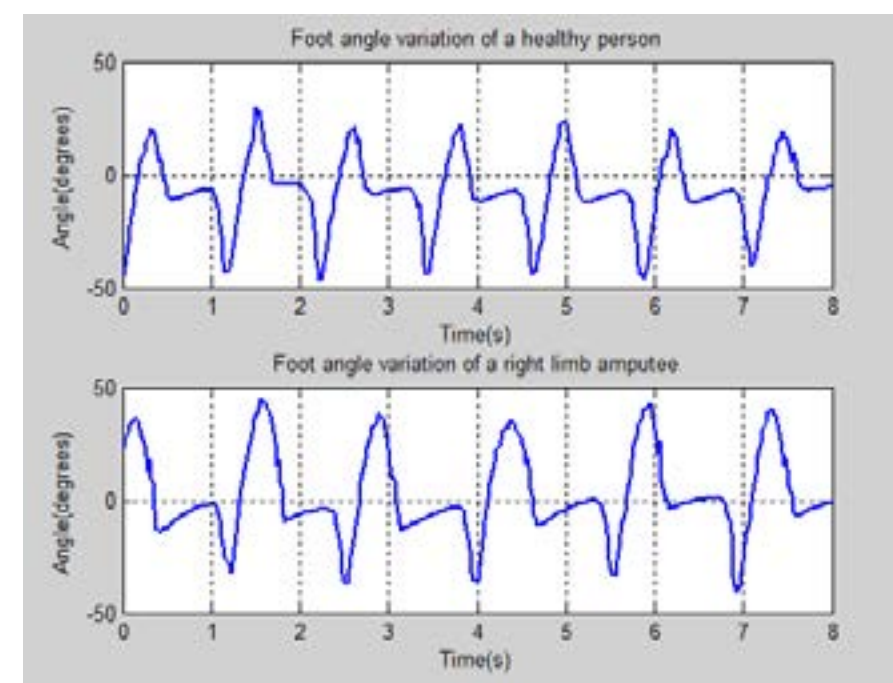


Figure 4: Variation of hip angle with time when

body is transferred to that foot. In the mid stance phase the body weight is aligned and balanced on the ground touched foot. Terminal stance is the phase where heel of the ground touched foot starts to rise. And in Toe off phase this foot swings in the air.

Following figure shows the variation of the hip angle of a walking person with time. Special peak detection algorithms can be developed to decompose this signal into unique gait phases. As indicated in the figure important gait parameters can be identified by analyzing this joint angle signal. This information is very helpful for the physicians to diagnose and monitor the gait disorders of patients and recommend suitable rehabili-

tation procedures. Calculating the speed of walking cannot be done directly from the joint angle signal, but the distance can be roughly estimated using the hip angle variation assuming the leg is in a circular motion about the hip joint.

Considering the unavailability of a complete Gait analysis facility in Sri Lanka introducing an IMU based gait analysis system can help the patients as well as the Physicians immensely. Due to the low set up cost, portability and high accuracy this is well suited in Sri Lankan context. On the other hand if this approach is extended to sports motion analysis thousands of Sri Lankan cricketers, athletes can benefit from this in the future.

Interview with Mr. Beshan Kulapala

Interviewed by: Srimal Lakshitha



Beshan Kulapala (37), one of the 25 experts in VEGA project, has a PhD in electrical engineering from Arizona and was called in from his 13 year career at Intel, a leading manufacturer of microprocessors based in Oregon, USA, to lead this project as Project Manager.

Working on an electric vehicle seems to be the right idea where there were so many different fields of expertise needed to come together and people could connect with an electric vehicle / car and sports car in general very easily. So that's how Vega got all started to working on this project.

e-Carrier: Briefly introduce the project.

Ok, So Vega is to build high performance super car right here in Sri Lanka. This has never been done before & we want to showcase that when experts get together we can build complex projects like this. The real motivation of course was to start on a project for Codegen to inspire the younger generation and to let the graduates, and recently graduates and the students know that we, Sri Lankans have the expertise and we can gain knowledge and expertise needed to do new and better things that can be world class products so we don't necessarily need to leave the country to do so with companies/projects that are interesting. So that was the big motivation factor for Vega.

e-Carrier: What inspires you to join this project Vega?

When I first joined Codegen, I was looking for opportunities to expand in to electronics and mechatronics and into product designing. We looked at number of options to see what would be the best to get in to that, which also would have a business plan as well as inspiration factor for the country.



e-Carrier: How did you find resources?

First we worked with the organization called trace which handles the expert city in Tripoli market to find the initial resources of expertise that needed to get the project started. So we reached out to them and lot of people enthusiastically volunteered to be part of this project. That was the starting point and after that we wanted to pick up young graduates who really passionate about the things not only in the auto mobiles but also in mechatronics, electronics and designing in general, who truly could find the value in doing complex projects in Sri Lanka for the first time. That was what we really looked at when we interviewed some of the students and the graduates. And then we are also powered by interns from number of universities both local and international. Volun-

teers and interns showcase that they have the knowledge and ability to grasp new ideas and work on new things easily with very little hand on guidance that we can't cherish here at Vega where doing thing in their own, being able to research things and complete a project to get in to a production kind of a time frame is kind of important to us and the interns have been in line with that.

The other kind of resource that we have are the volunteers that even have left their current jobs to join Vega as a volunteer. In the free time students and sometimes even younger people and also full time workers come to Vega to be part of the project to make this come true. So that is the kind of the profile we have.

e-Carrier: What is your business model?

Which was full electric super car because we wanted to understand the mechatronics, chemical materials and complexity of doing a super car. Once we understand the frontiers of all these, scaling down and building something smaller becomes much easier. Building a mid-size car or electric three wheeler becomes a much easier problem then. That is why we went with a high performance super car. From the business model point of view, there are number of companies in Europe that have a business model like this. They only build only a few cars; may be 30 cars per year, very handmade, very expensive super cars for the niche market, where the market is for people who already have Lamborghinis and Ferraris who need to buy something unique to add to their collec-

tion as a super car. This is the kind of market we are going after. And even in the Middle East there is a huge market for people who want to buy a unique car that nobody else has. That also in another niche market we can go after. That was the initial business model.

e-Carrier: What is an electric super car?

Good question. In terms of acceleration we want to achieve 0-100 per hour under 4 seconds. Acceleration becomes one of the key factors for what a super car is. And if you check electric super cars, then it is all completely electric. That adds electric super car fact to that.

e-Carrier: How do we differ from other well-known mainstream supercars?

We don't necessarily need to differ from others to go after this particular market. We need to capture percentage of this market. I think we easily fall in to this trap of inventing something that is totally new that nobody has ever done. And we all just wait thinking about it and not building the products. I think we need to get out of this hole and come to terms that may be that already being done and you want to capture certain market percentage and clearly that's what we are doing. Most importantly we don't have anything that world has never done before. So it is a mix of technologies that we are using.

e-Carrier: What are the main components of an electric vehicle?

The two electric motors and electric motor controllers are some of the main components. Apart from that you need an onboard charger to charge the batteries and the battery pack which is obvi-



ously the biggest component of the electric car. Then you need a comprehensive and complex control system to control all of these electronics, electrical and power electronics and so on. One other big component is the DC/ DC converter which you need to run for 12 V converting high voltages to 12 V+. So that is also another component of an electric car. Of course power steering, brakes, seats and all components of a regular car become parts of a super car as well.

e-Carrier: What are the future plans?

This is only a prototype. We want to get in to production of this car. Once the prototype is done we will step in to certification process. Then we will make necessary changes to get into production. From that point, we will start producing the car for the niche market we are going after. Also we need to go to another prototype as well. There we will look at mid-size car /electric three wheeler/electric bikes and electric motor cycles. The market is open for anything you want to introduce as far as it can be inverted in to completely electric. So this is what we need to get in to, this is the first step. Once this prototype is done we will go in to production, but this is not going to be the only car that we will be building.

e-Carrier: What is the future of Vega Company? Will you make only super cars or do you have plans for global automobile market?

Yes, Just like I have mentioned earlier also super car is just the starting point. If you look at number of other car companies like Tesla, Reebok, Granny, they all go after the high end first. So it becomes easy to scale down and get in to other automobile market. If you started from the bottom and try to work your way up you always will have to struggle to get in the tech-

nology. And from marketing point of view it makes great sense to start from the top and go down as this will enable you to have the kind of margins you have to get in to expensive research and development projects.

What is your message to undergraduates?

The message I want to send undergraduates is that you guys are doing awesome job at the university. It is very important that you all focus on different areas and not just keep studying in one area. As an example if you are doing software, don't just do JAVA, try to learn C++, learn how to write micro controller code, simple ones, but improve your ability to understand how you can do complex designs with microcontrollers where you use interrupt base, coding styles and architectures to get all of the performance of the microcontroller. That way when you enter the job market you have the ability to join not only coding teams but also designing teams of a world class product very easily. I think that is very important. And in Sri Lankan in general we want to showcase that we can do complex designs like this and we want you to be inspired not just Vega, think about your own products if you have any cool idea or cool gadgets for the world market don't be afraid to go after the dream. Some of the best products have been built in US for an example have been built by undergraduates, when they were undergraduates they kind of went through the thought process to build those and I think it is very important that more and more get in to this, so we can really expand our horizons for this country.



Are you a software *developer* or a software *engineer*?

**TIME TO
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Sometimes, you don't have to leave home to ink a world-class business deal. In early July this year, MillenniumIT and MAS Holdings signed the biggest-ever licensing agreement of its kind in Sri Lanka: a Microsoft Office 365 Enterprise Agreement that will give MAS companies access to Microsoft's cloud services, enabling their global workforce of over 50,000 people to collaborate more efficiently while simultaneously reducing business costs. By using Office 365, MAS staff gain greater mobility and the ability to work remotely, collaborating securely with one another across more than forty locations using their own devices – no matter what device or operating system they happen to favour. Another advantage of the new agreement is that the IT team at MAS now needs to spend less time on in-house IT maintenance and security issues and are thus free to concentrate on strategic projects.

Faiq Faiz, Executive Vice-President at MillenniumIT, pronounced himself and his people 'very happy' to have been MAS Holdings' considered choice of Microsoft Licence Specialist, which he said was a testament to 'our reputation for reliability.' 'MAS Holdings is one of Sri Lanka's largest and most admired companies, sharing with MillenniumIT an international outlook and customer base, as well as a reputation for hiring the best people and helping them shine,' said Mr Faiz. 'You could say we're two of a kind.'

Awards – At Home...

The MAS win underscores, yet again, the high reputation MillenniumIT enjoys not just within the industry, but also in the wider business world. Aside from its world-beating capital-markets software suite, MillenniumIT is also the go-to firm for leading Sri Lankan and regional businesses looking to make the most effective use of information technology for their businesses.

This high standing was endorsed yet again when MillenniumIT was chosen as 'most respected IT company in Sri Lanka' by Lanka Monthly Digest in its 2014 rankings of Sri Lankan businesses. MillenniumIT topped six other technology companies nominated in the survey, helped by high scores in areas such as 'innovation' and 'corporate culture'. LMD, Sri Lanka's leading business magazine, conducts this survey annually in collaboration with the global research firm Nielsen. This year's rankings were based on a survey of 800 senior executives from the state and private sectors.

It is an honour to be recognized by our peers,' said Mack Gill, MillenniumIT's CEO, adding that winning awards in its home territory is only one aspect of

the company's brand-building strategy. 'It is our ambition,' said Mr Gill, 'to make MillenniumIT one of the best-performing and most respected technology companies in our industry – globally.'

