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Southeast Asian Conference and Exhibition on Tunnelling and Underground Space

#### Tunnelling and Underground Space Technical Division

#### Theme:

#### Innovation and Sustainable Underground Space Development

Kuala Lumpur Convention Centre, Kuala Lumpur, Malaysia.



300+ delegates 20+ leading speakers regionally 40+ technical papers 24+ exhibitors (limited booths left) 90% decision makers/ key players 16+ hours of networking with industry professionals and regulators

5 - 7 March 2024

The Tunnelling & Underground Space Technical Division of The Institution of Engineers, Malaysia (IEM TUSTD) is hosting the 2nd Edition of the **Southeast Asian Conference and Exhibition on Tunnelling and Underground Space (SEACETUS2024)** in Kuala Lumpur, Malaysia. The conference will offer case studies and strategies that demonstrate innovation, skills, and best practices, and help delegates understand the trending technologies and techniques guiding the Tunnelling and Underground Space Construction Industry. Exhibition and Technical Visits will be held as an integral part of the conference.

This conference is aimed at providing a forum for practicing professionals – authorities, engineers, consultants, contractors, town planners, researchers, academicians, manufacturers, and suppliers to share their experiences, research, studies, ideas and views so as to contribute to the advancement of Tunnelling and Underground Space Development generally and particularly in South East Asia and the Asia Pacific. A wide range of high-quality scientific and technical papers of international or regional significance on tunnelling and underground space is expected on the following themes:

- Innovation in Tunnels and Tunnelling Technology
- Innovation in Rock Support and Water Proofing Technology
- Environment Sustainability and Strategic Use of Underground Space
- Planning, Modelling, Design and Construction of Tunnels
- Risk, Health and Safety, Contractual Practices and Project
  Management of Underground Construction
- Instrumentation and Monitoring in Underground Construction
- Conventional Tunnelling, Sprayed Concrete Use, Drill and Blast Excavation
- Mechanised Tunnelling and Excavation (Hard Rock, Soft Rock and Soil)

- Geological and Geotechnical Site Investigation and Ground characterisation
- Stability Assessment and Ground Stabilization in Underground Construction
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by Ir. Amir Hussein bin Jaafar Chairman, Information Communication Technology Special Interest Group

## **COVER** – NOTF

#### **Engineering Reimagined: Unleashing the Power of AI** in Malaysia

nformation Communication Technology Special Interest Group (ICTSIG) is delighted to present the August issue of JURUTERA magazine, dedicated to the fascinating domain of Artificial Intelligence (AI) in engineering. In this edition,

we explore the deep impact AI has had on the professional engineering landscape in Malaysia as well as its implications in the future.

Over the past few years, AI has emerged as a powerful ally for engineers, revolutionising the way they approach complex challenges and transforming traditional methodologies. In Malaysia, this technology has gained remarkable traction, redefining the boundaries of what engineers can accomplish, from intelligent systems that optimise energy consumption in buildings to Al-driven simulations for designing robust infrastructure.

We will showcase the remarkable applications of AI in various engineering disciplines, offering insights into its influence in the field. We bring you exclusive interviews with leading experts who have embraced AI as an integral part of their work, sharing their experiences and perspectives on how this technology is shaping the future of engineering in our country.

As you immerse yourself in the pages of this magazine, we invite you to envision a future where AI and engineering will intertwine seamlessly, propelling our engineering community to new heights of innovation and excellence. We hope this issue will spark inspiration and incite meaningful conversations among our readers.

Embrace the era of AI in engineering with us, as we embark on a captivating journey through its impact and prospects in Malaysia.

## **EDITOR'S NOTE**

by Ir. Razmahwata Mohamad Razalli Principal Bulletin Editor

#### Acta Non Verba



irstly, I would like to wish our readers a Happy 66th Malaysia Independence Day 2023.

Mr. Loo Weng Soon joined IEM in 1997 as Assistant Library Executive and rose up the ranks through his involvement in the various departments. Today, he heads the IT Department with four staff members,



was instrumental in IEM's smooth transition to webinars and virtual meetings when MCO was first implemented during the Covid-19 pandemic.

