

# E CARRIER

THE OFFICIAL MAGAZINE OF ENT C



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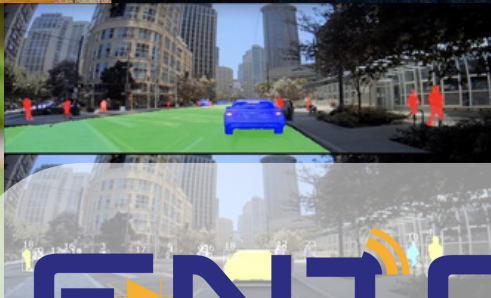
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# ENVOYAGE



# ENTC

Electronic and Telecommunication Engineering



E-CARE 2024

ENTC





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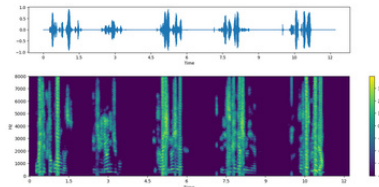
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## TECHNICAL

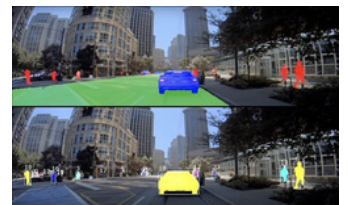


### MEL-FREQUENCY CEPSTRAL COEFFICIENTS

Discusses how MFCC captures essential speech characteristics and explore the potential of integrating MFCC with deep learning for superior speaker recognition performance.

### IMAGE SEGMENTATION

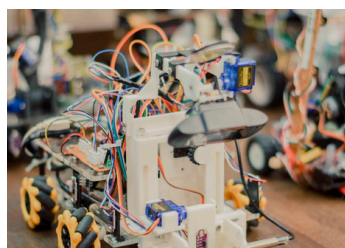
Delve into semantic, instance and panoptic segmentation methods highlighting deep learning-based models like Deeplab, U-Net, and Meta AI's Segment Anything Model. Discover their applications in autonomous vehicles, medical diagnostics, and robotics.



## NEWS

### RASPBERRY PI 4 MODEL B GIFTING

Raspberry Pi 4 Model B kits gifting to ENTC 2021 batch students as part of the SPARK program, fostering innovation, hands-on learning, and the development of sustainable solutions.



### SLRC 2024

The Sri Lankan Robotics Challenge (SLRC) 2024, the country's largest robotics competition, celebrated its 11th edition. Organised by the E-Club of University of Moratuwa.

## SPOTLIGHT



### A STUDENT TO SHINE

"Dedicate your brain to what your heart truly desires, because the impossible becomes possible only when your heart and brain are in synchrony."

# A Chat with Alumni

by Mihiran Wickramaratne



Mr. **Sandun Rathanayake**, a distinguished alumnus of the Department of Electronic and Telecommunication Engineering (ENTC), is currently serving as a Manager in Test and Validation Engineering at Synopsys. I believe his experience and expertise in the field will give you a fruitful and insightful insight into his field and the secrets behind his success. So, let's dive in.

**1. Reflecting on your undergraduate experience, could you share insights into the values that significantly shaped your career and personal development? Were there any particular experiences you found influential?**

Reflecting on our journey during that time, we initially had a year-long department selection process compared to the current way. The department stood out as a pivotal experience. I found myself greatly inspired by the remarkable achievements of our senior peers in various departments. Their projects sparked a deep interest within us, motivating us to join and engage with these activities.

At first, the work of our lecturers and seniors sometimes seemed beyond our grasp. But it played a crucial role in shaping our perspectives. I was amazed by their emphasis on undertaking projects and contributing to the development of

Sri Lanka. Overall, the collective influence of these individuals had a profound impact on our trajectory, guiding us toward personal and professional growth within ENTC.

**2. Navigating the diverse landscape of Electronic and Telecommunication Engineering, finding one's passion can be challenging. How did you discover your passion? Were there specific experiences, mentors or challenges that helped you identify and pursue your interests?**

Some people discover their passion early on, while others find it later in life. Until my third year, I followed a common path, unsure of the specific area I should focus on.

At that time, internships in the telecommunication field were very popular, and I decided to follow that path. I found that I was good at it. However, during my final year project, something interesting happened. We did a FPGA-related project under the supervision of Dr. Ajith Pasqual. This experience was a significant turning point in my career, as it helped me realise that this was the area I wanted to focus on.

In 2011, when I was graduating, representatives from Atrenta visited our university. They were just starting their business in Sri Lanka at the time, and I found their vision interesting. I joined them as one of the initial employees, specifically the ninth employee. We grew with the company, and now I am here.

There are so many opportunities out there for you to explore. If you feel like you haven't found your area yet, it's better to keep exploring.

**3. Can you provide an in-depth explanation of the scope and responsibilities of your role as a Manager of Test and Validation Engineering at Synopsys? How do you ensure product quality and reliability while overseeing testing processes and managing a team?**

Synopsis is an Electronic Design Automation (EDA) company. It's a software company that develops software for the electronic industry. The role of a Test and Validation Engineer is to test products initially and qualify them before they go to the customer. They check whether the product works as intended, whether new features meet customers' requirements, etc. Knowledge of electronics is very essential in this role. I am also a part of the Test and Validation section. Currently, I work with a team of around 50 people residing in Sri Lanka and India on static verification products.

**4. Considering the dynamic nature of the engineering industry, what do you consider the most crucial skills for professionals to possess? How do these skills contribute to success in navigating challenges and advancements within the field?**

Engineering is a dynamic industry, as you said. And we should be able to adapt to new trends in the field. In my career, we first used Perl for scripts, and then Python became popular because it was more efficient. Then Machine Learning became popular, so we had to incorporate Machine Learning in our projects. Now, we have Generative AI. We should touch on Generative AI and how it can be plugged into our activities. In my role, a good example is test generations. If we see any monotonous activity, we can probably use Generative AI.

Well because of these new technologies, we can move on to more advanced projects because technology is helping us with ground level work. Curiosity is the most important thing you should have and always be ready to learn.



**5. Besides technical engineering expertise, what additional skills do you believe are essential for professionals in engineering? How do skills such as communication, problem-solving and project management contribute to success in your role and within the industry?**

Well, there's this concept of dual career ladders. On one path, you have individuals who thrive on technical aspects; they become staff engineers, principal engineers and scientists etc. On the other hand, there are those who blend technical knowledge with people skills, leading them into roles like team leads and project managers etc. Not everyone fits neatly into one category, and that's okay. Both paths grow and develop simultaneously.

First, technical skills are crucial. Beyond technical skills, skills such as effective communication are important, whether it's through emails, appreciating colleagues, or managing conflicts and risks.

Collaboration with other teams and exploring new horizons are crucial. Most companies offer activities such as innovative days and empower a constant drive for exploration. Learning from peers and adjacent curiosity also plays an important role, as they often bring fresh perspectives.

Consistency is another important factor. Some people grow over time. In sum, all these skills are needed and play an important role in thriving in the industry.

**6. Can you discuss your experience with maintaining work-life balance during your time at university and how you believe it has influenced your approach to balancing professional responsibilities in your career?**

When it comes to maintaining work-life balance, everyone has their own definitions. For some, it might mean strictly working on set hours; for others, it's about getting the work done. Then there are those who work as their hobby.

Understanding one's personal definition is crucial, alongside considering the requirements of their job title and the organisational culture. Companies often provide resources to support this balance, but ultimately, each person needs to define what balance means to them without comparing themselves to others.

Reflecting on my experience at university, it was different compared to the professional world. We had projects and assignments, and a group of people was involved in the same task. It has been done by many others in the past so we could share knowledge and experiences. However, in a career, tasks tend to be more unique, requiring a different approach. But final year projects are similar to the professional world because your team is working on a unique problem. My approach in university was to work diligently, with the mindset of enjoying the rewards later. I was also involved in some club activities, including being the Secretary of the Nature Team. Most of my colleagues were also involved in clubs and societies or sports, and I believe it's necessary. But my approach isn't universal. Everyone must discover their own balance that aligns with their priorities and lifestyle.

**7. If you had the opportunity to meet your undergraduate self today, reflecting on your journey and experiences in the field, is there any particular advice or insight you would share?**

Certainly, there's some advice I'd offer my undergraduate self. In university, we often establish divisions based on factors such as department, hometown, or political views, which can impact collaboration and productivity. Engaging with a diverse range of colleagues provides a richer learning experience and opens doors to new perspectives and opportunities. So, I'd encourage my younger self to actively seek connections across these boundaries.

Then, I would advise myself to engage more in projects and competitions. These experiences not only enhance technical skills but also provide opportunities to develop teamwork, problem-solving abilities, and creativity.

Even now, when I interview new candidates, these are some of the qualities that I look for. Sometimes, I reflect on my undergraduate years and realise I could have done more.

**8. Lastly, as someone established in the field of Electronic Engineering, what advice would you offer to undergraduate students keen on pursuing a career in your industry?**

I'd say learn Hardware Descriptive Languages (HDL) and get your hands dirty with coding projects. Hands-on experience is invaluable, so the more you can see yourself in real-world projects, the better. You should learn a lot of things by yourself. The SolvNet platform offered by Synopsis is a good example of a platform that offers learning materials to undergraduates. You can also earn certificates from these platforms, so don't hesitate.

Another great tip is to get involved in worldwide competitions. Winning is not the only priority. It pushes your boundaries and exposes you to new technological materials and skills. Stay tuned in to the tech world. Read tech articles on the internet. Keep in touch with major players like Nvidia, Apple, AMSL, etc. EDA is a vast field, so it's also beneficial to understand what's going on there.

Remember, having additional skills and experiences will make you stand out once you graduate. So seize every opportunity to broaden your horizons and set yourself apart from the crowd. It's all about leveraging your unique strengths to thrive in this dynamic and rapidly evolving field.

# Mel-Frequency Cepstral Coefficients: Looking Beyond the Spectrum of Human Speech

by Devnith Wijesinghe

The Fourier transform, a convenient technique to determine the frequency components of a signal, serves as one of the primary methods to extract features of an audio signal. However, with the advancement of the signal processing domain, more sophisticated methods such as short-time Fourier transform (STFT) and wavelet transform have been developed. In this article, we demonstrate one such evolved technique named “mel-frequency cepstral coefficients” (MFCC), which is adapted particularly for speech recognition tasks as a competent feature extractor. Furthermore, we delve into an effective application of this technique for speaker recognition at the IEEE Signal Processing Cup 2024 competition.