...and Abroad

Which is not to say that the company has not already been recognized internationally – most recently in September, when it was named Systems Integrator Partner of the Year at the Oracle FY15 ASEAN Partner Forum in Bangkok, Thailand. MillenniumIT also bagged a unique second award at the forum, 'Specialised Partner of the Year for Applications' – the only company among sixty strong and competitive Oracle partners in the ASEAN region to be so recognised.

Executive VP Faiq Faiz said, 'This award places us in the region as a prestigious SI and Oracle Applications partner. It also reflects the strength of our Oracle work and reaffirms the trust placed in us by one of the world's leading software manufacturers.'

In other international news, MillenniumIT has been selected by India's National Commodity & Derivatives Exchange (NCDEX), to provide the core technology infrastructure for both the derivatives and spot market segments of NCDEX. The online commodity exchange has chosen MillenniumIT's multi-asset and ultra-low latency trading solution, Millennium Exchange™ for its matching engine technology and Millennium Surveillance™ to detect abnormal trading behavior and promote integrity for its spot and derivatives markets. Both products are based on MillenniumIT's next generation integration platform, Millennium Advanced Platform (MAP™), to support the firm's entire trading operations and to ensure it meets the market's evolving regulatory requirements.

Mack Gill, CEO, MillenniumIT said: "We're delighted that NCDEX selected MillenniumIT to support its impressive business momentum, with the very best in agile, low-latency, financial technology. While every market infrastructure and its requirements are unique, MillenniumIT's technology is designed to meet those requirements in a timely, efficient way. Our ability to handle any asset class across a wide breadth of financial market operators pays tribute to this. We look forward to helping NCDEX continue its success and growth as a long-standing and trusted technology partner."

“We build the **fastest** systems in the world. Can **you** make them Faster?”

www.millenniumit.com/join-us

Interview with Prof. Rohan Munasinghe

Interviewed by: Subodha Charles



Prof. Rohan Munasinghe is working as a senior lecturer in the department specialising in Robotics and Automation. He is leading the robotics related research heading the Intelligent Machines Laboratory and in the past few years, he has focussed on UAV (Unmanned Aerial Vehicle) related research. Since then, he has led the research teams to successfully launch several lightweight UAVs with the “CeyHawk” being the most recent. Despite his busy schedule, he was humble to find time to share his thoughts with us.

e-Carrier: ‘Robotics and Automation’ is a very fascinating field and technological advancements are coming out each and every day. To begin with, we would like to know what it is and why do you think it stands out as a prominent field?

Robotics is an evolving technology. One of the reasons for its popularity is that it is application oriented. There are four technologies that are marked as driving techs of the world. Robotics is one of them. The other three being Genetics, IT and Nano technology. So you can see the higher standard in which the field is considered all around the world. Robotics is not a standalone field. Most of the major technologies act as pillars. Ranging from Signal Processing, control theory, electronic design..you name it, chances are it has to play a part in robotics.

Any country can make use of Robotics to develop their industries and related areas. It can be a

driving force in the development of a country. That is why it has become a very important focus area to everyone.

e-Carrier: As a researcher and an experienced individual who works closely with Robotics, how do you see the evolution of the field over the past couple of decades?

Robotics was started as a part of mechanical engineering some 50 years ago. started by the inventor by the name George Devol. He produced an automated machine. It had the basic features of a robot. He met another physicist - Joseph Engelberger, known as the father of robotics today. These two people designed a robot and they also started a company with that. It was a simple pick and place robot. At first, they had to sell it at a lower price than the manufacturing cost. But, it quickly became very popular.

With the development of other fields, it was possible to design and build fast, accurate controllers. Robots got better capabilities. Advancement in computing technologies gave the capability to handle multiple tasks. For example, you can build a robot to do a painting job. Then you can do some slight alterations and program it to do welding. This flexibility has added a lot of value.

Lot of company owners saw this as an opportunity. and ultimately robotics became popular. Most of the leading manufacturing countries are using robots in their industries. If you observe, you can see a definite correlation between the development of a country and usage

of novel technologies like robotics.

e-Carrier: You have been with the field for many years. what are your predictions for the near future?

Lot of funding is coming for specific areas in robotics. For examples, welfare and rehabilitation, caregiving robots. New capabilities are needed if robots are to be deployed as caretakers. These are high end research happening ATM. In the future, there will be robots that u can buy and have in your homes and look after ur parents and elderly people.

Another major concern has been to replace humans in risky jobs by robots. If you take disaster management, firefighters, outerspace and underwater operations, Robots will be deployed for these applications.

Spectrum of robotics is changing. Robots are coming out of factories and they are getting involved with our day to day activities. Someday, we will have to "LIVE" with robots. They will be a part of our lives in the future. That is why research is giving priority to make robots behave like humans. These technologies are not matured yet. But in the future, they will definitely be.

e-Carrier: There's a lot of hype on Artificial Intelligence and it's capabilities. Do you think that machines will surpass human intelligence some day?

No. I really doubt it. You can program a machine. but you have to specify the behavior. As the technology stands today, there is no way that you can reproduce the thinking process going on in the brain and duplicate it to a robot. If the future if someone designs the entire brain, then that's another story. But I don't see it happening in the near future.

e-Carrier: Moving into the Sri Lankan context are you satisfied with the level in which

robotics and automation is used to assist industries? What major areas of improvements do you see?

To be honest, we are very weak in using these technologies. In Sri Lanka, only a handful of companies are actually using them. That is one of the reasons why we are lagging behind other countries. May be there are reasons. But, there is no way out without using these technologies to survive in the future competition. It's a global market and you can't be isolated. To compete, you need to have the latest technologies to make sure your manufacturing process is high quality, cost effective and efficient. As academics we are telling this story to industries, politicians and relevant parties. But the message has not been taken adequately yet. Things might change in the future.

e-Carrier: You have been involved with UAV related research as of late. What is your vision on that?

UAVs are highly capable flying robots. Can be deployed for a number of tasks. They are very efficient and capable. The good thing is that we can develop them in house. I see a great potential in this technology to contribute to national development. We are in a position to design and build UAVs and sell them to the world. If we can design and build them at a cheaper rate, we can be very competitive in the world market. UAVs are of different types. The ones with a weight of 7, 8 kgs with about 3, 4 meter wing spans has flying endurance of about half an hour. You can use these things to monitor areas from above. Traffic monitoring, wildlife, bush-fire... where ever you want aerial monitoring, you can use them. Of course you can improve the flying endurance and other aspects depending on the application.

We are in a good position to develop these at the university itself. We have thought about commercializing our work and we are almost

there.

e-Carrier: As a leading education institute in Sri Lanka, what is the role of Department of Electronics and Telecommunication in the industry in the field of Robotics? What are the recent projects with the contribution from the department?

Our main contribution as universities should be to educate our industries and encourage them to use these technologies. They sometimes fear about changing their manufacturing process from classical to modern. Nowadays, they have also felt the need to change. So it is our duty to educate and build their confidence that you should shift to the new one.

How to do it is the problem. Whether we go to them or they come to the university? The proven and recognized method is to do collaborative projects. As the department, we have tried with a number of industries locally and we collaborated in some projects. Some of the most recent being projects with SL Airforce and NRDC (National Research and Development Center). In most of them, we have been successful.

If you want to make an adequate impact, the industry should take the initiative. They need to have their own R&D sections. There are few who has them already. They try robotics and automation technologies and try to get them working in their facilities. We guide and evaluate their work. The process is happening. If this continues, we will definitely see our industries moving forward. It will take some time for the whole industry to adopt this trend. That being said, the negative point is that we don't have much experts in Sri Lanka. Since the number is small, it is difficult to make a huge impact.

e-Carrier: What sort of opportunities are available for the fresh graduates in the field both locally and globally?

Locally; I have to say, there are not a lot of va-

cancies or opportunities directly. They are being recruited as engineers in recognized fields. Most of the time, what they are doing is not actually engineering. But, when they get into their work places, they can recognize areas to improve. In the services sector such as telecommunications, not much of research is needed. There are a few places where u can do R&D. Thus, locally, the opportunities are not that high as of today. That is a worry for us. But, we have to accept it. At some point of time, if these companies decide that it is time to go for R&D, then these engineers will be able to do what they are really good at. At the moment, they are not performing to their maximum because they are employed in slightly different jobs.

In the international arena, there are opportunities for our graduate to perform on what they are really good at. That is why lot of people are trying to seek jobs elsewhere. Financial benefits are very high also. There's a clear difference between local and foreign companies. Some other students, who graduate from ENTC, seek higher education in respective areas. They eventually end up being academics in other universities. Some of them come back and join the university system here. But that number is minimal.

This is not to say that graduates should not work here. Just what is happening at the moment. We need more passionate people to change this existing situation and make an impact. We are doing our maximum and hope a whole bunch of others will join pretty soon.

e-Carrier: What do you think should be the next immediate steps in terms of establishing robotics and related applications in the country?

I would say that all the companies should start examining areas in which robotics and automation can be applied and work towards it as soon as possible. Currently, apparel sector is in a very

bad shape. They are losing their market. They badly need to improve the technology usage in their plants.

Chemical processes, mining are also areas to be improved. Rubber and tea industries are very labor intensive. Most of the stages in the process can be automated.

What we don't have right now is there is no one to take the initiative. Universities have much less power. Decision makers should take decisions and start projects with the experts in the fields to design these things. This has to happen right now. Not tomorrow. If we have this political will and the willingness by the industries to spend some money to sponsor projects, then few years down the line, we'll probably see new gadgets coming out. Sooner the better.

e-Carrier: Sir, we would be delighted if you could pass on your valuable advices to any undergraduate who is expecting to join this field? What sort of skills do they need to develop?

To become an expert in the field u need to learn multidisciplinary skills. You need to be a good coder, good electronic and mechanical designer, good physicist so that u can see the dynamics of a machine. But it's hard for one person to master all these things. That's where team work comes in. You can be a master in one of these areas and get together a perfect mix of people to balance everything. But of course, you need to have some knowledge in the other fields as well.

You also need to be somewhat philosophical. That is to say that you should be able to see things in a broader view. Not just looking into a single aspect of the machine. You have to look at details and analyze and design. So it's a bit of a challenge. If you are good at one thing, you can imagine a robot design, but you fail to manufacture or at some other stage. That is why this is challenging.

On the other hand, if u design something that

works, that feeling is very rewarding. That is why this field is fascinating. You can design a robot and put it to a real application.

My advice that u have to be able to work in a team and you should be able to address actual problems in the industry and your day to day life. In almost all the fields, this technology can be applied. You just have to see problems and come up with solutions. All in all, robotics engineers are very open minded, see problems in different perspectives and have multidisciplinary skills. These skills should be nurtured.

Unmanned Underwater Vehicles

Duminda Kaumadi Dharmadasa

Underwater Vehicles are of two types; unmanned type and Autonomous type. UUVs can also be divided into two categories by their capabilities as Flight type UUVs and Hovering type UUVs. The Flight vehicles are used for surveys, searches, object delivery or object location and the Hovering vehicles are used for detailed inspection and physical work around fixed objects.

UUVs are used for more advanced applications like mine countermeasures, harbor security, debris field mapping, search and salvage, scientific sampling and mapping, fishery operation, hydrographic surveys etc. UUVs are not limited to the enhancement of industries and human lifestyle, and are used in the field of research for environment conservation. For example UUVs aid in collecting oceanographic data, underwater environmental monitoring, waterway effluent,

monitoring the impact and breadth of oil, gas and mineral exploration activities and ben-thic populations etc.

The UUVs that are currently available in the market are Talisman UUV, Bluefin UUV, and HAUV etc. The Talisman UUV is made by BAE Systems and it is a fully autonomous. The Bluefin-21 is capable of carrying multiple sensors and payloads at once and used for the extended operation even at the greatest depths. The Bluefin-9M is a lightweight, two-man-portable autonomous underwater vehicle with a mission turnaround time being less than 15 minutes. This is equipped with a variety of user-selected payloads for multiple applications. HAUV is another UUV armed with high resolution imaging sonar available for ship hull and other structural inspection and capable of transferring real time data to the operators.