Ms. Valli Saminanthan joined IEM in 2016. In 2018, she was transferred to assist the International Office (IO) and was groomed to take over its management. Today she is the IO Manager responsible for IEM's international

Loo Weng Soon

Valli Saminanthan

affiliations with ASEAN Federation of Engineering Organisations (AFEO), ASEAN Engineering Register (AER), International Engineering Alliance (IEA), Federation of Engineering Institutions of Asia and the Pacific (FEIAP) and World Federation of Engineering Organisations (WFEO).

## Transforming Engineering:



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# The Rise of Artificial Intelligence



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**Ir. Prof. Dr Harikrishnan Ramiah** is with the Department of Electrical Engineering, Universiti Malaya (UM), working in RFIC/RFEH design. He also serves as a Director of the Centre of Industry Research 4.0 (CRI4.0) and Head of Analog, Digital & RF Research group at UM. He is a Fellow Member of The Institution of Engineers, Malaysia, a Chartered Engineer, a Fellow member of Institute of Electrical Technology (FIET), a Senior Member of the Institute of Electrical & Electronics Engineer (SMIEEE) and a member of The Institute of Electronics, Information & Communication Engineers (IEICE).

#### Ir. Prof. Dr Harikrishnan, as a Director of CRI4.0, tell us about your vision on the AI agenda

My vision is for CRI4.0 to serve as UM's strategic move in responding to the government's initiative in preparing the nation to face the global tsunami brought on by the 4th Industrial Revolution (4IR). In line with the aim to be the authoritative voice in the field of Industry 4.0 and to elevate the R&D activities of Industry 4.0 in Malaysia, CRI4.0 is committed to working closely with various companies to develop a substantial platform by connecting academia and industries through industrial projects.

Our vision is not only to provide leadership for industries to adopt the implementation of 4IR technologies but also to develop talent and expertise to support 4IR initiatives along with advising the relevant government agencies or organisations.

I hope CRI4.0 will continue to establish collaborative networks with other institutions or organisations to facilitate technology adoptions in the country and to gather experts in 4IRrelated fields by undertaking related projects and activities. In addition, we will also assist various small & medium enterprises (SMEs) for the implementation of 4IR.

#### What is your take on AI?

Al refers to the development and deployment of computer systems which can perform tasks that typically require human intelligence. Al technologies encompass various techniques, including machine learning, natural language processing, computer vision and robotics. These systems can process and analyse vast amounts of data, learn from patterns and experiences as well as make informed decisions or predictions. In engineering, AI is transforming traditional practices, optimising designs, automating tasks and enhancing decision-making processes.

Al also plays a significant role in automation. It can automate repetitive and mundane tasks, freeing up engineers' time to allow them to focus on more complex and creative aspects of their work. For example, Al can automate quality control processes, perform data analysis for fault detection and optimise maintenance schedules.

Moreover, AI technologies contribute to enhancing safety and sustainability in engineering. AIpowered systems can monitor and analyse data in real-time to detect anomalies or potential risks. This proactive approach improves safety measures and reduces the likelihood of accidents. Additionally, AI can optimise energy consumption, reduce waste and promote sustainable practices in engineering projects.

#### Is there any government intervention in advancing AI technology in engineering? Role of MOSTI, MIDA, MITI, MCMC:

The Ministry of Science, Technology & Innovation (MOSTI), the Ministry of International Trade & Industry (MITI), Malaysian Investment Development Authority (MIDA) and the Malaysian Communications & Multimedia Commission (MCMC) play crucial roles in advancing AI technology in engineering.

In response to the National 4IR Policy, the government launched

the Industry4WRD in July 2021 to drive digital transformation of the manufacturing and related services sectors in Malaysia. These government bodies provide strategic guidance, policies and regulations to foster AI adoption and innovation. They collaborate with industry stakeholders, research institutions and academia to promote research and development in AI and to facilitate the integration of AI into engineering practices.



Figure 1: Ir. Prof. Dr Harikrishnan Ramiah at the Centre for Research in Industry 4.0 (CRI4.0) Universiti Malaya



Figure 2: 6-Axis OMRON Collaborative Robot Arm Facility





### **SPARK P3**

Partial Discharge (PD) and Electromagnetic Interference (EMI) Analyzer



#### INSULATION SYSTEM DIAGNOSTICS FOR HIGH-VOLTAGE ASSETS

Doble Spark P3 is a universal PD and EMI analyzer that uses a software defined radio signal detector to identify characteristics of insulation system deterioration that could lead to the failure of high voltage equipment. It detects signals from suitable sensors in a frequency range between 9 kHz to 2 GHz for PD and EMI, and DC to 500k Hz for acoustic and reference voltage measurements.