## Feature Extractors: The Datasheet of Signals

Before tackling what MFCC practically means or its derivation, we first consider the necessity of such a tool. Simply put, a feature extractor identifies certain qualities of a signal, similar to how characteristics like age, height, weight and gender describe a human. They extract key features of an audio signal, like its power, frequencies and rate of change. A trivially simple feature extractor of an audio signal is its root mean square value. This tells us about the power contained within the signal. The zero-crossing rate is another such primary feature. This is a measurement of how fast the signal changes. It is a widely used metric in speech recognition and music information retrieval. Both these tools extract features of the signal in the time domain. However, integral transforms such as the Fourier transform (FT) enable us to investigate the domain of frequency, which unravels new features. The FT, or its primary derivative, power spectral density, encapsulates entirely the frequency components included in the signal and their relative power. However, by converting to the frequency domain, we lose temporal information. As a solution, we mediate the trade-off and localise the signal both in time and frequency by taking the STFT. The STFT, commonly known as the spectrogram, of a speech signal is shown in Figure 1.

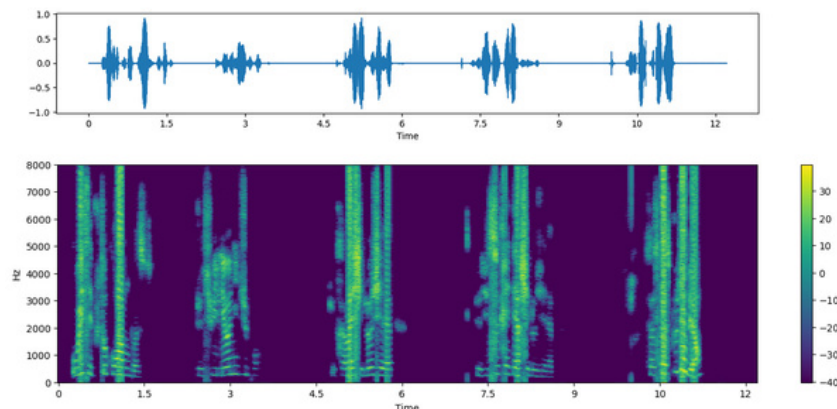


Figure 1 - The short time Fourier transform of a speech signal

This is a map of which frequencies are present at which time, hence a better feature extractor for speech signal processing. Usually, this is depicted using a figure more commonly known as a spectrogram. But what is the significance and superiority of MFCC when it comes to speech signal processing?

## Mel Scale: Extracting Human Voice Through Math

It was found that, by taking the spectrum of a spectrum, the periodic structures of the frequency spectrum can be visualised [1]. This tool is sensitive to the low-frequency periodic excitation produced in the human vocal cords and the formant filtering which the voice signal is subjected to in the larynx. This approach to frequency domain analysis, cleverly named as the cepstrum (anagram for spectrum), opened up a newfound domain in signal processing known as cepstral analysis. The exact formula for the cepstrum is as follows,

$$C_p = \left| F\{\log(|F\{f(t)\}|^2)\} \right|^2$$

Moreover, it was found that by interfering at the log-scaling stage, the cepstrum could be made more sensitive to human voice by taking the mel-scale [2] instead of simply the log-scale. The mel-scale is a perceptual scale of pitches, which, when used to scale the spectrum coefficients, results in a better representation of the cepstrum; and thus, we obtain the mel-frequency cepstrum. The formula for the mel-scale is as follows.

$$f = 700 \left( 10^{\frac{m}{2595}} - 1 \right)$$



The detailed process of calculating the cepstrum involves applying a triangular filter-bank and several other technical details.

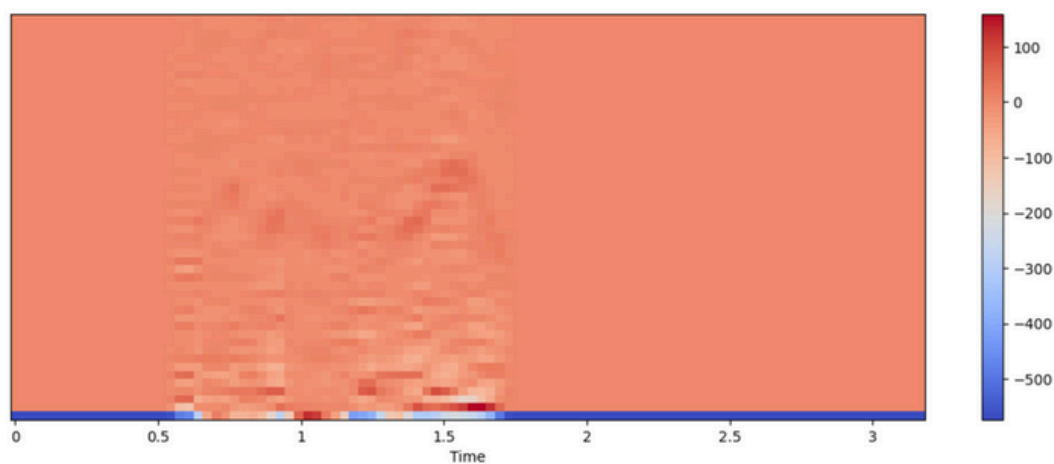


Figure 2 - The mel-frequency cepstrum of a speech signal

Next, we consider how to put the MFCC to good use in speech signal processing tasks. The next section builds on our experience from Signal Processing Cup 2024 as a case study to outline how MFCC can be integrated with deep learning techniques to build a speaker recognition inferencing system.

### Robovox Challenge: The Synergy of MFCC and Deep Neural Networks

The main task of the Signal Processing Cup 2024, organised by the IEEE Signal Processing Society, involved screening samples of noisy voice recordings from different speakers and identifying which speaker each recording belongs to from a pool of 71 speakers. During our attempt to provide a solution to this classification task, we applied the technique of extracting MFCC from the audio samples and feeding them into a deep neural network (DNN) to train it. Neural networks are a popular deep learning method where the model learns to identify features in the given data by itself. Therefore, when a feature extractor [3] of an audio sample (such as STFT or MFCC) is fed into a DNN model, it learns to create a feature space, known as an embedding, from several such samples of audio. That is, when given a unique voice recording of a speaker, the model maps it to a certain point on a feature space (similar to a vector space) unique to that speaker. We can force the model to map recordings of similar voices to the same point, by selecting an appropriate loss function. During our implementation, we architected a popular DNN structure known as a bidirectional long short-term memory with triplet cosine loss as the loss function. This loss function relies on Cosine distance, a popular metric of similarity in a vector embedding context. Using the speaker embedding we formulated using this approach, we were able to accurately do inferences on new data and classify which speaker each recording belonged to.

In conclusion, MFCCs prove to be versatile tools in speech recognition. They are a clever method of extracting features like pitch, tone, and the nature of utterances from the human voice. Moreover, this signal processing technique, when paired with modern data-driven learning methods such as deep learning, can help solve a variety of problems related to speech data processing.

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# Image Segmentation

by Sasika Amarasinghe

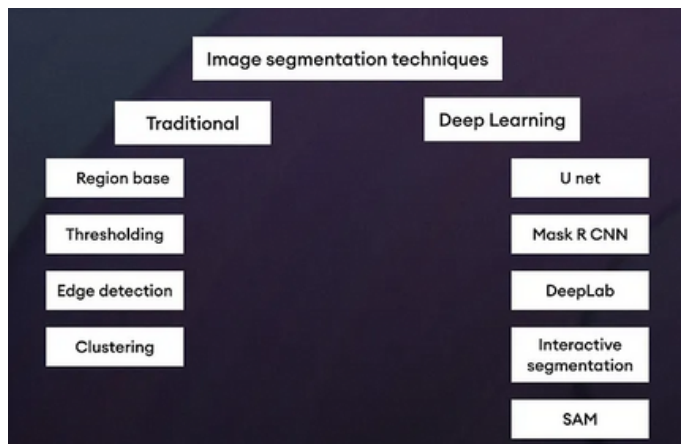
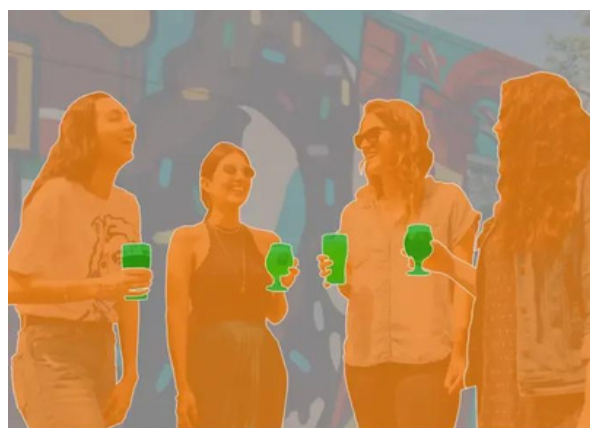


Image is adapted from blog of "superannotate.com"

As the name suggests, image segmentation is the concept of partitioning a digital image into multiple segments or image objects. The goal of image segmentation is to simplify and/or change the representation of an image into something more meaningful and easier to analyse. Image Segmentation methods can be classified into 2 categories.

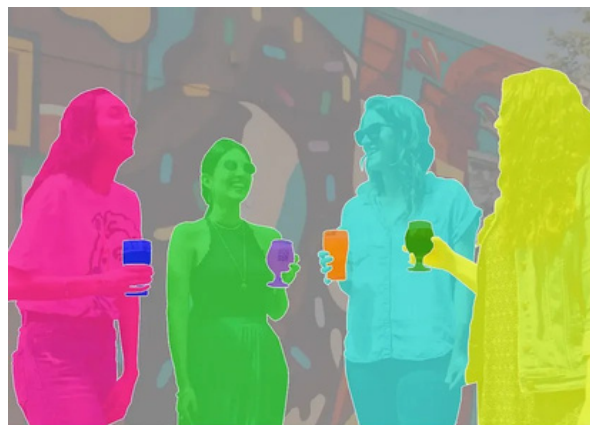
1. Traditional
2. Deep Learning



Semantic Segmentation (Image is adapted from blog of "superannotate.com")



Instance Segmentation (Image is adapted from blog of "superannotate.com")



Panoptic Segmentation (Image is adapted from blog of "superannotate.com")

## Types of Image Segmentation methods

### 1. Semantic Segmentation

Before we dive in, let's see what "semantic" means. According to the Oxford Dictionary, it is "connected with the meaning of words and sentences". In this context, we are trying to assign meaning to different pixel clusters in an image.

In Semantic Segmentation, all pixels in the image belong to a particular class. If two pixels in the image are categorised as "people", then segmentation mask pixel values will be the same for both of them. In the given figure, all the people are categorised under one element. Note that pixels corresponding to respective persons are not categorised into different masks.