This is the first time the department of electronics and telecommunication experiments UUV. Even though there were very few researched been done in this area in this country, the success rate was very minimal. This project consider the designing and the construction of a remotely operated, flight type Unmanned Underwater Vehicle (UUV) which is capable of real time video transmission. The vehicle will be wirelessly operated from the operator to the water surface and from the water surface to the vehicle the controlling will be done through wired connection. The development of the UUVs in Sri Lanka remains a challenge and the goal of this project is to set the ground layer the rigorous experiments in future for advanced applications. The project is supervised by Prof. Rohan Munasinghe and the project co-supervisor Mr. Darshana Makavita from Colombo International Nautical and Engineering Collage.



Talisman UUV



Bluefin 21

HAUV

Sanota (Pvt)Ltd

Sanota (pvt) Ltd is a company formed by the collaboration of few graduates from Electronic and Telecommunication as well as Mechanical departments in Faculty of Engineering, University of Moratuwa. They are providing solutions to the industry and individuals on Electrical and Electronic projects, Industrial Automation and Embedded Systems, Telecommunication, Bio medical research and applications, computer engineering and software development. The aim of the company is to bring fresh and innovative solutions to satisfy customer needs. The vision of the company is to exceed the expectations of every client, by offering outstanding customer service with increased flexibility and greater value which would ultimately optimize the system functionality and maximize the operational efficiency.



Mr. Sahan Ranasinghe
Managing Director, Sanota

Sanota was established in September 2010 and registered as private company in Sri Lanka. First project of the company was design and development of a Remote monitoring system. From the beginning, the company has reached many milestones while bringing the new areas of expertise including biomedical research and application development, electronic engineering product development, electrical installation, software development and more.

Mr. Sahan Ranasinghe is the Managing Director of the Company who has graduated from Department of Electronic and Telecommunication Engineering and currently following post graduate studies at the department.

Sanota, expertise already provided efficient and task oriented solutions to meet the requirements of clients from



many fields and will continue to do so.

In 2012, Sanota was selected to the Electronic and Electrical Technology Incubator Program which was a joint initiative by Ministry of Industry and Commerce, Central Bank and University of Moratuwa.

Highlights of the projects have done by Sanota,

- PLC automation systems for requirements from clients as Samson International (pvt) Ltd and Randiya Engineering. (Automation)
- Designed RFID based monitoring system for Aura creations.
- Customized the Doppler probe system according to the needs of Krish International.
- Repaired German made Jar seal cutting machines which were not operated for more than a decade for Samson International.



- Developed monitoring system for the endoscopy system of Surgipharma (pvt) Ltd. (Biomedical)

One of the major achievements of Sanota is that it is able to reach the international market. It has done projects in collaboration with Japan and UK based electronic and embedded system design companies.

Our target is become a global recognized company after 15 years. We are moving forward to our goal slowly and steadily.

With my experience, start is always the hardest part. First 3-4 years should be tough. But if you have courage to start, never give up within first 3-4 years and you really want to achieve your goal then you have path to success.

Electronics sector has more opportunities than you imagine. You can innovate things what you imagine it has to be. It is a rare chance to change the world and make the life easy for everyone with your knowledge.

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Effective Solutions (Pvt) Ltd

"Let the passion be your profession...!". That's how the success story of Effective Solutions (Pvt) Ltd sums up to a single sentence. It all goes back to May 2012 when two undergraduate students got involved in the project of "Sri Lankan Government Vehicle Fleet Management System" at Zone 24x7 research laboratory, University of Moratuwa. With the stimulation of proper industrial exposure, they finally found their way to make to their true passion a reality, giving birth to Effective Solutions.

Today, Effective Solutions (Pvt) Ltd is successfully operating with five permanent staff members. The company is specialized mainly in the areas of Software development(Web application development, android application development) and electronic hardware designing while following industrial standards. In addition to client based projects

the company has managed to launch their own chain of products including,

O2O
Machine learning based platform for location prediction.



Route Radar
GSM based mobile tracking platform.
(www.routeradar.lk)



Medical Network
Web platform for medical personals



TrackerZ
GPS tracking & Remote sensing device



eBase
Robot development platform



As of now, the company is extending its expertise to the biomedical industry with their upcoming product series.

The CEO & co-founder of Effective Solutions, Keerthi Kodithuwakku mentions that, as a crew of undergraduates they had to balance everything in the busy academic schedule and this was a huge challenge. As a result of tireless effort to match the industry standards and quality, today they have managed to expand their client base from Sri Lanka to USA. Furthermore he mentions, "we always provide the best possible solutions with modern technology without compromising the quality and the performance..".

While recalling the past, the challenges they faced and the achievements, the CTO & co founder of Effective Solutions, Isuru Rajakaruna mentions "I remember we had those goals; first to properly deliver a single project, at least for free. Then to earn some profit. Finally to handle few million LKR projects." Further emphasized that "Passing all those milestones and looking back at the bumpy road behind, what matters the most is that the untraveled path lies in front of us to become an icon of the technology world."



Company Members, Effective Solutions

ParaQum Technologies

ParaQum Technologies is a startup company specializing in niche areas of electronics, formed with the objective of uplifting the value of the said industry in Sri Lanka.

The formation of a 'Special Interest Group' (SIG) on Reconfigurable Digital Systems by several enthusiastic undergraduates in 2012, at the Department of Electronic and Telecommunication Engineering, University of Moratuwa, laid the foundation for the company. The idea brought up at the SIG to form a startup to pursue commercial prospects of electronics related research and development carried out at the department, inspired to founding of the company. Then known as 'GalaxyCores Pvt. Ltd.', ParaQum Technologies, formally started its operations in March 2014, with four passing out undergraduates. The company was formed under the patronage of Dr.Ajith Pasqual, the present head of the Department of Electronic and Telecommunication Engineering.

The main field of specialization of the company is the development of Semiconductor Intellectual Property Cores (or simply IP Cores) and products based on those IP cores. An IP core refers to Digital Designs applicable for both Integrated Circuits(ASIC) and Reconfigurable Digital platforms(FPGA). The idea was to create re-

newed interest and commercial opportunities in this field which previously had little or no presence in the Sri Lankan electronic industry. The company also extends its reach to other areas such as Embedded Systems development, Circuit Design and prototyping to software development.

The primary product of the company is an FPGA IP core of a High Efficiency Video Coding (HEVC) Decoder which is capable of decoding 4K resolution (3840x2160) video at 30fps. In addition the company also offers design services to several US based clients in the areas of embedded systems, FPGA Prototyping, RTL Verification and software tool chain development. The company is currently involved in a partnership with a US based Silicon Valley company, developing a new massively parallel processor chip. Sri Lanka has now become their main point of operation for FPGA prototyping of the new processor chip which they hope to tape out in the near future.

Also in the client list is a US based broadcast video equipment manufacturing company for whom the company develops electronic products from specifications. The services offered to them fall in the areas of embedded design, circuit design and development. In less than a year, what started as a small company coming out

of the Electronic Department with four fresh graduates, has grown to become a fully functional startup company having its own flagship product and also offering services to global companies in the electronic and semiconductor space. The company would like to acknowledge and greatly appreciate the huge support given by the Department of Electronic and Telecommunication Engineering, through the "Facilitation Center for Advanced Electronic Design" during this period.

The company currently employs 7 engineering graduates and 6 interns, with 12 new undergraduates already recruited and expected to join after graduation in April 2015. The company now operates from its office in Colombo 5.

The primary objective of ParaQum Technologies is to encourage the most enthusiastic and brightest electronic undergraduates of the country and to give them the opportunity to use their skills and passion to make their mark in the industry. We believe that the human resource is the biggest resource of our company.

Our long term goal is to launch our own line of products including semiconductor IPs and electronic products and systems. We envision to become a leading company in the electronic and semiconductor space and bring the attention of the global electronic industry to Sri Lanka.

A & T Labs Private Limited

A&T labs Private Limited Company was initiated in June 2014, the founders being two graduates Mr. Thilina Ambagahawatta and Mr. Anuruddha Tennakoon from the 07' and 08' batches of the Department of Electronic and Telecommunication engineering, who at present serve as full time research engineers. The core areas of specialization of the company are Embedded Systems, PCB Design and Electronic Design Services. The company basically focusses on developing in-house design solutions for Sri Lankan electronic designers and electronic hobbyists and serve to fulfill hardware and software requirements.

Even though A&T Labs was registered and formally originated only by last year mid, their first product launch dates back to early last year where they designed 'Gandalf', a universal microcontroller development board for IET. And also, in the span of this past year they have developed many products in their name, one of which is 'Boromir', a universal robotics development board. And another is the 'Navigator', a GPS based tracking device. Along with these products, they have currently undertaken R&D projects for some organizations and are in the process of designing more

development boards for IET Sri Lanka and University of Moratuwa itself which form their main customer base. Their pool of customers further includes universities, small scale factories, technical institutes, schools and also electronic hobbyists.

The company was a mere 6 months old when they could clinch the prestigious Gold award for the most innovative local product at Techno 2014 organized by the Institute of Engineers Sri Lanka (IESL), which bears the privilege of being the local exhibition with maximum international participants each year.

Expressing their views for the future of their company, the engineers say that they hope to widen their scope by moving onto new emerging areas, in essence they say they are interested in moving in to the area of data reporting systems, where the location/station data in remote areas is to be collected using some hardware (which they can provide, depending on the application) which will send the data via GSM/GPRS and at the server end they will provide flexibility to users to access the database directly to run their application or else they are to develop the

applications for them.

The young innovators of A&T Pvt. Ltd. hold quite a lot of delicate and comprehensive plans in store in their minds, with only a matter of time before they bloom into finely developed high-tech products which is clearly envisaged by their vision for the long run too, which is 'To be the number 1 Microcontroller based Development Platform provider in South Asia', and which they seem quite capable of achieving one day.

And on a final note, the young research engineer Mr. Ambagahawatta, one of the masterminds behind all these, did not forget to share with us a few words of wisdom for the upcoming, to-be innovators, by saying that "You'll never know how far you can run unless you run", which is definitely a touch of motivation for us all.



Interview with Eng. Kithsiri Samarasinghe

Interviewed by: Harini Hapuarachchi and Poorna Senaratna



Eng. Kithsiri Samarasinghe is one of the senior most academic staff members of the Department of Electronics and Telecommunication at University of Moratuwa and the former Director Engineering of Sri Lanka Rupavahini (TV) Corporation. He is well renowned as an excellent teacher and a student counsellor at the department who contributes significantly to engineering education as well as to the Telecommunication and Broadcasting industries.

E-Carrier shares with you, an insightful conversation with Eng. Kithsiri Samarasinghe which we hope would equip you with insights and direction

e-Carrier: What is the secret behind you being one of the most impressive lecturers who always relate any kind of engineering aspect to real life?

I see engineering as the bridge between science and the people in the society. On one side of this bridge we can notice the scientific discoveries and breakthroughs at an abstract level. On the other side there are masses of people who struggle to lead a better and a happier life. Engineering is the art of bridging these two. Therefore engineering is always highly related with the real life. The main role of the engineer is to develop new technologies using those scientific principles that can improve the living conditions of the people in society. I always think that way. So we need to teach our students how to relate engineering work to the needs of the society.

e-Carrier: Being able to perform well as both a practical engineer and an academic staff member, how do you think, students can improve such career for themselves?