An automatic classification system enables users of all experience levels to easily distinguish partial discharge activity from nuisance signals and classify different types of PD/EMI defects in high-voltage apparatus, including:

- Rotating machines (PD couplers, HFCT sensors)
- Power transformers (HFCT sensors, UHF antennas, acoustic microphones)
- Instrument transformers (HFCT sensors)
- Switchgear (GIS and AIS TEV sensors, UHF antennas, HFCT, acoustic sensors, spacer sensors, window sensors)
- Cables and accessories (HFCT, UHF sensors, acoustic sensors)

#### **FEATURES**

- Automatic signal fault classifier
- Universal detector applicable for most PD testing scenarios
- Guided mode for minimum operator training requirements
- Freely configurable and pre-set test plans for any application and automatic data acquisition
- Battery operated benchtop (lab) or Pelicase (site), 19-inch rack-mount adapter available

#### BENEFITS

- Signal classification algorithm helps inexperienced operators obtain reliable results
- Guided measurements
- Automatic measurements and test plans (*Can be edited*)
- Suits most PD/EMI applications
- Lightweight battery-operated device (Suitable for cabin and hold air travel)





Figure 3: AI-Powered Remote Monitoring System for Smart Manufacturing

**Grants and funds:** Government grants and funds are instrumental in supporting AI research and development in engineering. These initiatives aim to foster collaboration between industry and academia, stimulate innovation and provide financial resources for projects that leverage AI to address engineering challenges.

For instance, MIDA has provided funding for a research project in collaboration with LSF Technology, a local small and medium-sized enterprise located in Kajang. In this collaboration, the project will apply AI techniques to optimise the manufacturing processes and improve productivity.

The funding from support MIDA enables the research team from CRI4.0 to work closely with LSF Technology, leveraging their expertise in engineering and AI to develop innovative solutions that will benefit the industry. The funding also enables the CRI4.0 research team to access the necessary resources, such as computing infrastructure, research equipment and expert guidance to successfully develop and implement Al-based solutions.

This collaboration not only benefits the industry partner by improving their processes and productivity but also contributes to the advancement of AI in engineering. The research outcomes and insights gained from these projects can be shared with the broader engineering community, fostering knowledge transfer and driving further innovation.

Research & **Development:** Research & Development is a priority for the government in advancing AI technology in engineering. Funding and support are allocated to research institutions and universities to conduct cutting-edge research, develop AI-based solutions and explore new applications in engineering.

#### Role of AI in Engineering

**Economy benefits:** Al offers significant economic benefits in engineering. By optimising designs, reducing waste and improving efficiency, Al contributes to cost savings and productivity enhancement. It enables engineers to make data-driven decisions, leading to better outcomes and the improved performance of engineered systems.

Al algorithms can analyse vast amounts of data, including historical designs, simulations and performance data. By processing this data, Al can identify patterns, correlations and optimal design parameters that human engineers may overlook. This leads to improved designs that are more efficient, cost-effective and which perform better in real-world conditions. Design optimisation will reduce material and resource waste, resulting in significant cost savings.

**Energy consumption:** Al also plays an important role in managing energy consumption in engineering. Through Al-powered algorithms, energy systems can be optimised, leading to reduced energy waste and increased sustainability. Al enables the prediction and management of energy demands, allowing for more efficient utilisation of resources. Al enables engineers to implement predictive maintenance strategies which can significantly reduce downtime and maintenance costs.

By analysing real-time sensor data and historical maintenance records, Al algorithms can predict equipment failures and schedule maintenance proactively. This approach minimises unplanned downtime, optimises maintenance schedules and reduces costs associated with reactive repairs.

with Sustainable Aligning Development Goals (SDGs): Al plavs a crucial role in driving innovation, enhancing efficiency and promoting sustainable practices in engineering, aligning with SDG 9: Industry, Innovation & Infrastructure. By automating processes, optimising designs and improving overall operations, AI fosters technological advancements and streamlines industrial practices. It enables engineers to explore new possibilities, develop innovative solutions and improve existing systems, leading to sustainable growth in various industries. Furthermore, the ability of AI to analyse data and optimise infrastructure planning contributes to the development of resilient and sustainable infrastructure. By leveraging AI technologies, industries can achieve higher efficiency, reduce waste and streamline operations, thus promoting sustainable industrial practices and infrastructure development.