### 2. Instance Segmentation

Unlike semantic segmentation, instance segmentation not only assigns class labels but also differentiates between distinct instances of objects within the same class. For example, in an image with multiple people, instance segmentation would assign a unique ID to each individual, effectively separating them.

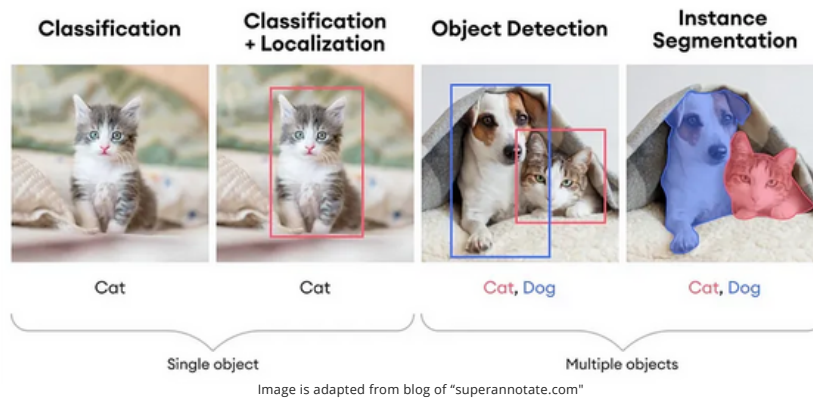
### 3. Panoptic Segmentation

Panoptic segmentation is a combination of Semantic Segmentation and Instance Segmentation. In panoptic segmentation, every pixel in the image (belonging to both object and stuff classes) should be labelled, and pixels from different instances should have distinct values, even if they belong to the same category. It's important to note that the background is also masked in panoptic segmentation, unlike in instance segmentation.

## Image Classification vs Detection vs Segmentation

Image segmentation is often merged together with other image annotation processes such as image classification, localization, and object detection. While they may seem similar, each process has its unique characteristics. Now that we have defined what image segmentation is, let's briefly define the characteristics of each one.





**Image classification** - A single class is assigned to an image, typically corresponding to the main object depicted in the image. For instance, if an image contains a cat, the image will be classified as "cat". With image classification, we do not determine the precise location of the cat in the image nor can we identify its boundaries compared to object localization, detection, or segmentation.

**Object detection** - The objects within an image or a video are detected, marked with a bounding box, and then labelled. The primary difference between object detection and image segmentation lies in the final output. With object detection, the key identifier is the bounding box that draws a square or rectangle around the boundaries of each object. In contrast, image segmentation considers the entire outline of the object, excluding any background content.

**Localization** - With image/object localization, we can identify the location of the main subject of an image. However, image localization does not typically assign classes to the localised object as it focuses on the main subject rather than all of the objects present in a given frame.

These are some questions that we can ask in each of the above computer vision tasks :

- Classification: Is this a cat?
- Object Detection: What is there in the image and where?
- Image Segmentation: Which pixels belong to which object?

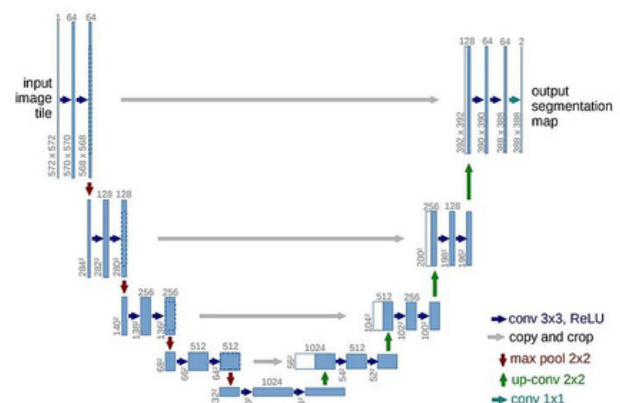
## Deep Learning Based Image Segmentation

**Deeplab** is a state-of-the-art convolutional neural network architecture designed for semantic image segmentation. It employs atrous convolution, also known as dilated convolution, to capture multi-scale context information without down-sampling the input. With its deep architecture and powerful feature extraction capabilities, Deeplab achieves high-quality segmentation results even for large and complex scenes. It has been widely used in various applications such as autonomous driving, medical image analysis, and scene understanding in robotics, where precise segmentation of objects and backgrounds is crucial for making accurate decisions and navigating environments safely and efficiently.

**U-Net** is a convolutional neural network architecture designed for image segmentation tasks, particularly in the field of medical image analysis. Its distinctive U-shaped architecture consists of a contracting path for capturing context information and an expansive path for precise localization. U-Net is highly effective for segmenting structures of interest in medical images, such as organs, tumours, or cells, due to its ability to capture fine-grained details and spatial relationships. It has become a standard model for various segmentation tasks in medical imaging, facilitating advancements in diagnosis, treatment planning, and research in healthcare applications.



Segments done by SAM model (Image is adapted from "Segmented Anything" paper by Meta AI)



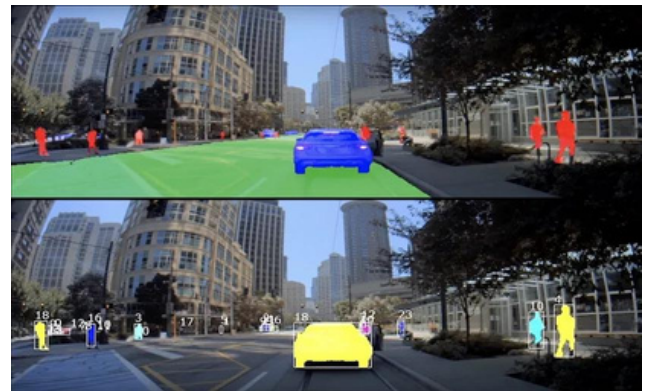
Unet Architecture (Image is Adapted from "U-Net: Convolutional Networks for Biomedical Image Segmentation" by Olaf Ronneberger, Philipp Fischer, Thomas Brox)

**Segment Anything Model (SAM)** by Meta AI excels in image segmentation, pinpointing specific objects or all objects within an image. This state-of-the-art foundation model thrives on promptable segmentation tasks, using spatial or textual prompts to create accurate segmentation masks. Notably, SAM achieves zero-shot performance on new objects and images, bypassing the need for further training. This model was trained using one image to multiple target masks. This model supports point prompts, area prompts, and text prompts, meaning you can input point coordinates, an area, or even a text prompt to segment images.

## Applications of Image Segmentation

### Autonomous vehicles

Self-driving cars use semantic segmentation or panoptic segmentation to see the world around them and respond in real-time. Semantic segmentation separates what the car perceives into categorised visual regions like lanes on the road, other cars, and intersections. The insights provided to the car by semantic segmentation enable it to navigate safely, and take crucial actions in response to unexpected events like a pedestrian crossing the road or another car braking suddenly.



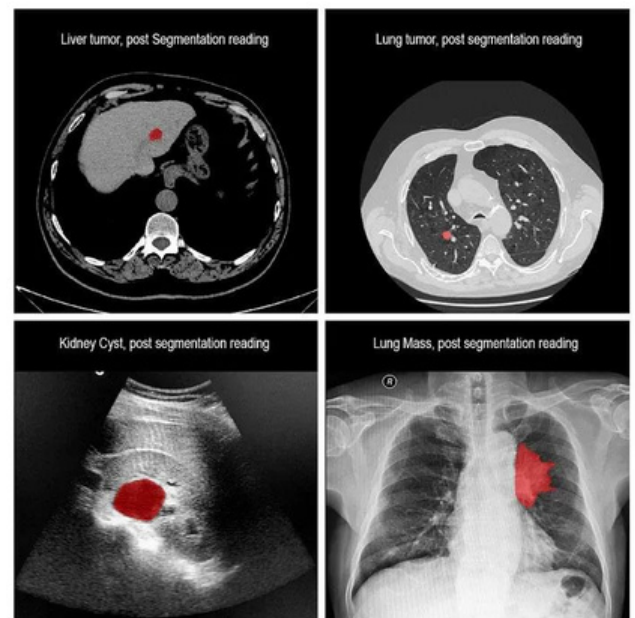
### Medical diagnostics

Many common medical procedures such as CT scans, X-rays, and MRIs rely on image analysis. While this task has typically been performed by a medical professional, today, medical image segmentation models are achieving similar results. By analysing the image and drawing exact boundaries around the various objects in it, semantic segmentation can help detect anomalies and even suggest potential diagnoses.

### Robotics

Image segmentation in robotics enables machines to interpret visual data by dividing images into distinct regions. This allows robots to identify objects, navigate environments, and interact effectively with their surroundings. By segmenting images into meaningful components, robots can make informed decisions and perform tasks such as object recognition, obstacle avoidance, and path planning autonomously.

In conclusion, image segmentation is a powerful and transformative technique in the realm of computer vision and artificial intelligence. As deep learning-based methods continue to advance and refine image segmentation, the potential for this technology to reshape industries, improve daily life, and unlock new possibilities is immense and inspiring.



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# Honouring the Past, Embracing the Future: A Tribute to Dr. Rodrigo and a Warm Welcome to Dr. Subramaniam

by Dinujaya Wijewickrama



## Dr. Ranga Rodrigo: A Fond Farewell as Head of the Department

In April 2024, the Department of Electronic and Telecommunication Engineering (ENTC) bid farewell to Dr. Ranga Rodrigo as he gracefully stepped down from his position as Head of the Department (HoD). Dr. Rodrigo's departure marks the conclusion of a tenure marked by exemplary leadership and profound contributions to the department's growth and development.

Dr. Rodrigo's academic journey is distinguished by his pursuit of excellence. He earned his Bachelor of Science in Engineering from the University of Moratuwa, Sri Lanka, graduating with first-class honours. He furthered his education abroad, obtaining a Master of Engineering Science and a Doctor of Philosophy in Electrical and Computer Engineering from The Western University of Canada. His doctoral research focused on computer vision, specifically indoor feature tracking, demonstrating his expertise in a specialised area of study. Dr. Rodrigo's scholarly endeavours have significantly enriched the academic landscape. His research contributions are evidenced by numerous publications in esteemed conferences and journals. His work encompasses a wide range of topics, from convolutional filter optimization to context-aware image processing techniques. Each publication underscores his commitment to advancing the boundaries of knowledge within his field.