Two different characteristics need to be blended here. Academia involves knowledge creation by research and development and knowledge dissemination. To be successful in the academia you need to have a researcher's analytical mindset blended with a good teacher's characteristics such as empathy and the ability of clear expression of the thoughts. The teacher's role must include compassion and empathetic joy of the well-being of the students. When students do well in the industry and succeed in life, I always enjoy their success. I think there are people who are naturally inclined towards that empathetic joy. Others can be trained towards it. On the other hand this kind of characteristics are not so important, relevant or valued when you practice engineering in the industry. When you work as a practicing engineer, you mostly work with the applied technologies. Such work needs a different mindset that is more mission oriented, task oriented and focused mostly on technologies. Therefore those who wish to follow should take extra effort to understand the duality in these two kinds of roles, accordingly improve in both areas and achieve a nice blend of these characteristics.

e-Carrier: As one of the senior most academic staff members of the department how do you see the potential of the engineering undergraduates here?

Here we have a huge potential because we are getting very bright students. But I'm not convinced whether they are the best for engineering. Because engineering, as I see, is a science as well as an art. I'm not sure whether those who are having very high levels of abstract thinking and intellectual capabilities fit properly to the shoes of the 'practicing engineers' and 'technopreneurs' expected by the country. Of course, they are fitting well in the shoes of 'technology leaders' who can invent and innovate. I think if the brightest set of people in the society are to do engineering, their intellectual capabilities get limited due to engineering itself. I think the people who really like engineering and have a knack towards giving engineering solutions to such pressing needs of the society should do engineering. But as you know, the trend in Sri Lanka is not that. Therefore some students might not find the engineering jobs fitting well with their intellectual capabilities. One way to alleviate such mismatch is to broad base the curriculum in such a way that students can select subject baskets that matches with their capabilities.

e-Carrier: Lack of excellent communication skills and soft skills of engineering undergraduates is a much discussed topic in the industry, what is your idea on that?

This has been a complaint all the time when we meet with the industry. They say that when students pass out and get employed, they are not that expressive and more self-contained. It is true I think. It has to be improved. In the university, a lot of things are being done to improve on this aspect. New course modules have been added and we have seen over the years that those capabilities of the students are now improving significantly. I think those efforts are becoming fruitful. University has taken measures to introduce such modules from the very early part of the course so that they have enough time to gradually develop these skills. Student awareness on this should be improved as well.

e-Carrier: How can students improve themselves and fill the gap between academics and industry?

During the course you will have opportunities to do mini-projects with the industry, final year project, industrial training and field visits. These activities are aimed at relating the academic course to the real engineering practices out there. They will open up the practical engineering side to the students. With the new curriculum design such activities get further enhanced. More mini-projects and more work with the industry is promoted. I think students should make the best use of each of these opportunities that they encounter during the course to interact with the industry and thereby relate theory to practice in a better and more enjoyable manner.

e-Carrier: What role does engineering curriculum play in order to minimize this gap?

The curriculum is the manuscript for the actors and therefor it plays a very vital role. Some time back we had a curriculum which is more aligned towards producing only the practicing engineers. When we analyzed the big picture we realized that there can be three kinds of profiles for our engineering graduate. Practicing engineer is definitely the more significant requirement for the local industry. Therefore still some numbers are to be produced in that category. However there is a real need for the technology entrepreneurs (technopreneurs) who can start and develop technology based businesses and also technology leaders who aligns themselves with R&D, do higher studies and develop new technologies. The curriculum has to play a role of aligning and developing the capabilities of each student to play one of these three roles. Some students are capable of going into these technology leadership positions. Some students' capabilities are matching more with the technopreneurship role. Some students' capabilities are matching more with the general practices of engineering in the industry. Now the curriculum

has been changed so that the students can be guided towards an identified role which has a better match with his capabilities and attitudes. It's being implemented now and we can see even better output in future.

e-Carrier: Is it what you are expecting or has it been the trend?

It is what we are expecting. It hasn't been the trend. The trend has been that we continue to produce practitioners. But we have the entry level of students with the mindset and characteristics not exactly suitable for a practitioner. Many are having higher capabilities than becoming a general practitioner. Therefore there was a mismatch and the industry is not yielding the full potential of these students when they pass out, so after some time in the industry we see that they get bored with the routine work that the industry offers. Some jobs do not offer matching challenge in the work for these minds. In this scenario, it may become necessary to take the risk and create such challenging work by ourselves. So some of our students need to create such new industries which offer more challenging work to their minds. That's why the curriculum has to be adjusted to cater for all these three levels, but there is a very delicate boundary between the three. So how we can adjust the course modules to suit all these three requirements is being tested at the moment..

e-Carrier: Apart from all these measures, the curriculum and everything the department can ask the student to do, what other things can the student do to improve himself, to fill the gap between the industry and the academics?

The local industry usually expects all-rounders who are capable of multitasking mainly as a cost cutting strategy. Therefore it is better to broad base the talents. Nowadays virtual industrial visits can be done by the student himself through the internet. There are so many educational vid-

eos on different industries, factories, manufacturing, installations etc. that you can get hold through the internet. Watch all of them and then you are preparing yourself for the industry. Talk to the friends in the senior batches who are employed and explore the opportunities to bring mini-projects here. For some of them you will have a chance of claiming credits in the new curriculum. Engage in all kinds of extra-curricular activities such as sports, societies etc. They help a lot to prepare you for the industry and the society.

After working few years in the industry one may feel what he/she is lacking to fit into those roles of middle management and top management. When you climb in the management ladder, even in the engineering discipline, it demands management skills. After about two to five years of experience in the industry you might have to update such knowledge and skills. Then engage in some kind of a management training, a diploma or could be even a higher degree.

e-Carrier: May be that is why they have introduced the management modules into the curriculum.

Yes. The curriculum has a lot of management modules now. Some management concepts you learn in them may still be too early. Some content of these modules are well understood once you are in the industry for about two years. In my case, this is what I felt. I noticed that I had done some of these management concepts earlier at the university, but after a few years of experience when I revise the same thing, it give a lot of meaning. Therefore, after graduation, may be within two to 5 years, I would recommend to do another management related course.

e-Carrier: Current university curriculum consists of subjects offered by Department of Management Technology. Entrepreneurial leadership is a much discussed topic within the University today. What will be the impact of it on engineering undergraduates?

There will be a very positive impact specially for breeding the technopreneur category of graduates. Technoprenureship is seriously lacking in Sri Lanka. If you look at developed countries like US, engineering graduates, by the time they pass out, they are thinking of starting their own company. Many of them have the willpower and courage to make an attempt. A certain percentage fails, but even then the attempt is a big experience for them. We don't see that scenario here when students pass out. Therefore I think this technology entrepreneurship subject is very important, because we want that change to happen, and it's good for the country and good for the graduates. We would like some percentage of our output, at least 5 percent to take technology entrepreneur role and lead new industries in the country. On the other hand, technoprenureship can be practiced even within an already established company after you join it. Then you have a better chance of climbing up the management ladder faster.

e-Carrier: What if they fail?

Due to various reasons, these initial attempts can fail. Reasons could be lack of experience, lack of resources, lack of integrity in the team etc. These things may happen, but that experience will do a lot of good for them because failing early, when you have nothing much, is better than failing later. If you fail early, you are not losing much. If you fail later, or in the long run, it can be disastrous for a carrier.

e-Carrier: There is a trend that many engineering undergraduates try to complete CIMA in line with their engineering degree, what you would think is the impact of that?

I can see the need. Job opportunities are likely to increase when management knowledge is blended with engineering. This may be the reason why students go for CIMA. It's not bad, but what I would like to show is another alternative. The alternative is to go in series, you concentrate

on engineering first, finish it get some industry experience and then do a higher management degree like an MBA. Then you have a better academic qualification as well, because it's a higher degree.

e-Carrier: There is a trend in undergraduates today to make groups and show interests in starting their own companies after graduation. How do you see this trend?

I think it's a very good trend. That is how it should happen. It is due to the curriculum changes the university has introduced. The new curriculum, supports them to enhance teamwork and better integration with the industry. Our graduates should lead the industries. It is the university's duty to give them the chance to gather necessary knowledge and skills in order to start their own companies.

e-Carrier: On the other hand many of the engineering undergraduates prefer to select their carrier based on the salary rather than what interests them the most. What is the negative side you see in that?

I have seen the careers of many people and this idea of initially getting employed in a high salary job which may not be fitting into your interest is actually a waste of time. Because later on the person start to feel the dissatisfaction and that harms their character and the confidence. Then their own actions slowly demoralizes themselves. So what I advise is, go for what you like and the type of work which motives you. Initially it may not pay much dividends to you, but in the long run, it pays off with arrears. If you go for what makes you happy first, money will follow sooner or later.

e-Carrier: Meditation is always a discussed topic whenever you are around, how can it help young undergraduates to shape their lives?

It helps immensely. Let me show you the broader picture. Although you call yourselves undergraduates, you are living beings or humans. A life of a human is short enough. Within that time everyone wants to build a successful life. What is a successful life? I have seen and analyzed many lives and their patterns both as a counsellor and a meditator. As I see it, to lead a successful life, one has to succeed in four areas. First is to be a good citizen. You have to play the citizen's role well and contribute to local society where you live. Second is the professional role, ie. the role of the engineer. Third is the family member role. The fourth one is your individual role. That is, doing some good for yourself, that helps in the long run through the individual journey of sansāra. Each of these roles needs completely different set of characteristics, attitudes and styles. If a person can succeed in all four areas, I would call him a successful person. I have seen through my counselling experience, people who succeed professionally but fail miserably in the other areas. This is where meditation can come in. Meditation practices will initially help you to see the big picture that helps to balance these roles. It will not allow you to lock on to one particular area. My measure of success in a life is by an index called 'happiness-index'. Meditation can play a big role towards the individual development and individual 'happiness index'.

e-Carrier: A common complain of undergraduates is that they are stressed with workload. So how can students manage certain situations without being overstressed?

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role well and contribute to local society where you live. Second is the professional role, ie. the role of the engineer. Third is the family member role. The fourth one is your individual role. That is, doing some good for yourself, that helps in the long run through the individual journey of sansāra. Each of these roles needs completely different set of characteristics, attitudes and styles. If a person can succeed in all four areas, I would call him a successful person. I have seen through my counselling experience, people who succeed professionally but fail miserably in the other areas. This is where meditation can come in. Meditation practices will initially help you to see the big picture that helps to balance these roles. It will not allow you to lock on to one particular area. My measure of success in a life is by an index called 'happiness-index'. Meditation can play a big role towards the individual development and individual 'happiness index'.

e-Carrier: What can you say to people who complain that they don't have much time to practice meditation due to academic work, otherwise they would like to do so?

It is a lame excuse that arise from the mind due to the lack of proper knowledge on meditation and also the lack of merits. Meditation is to know oneself. It is based on developing complete awareness of the phenomena as they occur and as they are. Such awareness and the resulting wisdom definitely supports handling of the workload. You can practice meditation on-the-go while you are attending to your more demanding tasks. This is called "Sathi" meditation. So all students can do "Sathi" meditation which will really help in their academia. Not only academia, but in whatever extra-curricular activities they do. Once you establish 'Sathi' then those who wish to develop further can gradually practice "Samadhi" meditation. It means concentration on one thought. When you practice that you have to be in one place, in one pose. The common understanding of meditation is that you have to

go away from the society, be alone, and then practice. That is only true for "Samadhi" meditation and not true for "Sathi" meditation. So why not start with sathi meditations? After establishing Sathi and Samadhi finally you can move into "Vipassana" meditation. You may now notice that there is a very good sequence to build. If the students are aware of the sequence, this question will not arise.

e-Carrier: Why do you think student counselling is needed, especially in the context of universities?