**New skills set resources:** The integration of AI in engineering

necessitates the development of new skill sets. Engineers need to acquire knowledge in AI technologies, data analytics and algorithm development to effectively utilise AI tools. Resources such as training programmes, online courses and educational institutions can provide the necessary training and upskilling opportunities.

### Role of CRI4.0 in Championing AI for Engineering Community

Example of industry collaboration in AI and Engineering: CRI4.0 plays a pivotal role in championing Al for the engineering community through its active promotion of industry collaboration. By closely engaging with industry partners, CRI4.0 identifies specific challenges and opportunities where AI can be effectively applied to enhance engineering practices. This collaborative approach allows for a deeper understanding of industry needs and enables the development of tailored AI solutions.

One notable example of industry collaboration is the partnership between UM CRI4.0 and AMS Osram. They embarked on a joint research project aimed at developing Aldriven asset management systems for the manufacturing facilities of AMS Osram. By leveraging Al technologies, CRI4.0 worked alongside the industry partner to analyse data, identify patterns and develop predictive models that optimise asset management processes.

**Engineering education in enabling AI:** CRI4.0 recognises the significance of engineering education in enabling the adoption of AI. As part of its efforts, CRI4.0 actively collaborates with academic institutions to incorporate AI into the engineering curriculum. This collaboration ensures that students will receive a well-rounded education that helps them to understand and apply AI technologies in their careers in the future.

CRI4.0 works closely with academic partners to develop Alfocused courses that cover essential topics such as machine learning, data analytics and AI applications in engineering. These courses provide students with a solid foundation in Al concepts, algorithms and tools, enabling them to comprehend the potential of AI in solving complex engineering problems. By integrating Al into the curriculum, CRI4.0 ensures that engineering students are equipped with the necessary knowledge and skills to harness the power of AI in their professional endeavours.



Figure 4: Industrial Collaboration Discussion for AI Projects

CRI4.0 Additionally, provides training resources and support for both educators and students. This includes access to AI development platforms, online resources and practical training materials. By offering these resources, CRI4.0 facilitates hands-on learning experiences and encourages students to explore AI applications in engineering. The research centre also engages Master's and PhD students who actively contribute to Al-related projects, further enhancing their expertise in the field.

By emphasising AI education in engineering, CRI4.0 aims to produce a new generation of engineers who are well-versed in AI technologies that can effectively leverage them in their careers. This not only strengthens the capabilities of engineering graduates but also promotes interdisciplinary learning and collaboration between AI and engineering disciplines. By integrating AI into the curriculum and providing training resources, CRI4.0 plays a crucial role in preparing students for the AI-driven future of engineering.

**Public Training:** CRI4.0 recognises the importance of public training in AI. We conduct workshops, seminars and training programmes which are open to the public. These initiatives aim to raise awareness about AI applications in engineering, provide hands-on experience with AI tools and techniques and foster a culture of continuous learning and upskilling.

#### Potential & Challenges of AI in Engineering for Malaysia

presents immense potential AI benefits for the country in the field of engineering, contributing to its economic growth and competitiveness. By integrating AI into engineering practices, Malaysia can drive innovation and enhance productivity in various industries. Al-powered optimisation of designs and processes leads to more efficient and cost-effective solutions, giving Malaysian businesses a competitive edge in the global market.



Furthermore, the application of Al in engineering can help create sustainable infrastructure, aligning with our goals for sustainable development and environmental conservation. This positions Malaysia as a forward-thinking nation that embraces technological advancements to address societal and environmental challenges.

However, along with the potential benefits, there are several challenges that we need to address to fully leverage the power of AI in engineering. One key challenge is the need for a skilled workforce proficient in AI technologies and engineering practices.

To do this, we need training and research programmes that focus on developing AI expertise within the engineering community. This includes promoting interdisciplinary collaboration between engineering and AI disciplines, encouraging the pursuit of advanced degrees in AI-related fields and fostering partnerships between academia and industry for knowledge exchange and practical training.

Another challenge lies in addressing concerns related to data privacy, security and ethical considerations. As AI relies heavily on data, ensuring the privacy and security of sensitive information becomes crucial. Robust data protection measures and ethical guidelines need to be in place to address these concerns. The government, industry and regulatory bodies should work together to establish frameworks and regulations that govern the ethical use of AI in engineering, fostering trust and confidence in the technology.