Throughout his tenure as Head of the Department, Dr. Rodrigo exemplified exemplary leadership qualities. His guidance propelled the department to new heights, fostering an environment conducive to academic excellence and student welfare. Dr. Rodrigo's decisive leadership and compassionate mentorship have left an indelible mark on the department, shaping the professional trajectories of both faculty and students alike. Dr. Rodrigo's exemplary leadership extended beyond administrative duties; he never missed events involving ENTC students, demonstrating a fatherly commitment to their academic and personal development.

As Dr. Rodrigo transitions from his role as Head of the Department, the ENTC community expresses deep gratitude for his dedicated service and enduring contributions. While his formal leadership as HoD may conclude, his wisdom and expertise will continue to enrich the department's endeavours for years to come.

## Dr. Thayaparan Subramaniam: Leading ENTC into a New Era

The Department of Electronic and Telecommunication Engineering (ENTC) welcomes Dr. Thayaparan Subramaniam as its new Head, ushering in a new chapter of growth and innovation under his capable leadership.

Dr. Thayaparan Subramaniam brings a wealth of academic and professional experience to his role. He obtained his PhD from the University of Hong Kong in 2000, following his undergraduate studies at the University of Peradeniya in 1994. With over a decade of industry experience, where he worked for renowned companies such as Sri Lanka Telecom, Agilent Technologies, Avago Technologies, and ST-Microelectronics, Dr. Subramaniam's contributions to these organisations were in alignment with the fields of digital systems and integrated circuit design. Since 2011, Dr. Subramaniam has devoted his time to imparting his knowledge and experience as a Senior Lecturer at the University of Moratuwa. His unwavering commitment to academia has inspired many undergraduates over the years.

Dr. Subramaniam's research interests span a wide range of areas, including noise reduction techniques in digital systems, digital system designs, and IP developments for integrated circuits. His expertise in these areas positions him as a valuable asset to the department, fostering innovation and advancement in both research and teaching.

Known for his kindness and strong leadership qualities, Dr. Thayaparan Subramaniam is poised to guide ENTC into a future brimming with possibilities. With Dr. Subramaniam at the helm, ENTC embarks on a journey of transformation, fueled by optimism and a shared commitment to excellence.

As Dr. Subramaniam assumes his new role, the ENTC community eagerly anticipates the realisation of a future where magic is not merely imagined but intricately woven into the fabric of everyday endeavours. With Dr. Thayaparan Subramaniam leading the way, the department stands poised to achieve new heights of success and distinction.



# An ENTC Undergraduate's Contribution to Two Papers on Neuromorphic Audio Signal Processing, with Spiking Neural Networks and its Security

by Dusara Camidu



Throughout history, ENTC has been a home for many talented individuals across various academic fields. Today, we are celebrating the achievement of one such individual, Hiruna Vishwamith, a third-year undergraduate in the department.

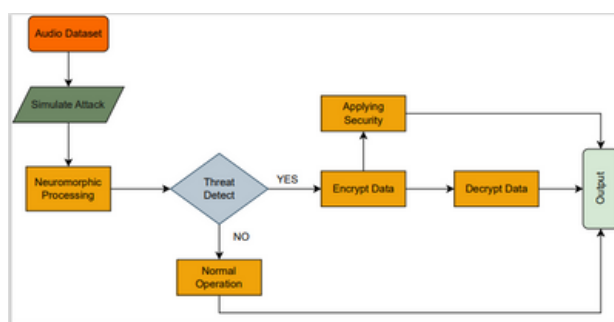
Hiruna Vishwamith, an alumnus of St. Joseph Vaz College, Wennappuwa, has shown a passion for designing and implementing hardware-accelerated machine learning models, reconfigurable electronics, and computer architecture during his time at the university. In his third year of study, he had the opportunity to conduct research related to machine learning with Murat Isik, a research scholar at Stanford University who was also pursuing a PhD at Purdue University.

After successfully concluding their research, the team published two papers at two academic conferences. The papers, titled "HPCNeuroNet: Advancing Neuromorphic Audio Signal Processing with Transformer-Enhanced Spiking Neural Networks" and "NEUROSEC: FPGA-Based Neuromorphic Audio Security" were presented at the IEEE INTCEC 24 (Interdisciplinary Conference on Electrics and Computer) and ARC 24 (Applied Reconfigurable Computing), respectively.

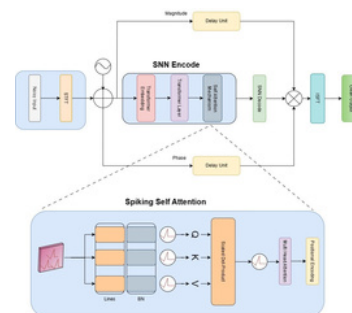
Hiruna, Murat Isik from Stanford University and I. Can Dikmen from Temsa R&D Centre in Turkey found that efficiently processing audio signals in noisy environments is a challenging task. As a result, the team decided to go for a hardware-accelerated approach to "neuromorphic computing". Neuromorphic computing is an emerging field that aims to mimic the structure and operation of the human brain, using artificial neurons and synapses to process information. For this, they used spiking neural networks (SNN), which more closely resemble the human brain function than artificial neural networks (ANN). Simply put, SNNs differ from traditional neural networks by the input being spikes rather than a continuous stream of data. The SNNs were combined with transformers to create the final model architecture named, "HPC Neuronet". It employs the short time Fourier transform (STFT) for time-frequency representation, transformer embeddings for dense vector generation and SNN encoding/decoding mechanisms for spike train conversions. Apart from using traditional hardware like CPUs and GPUs, the team also created a novel and efficient implementation on a FPGA platform, which outperformed existing solutions in both efficiency and flexibility.

The second paper, "NEUROSEC: FPGA-Based Neuromorphic Audio Security", discusses the resilience of the HPC Neuronet model against security threats. This time, the team was joined by two additional members, Yusuf Sur from Abdulla Gul University in Turkey and Kayode Inadagbo from Prairie View A&M University in Prairie View, TX, USA. Their results highlight the robustness and precision of the FPGA-based neuromorphic system. Specifically, the system showcased a commendable balance between the desired signal and background noise, efficient spike rate encoding, and unparalleled resilience against adversarial attacks such as FGSM and PGD. A standout feature of the framework was its detection rate of 94%, which, when compared to other methodologies, underscored its greater capability in identifying and mitigating threats within a commendable signal to noise ratio (SNR) of 5.39 dB.

Hiruna and the team will be presenting at IEEE INTCEC in June this year. He has a long journey ahead of him. We wish Hiruna all the best in his future endeavours and hope he continues to bring more recognition to the department.



Neurosec



HPCNeuronet



# Revolutionising Healthcare: BioSense-AI Takes 3rd Place at MECHA 2023

by Isuranga Senevirathne

A noteworthy accomplishment in the rapidly evolving field of medical technology innovation was made at the Medical Electronics and Coding Hackathon (MECHA) 2023, the esteemed Medical Technology Hackathon hosted by the Medical Faculty Science and Technology Community (MFSTC) and the Department of Medical Technology at the University of Colombo. Amidst the multitude of creative ideas showcased, BioSense-AI secured the third position in the open category, marking a significant advancement in its developers' careers and emphasising the potential to revolutionise healthcare.

The BioSense-AI system was created by a group of students from the Electronic and Telecommunication Department at the University of Moratuwa, including Hasitha, Sandun, Jaliya, and Thuvaragan. It combines state-of-the-art technology with a dedication to improving healthcare accessibility and effectiveness. This revolutionary pocket-sized health monitoring device represents a paradigm shift in personalised healthcare, offering real-time insights and empowering individuals to manage their well-being proactively.

What makes BioSense-AI stand out is its unique approach to health monitoring. The device's precision analog circuitry provides accurate ECG signal collection, giving users crucial insights into their heart conditions. Its small size and rechargeable design make it highly portable, allowing users to check their health from anywhere at any time. However, the most innovative feature of BioSense-AI may be its integration of machine learning and artificial intelligence. The device displays real-time ECG readings and uses sophisticated machine learning models to accurately detect and classify different heart diseases, all communicated seamlessly to a smartphone app.

With unmatched precision, BioSense-AI can detect and classify a wide range of illnesses, from pneumonia and bronchitis to asthma and heart failure. It can classify ECG signals in detail, including fusion beats, supraventricular ectopic beats, ventricular ectopic beats, and non-exotic beats. However, BioSense-AI is more than just a technological marvel; it's evidence of how innovation can propel advancements in healthcare. BioSense-AI enables people to proactively take charge of their health and well-being by providing them with actionable insights.

In the halls of MECHA 2023, BioSense-AI may have been awarded the third place, but in the realm of healthcare innovation, its impact is immeasurable. As we celebrate the achievements of Hasitha, Sandun, Thuvaragan and Jaliya and their groundbreaking creation, let us also look to the future with optimism and anticipation, knowing that the best is yet to come.



# Excellence at the IEEE Sri Lanka Section Awards 2023

by Chathura Weerasinghe

In the heart of technological innovation, the IEEE Engineering in Medicine and Biology Society (EMBS) at the University of Moratuwa has etched its name in the annals of success. The recent IEEE Sri Lanka Section Awards 2023, held on November 4th, 2023, marked a momentous occasion for the EMBS chapter as it clinched not one but two prestigious awards, signifying the culmination of unwavering dedication and exceptional prowess.

## Outstanding Student Branch Chapter Award

The spotlight shines brightly on the EMBS, University of Moratuwa, as it proudly accepts the Outstanding Student Branch Chapter Award for the second consecutive time. This remarkable achievement underscores the chapter's commitment to excellence, innovation and collaborative spirit. The icing on the cake is the recognition of the Best Technical Student Chapter Project, Brainstorm 2023, a testament to the chapter's ability to push the boundaries of technological advancement.

## Best Technical Student Chapter Project - Brainstorm 2023

In the realm of innovation, the EMBS chapter has set a new standard with the success of the Best Technical Student Chapter Project, Brainstorm 2023. This achievement is not merely a victory; it's a testament to the hard work, ingenuity, and collaborative spirit of the chapter's members. The project stands as a beacon of technological excellence, showcasing the chapter's dedication to pushing the envelope.

Amidst the jubilation of our recent achievements, the EMBS chapter at the University of Moratuwa takes a moment to extend heartfelt gratitude to everyone who played a pivotal role in this remarkable journey. The unwavering support, invaluable mentorship, and collaborative efforts of our community have been instrumental in reaching these significant milestones. As we revel in the joy of our success, it's important to acknowledge that this triumph is not ours alone; it is a shared victory with every individual who has contributed to our journey. Looking ahead, the recognition as the winner of the Outstanding Student Branch Chapter Award serves as a powerful affirmation of our commitment to advancing technology for the betterment of humanity. Fueled by this success, the EMBS, University of Moratuwa, eagerly anticipates continuing our journey of innovation, exploration, and meaningful contributions to the ever-evolving landscape of engineering and technology.