Undergraduates are going through a special and also crucial period of life. They are in transit. Being neither a child nor an adult is not an easy period. During such transition periods usually there are problems that a person might not be able to handle alone. For such problems they need help. Usually it's the friends one would turn to get advice or help because this is the age that one 'feels' that the parents cannot understand his/her situation properly. Friends just talk about the problems with each other and sometimes good solutions come up. However for some students do not have such good close friends. When personal problems appear they find it difficult to handle alone. Then we consider it as a duty of the university and the teachers to help them find proper solutions of their own. Counselling will strengthen them and empower them to overcome problems. This is the need that we fulfil as student counsellors. University has a professional counsellor as well who can be of assistance for even serious problems.

e-Carrier: To which extent are you satisfied with counselling here?

There are a lot of counselling needs among students. We have not fulfilled all those, I think. Lack of awareness among students, cultural barriers, delays in giving attention needy students etc. seem to be the barriers at present. We have only one professional counselor. Awareness

must be enhanced. Students sometimes don't want to come to us because they think we are so busy and should not be disturbed. All the western counselling theories are coming in our way and we are trying to apply them here. There is cultural mismatch. The counselling techniques must be blended with the culture. This is another issue I see.

e-Carrier: Apart from all these guidance, is there anything else that you would like to add to this conversation as a final advice?

I can emphasize what I said earlier. I would like the students to think of all four areas/roles, as early as possible. The citizen's role, the professional's role, family member role and the individual role. The university is mainly supporting this professional role. There may not much direct support for the other areas. If you are aware that you have to develop the other areas as well, maybe that awareness will help a lot. Otherwise one may think that the whole success of life is the professional success. If your mind is trained like that, to see the success only in the profession, you are handicapped. Be humble in all your worldly achievements. It's your happiness index that finally measure your success in a life.

Interview with Mr. Thilina Anjitha

Interviewed by: Lahiru Jayasinghe, Viduranga Wijekoon and Yassas Hemachandra



He was a student of Department of Computer Science and Engineering at University of Moratuwa which is an emerging field to explore. Presently being the Manager Engineering at hsenid Mobile Solutions, he has had more than 10 years of continuous experience in specializing Software Development, Project Leading, Team Leading, System Designing and Architecting along with the exposure to Telco Platform Developments, including Analytics and Telco API Management Platforms.

e-Carrier: Computer science and also electronics are famous as engineering fields where dedication and hard work are of importance. As undergraduates in those fields, we often find ourselves under stress. At times like that, practicing a good hobby can be very beneficial. So can you tell us a bit about your hobbies?

As I believe, balancing both sides of our brain's hemispheres: left and right, is essential to maintain a healthy life style. When we are working at office, we utilize our left brain more, for critical thinking, logics, reasoning etc. We can use our right brain effectively when we expose ourselves to aesthetic values, such as; Music, Painting etc.

I mostly prefer listening to music as it relieves stress, pacify my mind and prepare myself for another challenging day. Adventure and wild life is another energizer for me. As we spend quite a lot of hours working with the electronic

equipment, the nature, greenery and wild life composes the best medication for our stressed out eyes. Above all, my passion is photography and would never hesitate to capture vivid scenarios when I'm out of Colombo.

e-Carrier: hsenid mobile solutions is known as a Telco platform provider. Could you explain what that actually is and also what inspired you to join a company that specializes in such an area?

hSenid Mobile Solutions is truly, a Sri Lankan Company. Being a Telco-Mobile Software Solutions provider, catering primarily to the Telecom and Financial markets across the globe, it is an arm of hSenid Group.

The company's organizational culture is based on four core values: quality, accountability, personal growth and discipline. This culture promotes achievers, makes people accountable, builds customer/team oriented employees and also makes people passionate on every work they perform. Above all, hsenid encourage and provide us freedom for innovation.

Apart from the organization's core values, self driven passion to work in a challenging Telecom application domain inspired me to work for hsenid Mobile Solutions. Also it was one of my childhood dreams to develop things which could be used by numerous people and engage in activities that are beneficial for the society.

e-Carrier: As a person who has had vast experience in the field of computer science, what do you recognize as new trends in this field and how can we benefit from these and what the effects would be to us as University students?

New trends in the field of computer science can be predicted as, Analytics, big data, Internet of things, Machine to Machine communication, wearables, 3D printing and Smart TV. Also work force moving to cross functional teams with different backgrounds (Electronic, Programming, Mechanical etc.) and different expertise is an emerging trend. Presently, multi disciplinary capabilities such as knowledge and expertise in design, hardware, software, creativity, management skills are essential to successfully complete a project.

I'm quite sure, that UOM is well positioned to mould the students and make them confident to cope up with these emerging trends as they offer interdepartmental modules and maintain a greater collaboration between different departments such as electronic, electrical, mechanical and computer science departments.

e-Carrier: Something that we have noticed recently is that many software companies have started to invest heavily in hardware development. I think we can agree that HMS is mostly a software company. Are you also looking to embrace this trend and if so what are the steps that you have taken in that regard?

Actually, in modern world there is no clear boundary between Hardware and Software components but both components work together to provide services to users.

When it comes to hsenid, we are a Software company providing platforms for telco providers. However, since we are embracing IOT and M2M, definitely we will be investing in hard-

ware development that includes open source hardware too.

Also, since we are into big data analytics, there needs to maintain a limit that Software can handle the data. So, we are hoping to go for hardware level, considering this aspect as well. We will be using GPU programming and FPGA programming to achieve it.

Recently we have started the microcontroller programming which need electronics knowledge, as we are to build the required circuits for our developments.

e-Carrier: What is the industry expectation of the students? Are there any noticeable differences between university undergraduates in your time and now?

Basically, the students should have the required analytical and problem solving skills. Most importantly, they should possess great attitudes and hunger for learning. Since IT is a changing field, today's technologies go outdated within few months. Therefore the learning attitude is crucial. Above all, industry expects people who are passionate on the work they do. Therefore if you are passionate about the latest technologies and can adapt easily to any programming language you can consider yourself as a person who is having a key strength. Also the industry welcome innovative and forward thinking people who can drive the growth of a business.

Unlike older days, present days students have lots of opportunities to improve their designing, development and presentation skills by taking part in Google Summer of Code, Hackathons, open source projects etc. But it is very sad to say that, only very few students take the advantage from these opportunities. Nowadays learning has become a very easy task because of Youtube, Coursera open online courses, Free eBooks etc. But, only very few are taking advantage from these types of novel learning re-

sources.

Also, I should mention this as well, I have seen that students are conquering the breath of any subject knowledge but the depth of it seems insufficient.

e-Carrier: Finally, as a person who has had a very successful career in the industry, how do you balance your personal life with your workload and are there any regrets in regard to that? Also, what would you advice current undergraduates who look forward for such a career to develop in regard to their soft skills?

I plan and prioritize on each of the tasks at hand. I would never miss to go out and be with the family and the kids during weekends, holidays and vacations. It is important to recognize the value of exercise, leisure activities and also the friendships. We should ensure that we do not compromise all above since we work long hours. At least we need to ensure that we spend our leisure time on such valuable activities. At the end, it is worthwhile if we can evaluate our work-life balance on a regular basis.

If you expect to develop your soft skills, then at the first place, you should never say no to the chances that you receive: to lead a team, to do a presentation or even to interact with a lecturer in interactive lecturing sessions. Always be brave enough to take the chances to improve yourself. Also read the books and articles written on improving soft skills that you wish to improve. There are enough materials around. Anybody can use those and grow. UoM has Toastmaster, Gavel and Rotract clubs, so you can also join those clubs and improve your skills.

“We need more and more innovators in our country” – an interview with Dr. Pujitha Silva

Interviewed by: Imesh Lihinikaduarachchi and Sajith Rajapaksha



He holds a Bachelor of Biomedical Engineering and a PhD in Mechanical Engineering from Australia. He started his life in academia as a researcher in Biomedical Engineering with a specific interest in the biomechanics of the human spine before joining an Engineering Consultancy in Australia, in mining and ports infrastructure where he was exposed to the multidisciplinary nature of large scale engineering projects. He has been on the teaching staff at the Queensland University of Technology (QUT) from 2010-2014 and was appointed the sessional academic advisor for the school of chemistry physics and mechanical engineering at QUT. Currently he is at the University of Moratuwa as a senior lecturer in Biomedical Engineering. Also he is a certified professional coach with International Coach Federation (ICF) and head the research and development team at Full Life Coaching.

focus was to serve the people of my country using my knowledge where there is a special need. In that regard Gait analysis was one of my prime concerns because there is high population of people with walking problems and in Sri Lanka and we still don't have any scientific way of quantifying it properly or way of doing any scientific research. So I thought that would be a unique area I can contribute.

e-Carrier: Some other areas that you find interest are engineering education and Life coaching. Also you engage in doing coaching and training for corporate clients. How this is relevant to Sri Lankan undergraduates and what is the response from industry for it?

It is at a satisfactory level actually. Basically I think the undergraduate education, not only in Sri Lanka but also universities all around the world, the academic output are not matching what exactly the industry need. People talk about it in different kind of settings. It is because students do not consider about different kinds of soft skills. I saw that this gap is kind of an avenue that I can pinch in. Even though we produce brilliant engineers and when they go abroad and in to research, they get stuck in the technical level. This short fall comes from their lack of skills. There are some cases where engineers are found difficult to work with other people. So these are some fields that coaching

e-Carrier: You are especially interested in research areas such as Bio mechanics of soft tissues, Finite element modeling & Bio materials and Gait analysis. Is there any particular reason for selecting these particular fields?

Yes, Bio mechanics and Bio materials are of special interest to me when I was studying as an undergrad and for my PHD back in Australia. But when I moved back to Sri Lanka my main

can help. So being an engineer, it was more approachable and more appealing for me to address those issues by going in to the industries. For me this was really fulfilling since working with students, engaging in academia and at the same time working with corporates was something that I found interesting. This was in another way, a mean of personal growing for me as well.

e-Carrier: According to your point of view, what is the future of bio medical engineering?

What would be the opportunities for the students who are studying bio medical engineering in terms of Sri Lankan and global context? There is definitely a very bright future for the students in the field of bio medical engineering. But the immediate future is something I think that we have to create. The main reason for this being most of the requirements for this field has been fulfilled by a handful of overseas companies. One of the main factors we need to consider is that we need to create awareness about what is happening in this field of engineering. At the moment, the career opportunities are limited in Sri Lankan context. But more and more openings for the field can be created by making awareness to the field of bio medical engineering. But as I believe the bio medical engineers should be able to create their own niche rather than going for the industry directly because they are in huge demand worldwide and they should direct that potential in succeeding their own in Sri Lankan and in global context as well. The area of research is also a huge stream that one can venture in to. Also the kind of solutions that they can develop would be more and more applicable and more and more relevant. That's the way I believe this industry will grow and of course this is not an overnight growth but a mere step by step one. Moreover the universities should be the catalyst of this growth rather than waiting for the industry to respond.

e-Carrier: As a final note, what is your advice to the undergraduates who are willing to pursue their set goals in the future?

My main advice for them is first you need to identify what kind of a difference that you want to make in life. As part of my life coaching part of my work is helping others to define and identify what their success level is. To identify whether they want to make success in industry level or whether they want to be global citizen. Because your growth will be the extent to which you want to grow ultimately. So I would say don't look for a monthly pay check or stop growing. Even if you get a job, keep growing and keep working towards your dream despite the pressure that life gives you. If you have a dream, you can keep going forward. And I firmly believe that we need innovators in our Country. We have lot of hard working and very brilliant students that graduate whom we don't want their journey to end in a 9 to 5 job or even in a PHD for that matter. What really matters is achieving what you define as success for yourself.