#### Employability Prospect for AI Engineers

The employability prospects for AI engineers in Malaysia are indeed promising, due to the widespread adoption of AI technologies across various industries. As AI continues to transform traditional practices and drive innovation, there is an increasing demand for professionals who possess expertise in AI and engineering. AI engineers are equipped with the skills to develop and implement AI models, design intelligent systems and analyse complex datasets, making them valuable assets to organisations seeking to leverage AI in their operations.

Industries such as manufacturing, energy, transportation and infrastructure development are actively embracing AI to enhance productivity, efficiency and decisionmaking processes. AI engineers play a vital role in developing AI-driven solutions tailored to the specific needs of these sectors. For example, in manufacturing, AI engineers can optimise production processes, predict equipment failures and automate quality control systems.

Furthermore, the continuous in advancements AI present opportunities for AI engineers to become entrepreneurs and to contribute to Malaysia's growing AI ecosystem. With their expertise, AI engineers can establish startups and develop innovative AI solutions to address industry-specific challenges. This entrepreneurial spirit not only fosters economic growth but also promotes Malaysia as a hub for Aldriven innovations.

#### **Advice for Inspiring Engineers**

My advice to engineers is to embrace life-long learning. The field of Al is evolving rapidly and engineers need to stay updated with the latest advancements, tools and techniques. Seek opportunities to gain practical experience in Al projects, collaborate with multidisciplinary teams and expand your knowledge through continuous education. Developing a solid foundation in engineering fundamentals while acquiring skills in Al technologies will provide you with a competitive edge in this exciting and transformative field.

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## Harnessing the Potential: Applications of Artificial Intelligence, Machine Learning and Deep Learning in Electrical Engineering

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n today's ever-evolving technological landscape, Artificial Intelligence (AI) has emerged as a transformative force with profound implications for various industries. One field that has witnessed remarkable advancements fuelled by AI is electrical engineering. Driven by powerful subsets such as Machine Learning (ML) and Deep Learning (DL), AI has revolutionised traditional approaches and opened up new horizons for innovation.

In this article, we will explore the boundless applications of AI in electrical engineering, starting with an overview of AI, followed by a deeper dive into the concepts of ML and DL. Together, these cutting-edge technologies are empowering engineers to tackle complex challenges, optimise systems and unlock unprecedented possibilities.

#### **Artificial Intelligence**

At its core, AI refers to the development of computer systems capable of performing tasks which typically require human intelligence. These tasks range from simple rulebased operations to complex decision-making processes. AI systems aim to simulate human-like cognition, enabling machines to perceive, reason, learn and make informed decisions. Through the amalgamation of data, algorithms and computing power, AI systems analyse vast amounts of information, extract patterns and generate insights that drive intelligent actions. In the realm of electrical engineering, AI serves as a catalyst for transforming traditional practices, enhancing efficiency, accuracy, and innovation across multiple domains.

#### Machine Learning

ML, a subset of AI, empowers computer systems to learn from data without being explicitly programmed. By leveraging algorithms and statistical models, ML algorithms autonomously identify patterns, correlations and trends in complex datasets, enabling predictions, classifications and intelligent decision-making. In electrical engineering, ML algorithms have found immense applications in optimising power systems, signal processing, fault diagnosis, and more. By harnessing historical data and real-time inputs, ML algorithms can generate insights that assist in power resource allocation, load forecasting, adaptive filtering and a multitude of other tasks, revolutionising the efficiency and reliability of electrical systems. ML algorithms can be further classified into supervised learning and unsupervised learning.

In the context of electrical engineering, ML has found compelling applications across various domains. For instance, in power systems, ML algorithms can be employed to predict electricity demand, optimise energy generation and improve the efficiency of power grids. ML techniques are also invaluable in fault diagnosis, allowing engineers to detect anomalies, identify potential failures and mitigate risks in electrical networks. Moreover, ML-based algorithms can aid in optimising the routing of power transmission lines, reducing losses and enhancing reliability. Examples of ML algorithms include the following:

• Linear Regression: A supervised learning algorithm used for regression tasks, where the goal is to predict a continuous numeric value based on input features.

It fits a linear relationship between the input features and the target variable.