In the wake of this double victory at the IEEE Sri Lanka Section Awards 2023, we take immense pride in these accolades, viewing them not merely as milestones but as a reflection of the dedication, innovation, and collaborative spirit that define our chapter. With gratitude and determination in our hearts, we enthusiastically look forward to more victorious moments, united in our mission to propel technology forward for the betterment of humanity.





# Graph Neural Network Based 77 GHz MIMO Radar Array Processor for Autonomous Robotics

by Kavishka Abeywardana

The “Graph Neural Network-Based 77 GHz MIMO Radar Array Processor for Autonomous Robotics” paper by Ransara Wijitharathna, Pahan Mendis, Rahal Perera, Punsara Mahawela, Dr Nilan Udayanga, Dr Chamira U. S. Edussooriya and Prof. Arjuna Madanayake is a significant achievement in ENTCT history. This paper pushes the boundaries of radar sensing by proposing a long-range 77-GHz FMCW MIMO radar system for the automotive industry.

Multi-modal sensing is crucial for situational awareness in autonomous robotics and robotic vehicles. The modes of sensing must be reliable and resilient against obstacles. They used lidar, video signals and radar as multimodal sensing technologies in autonomous driving. Optical sensing-based video signals and lidar lack robustness against weather conditions and visual blockages. Thus, radar has become the leading candidate for long, medium, and short-range environmental sensing. Linear frequency-modulated continuous wave (FMCW) radar is the most commonly used radar technology in autonomous driving. While designing FMCW radar systems, they encountered multiple challenges, such as the limited behaviour of power amplifiers at high frequencies and preserving sufficient FoV (field-of-view). However, they couldn't use beam scanning since it will reduce the velocity resolution. Multiple-input multiple-output (MIMO) processing techniques are used to improve the angular resolution.

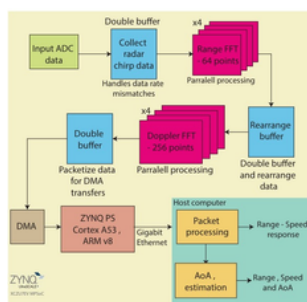
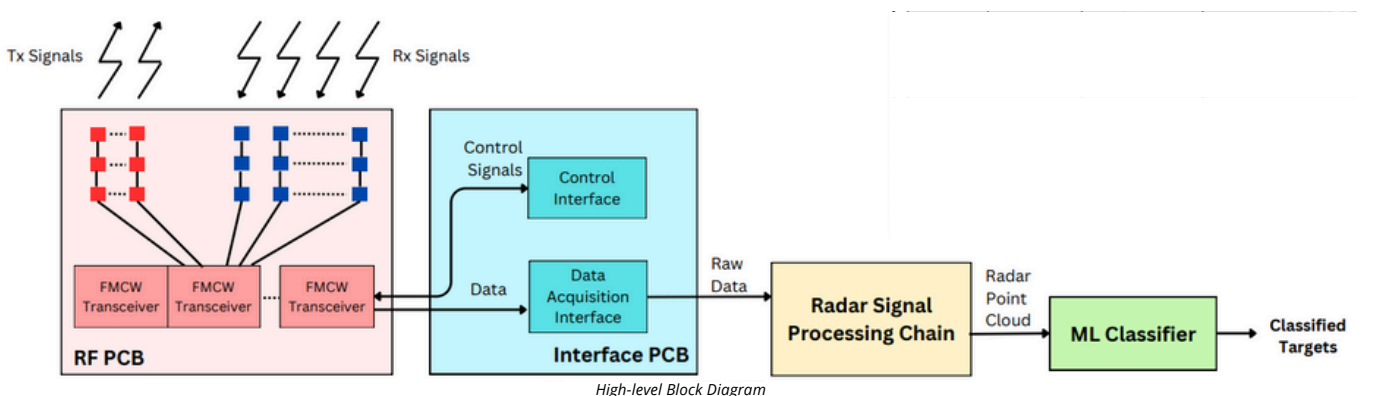
The transmitter generates four transmit beams, each using a three-element subarray with analog beamforming. The receiver consists of sixteen antenna elements.

The architecture contains a radar front, an FPGA, and a host computer for visualisation. The FPGA is used for radar signal processing and a graph neural network (GNN) analyses the point cloud. A range fast Fourier transform (FFT) and a Doppler FFT with additional buffers are used to process the signal.

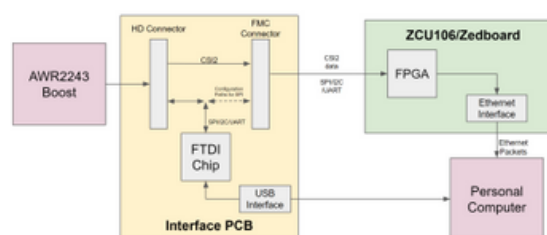
Point-based, grid-based and graph-based methods are common approaches to analysing a point cloud. GNNs accurately capture point features and their relationships. Thus, RadarGNN, a variant of GNNs, is used to perform multiclass object detection. Separate multi-layer perceptrons (MLPs) capture node and edge feature embeddings. Detection heads use two-layer MLPs.

The radar processing pipeline was only partially implemented on a ZYNQ Ultrascale+ ZCU106 development kit. A future research team can fully implement the pipeline on an FPGA and experimentally validate the system. Moreover, the system can be extended to military and automotive cruise control applications.

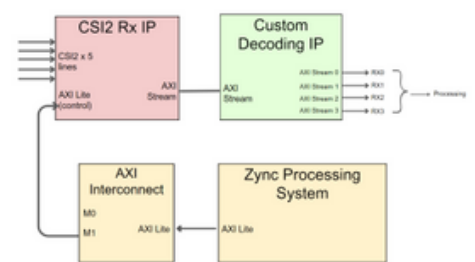
This research project stands out as a comprehensive use of electronics, telecommunication and machine learning in a real-world application. The research's analytical and innovative approach will motivate future members of the ENTCT family to push the barriers of global industries.



The real-time radar processing pipeline



Connection Block Diagram



FPGA Interface Block Diagram

# Envoyage 2023

by Javin Manatunge

“Envoyage: a Distinguished Dinner and Forum” is one of the most anticipated events that serves as a platform bringing together industry professionals, alumni, academia, and undergraduates from the electronic, telecommunication, and biomedical sectors. This evening, filled with tech and elegance, provides a prime opportunity for industry professionals, alumni, academia, and undergraduates to network, learn, collaborate, and strategize the way forward for our department in the years to come.

Envoyage 2023, held at the Galadari Hotel on the 30th of October, is an important event for the Department of Electronic and Telecommunication Engineering for the opportunities it creates for the department's future. This year's gathering stood out as a collective forum, bringing together industry leaders, alumni, faculty, and students to discuss, strategize, and celebrate the department's advancements and visions.

The evening commenced with the opening ceremony and an introduction to ENTCE, followed by traditional customs, including the lighting of the oil lamp. The forum featured notable addresses by strategic and innovation partners: LSEG, SLT Mobitel, and Dialog Axiata PLC, who highlighted the importance of industry-academic collaboration and spoke on advancements in the industry.

A key moment of the evening was the inauguration of the Alumni Association, signifying the department's commitment to long-term community and professional development. The event culminated in the launch of the E-Carrier Magazine, the official magazine of the department, aimed at providing insights into the latest achievements of the department and research breakthroughs.

Industry participation was robust, with companies like 4Axis Solutions, ACCELRL, ACL Cables, Paraqum, Zone24x7 and Synopsys among the many in attendance. These organisations underscored their role in providing real-world platforms for student projects and research initiatives. The involvement of silver sponsor SLT MOBITELE and bronze sponsors Synopsys, Synergen, and Huawei demonstrated the industry's investment in the educational pillars of the department. The evening also shone a spotlight on student achievements, including project presentations that highlighted innovative solutions developed by the students. One of the notable achievements was winning second place in the RISC-V Processor Design and Verification Contest held in India.

The forum discussed Sri Lanka's economic challenges, the evolving global technological landscape, and the pivotal role that electronic and telecommunication engineers play in this context. It served as a prelude to a series of addresses by sponsors who reaffirmed their support for the department's goals and its students.

Envoyage 2023 was more than just an academic event; it was a testament to the enduring partnerships between the department and industry giants poised to enhance the nation's technological landscape. The event promised a future where the department fosters innovation, skill development, and industry readiness among its students.





# Bridging Futures: ENTC Career Fair 2024 Paves the Path for Aspiring Engineers

by Isuranga Senevirathne

The Department of Electronic and Telecommunication Engineering successfully hosted its highly anticipated Career Fair on January 5th, 2024, exclusively for final-year undergraduates. The event drew significant attention from students and industry leaders, creating a dynamic platform for networking and employment opportunities.

The Career Fair saw the participation of nearly 18 leading companies in the field, including Axiata Digital Labs (ADL), London Stock Exchange Group (LSEG), Zone 24x7, Yaala Labs, IronOne, Paraqum Technologies, CodeGen, Cloud Solutions, Promise Q, WSO2, ZeroBeta, NCINGA, IFS, Thakhana Technologies, XdotO, Synergen, Millennium IT and Fcode Labs. The event was proudly sponsored by Axiata Digital Labs, LSEG, CodeGen and Cloud Solutions, whose support was instrumental in the event's success.

This impressive lineup of companies provided a unique opportunity for students to engage with potential employers and gain valuable insights into the current trends and requirements of the electronic and telecommunication industry. The companies represented a diverse range of sectors within the field, including telecommunication, electronic manufacturing, software engineering, robotics and machine learning.

For the final-year undergraduates, this event was a pivotal milestone towards launching their careers. They had the opportunity to showcase their skills, discuss their academic achievements, and leave a lasting impression on potential employers. Many students seized the chance to submit their resumes and engage in on-the-spot interviews, further cementing their connections within the industry.

Overall, the ENTC Career Fair 2024 was a resounding success. It created a mutually beneficial space for students and industry leaders to connect, collaborate, and pave the way for a bright future in the dynamic world of electronic and telecommunication engineering.





# Shuttle Fest '24: Celebrating Sportsmanship and Team Spirit in ENTCT

by Viyathma Vidumini



Shuttle Fest '24, the badminton tournament held within the Department of Electronic and Telecommunication Engineering, took place on 12th February 2024. The event commenced with a welcome speech by the head of the department, Dr. Ranga Rodrigo, emphasising the importance of sports alongside academic pursuits.