Lip Synchronization

Yasith Amarasinghe

Do you know how the deaf people communicate with other normal people? Did you think for a moment how they can recognize what you are saying? Actually they can read the lips of other people and correctly understand it 95 percent of the time. That's how powerful lip synchronization is. Moreover modern game developers are working really hard to synchronize voice with characters.

What is the first thing that will come to your mind when you hear "Siri" or "Cortana" or "Now"? As we all know they are voice assistants available on smart phones these days. People are always comparing these things but they all have ignored an important fact. That is, all these software need internet connection for them to work. They will record the voice for a short period, process this voice, extract features from this and send them to their own database. Then, they will be processed further and recognized speech will be sent back. As for us Asians our accent is far more different than that of Europeans. Most of you probably have experienced that our voice is not really compatible with these voice assistance software.

Why is it so hard to recognize or extract features from human voice in real time? If you search through the internet you will see lots of papers and patents regarding voice recognition. But the funny fact is that there isn't a single software as of now that will process the voice in real time and extract its features. At present all the programs use a database to communicate and identify the phonemes. You have to understand that there are many software that will process voice but none of them are real time. Phoneme is the basic phonological unit of a language, which is combined with other phonemes to form meaningful units such as words.

But if we extract the features from voice, then our work will be much easier. What remains is the image processing part. There are many software that will process 2D images. Presently scientists have found out that there are 21 visemes in our mouth. Viseme is how our mouth shapes when we talk. Our mouth can take 21 shapes. The main feature of a viseme is the shape of the lips. If we can take out these visemes and view them in an

actual face, 95 percent of our work is done. Then all we have to do is to make transition image sets from every viseme to viseme.

Briefly said, first identify the phonemes of the speaker and match them with the correct viseme and translate between visemes. From this method you can easily synchronize an avatar's lips with its voice. This looks so simple but in present nobody has ever done this. So why don't you try to do this?

Life as an ENTC Undergraduate

I like to think of every memory, every instant in time, as a tiny droplet of water that makes up this giant sea of memories. Like any ocean, this one is full of waves that wash up against our minds' shores, drifting us back to specific moments in time, asking us to stop and remember, to appreciate and reflect. Before we dive into our future let's take a moment to swim in our sea of memories, to recognize this wonderful journey so far and appreciate how great the water really is.

University of Moratuwa, Sri Lanka's prime technological institution in Sri Lanka is the dream of each and every school student who is doing Advanced Level examination in the physical sciences stream. It was once mine as well, almost 6 years ago, where I had no other goal, but to become an undergraduate at this renowned university. Continuous hard work and dedication paved my path to this prestigious university and in no time got the privilege to become a member of the family of Electronic and Telecommunication Engineering department (ENTC). Why privileged? Because in my opinion, this is most sought after field of engineering specialization in the university. Why family? You will

get to know why from now on.

When we first entered the department as the fresh undergraduates, there was this feeling of excitement about the fact of what lies ahead. We had seen and heard of many success stories of ENTC alumni who were performing extremely well all around the world, but, we had no idea as to how it all began. With hearts full of hopes and expectations, we sat at the ENTC auditorium, eagerly waiting to begin life at ENTC. The words of wisdom by the elite panel of lecturers on the very first day assured us that we had taken the right decision to be a part of this wonderful family.

Obviously it was not a cake walk from the beginning to the end. Tough work, huge piles of assignments and submissions, extensive and in depth research and projects were quite often and I have to admit that there were times when we were truly exhausted. However, we cannot complain that all these hard work went in vain. From the ABC's of this field, by the end of four years, we have gained immense knowledge to win the world proving the fact that 'you reap what you sow'. If we were to swim into our ocean of memories, we would find an assortment of waves: some rough, come calm, but all teaching us how to feel, think, live and learn. During our stay at the department, we get the opportunity

to explore the world of Electronic and Telecommunication Engineering and identify the world's newest trends and open up new avenues to reach greater heights. Being an ENTC undergraduate, we get tremendous opportunities to meet the world class expertise, to work with them and to get the finest exposure with hands on experience on new technologies. May it be robotics, biomedical engineering, telecommunication, electronic design, embedded systems, machine vision or whatever the field you like to pursue, this department possesses well experienced expertise as the lecturers to guide us on our way through and to enlighten us. Despite their very busy schedules, they never let us down when we reach them for guidance and help. Their continuous support and advices are always there when we need.

Many of the outsiders might think of our undergraduates as merely technocrats, but I am proud to say that we are all-rounders. The department always emphasizes on the importance of being a well-balanced, versatile person as a professional-to-be and encourages us to engage in extracurricular activities; sports, clubs, societies etc. We have never been deprived of a chance to participate in these kinds of activities and from my personal experiences, I am thankful to the department for helping us to be who we

are today. This department has molded our personalities to fit into anybody's shoes and never say 'no' to a great opportunity lying ahead of us. Another aspect which is highly appreciated in the department is fulfilling the obligation towards the society through community service projects. It is really inspiring to see how each and every one join hands together when organizing these kinds of activities.

Electronic club is a great platform for all the department undergraduates to serve the department while being an undergraduate. They organize all sorts of activities; competitions, community service projects, technology related projects, professional network development etc. where the students can actively engage in planning and executing stages of each event

and gain firsthand experience on project management while enhancing their soft skills such as leadership skills, PR skills and organizing abilities etc.

I have enjoyed every moment I spend as an ENTC undergraduate and I am sure everyone thinks in the same way. I will be opting out a significant component of this life if I did not mention about the joy and happiness we gained through various kinds of activities. We are kind of people who are serious where necessary, but always enjoy the life to the fullest. E-Nite, batch video and batch trips etc. are some very good examples to prove this fact. I have met an amazing group of people as my friends at the department whom I can always count on. We tease each other, we make fun of each other, but more importantly we

are there for each other whenever needed. They also are one of the many reasons for my sense of belongingness for this ENTC family. Our lives are filled with love and laughter, honesty and honor thanks to the strong bond among us.

All in all, we have made the best decision to become an undergraduate of this department. We are grateful for everything ENTC has given us to become what we are today. The memories we gathered here will be cherished in our hearts forever. If you want to fly high, ENTC is the place to be.



Group 1 Student Response System Supervisor: Prof. Dileeka Dias

"Interactive classroom" is a much more discussed topic today. Students sitting in classroom just hearing to lecturer is not that appealing to the current context of learning/teaching. Our system allows teacher to create online short exams (quizzes, short answer questions etc.) through university Moodle using mobile phone (Android) or the laptop. Student can answer to the short exam using the mobile phone (Android). Just after the exam student gets the marks and the Moodle will be updated with marks. Teacher can view reports having different set of information regarding to the exam like average mark of the exam, mark of a particular student etc.

Group 2 Train Detection System Supervisor: Dr. Jayathu Samarawickrama

In passenger transportation, trains remain a popular method of transportation. People select train as a mean of transportation mainly because of its safety and ease. Therefore safety ensuring methods and procedures are critical in train operations. Hence we have identified the need of an accurate, cost effective train detection system. Objective of the project is to measure the distance to the train in real time from a given point. Existing railway infrastructure is used for the implementation. Rails are modeled as a transmission line and effect of impedance mismatches caused by a train, is analyzed using digital signal processing methods. Obtained distance data can be used in several applications such as signaling and information systems, rail gates and train controlling

stations.

Group 3 Rapid Hearing Screening For Newborns Using Automated Auditory Brainstem Response Supervisor: Dr. Anjula De Silva

"Rapid hearing screening for newborns using Automated Auditory Brainstem response" is a cost effective, efficient screening procedure which is planned to be adapted for mandatory hearing screening in newborns in Sri Lankan Public Health sector. The Project incorporates a hearing screening hardware implementation, faster stimulus delivery mechanism for AABR and an efficient signal processing algorithm, namely, the Empirical Mode decomposition instead of the traditional averaging mechanisms. Design and Implementation of ABR acquisition hardware system incorporates the TI Analog Front End chip ads1299 for the EEG Signal acquisition and the system communicates via SPI communication with the processing system of the prototype device, which is the FPGA platform. The fast stimulus delivery method reduces the screening time by replacing the Click stimuli with Chirp stimuli, which provides input compensation for cochlear traveling wave delay. Efficient Signal Processing algorithm for ABR extraction which utilize EMD, is designed and implemented on FPGA platform with Automatic Peak Detection Algorithm for the ABR. The Hardware portable prototype of AABR screening displays a PASS or REFER output for a generalized dB level of Stimuli presented to the patient.

Group 4 HEVC Encoder Supervisor: Dr. Ajith Pasqual

HEVC is the latest video compression

standard offering a solution to growing concerns over increased video traffic on communication networks and heavy burden on storage. HEVC includes provisions to double compression capability, deliver higher resolutions and frame rates, achieve levels of higher quality through higher dynamic range and wide color gamut and pave way for new video service UHD TV. However due to increased computing power and memory requirement, early mover software encoders fail to achieve real time compression. This project offers a real time HEVC encoder implementation on FPGA for HD video at 30 fps and 8 bit resolution with provisions to scale up to 4K.

Group 5
SCADA System Integration of Distribution Substations in Colombo City (CEB)
Supervisor: Eng. Kithsiri Samarasinghe

SCADA is an industrial control computer system which is capable of gathering and analyzing real time data. Ceylon Electricity Board is having a distribution SCADA system for its 132/33/11 network in Colombo City. Primary Substations, Radial substations, Ring substations and Satellite substations are the main points the Colombo City distribution network. In the existing system, most of the Primary, Radial & Ring substations have been linked to the SCADA system through Fibre, Leased lines (E1) and GPRS communication. The requirement is to connect rest of the Satellite substations to the SCADA system in a cost effective manner. First phase is connecting the satellite substations to the SCADA system using GPRS communication system and enable automation. Next phase is creating an Android based application in order to view the status and alarms

at any satellite substation from any authorized mobile phone. Final phase is the research on designing an equipment to bypass data signals from 11kV line to 400V line which will be used in Power Line Communication.

Group 6
Unmanned Underwater Vehicle
Supervisor: Prof. Rohan Munasinghe

The project Unmanned Underwater Vehicle (UUV) is the construction of a flight type underwater vehicle which is remotely operated without human occupant. The vehicle is wirelessly operated from the operator to water surface and from the water surface to the vehicle the controlling will be done through wired connection. Modern world applications of UUVs are Mine Countermeasures, Harbor Security, Debris Field Mapping, Search and Salvage, Scientific Sampling and Mapping, Hydrographic Surveys, Environment Monitoring, and Fishery Operation etc. The project consists of four main parts; structure, navigation control, propulsion and communication. Fiber is used as the material for the hull. The navigation consists of the control systems for surge, yaw and depth control and sensors to identify the location and orientation. Assembly of Thrusters, Gliders and Drifters comes under the propulsion with the maximum utilization of drag force provided. Zigbee, the high level communication protocol is expected to be used for the wireless communication.

Group 7
Development of an IVF Incubator
Supervisors:
Dr. Nuwan Dayananda
Dr. Anjula De Silva

In Vitro Fertilization (IVF) is the process

of conceiving an embryo in a test tube. The process requires exact replication of the environment of the womb for the successful development of the embryo. Existing incubators have a common chamber which disturbs all the embryos when one is examined, while the highly advanced incubators are of premium prices. The objective is to provide a cost effective and an accurate solution, reducing the embryo stress by limiting the number of embryos per module to four. Opening and closing of the modules will be minimized with top and bottom sides of the module being made of heated glass, and by supporting embryo inspection without removal from chamber. All the necessary in-vivo conditions will be maintained at standard levels and the necessary networking, alerting and data management facilities are incorporated.