- Logistic Regression: Another supervised learning algorithm used for binary classification tasks. It models the relationship between input features and the probability of belonging to a specific class using a logistic function.
- **Decision Trees:** A versatile supervised learning algorithm that builds a tree-like model to make predictions. It splits the data based on different features at each node and assigns a class or value to the leaf nodes.
- Random Forest: An ensemble learning method that combines multiple decision trees to make predictions. It generates a collection of decision trees and aggregates their predictions to obtain a final result.
- Support Vector Machines (SVM): A supervised learning algorithm used for both classification and regression tasks. It finds an optimal hyperplane that maximally separates the data points of different classes or fits a curve to approximate the data in regression problems.
- Naive Bayes: A probabilistic algorithm commonly used for text classification tasks. It assumes independence between the features and calculates the probability of a sample belonging to a class based on Bayes' theorem.
- K-Nearest Neighbours (KNN): A simple but effective algorithm for both classification and regression tasks. It classifies a sample by assigning the most frequent class among its K-nearest neighbours or predicts a value based on the average of the values of its K-nearest neighbours.
- Neural Networks: A class of algorithms inspired by the structure of the human brain. Neural networks consist of interconnected nodes called neurons, organised in layers. They are capable of learning complex patterns and relationships from data and are used for various tasks, including image recognition and natural language processing.
- **K-Means Clustering:** An unsupervised learning algorithm used for clustering tasks. It groups data points into K clusters based on their similarity, aiming to minimise the intra-cluster distance and maximise the inter-cluster distance.
- Principal Component Analysis (PCA): A dimensionality reduction technique that transforms high-dimensional data into a lower-dimensional space. It identifies the principal components, which capture the most significant variance in the data.

#### **Deep Learning**

DL, a subset of ML, derives inspiration from the structure and function of neural networks in the human brain. Through the deployment of artificial neural networks comprising multiple layers of interconnected

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nodes (neurons), DL algorithms excel at processing vast amounts of data and uncovering intricate patterns and representations. DL algorithms, with their hierarchical learning capabilities, have witnessed remarkable success in complex tasks such as image and speech recognition.

In electrical engineering, DL is driving breakthroughs in image processing, power electronics and autonomous systems. By leveraging DL, engineers can develop advanced vision systems a.k.a. computer vision which enable accurate object detection, image classification and even facilitate autonomous vehicles functioning. Moreover, DL algorithms contribute to power electronics advancements, optimising energy conversion processes, improving efficiency and enabling early fault detection, thereby bolstering system reliability.

In electrical engineering, DL has emerged as a gamechanger across numerous applications. For instance, DL algorithms can revolutionise the field of smart grids by optimising energy distribution, predicting power demand patterns, and managing energy resources more efficiently. Additionally, DL techniques enable the development of intelligent systems for power quality monitoring, ensuring stable and reliable electricity supply while identifying and mitigating voltage fluctuations or harmonics.



Figure 1: Deep Neural Network (Source: Indiaai.com)

Furthermore, its ability to analyse and understand visual and audio data finds utility in robotics, where autonomous systems can use vision-based DL algorithms to recognise objects, navigate complex environments and perform tasks with precision. DL has also found applications in signal processing, enabling advanced techniques for noise reduction, signal denoising and signal reconstruction.

Example of DL algorithms are:

- Convolutional Neural Networks (CNNs): These are designed to process image and video data and are commonly used in tasks such as image classification, object detection and segmentation.
- Recurrent Neural Networks (RNNs): RNNs are designed to process sequential data, such as time series data, speech and text.
- Long Term Short Memory (LTSM): A variant of RNNs that is able to handle long-term dependencies in sequential data.
- Reinforcement Learning (RL): A branch of machine learning which focuses on how an agent can learn to make optimal decisions in an environment by

interacting with it. It draws inspiration from behavioural psychology, where the learning process is guided by rewards and punishments.

#### **Application of DL in Autonomous Vehicles**

DL has emerged as a driving force behind the advancements in autonomous vehicles, paving the way for the realisation of a fully automated vehicle. By leveraging the power of DL algorithms, autonomous vehicles are becoming increasingly capable of perceiving their surroundings, making informed decisions and navigating complex road scenarios. Let's find out how DL is revolutionising the world of autonomous vehicles and the specific DL algorithms being used to make autonomous vehicles a reality.