Shuttle Fest featured four categories: men's doubles, women's doubles, mixed doubles and the highly anticipated batch-wise team tournament, providing a platform for students to showcase their sportsmanship and team spirit. In a display of skill and determination, champions emerged from each category. Javin and Gavin from the 21st batch emerged as the victorious champions among the 37 participating pairs in the men's doubles category while the championship of the women's doubles was secured by Umesha and Ruwani from the 20th batch among the 6 pairs that participated.

Javin and Viyathma from the 21st batch triumphed in the mixed doubles category from the 16 participating pairs.

However, the most fiercely contested event was the batch-wise team tournament, which was ultimately won by the formidable team from the 21st batch after a fierce battle with the team from the 22nd batch. The victorious team was led by Gavin, Udula, Bimsara, Chamikara, Viyathma, Nimshi and Meghana. During the tournament, camaraderie peaked as colleagues from the same batch, even those who did not compete, rallied together to cheer their team to victory.



Dr. Peshala Jayasekara and Dr. Subodha Charles, esteemed faculty members of the department, graced the event with their presence to distribute prizes to the deserving winners, adding prestige to the occasion. Additionally, several staff members including Dr. Udaya Jayathilake, Dr. Subodha Charles and

Dr. Peshala Jayasekara participated in friendly matches with the students, further encouraging unity and camaraderie within the department.

In conclusion, Shuttle Fest '24 was more than just a badminton tournament; it symbolised the core values of sportsmanship, teamwork and camaraderie within the Department of Electronic and Telecommunication Engineering. As participants engaged in competitive matches, they not only showcased their athletic prowess but also fostered enduring friendships and created cherished memories. The sight of friends cheering on their peers from the sidelines further emphasised the unity within the department. In addition to the department's renowned academic excellence, it is also essential to prioritise the balanced growth of students, where both academic pursuits and extracurricular activities contribute. So, Shuttle Fest represents the department's spirit of collaboration and unity by emphasising friendship and joy alongside competition.



# Empowering Tomorrow's Innovators: SLRC 2024 Workshops

by Rushen Disanayaka

In the heartlands of Sri Lanka, away from the bustling tech hubs of Colombo, a revolution is brewing. The Sri Lanka Robotics Challenge (SLRC) 2024 took a bold step this year, bringing the magic of robotics to the eager minds of students beyond the city limits. With a vision to empower young innovators with hands-on experience, SLRC organised two massive workshops with over 150 enthusiastic participants each.

On February 19th at Dharmaraja College and March 8th at Tholangamuwa Central, Kegalle, the air was electric with anticipation as students gathered to dive headfirst into the realm of robotics. The workshops were meticulously designed to bridge the gap between theory and practice, catering to the innate curiosity and thirst for experience among young learners. The workshops unfolded in two distinct phases, each aimed at nurturing the budding passion for robotics. In the initial phase, participants were introduced to the fundamental concepts of robotics, focusing on sensors and actuators - the building blocks of robotic systems. This foundational knowledge served as the launchpad for their journey into the world of innovation and creation.

The real magic unfolded in the second phase, where students were handed the reins to their own robotic creations. Equipped with a robot and a challenge, participants were thrust into the heart of the action, tasked with programming their machines to conquer a series of tough challenges. Working in teams under the guidance of instructors, they not only learned the intricacies of robot development but also honed their collaborative skills - a vital ingredient for success in both competitions and real-world scenarios.

Beyond the technical skills gained, the workshops served as a catalyst for passion and creativity. Participants were not mere spectators but active creators empowered to shape the future of robotics in Sri Lanka. The collaborative learning environment fostered a sense of camaraderie and shared purpose, laying the groundwork for future collaborations and breakthroughs in the field.

As the echoes of excitement from the workshops fade, the stage is set for the SLRC 2024 competition. Organisers eagerly await the unveiling of participants' innovations and the application of skills honed during the workshops. With each robot crafted and each challenge Conquered, the seeds of growth are sown, nurturing the burgeoning robotics industry in Sri Lanka.

The SLRC 2024 workshops stand as a testament to the transformative power of hands-on learning and experiential education. In the journey from novice to master, from theory to practice, young minds are empowered to dream, create, and innovate. As the future of robotics in Sri Lanka takes shape, one thing is certain: the spark ignited in these workshops will illuminate the path to a brighter, more innovative tomorrow.





# Sri Lankan Robotics Challenge (SLRC) 2024

by Sasini Wanigathunga

Sri Lanka's largest robotics competition, Sri Lankan Robotics Challenge (SLRC) 2024, took place with much anticipation and excitement, marking its 11th successful edition. Organised by the Electronic Club (E-Club) of the Department of Electronic and Telecommunication Engineering at the University of Moratuwa, the competition aimed to provide a platform for young minds to showcase their talent and passion for robotics.

The competition was organised into two categories: school and University. The School category was open to students attending school, and the University category was for undergraduates attending any state or private university in Sri Lanka at the time of their participation in the competition. The goal was to provide an international standard platform for students to learn, experience, and demonstrate their skills in the field of robotics.

In the lead-up to the competition, the E-Club conducted a series of robotics workshops for school students. These workshops, which were held physically over four weeks, provided students with a hands-on, A-Z experience of building a robot, with supportive guidance and feedback.

The SLRC 2024 was proud to have Axiata Digital Labs as its exclusive partner, the London Stock Exchange Group as its strategic partner, and Synopsis as its bronze partner. These partners' support was crucial in ensuring the event's success and providing the necessary resources for the competition.

The University and School categories tasks were released on 31st January, and registrations opened soon after. The competition was fierce, with teams from all over the country striving for the top spot and a share of the prize pool.

The elimination rounds for the SLRC 2024 were held on the 23rd and 24th of March, with the School category competition taking place at the Department of Electronic and Telecommunication Engineering (ENTC) premises, and the University category competition at the Faculty of Engineering Auditorium at the University of Moratuwa.

Both competitions were intense and closely contested, with various school and university teams showcasing their innovative and creative robotics designs. After a day of challenging competition, the finalists were selected, and the teams eagerly awaited the grand finale.

The SLRC 2024 grand finale was held on 31 March at the Faculty of Engineering Auditorium at the University of Moratuwa. One of the most exciting aspects of SLRC 2024 was that, for the first time in the competition's history, the grand finale was open to the public. This meant that anyone, regardless of age or background, could witness the thrill of this robotics competition and see the innovative creations of young minds.

In the School category, Team FUTURE TECH emerged as the champion, showcasing their exceptional skills in robotics and engineering. Team HEXBOTZ secured the runner-up position, while Team MAVERICKS was awarded the second runner-up position.

The University category was highly competitive, with Team SPARK SQUAD ultimately emerging as the champions. Their innovative and well-executed robot design impressed the judges and earned them the top spot. Team RALPHY BOY was awarded the runner-up position, while Team DEATHEND secured the second runner-up position.

The SLRC 2024 was more than just a competition; it was an opportunity for students to explore the world of robotics, learn new technologies, and gain experience that would be valuable in their future careers.

The SLRC 2024 was a huge success, with teams from all over the country showcasing their talent and passion for robotics. The event was a testament to the power of innovation, the importance of education, and the potential of young minds. The E-Club of the Department of Electronic and Telecommunication Engineering of the University of Moratuwa did an excellent job organising the event and providing a platform for young minds to shine. The SLRC 2024 will be remembered as a milestone in the development of robotics in Sri Lanka, and we can't wait to see what the future holds for this exciting field.





# Pioneering Collaboration Unveils Sri Lanka's First Open-Source 5G Network Sandbox

by Tharushi Karavita

In a groundbreaking collaboration, Axiata Digital Labs (ADL), Dialog Axiata PLC (Dialog), and the University of Moratuwa (UoM) have collaborated to launch Sri Lanka's inaugural Open-Source 5G Network Sandbox. This initiative marks a significant milestone in the nation's technological advancement, fostering innovation and exploration within the realm of 5G technology. The primary objective of this collaborative endeavour is to provide a conducive environment for the exploration and development of potential 5G use cases.



Establishing Sri Lanka's first Open-Source 5G Network Sandbox is a treasure for stakeholders across various sectors, particularly within the Electronic and Telecommunication Engineering Department of the University of Moratuwa. This initiative presents an unparalleled opportunity for researchers, developers, startups and students alike to delve into the realms of 5G technology and its potential applications, thereby paving the way for future advancements that will benefit the industry landscape of Sri Lanka.

Within the department, students and faculty members now have access to a dynamic platform to actively engage in experimentation, testing, and prototyping of 5G applications and services. This hands-on experience not only enriches their academic pursuits but also equips them with invaluable skills and insights that are directly applicable to real-world scenarios. ADL's Axonect Enterprise Enabler (AEE), which is employed in the sandbox initiative, streamlines telecom software development through industry-standard frameworks like TM Forum ODA. AEE's modular architecture and microservices layer enable independent deployment of 5G applications, while continuous integration tools and 5G architecture patterns promote faster development. A cloud-native 5G technology stack ensures the portability, scalability, and resilience of applications developed on the platform.

Dialog Axiata showcases its dedication to research and innovation through its longstanding collaboration with the University of Moratuwa at the Dialog-UoM Mobile Communication Research Laboratory since 2004. This partnership emphasises Dialog's commitment to dynamic collaborations with academia, leading to significant recognition for pioneering contributions in telecommunications, IoT, and automation. ADL provides expertise in cloud-native software development and platform architecture for seamless integration and scalability. As Sri Lanka's primary mobile telecommunications provider, Dialog contributes extensive 5G network infrastructure and deployment knowledge.

With this pioneering initiative, ENTCT takes a significant step forward in the global technological landscape, setting the stage for transformative advancements in 5G technology.

# University of Moratuwa Enhances Innovation with Raspberry Pi 4 Model B Gifting

by Dr. Ranga Rodrigo

In a significant step towards fostering technological innovation and hands-on learning, the Department of Electronic and Telecommunication Engineering at the University of Moratuwa has gifted Raspberry Pi 4 Model B kits to all 115 students of the 2021 intake. This initiative is a part of the SPARK program, which aims to encourage students to engage in innovative projects and challenges.

The Raspberry Pi 4 Model B, renowned for its robust capabilities, offers students a versatile platform for a wide range of projects. Equipped with a quad-core Cortex-A72 (ARM v8) 64-bit SoC, LPDDR4-3200 SDRAM, and dual-display support at resolutions up to 4K via a pair of micro-HDMI ports, the Raspberry Pi 4 is a powerful tool for developing complex computing solutions. Its gigabit Ethernet and USB 3.0 connectivity also make it suitable for high-speed data transfer and network projects.