Group 8
SimKits: an Exploration of Tangible Interface for Programming and Circuit Simulation
Supervisor: Prof. Dileeka Dias

SimKits is a research project that explores the possibility of having interactive cubes as an educational platform. It consists of a set of interactive tangible cubes which detects and communicates with neighbors, day to day objects (e.g. smartphones) and a server (i.e. smartphone /tablet /laptop). SimKits enables children (middle school) to learn programming concepts and circuit simulation easily while having fun through tangibility. It also addresses the deficiencies of existing tangible platforms to give better user experience through the interaction with day to day smart objects.

Group 9
Blocking Cellular Phones in Prisons Using USRP
Supervisor: Prof. Dileeka Dias

In today's context there is a requirement to block cellular phones in places like prisons. The goal of the project is to block the unauthorized phone numbers and connect only the authorized numbers. For the implementation of this idea we have used the USRP (Universal Software Radio Peripheral), a product of Ettus Research, which could be configured as a fake GSM Base station using the software which are compatible with this hardware peripheral. And we have used OpenBTS (handles Base Station function), Asterisk (handles switching and routing function), UHD device (software that communicates with USRP and OpenBTS) and GNU radio software (handles mathematical analysis and functions) to configure the fake BTS. Then the authorized phones latched to the USRP will be identified based on the IMSI (International Mobile Subscriber Identity) number which is in SIM. Other numbers will be blocked using the USRP configurations. Unauthorized numbers will be blocked by setting restrictions in the Systems Database.

Group 10
Careu - Design and Development of a Plantar Foot Pressure and Temperature Measurement System for Diabetic Patients in Sri Lanka
Supervisors:
Dr. Anjula De Silva
Dr. Pujitha Silva

About 10% of the Sri Lankan adult population is affected by diabetes. If not properly monitored, chronic diabetes may lead to ulceration of the foot which could result in lower limb amputations. Among the fore mentioned diabetic

population, foot ulceration is estimated to be 5.5 – 7.5%. However, early detection of these ulcers is possible by analyzing the pressure and temperature of the foot plantar in which case, remedial measures can be prescribed to prevent lower limb amputations. A well-established method of estimating the risk of foot ulceration due to diabetes is by detecting abnormal pressure points on the foot plantar. As a secondary measurement, temperature variations of the foot plantar are found to be a good pre-detector of foot ulcers in diabetic patients. Our aim is to develop a low cost plantar foot pressure temperature measuring system for early diagnosis of diabetic foot ulcers.

Group 11
Smart Building
Supervisor: Prof. Dileeka Dias

Smart Building is an evolving concept for making the life people easier, to predict what is happening in a place using the sensors as eyes, to manage the energy efficiently. As the presented proposal mainly focus on activity detection and energy management. Smart Building for a university will help students to find their lecturers' presence, Progress of lectures, Silent places to study, Practical in lab is going on or not. For a home, it helps to monitor children arrived from schools, no one at home, etc. Smart building for an office will help to monitor workers presence and activity. The system is developed using simple ubiquitous wireless sensor network without intruding the privacy of people.

Group 12
Fpga Based Hardware Implementation of Advanced Receiver for Lte-A Uplink
Supervisors:
Dr. Chandika Wavegedara
Dr. Ajith Pasqual

In modern industry driven economy, speed has become a key factor in every field. As most of the people are seeking to work on-the-go, wireless communication has become a key technology among others, requesting higher and higher bandwidths day by day. Currently Long Term Evolution (LTE) is being deployed over the world, promising 300Mbps DL and 75 Mbps UL speeds. Still, the world requires more and hence LTE-Advanced has been brought forward, promising 1Gbps DL and 500Mbps UL speeds. LTE-A gives a significant increase in data-rates with the use of technologies like MIMO and carrier aggregation. In this project our target is to implement the nonlinear uplink receiver for multi user MIMO scenario in LTE-A conforming to the 3GPP release 11. We are to carry out the software implementation in MATLAB and hardware implementation in FPGA.

Group 13
Vision Based Inventory Management
Supervisors:
Prof. Rohan Munasinghe
Dr. Ranga Rodrigo

Inventory Management has been a very time consuming process so far in many industries. It requires more man power and vulnerable to human errors. Presently there are security cameras in almost all the places and the vision based surveillance and image processing technologies are gradually emerging. In this project we propose a solution to automate the inventory management process in selected industries. A mobile robot (both autonomous and manual control) which is controlled by a computer interface is used to carry a camera around and take necessary images in a jewelry shop. The images are transmitted through wifi to a central computer and processed. Then the

inventories are automatically updated. The system is also capable of providing some additional features like security alert, display available items and offers on a screen etc.

Group 14
IEEE 802.3ba 40Gbps PCS Layer Implementation
Supervisors:
Dr. Subramanian Thayaparan
Dr. Ajith Pasqual

The Physical Coding Sublayer is a sub-layer in the Ethernet standard. According to the OSI seven layer model, the PCS resides in the Physical Layer, at the top border of it, just below the Reconciliation sub-layer of the Data-link Layer. The task of this medium independent layer is to convert the signal formats coming from top layers to facilitate the transmission in the physical layer. In converting signal formats across layers, the PCS layer performs a well-defined functionality according to the IEEE 802.3ba standard. The PCS layer is responsible for data encoding/decoding, scrambling/descrambling; alignment marker insertion/removal, block and symbol redistribution, and lane block synchronization and deskew. The forward process is carried out at the Transmitter side while the reverse process is at the Receiver side. The aim of the project is to implement the 40 Gigabit Ethernet PCS Layer in Hardware Description Language (Verilog) and to verify it.

Group 15
Tool for Determination of the Optimal Maximum No of Harq Retransmissions
Supervisors:
Dr. Chandika Wavegedara
Mr. Bhathiya Pilanawithana

HARQ technique plays a major role in

providing a better user throughput in the air interface in HSPA. Considering that existing 3G HSPA network does not consist tools that optimize the number of maximum HARQ retransmissions and to analyze the impact of this optimization on the HSPA system performance (e.g., throughput performance), in our final year project we develop a commercially viable software tool that output this optimal value using the radio data provided by Etisalat Lanka Pvt. Ltd. We model HARQ in HSPA in Matlab with MMSEturboequalization, turbodecoding along with Incremental Redundancy. Ec/Io values calculated through required sample radio measurement data is fed to the model to obtain optimal number of maximum HARQ retransmissions. Other than the requirement raised by Etisalat Lanka Pvt. Ltd, there will be a research component associated because optimizing the maximum number of HARQ retransmissions in HSPA is not a much discussed topic in literature.

Group 16
Sports Analysis Using Video Tracking
Supervisor: Dr. Ajith Pasqual

Introduction of technology for analytical purposes have been able to change the complexion of every sport in past few years. The main objective of this project is to develop an analytical tool for coaches and players for the sport tennis to enhance their approach and techniques towards the game. The finalized bespoke offline analytical tool enriched with friendly user interface will guide user to upload a single video of game and later to perform relevant actions in order to preprocess the video. Continuous tracking of the tennis ball according to instructions from user will compute statistically and technically significant data which will be interpreted in the

graphical form and as well as advanced features like 3D reconstruction.

Group 17
Lte-A Transceiver Implementation Using StreamJIT
Supervisors:
Prof. Dileeka Dias
Dr. Chandika Wawegedara

The main idea of the project is to implement the LTE-transceiver on the novel stream programming language, StreamJIT. We are implementing an uplink 2x2 MIMO transceiver conforming to the LTE-A standards.

The StreamJIT language is built using the infrastructure of the JVM with additional constructs to facilitate the streaming nature of the data being processed and also uses the Opentuner to properly tune the optimization parameters to achieve better efficiency. The main constructs of the language are filters, pipelines, splitters and joiners. The LTE-A transceiver we implement will be tested with a channel we will implement. The main objective is to achieve far better performance than traditional programming languages for multi-core environments giving better efficiency in decoding LTE-A channel data. The portability of the underlying JVM also ensures the portability of the stream programs.

Group 18
Quadrotor Auto-Pilot With Auto Take-Off and Auto Landing
Supervisor: Prof. Rohan Munasinghe

This is development of a VTOL (Vertical take-off, Landing) type unmanned aerial vehicle which is capable of auto-take off, Landing and navigation through given GPS points without human interaction. This is a continuation of a previous

project, expecting improved performance on state estimation and navigation. The UAV has been assembled to support its mathematical model and GPS aided AHRS systems are used for accurate state estimation. Smooth navigation is achieved by trajectory planning/controlling algorithms. Other than regular uses of a fully autonomous flight such as uses in disaster management, object tracking and any other task related with aerial photography, the successful outcome of this project will contribute for integrating VTOL capability to a fixed wing unmanned air craft in the future.

Group 19
40Gbps Deep Packet Inspection Engine
Supervisor: Dr. Ajith Pasqual

Deep Packet Inspection (DPI) Engine is a computer network application, which examines the network packets thoroughly for a known keyword. It looks at the data part of the network packet during inspection, where traditional applications only look at the header part. The DPI engine searches for known keywords to classify or identify threats such as viruses, spam, intrusions and takes actions accordingly.

The applications of the DPI Engine are countless. Deep Packet Inspection in network firewalls, Policy and Charging Rule Function (PCRF), data billing for Internet Service Providers, Quality of Service maintenance of a network are some of them. This project is designed to be implemented on a Field Programmable Gate Array (FPGA). The 40Gbps DPI Engine comes with a PCI Express interface which sends the information about the data traffic to a host computer. The implemented system's architecture has been designed to process network packets rapidly with high accuracy and

many steps have been taken to reduce the power consumption.

Group 20
Analyzing Gait in Lower Limb Amputees Using Inertial Measurements
Supervisor: Dr Pujitha Silva

Lower limb disorders and amputations are common causes for abnormalities in human gait patterns. Currently recognizing these gait disorders at an earlier stage and carrying out rehabilitation process is mainly done by prior experience of the physician. The Inertial Measurement Units based Human Gait Analysis System, done in collaboration with SLSPPO (Sri Lanka School of Prosthetics and Orthotics) provides a more scientific way of identifying and monitoring Gait disorders in clinical study of Prosthetics and Orthotics. It helps the physician by providing real time measurements of human movement and analyzing the Human Gait in detail.

Group 21
Capacity Planning Tool for 3g Network
Supervisor: Dr. Chandika Wawegedara

Capacity planning is a very essential aspect in 3G networks. A 3G system is very complex compared to 2G because 3G uses a single frequency for each and every base station. In 3G it is required to consider both capacity and coverage due to high interdependency. We are developing a web based software as a solution to issues present in the traditional methods used for capacity planning. Following steps will be executed.

1. Derive the coverage foot print and capacity for each and every cell independently
2. Consider adjacent cells and optimize parameters

3. Consider all the cells and optimize parameters

Group 22
Effective Ground Scanning Method for Landmine Detecting Robots
Supervisor: Prof. Rohan Munasinghe

Humanitarian-demining is arguably one of the toughest and high-risk tasks in the world. Minesweepers use many tools in order to accomplish this. Tools have historically included many trained animals, including dogs and rats, but most often in the modern world minesweepers rely on vehicle-mounted mine detectors (VMMD) that are equipped with either metal detectors or GPRs.

Scanning the ground profile just like you are sweeping it with your hand is what required and that is where most of the machines have failed. So an effective ground scanning method is an indispensable part in achieving this. The objective of this project is to develop an advanced tele-operated robot arm to effectively scan the ground. This is mounted on a remotely operated terrestrial vehicle so that humans performing the task are kept at a safe distance. A real time feed of the terrain ahead and other parameters like distance to the ground, speed of the vehicle etc. will be displayed in the remote controller for the ease of operation.

Group 23
Mems Based Data Acquisition with Cloud Based Processing/Alerting System
Supervisors:
Dr. Ajith Pasqual
Dr. Prabhat Samarathunge

This project is to design and develop a marketable product and necessary services for an Internet of Things (IoT)

application. The project was proposed as a cost effective solution to an existing problem and the project idea came from a client who has identified the market potential of this product. The successful implementation of this project can significantly reduce the man-hours that would have been needed otherwise for manual observations while improving the living conditions of the particular group of people. It consists of designing and developing of following components.

1. Small form factor sensors with a very low power consumption that can communicate over Bluetooth Low Energy (BLE)
2. Application software for Android and Linux platforms to communicate with the sensors, along with necessary robust algorithms to interpret the time-series data generated by the sensors
3. A Database, a web back-end and a front-end to store and manage the generated Information

Group 24

Study of Endothelial Function by Non-Invasive Monitoring at the Fingertip

Supervisor: Dr. Anjula De Silva

The endothelium is a highly active monolayer of cells which forms the interior of blood vessels and plays a key role maintaining vascular homeostasis. Many diseases related the cardio vascular system including heart attacks, blood clots, some kidney diseases etc. can be predicted analyzing the condition of the endothelium. Moreover, since endothelial dysfunction is reversible, its early detection and quantification may have greater therapeutic and prognostic value. Therefore through this project we try develop a non-invasive high sensitive and reliable temperature, pressure or volumetric blood flow changes/wave pattern measuring device to analyze the

endothelial function.

Group 25

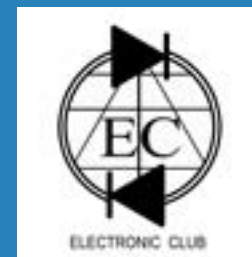
Geo-Sensory Data Mining for Landslide Prediction

Supervisors:

Prof. Rohan Munasinghe

Dr. Upeka Premaratne

Landslides are one of the most devastating natural disasters all around the world. In our project, a wireless sensor network (WSN) is implemented over a selected region to provide an early warning system for rainfall induced landslides. The WSN is composed of several sensor nodes, each of which consists of a geo-phone sensor, soil dampness sensor, rainfall sensor, and a gyroscope. A machine learning model is developed to predict the impending landslides and alert the people to plan the evacuation ahead of time. Our goal is to provide a reliable, scalable and easy to install sensor network to minimize the loss of life and property caused by landslides.



E-Club

Department of Electronic and Telecommunication Engineering
University of Moratuwa

Annual General Meeting

Marking another graceful beginning for a new operational year of the Electronic Club, the Annual General Meeting was held on the 3rd of July 2014 from 6.00 pm onwards at the department with the participation of the Academic staff and students. The new committee was appointed on this day where Mr. Pradeep Sanjeewa was elected as the President while Ms. Nadee Seneviratne was elected as the Secretary. The new junior treasurer is Mr. Samith Elvitigala and Mr. Kasun Piyumal was elected as the Editor of the E-Club. The committee altogether consists of 20 students representing all the batches in the department.

Dr. Ajith Pasqual, Head of the Department addressed the gathering and highlighted the importance of this student body in order to bridge the communication between the staff and the students and also to craft a versatile personality out from the department undergraduates. He mentioned about the significant contribution from the E-Club to uplift the standards of the department as well.

The newly appointed president presented the year plan for the coming year in order to give an insight to the future activities lying ahead.

Tronic Premier League (TPL) 2014

The most awaited sports extravaganza of the department, TPL, was held on the 17th July 2014 at Mora grounds with the ENTC family. TPL is a friendly cricket encounter between all three batches of the department as well as with the academic staff. The purpose of this event is to enhance the bond between department students while giving them the opportunity to enjoy the life at the university despite of the regular academic work.

All the participants were equally talented which made the tournament more and more interesting throughout the day. The finals were held between the teams from Batch '10 and batch '11 and



batch '10 emerged as the champions of TPL 2014 as the only unbeatable team of the tournament. Then a friendly match was held between the team from batch '10 and the team from the staff which was one of the most enjoyable moments of the day's proceedings.

Tronic Shuttle Fest 2014

This badminton tournament is a novel event introduced to the event calendar of the E-Club with the motive of developing the soft skills of the engineering undergraduates in the department. Sports have been identified a major fact that could help create a balanced personality and we at E-Club are willing to provide a platform where everybody could get the opportunity to experience that.

Through this intra-department badminton tournament we expected to recognize those who excel at sporting activities and those who dedicate their time and effort towards the department activities. It was also expected to see the unity between the different academic years would enhance during the tournament which will be of key importance for the department's future activities. It is believed that these kind of events would create an opportunity for every student in the department to experience a different perspective of learning and showcase the unbounded talents of the conventional technocrats.



The grand finale was held on the 4th of September 2014. Men's Category championship was won by a team from Batch '11 while a team from Batch '12 grabbed the winning trophy in Women's category.



Pansilu – The journey towards a musical tranquility

'Pansilu' was an instrumental music concert organized by the E-Club for the first time in the history in collaboration with Batch '10 of the department. The event was held on the 18th of September 2014 at the Civil Auditorium and a large number of passionate music lovers gathered there to witness the brilliant performances of three of the pioneering musicians of our time. The sense of relaxation gained after the enjoyable evening was a unique experience for everyone because these kind of musical evenings are rarely being held for the university community. Music pieces from all the musical eras both western and oriental were played making it enjoyable to all kinds of music lovers.

Mora Hack 2014

Preceding the success achieved in last year, Mora Hack organized by the Dialog Ideamart in collaboration with the Electronic Club of University of Moratuwa was successfully held for the 2nd consecutive year on the 29th and 30th of August 2014 at Dialog Future World with the participation of enthusiastic UoM undergraduates pioneering in mobile application development. Despite the huge competitive environment, it was full of fun and enjoyment! The was held with the intention of generating creative and innovative applications using Ideamart platform.

The Winner of the Mora Hack 2014 was team EI, a team from the faculty of Information Technology who developed IMTraffic API to monitor traffics and used those details as business analytical tool. A team from the department of Electronic and Telecommunication secured the 1st runners up position. The significance of this initiative event is that apart from the fabulous prizes acquired, the competitors had the opportunity to generate continuous revenue through their mobile applications by being a Dialog Ideamart app developer.

E-Care 2014

The Department of Electronic and Telecommunication Engineering always encourages the importance of unity among its students in striving towards excellence. It is with this motive, the E-Club initiated the project E-Care several years ago, in order to harness the brotherhood between our undergraduates. E-Care is the department's major CSR activity where all the students in the department join hands together regardless of all the ethnic and religious differences with the ultimate objective of serving the community as the professionals-to-be.



This year, the E-Care project consisted of an array of activities ranging from dissemination of knowledge to entertainment. Balangoda Hatharabhage Vidyalaya was chosen for the E-Care project this year and the event took place on the 20th and 21st of December 2014 with the voluntary participation of department students.



Situated about 10 km away from Balangoda Town, Hatharabage Vidyalaya is a village school with around 160 students studying from Grade 1 to Grade 11. When the E-Club initially contacted the Principal of the school we were able to identify several major issues faced by the school which is affecting the studies of the students.

With the generous donations provided by the Department Academic staff, ENTC Alumni and present undergraduates, the E-Club was able to collect financial donations amounting to LKR 168,200. Apart from that goods worth of approximately LKR 18,000 were collected along with story books to be donated to the library.

We were able to carry out following tasks during the two days spent there.

- Electrical wiring and installation in the main hall, class rooms and the science laboratory
- Painting the buildings, desks and chairs
- Donating sporting equipment
- Donating stationary items gift pack for each student in the school and story books and work books to the school library
- Rearranging the library
- Repairing the computers in the computer laboratory
- Conducting a motivational session and an IT seminar for Grade 10 and 11 students
- Constructing the Volley Ball court
- Drawing wall pictures
- Interactive session followed by a prize giving symbolizing the donations of sporting equipment and stationary items with the participation of school students and parents

At the end of the day, there is nothing more rewarding than the smiles we drew on the little kids' faces with what we did and each and every one of you in the ENTC family deserves a share in the credits.

SLRC 2014

University of Moratuwa, being the country's leading technological higher education institute, have been monumental in introducing cutting-edge technology to the local communities. This event is a gateway for all those interested in robotics and industry automation to unleash their talents in the field to a much versed audience and also in itself a gathering for the tech savvy youth to enhance their knowledge and gain outright experience. Alongside with the Department of Electronic and Telecommunication Engineering, it has been a key partner in organizing the Sri Lankan leg of the robot competition for 'Techfest-International Robotics Challenge- 2015' (IRC) for the 7th consecutive time this year.

Sri Lanka Robotics Challenge 2014 was focused on three major events: Industry Challenge, University Challenge and School Challenge. Industry and school level category competitions were held on the 11th of December 2014 while the university category competitions were held on the following day.

The University category named as 'Island Thunder' was open for all the innovative Sri Lankan undergraduates (government or private). This challenging competition was the Sri Lankan Country Final for the IRC. The unbeatable winners of the competition were to compete at the finals of Techfest 2014-15 at IIT, Bombay, India. After a huge competition we are happy to say that all three winning teams were from University of Moratuwa. Cash prizes were awarded for the winners to participate in Techfest-India. Then, the teams who became 1st and 2nd in the competition competed at the finals of Techfest and the team comprising of Kaluarachchi K. K. T. I., Singhabahu C. M., Elayes R. P. M., Senarathna H. P. M. D. D. and Senevirathna N. M. became the champions of this international competition as well and more importantly this is for the 2nd consecutive year we brought glory to our motherland.

SLRC school category competition ('Shadow Wars') was conducted under the aim of delivering the island wide school community, a platform and an opportunity to experience one of the biggest national level robot competitions in Sri Lanka. This was a great opportunity for the school students who expect to pursue studies in universities in the field of robotics and industrial automation. By organizing such a competition E-Club intends to uphold the awareness and the positive attitudes among school community, about Robotics and Automation. The winners in this category was the team from Dr. Richard Pathirana College, Galle.

Again it was the teams from our very own university clinched the gold, silver and bronze medals in the Industry category as well, doing much proud to the university depicting the true caliber of our undergraduates.



Lecture Series and Workshops

Electronic Club always helps the department in organizing academic related events in order to help the students to enlighten their technology related knowledge. A 3D printing demonstration workshop was held in the department in order to promote the 3D printing facility which is going to be introduced to the department soon which is a low cost high quality prototyping solution.

E-Club facilitated a higher education guidance seminar which was conducted by Dr. Suranga Nanayakkara, Assistant Professor at Singapore University of Technology and Design (SUTD) in order to make the department students aware of the leading-edge research opportunities with overseas internships and attractive scholarship funding.

E-Club also contributed to organize two other technical lectures which were held at the department. The first one is about 'Technical Writing' by Mr. Nihal Kularatna, Senior Lecturer, Engineering, University of Waikato, New Zealand who is also the Author of several books on Electronics. The 2nd one is on 'Introduction to Systems Thinking/Systems Engineering' by Dr. Padman Nagen-thiram, a Retired Chief Systems Engineer, Boeing Corporation.

Athwala – Pay it Forward

This is a scholarship scheme initiated by the Electronic Club starting from this year onwards with the intention of providing financial aids exclusively for the department undergraduates who are in need. The benefactors of the funds would be the ENTC Alumni who have eagerly joined hands with the E-Club for this noble cause.

Through this initiation, the E-Club expects that the financial barriers will not limit the odyssey beyond excellence of our undergraduates. Athwala will help the brilliant minds of the department to perform better in their academic career while engaging in extra-curricular activities.

This brings out another perspective for the brotherhood of the ENTC family by enhancing the relationship between the ENTC Alumni and the present undergraduates. We at E-Club, believe that the future generations will understand the duty towards their alma-mater through this project.