The head of the department, highlighted the significance of this initiative, stating, "The Raspberry Pi 4 Model B kits provide our students with the essential tools to explore, innovate, and create. These devices will not only assist them in their coursework but also inspire them to participate in the SPARK Challenge and other innovative activities."

## Innovative Projects and Real-World Applications

The Raspberry Pi has already been instrumental in several notable student projects at the university. One such project, sponsored by Dialog Axiata PLC, is the Virtual Cycling Project. Utilizing a VR headset, this project enables users to experience virtual cycling through Sri Lanka's breathtaking mountainous routes. The Raspberry Pi served as the primary controller, showcasing its potential in virtual reality applications.

Another impressive project involved digital IC replication, where the Raspberry Pi generated patterns to train a neural network module, demonstrating its capability in advanced digital signal processing and machine learning applications.

There have been numerous such projects using Pis.

## The SPARK Challenge: Driving Innovation

The SPARK Challenge is a yearlong endeavour designed to encourage students to develop unique and novel products that address the adverse effects of climate change. The challenge emphasises the creation of sustainable solutions and aims to foster the growth of new commerce and industry in Sri Lanka. Teams of five students will present their solutions to external specialists in a format reminiscent of "Shark Tank" or "Dragons' Den."

To support the students, the SPARK program and the department provide comprehensive training and resources, including:

- Modern Design Workshops: Eight facilitated workshops that help teams formulate and deliver strong, innovative solutions.
- Briefing Sessions on UN Sustainable Development Goals (UN-SDGs): Guidance on developing sustainable products and services.
- Agile Methodology Training: Enabling rapid iteration of software and hardware solutions.

Dr. Ajith Pasqual expressed his optimism about the program, stating, "The SPARK Challenge is a platform for our students to not only demonstrate their technical skills but also to create impactful solutions that can drive sustainable development in Sri Lanka. We are excited to see the innovative ideas that will emerge from this initiative." Nisitha Silva, Vice President of the Electronic Club that runs the SPARK program too spoke.

## Fostering Future Innovators

By providing the Raspberry Pi 4 Model B kits, the University of Moratuwa is investing in the future of its students, equipping them with the tools needed to excel in the rapidly evolving tech landscape. This initiative aligns with the university's commitment to fostering innovation, creativity, and practical problem-solving skills among its students.

The SPARK program and the gifting of Raspberry Pi kits symbolise a forward-thinking approach to education, where students are encouraged to push the boundaries of what is possible and contribute to the technological and industrial growth of Sri Lanka.



# A Win-Win Relationship Industry Collaboration

by Kalinga Bandara

As a department continuing its legacy of over 50 years, ENTC has received immense support from various parties. Among them, the industrial collaborators who have been a pillar of strength to the department should be specially highlighted.

## Metaverse-based banking system with NCINGA

The Metaverse is an emerging technology in the modern world where people can interact, communicate, work, play, and create in immersive virtual environments. A group of final-year students of the Department of Electronic and Telecommunication Engineering supervised by Dr. Ranga Rodrigo, in collaboration with the industry assistance of NCINGA, has successfully created a Metaverse-based banking system where financial transactions, opening an account and financial consultations are possible in a virtual setting, resulting in an unmatched customer experience.

Furthermore, they have attempted to revolutionise the jewellery shopping experience by designing a Meta Jewellery application. This application offers universal accessibility and customizability that allows customers to personalise their jewellery, virtual fitting, and the ability to purchase and checkout. NCINGA sponsored the group by providing aids for two Virtual Reality headsets.

The metaverse-based banking application comprises two main components: the Meta Bank mobile application and the Unity-based Meta Bank Virtual Reality application. The Meta Bank mobile application authenticates users, creates personalised avatars, collects user details, and synchronises them. On the other hand, the Unity-based Meta Bank Virtual Reality application provides banking infrastructure and services such as account creation, credit transactions, and real-time consultation through Normcore servers. The user experience has been enhanced by incorporating Automatic Speech Recognition (ASR), which allows users to fill in details by speech. Due to the unique advantage of having a dedicated plugin in the Unity asset store, the Ready Player Me server has been used to create high-quality Avatars with minimal input requirements.

In the research area of 3D scene reconstruction, they have delved deep and successfully generated 3D images using a controlled image. This image is produced by an image and a textual prompt; both sent through a stable diffusion model. They have proposed an automated method for constructing coloured 3D models. This method comprises a ControlNet model, which adds conditions to the Text-to-Image diffusion model, and the Latent-NeRF model, which generates a text-guided 3D model.

The industry collaboration with NCINGA was invaluable for the success of the project. In addition to the support they provided throughout the final year with brainstorming and quality validation sessions, NCINGA joined hands with the team members to continue the project. They were crucial in finding clients to make the project a reality and ensure its practicality.

Currently, the project is in its second phase, out of a total of five phases of the end-to-end developed Metaverse banking application. This final-year project showcases the transformative power of immersive technologies and their potential to revolutionise various aspects of our daily lives. As we continue to explore the possibilities of the Metaverse, these initiatives stand as remarkable milestones in our journey toward a more interconnected and digitally enhanced future.

**NCINGA**  
ENGINEERED FOR HUMANITY



# Exclusively for Tech Enthusiasts

by Dr. Ranga Rodrigo

The Department of Electronic and Telecommunication Engineering has pioneered not only the internal educational curriculum but also through numerous hands-on workshops and seminars it has conducted. These events have delved into the practical aspects of engineering, benefiting both the undergraduates of the department and tech enthusiasts across the nation.

## **Prof. Kirthevasan Kandasamy's Engaging Talk at University of Moratuwa on Machine Learning and Game Theory**

On January 8, 2024, the Department of Electronic and Telecommunication Engineering at the University of Moratuwa had the honour of hosting a special lecture by distinguished alumnus, Prof. Kirthevasan Kandasamy. Currently an assistant professor at the University of Wisconsin-Madison, Prof. Kandasamy returned to his alma mater to share his groundbreaking work in the fields of machine learning and game theory.

Prof. Kandasamy, who completed his undergraduate studies in Electronics and Telecommunications Engineering at the University of Moratuwa, has established himself as a leading researcher in theoretical machine learning and game theory. His academic journey took him from Sri Lanka to prestigious institutions such as Carnegie Mellon University and UC Berkeley, culminating in his current role at UW-Madison.

In his talk, Prof. Kandasamy explored the dynamics of data sharing mechanisms and the development of marketplaces that incentivize truthful data contributions. This research is particularly pertinent in today's data-driven world, where ensuring the accuracy and integrity of shared information can have far-reaching implications for both individuals and organisations.

Prof. Kandasamy's extensive body of work includes numerous high-impact publications. His recent research addresses critical issues such as active cost-aware labeling of streaming data, mechanism design under stochastic feedback and online learning of competitive equilibria. At UW-Madison, he teaches "CS639 - Introduction to Algorithmic Game Theory & Mechanism Design" and actively recruits students with strong mathematical and statistical backgrounds to join his research endeavours (CS User Pages).

The lecture at the University of Moratuwa not only provided valuable insights into the latest advancements in machine learning and game theory but also served as an inspiration to current students. Prof. Kandasamy's achievements underscore the global opportunities available to graduates from the University of Moratuwa.



## **Renowned Expert Prof. Anna Förster Enlightens University of Moratuwa on Sustainable Communication Networks**

Prof. Anna Förster, a distinguished researcher from COMNETS, University of Bremen, Germany, graced the halls of the University of Moratuwa on Wednesday, February 7th, 2024, captivating attendees with her insights into Sustainable Communication Networks and postgraduate study prospects in Germany.

Addressing an audience in the Electronic and Telecommunications department, Dr. Förster delved into her pioneering research, which focuses on self-organising and autonomous sensor networks, opportunistic networks, and underground sensor networks. Utilizing a blend of artificial intelligence techniques such as machine learning and swarm intelligence, she sheds light on various aspects of wireless communication protocols and applications.

One of the highlights of Dr. Förster's research is its practical applications, aimed at contributing to the global achievement of Sustainable Development Goals. These applications span decision agriculture, environmental monitoring, safety monitoring, health applications, and more. Additionally, her work emphasises the usability of Internet of Things (IoT) applications to maximize their impact and utility.

During her visit to the University of Moratuwa, Dr. Förster engaged in multifaceted activities, including providing feedback on final-year project mid-evaluations and delivering illuminating talks on her research on sustainability and IoT. Furthermore, she shared invaluable insights into studying in German universities, offering aspiring scholars a glimpse into the educational opportunities available in her home country.



# Exemplary achievements of ENTC students

by Warren Jayakumar

The Department of Electronic and Telecommunication Engineering has built a reputation for cultivating exceptional achievers who consistently set new benchmarks in various academic and extracurricular endeavours. This article aims to shine a spotlight on the outstanding accomplishments of a few students within our department. Join us as we celebrate the accomplishments of these exceptional individuals and explore the lasting impact their success has had on both their personal journeys and the department as a whole.

Our journey begins with an extraordinary achievement by team HelloWorld, comprising Lasitha Amarasinghe and Hasitha Gallella, who emerged as champions in CYPHER, a hackathon organised by the IEEE Women in Engineering Affinity Group of the Kothalawala Defense University. The 6-hour hackathon put the problem-solving skills of participants to the test, and the team's outstanding performance showcased their exceptional talent and dedication. Continuing with the theme of exceptional performance in challenging circumstances, let's turn our attention to the next achievement by our talented students.

Team Sharks, consisting of Anuki Pasqual, Dulan Lokugeegana and Sadeep Rathnayaka, claimed the championship title. At the same time, Team Code\_commandos, with members Subitson Croos, Hansa Marasinghe and Avishka Herath, secured the position of first runner-up in Phase 2 of Sparklink 1.0, an Inter-University Electronic Design Competition organised by the IEEE Student Branch of the University of Ruhuna. The competition, held on the 10th of September 2023, tested participants' technical skills and creativity by challenging them to solve a given task using Hardware Description Languages (HDL). This accomplishment further highlights the department's commitment to fostering an environment that encourages the development of problem-solving skills and deepens students' knowledge of HDL.

Following the impressive performance of team Code\_commandos in Sparklink 1.0, we now turn our attention to another remarkable achievement by a diverse and talented group of students from our department working in collaboration with students from other departments. Team FreshFix, comprising Saeedha Nazar (Team Leader - ENTC), Vishagar Arunan (ENTC), Thusyanthan Jeyathanan, Amrithshagar Jeganmohan, and Navindu De Silva, secured the position of 1st runners up in the open category of Idealize 2023. This all-island technopreneurship and mobile/web app development competition was organised by AIESEC at the University of Moratuwa and spanned four months. Under the guidance of Mr. Asoke Rathnayake, the team developed a productivity mobile application, "GoGetOn," with the intention of making productivity an attainable choice for users. The app features a scheduler for task management, a focus mode to help users concentrate on their tasks, a habit creation tool to transform routines into habits, and a stats feature to analyse user progress. The team also plans to integrate an AI chatbot, augmented reality for gamification, and a machine learning model to provide personalised suggestions. The unique aspect of "GoGetOn" is that it combines all these features into a single, user-friendly application.

Continuing our celebration of exceptional achievements, we now turn our attention to the accomplishment of team Horizon, a collaboration of seven students from the 19th batch. This talented group, comprising Nima Wickramasinghe, Vidura Munasinghe, Wikum Jayasanka, Chathushka Ranasinghe, Kavindu Weerasinghe, Dinuka Sandun and Akila Abeyratne, secured 1st place in the Everbolt Most Innovative Idea Competition held at EXMO 2023. Team Horizon designed an electrooculogram (EOG) based interaction device that enables users to control a computer using their eye movements. This groundbreaking innovation demonstrates the team's commitment to developing solutions that enhance accessibility to all users.

Last but certainly not least, we focus our attention on Mr. Tharindu Wickremasinghe, a student of the 18th batch of the ENTC department. He was awarded the prestigious award of "The Most Outstanding Graduate of the Faculty of Engineering", the UNESCO gold medal for the Best Academic Performance at the university, and the Ceylon Electricity Board gold medal for the highest overall GPA at the Department of Electronic and Telecommunication Engineering. His remarkable accomplishments serve as a validation of the academic excellence upheld by the department.

In conclusion, the achievements of our students are a testament to their dedication, talent, and hard work. From winning hackathons and inter-university competitions to publishing research papers in prestigious symposiums, these accomplishments underscore the department's commitment to fostering an environment that encourages innovation, collaboration, and academic excellence.



### Eng. Kithsiri Samarasinghe

by Erandee Jayathilaka



In the realms of engineering and technology management, few names command the respect and admiration that Mr. Kithsiri Samarasinghe has garnered throughout his illustrious career. His professional journey began at the University of Moratuwa, where he earned his Bachelor of Science in Electronic and Telecommunication Engineering in 1985. He gained industry experience and expertise in civil aviation and broadcasting industries for over 15 years. In the meantime he pursued a Master in Business Administration from the University of Sri Jayewardenepura in 2001, showcasing his ability to seamlessly blend technical expertise with business management.

Eng. Kithsiri Samarasinghe has accumulated a wealth of diverse experiences and held various leadership positions in industry and academia throughout his career. He has served as a Senior Lecturer at the University of Moratuwa for over 23 years, imparting his wealth of knowledge to aspiring engineers and shaping the minds of future leaders in the field. During his tenure at the university, he held the esteemed positions of Head of the Department of Electronic and Telecommunication Engineering, Acting Head of Department of Electrical and Electronic Engineering in ITUM, Director of the Center for IT Services of UoM and the Director of Zone24x7-UoM Electronic Systems Research Lab, showcasing his administrative and managerial competence.

With a very diverse array of research interests spanning from industrial automation, technology management, ICT policy to wireless applications and meditation, his contributions have left an enduring legacy on the industry and academia.

Beyond academia, his expertise has been sought after by prominent organisations in the telecommunication and broadcasting sectors. He served as a member of the Board of Directors at the Sri Lanka Broadcasting Corporation from 2014 to 2015, contributing to the development of the nation's broadcasting landscape. Prior to that, he held the position of Director of Engineering at the Sri Lanka Rupavahini (TV) Corporation from 1997 to 2001, where he played a pivotal role in planning, installing, and maintaining the island-wide transmission and broadcast networks, as well as the organisation's IT infrastructure. From 1985 to 1997, he served as an Avionics Engineer at Airport and Aviation Services Sri Lanka contributing to planning, installing, and maintaining air-ground communications, navigational aids, radar systems, baggage screening systems, and flight information systems, solidifying his expertise in the aviation industry. He has worked as a consultant/resource person in multiple engineering projects/committees at national level.

What sets Mr. Samarasinghe apart is his multidisciplinary approach and ability to bridge the gap between engineering and management. His research interests have encompassed a wide range of disciplines, from technology management and industrial automation to cellular communication systems, satellite communication, broadcast technologies and meditation related brain-computer interface. This breadth of knowledge has enabled him to provide comprehensive solutions and innovative approaches to complex challenges in the industry. It is also noteworthy that he has devoted a lot of time and effort to support many needy students and individuals as a student counsellor to overcome their difficulties.

Mr. Kithsiri Samarasinghe's journey is a testament to the power of lifelong learning, adaptability, and a relentless pursuit of excellence. His contributions have transcended boundaries, impacting industries, academia, and the lives of countless individuals. Eng. Kithsiri Samarasinghe epitomises the ideal of a well-rounded professional, seamlessly blending remarkable achievements in engineering and technology management with a deep commitment to personal growth and balance.



### Dr. Thayaparan Subramaniam



Dr. Thayaparan Subramaniam, a beloved figure at the Electronic and Telecommunication Engineering department, began his journey with a Bachelor of Science degree from the University of Peradeniya in 1994, followed by a Ph.D. from the University of Hong Kong in 2000, both in Electrical and Electronic Engineering.

Dr. Thayaparan's expertise was honed through over a decade of industry experience, where he worked for renowned companies such as Sri Lanka Telecom, Agilent Technologies, Avago Technologies, and ST-Microelectronics. His contributions to these organisations were in alignment with the fields of digital systems and integrated circuit design.

Since 2011, Dr. Thayaparan has devoted his time to imparting his knowledge and experience as a Senior Lecturer at the University of Moratuwa. His unwavering commitment to academia has inspired many undergraduates over the years. His research interests span a wide range of areas, including noise reduction techniques in digital systems, digital system designs, and IP developments for integrated circuits.

Dr. Thayaparan's dedication to his field is evident in his publications. Some of his notable works, "Minimum leakage vector with sparse power gating – a combinational approach for standby leakage power reduction in CMOS circuits," published in the IEEE International Circuits and Systems Symposium (ICSyS) 2019, showcase his innovative approach to reducing power consumption in CMOS circuits. He has authored seminal works that have shaped the field of digital systems and integrated circuits.

Dr. Subramaniam Thayaparan's journey to the forefront of digital systems and integrated circuit design is a testament to his unwavering dedication, expertise, and passion for his field. His contributions have not only shaped the academic landscape but have also had a profound impact on industry practices, making him a true trailblazer in his domain.

## Mr. Dasun Premathilake

by Linuka Ratnayake



**“DEDICATE YOUR BRAIN TO WHAT YOUR HEART TRULY DESIRES, BECAUSE THE IMPOSSIBLE BECOMES POSSIBLE ONLY WHEN YOUR HEART AND BRAIN ARE IN SYNCHRONY.”**

Mr. Dasun Premathilake is a brilliant mind and a talented academic produced by the Department of Electronic and Telecommunication Engineering at the University of Moratuwa. Being a student of the 18th batch, he specialised in BioMedical Engineering, achieving the highest overall academic performance in that stream.

This talented individual's roots lie in Royal College, Colombo, where he sat for both G.C.E. Ordinary Level and G.C.E. Advanced Level. During his early years in school, he won the silver medal in the National Mathematics and Science Olympiad competition and the Best Mathematical Talent (Junior) award by the Sri Lanka Mathematics Olympiad Foundation, both in 2009. He has also participated in the 6th International Mathematics and Science Olympiad competition held in Indonesia. In 2011, he won the bronze medal (Junior) at the 1st National Astronomy Olympiad. Later in school, he received the Sir Edward Denham Memorial Prize for the best performance in Mathematics and the Cameron Samarasinghe Memorial Prize for the best performance in Combined Mathematics.

After selecting Bio-Medical Engineering as his specialization at the university, he continued to showcase his exceptional talents in both local and international competitions, earning a reputation for the Department of Electronic and Telecommunication Engineering. He was a member of the team that emerged as the 1st runner-up in the SPARK Challenge 2021/22, a unique challenge presented to the ENTC students every year. He became the 1st runner-up of the 3rd International Energy and Electricity Market Business Decision Simulation Competition organised by the Batangas State University, Philippines. Winning the 5th place at the IEEE Video and Image Processing Cup (VICUP) held in September 2022 is also a significant milestone in his life.

Some interesting projects were behind some of the above achievements. For VICUP, he worked on a project that uses a parallel deep-learning model for generalised synthetic image detection. For SPARK Challenge 2021/22, his team developed CAMSAT: pediatric anesthesia monitoring system. In addition, he worked on a project on parasitic egg detection and classification in microscopic images for the ICIP 2022 Grand Challenge. For the final year project, Mr. Premathilake worked on using a deep geometric framework to predict antibody-antigen binding affinity in collaboration with Dr. Aravinda Munasinghe from Pfizer Incorporation, USA, Dr. Kaushalya Madhawa from the University of Tokyo, Japan, and Dr. Subodha Charles from ENTC.

During his internship at Effective Solutions (Pvt.) Ltd., he worked on deep learning models for diabetic retinopathy severity grading and neovascularization segmentation.

Mr. Premathilake is interested in learning the mathematics behind statistical learning theory, pattern theory, and neural differential equations. Moreover, he is keen on applying concepts from those fields in computational anatomy and computational pathology.

Currently, he is a research intern in the Computer Vision and Pattern Discovery for Bioimages Group at the Bioinformatics Institute, A\*STAR, Singapore. There, he has worked on two projects, namely a computational pathology project in collaboration with Singapore General Hospital and a genomics project in collaboration with Genomic Institute of Singapore.

Moreover, to the juniors who would like to follow his path, Mr. Premathilake wishes to advise that although the undergraduate years at the university are not easy by any means, the rewards they can reap in the end are worth the toil. Furthermore, he emphasises the importance of discovering one's true passion and identifying the areas that someone would like to work on or study further. Moreover, he wanted to highlight that engaging with the lecturers and discussing ideas with them is necessary since they are well-experienced and can give proper guidance.

Finally, as the Department of Electronic and Telecommunication Engineering, we wish Mr. Dasun Premathilake good fortune in his future endeavours.







"Many ideas  
grow better  
when  
transplanted  
into another  
mind than in  
the one  
where they  
sprang up"

- OLIVER WENDELL HOLMES -

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