One of the key challenges in autonomous driving is the ability to accurately perceive the environment and make sense of the vast amount of sensory data collected by the vehicle sensors. DL algorithms, particularly CNNs, have revolutionised perception tasks in autonomous vehicles. CNNs excel at analysing visual data, making them ideally suited for tasks such as object detection, lane detection and traffic sign recognition.

Through training on large annotated datasets, CNNs can learn to identify and classify objects in realtime, enabling the vehicle to detect and track vehicles, pedestrians, cyclists and other obstacles on the road. This real-time object detection capability is essential to ensure the safety of autonomous vehicles and to enable them to make informed decisions based on their surroundings.

Furthermore, DL algorithms such as RNNs and LSTM networks have been instrumental in improving the understanding of dynamic aspects of driving, such as predicting the behaviour of other vehicles and anticipating potential hazards. These algorithms can process sequential data and capture temporal dependencies, enabling the vehicle to make predictions about the future trajectory of objects on the road.

To navigate autonomously, vehicles must possess robust mapping and localisation capabilities. DL algorithms, particularly Semantic Segmentation models, have proven effective in creating detailed maps of the environment by segmenting the scene into different classes such as roads, sidewalks, buildings and vegetation. This semantic understanding of the scene provides crucial information for the vehicle to plan its path and make navigation decisions.

In addition to perception and mapping, DL algorithms play a vital role in decision-making and control systems of autonomous vehicles. Reinforcement Learning (RL) algorithms, a type of DL algorithm, have been employed to train autonomous vehicles to make optimal decisions in complex and uncertain environments. RL algorithms learn through trial and error, receiving rewards or penalties based on their actions and gradually improving their decisionmaking policies. This approach allows autonomous vehicles to learn how to handle a wide range of scenarios, from merging into traffic to handling unexpected obstacles. Tesla, one of the pioneers in autonomous driving, utilises a DL framework called Tesla Autopilot, which combines various DL algorithms to enable fully autonomous vehicles. The system incorporates a combination of CNNs for perception tasks, RNNs and LSTM networks for predicting object behaviour and RL algorithms for decision-making. This integration of DL algorithms allows Tesla vehicles to continuously improve their performance and to adapt to various driving conditions, pushing the boundaries of autonomous driving capabilities.



Figure 2: AI-Based P2P Energy Trading System (Source: pyimagesearch.com)

DL is revolutionising autonomous vehicles by enhancing perception, decision-making, mapping and control systems. DL algorithms such as CNNs, RNNs, LSTM networks, and RL algorithms are instrumental in enabling vehicles to perceive their surroundings, understand dynamic aspects of driving, create detailed maps and make optimal decisions. With ongoing advancements in DL and AI, we are moving closer to a future where autonomous vehicles equipped with advanced autonomous driving capabilities will transform transportation, making it safer, more efficient, and more accessible for all.

#### Application of DL in Energy Trading

Trading energy poses a distinct challenge compared to trading commodities as it necessitates immediate delivery. This challenge presents significant hurdles for energy traders. Load forecasting plays a crucial role in assisting energy traders and regional providers in determining electricity generation and energy pricing. Utilising AI algorithms, trading can be enhanced by predicting energy demands and offering real-time energy prices, empowering traders to make informed buying and selling decisions. These algorithms attain greater accuracy by harnessing additional data from micro weather conditions, meter-level consumption data and social media posts, such as those found on Twitter.

Research has been conducted on LSTM and SVM models to achieve load forecasting at the individual household level. However, given the volatile nature of user behaviour, this approach relies on historical load and appliance measurements to yield superior outcomes compared to traditional methods. Another technique, known as the bottom-up hierarchical approach, puts forth a fresh perspective utilising smart meters. Initially, K-means Clustering is employed to group customers based on their similar energy usage patterns. Subsequently, deep neural

networks (DNNs) are employed for each cluster, culminating in aggregation of electricity consumption from all clusters to obtain the overall load.

#### **DL in EV Charging**

In conjunction with peer-to-peer (P2P) blockchain technology, integration of AI can play a vital role in accelerating the deployment of electric vehicle (EV) charging stations (Figure 3). AI technologies can assist EV owners in selecting and managing suitable charging stations. Conversely, blockchain-based platforms utilising the technology can facilitate discovery of charging stations and enable smart contracting on the charging station's side. The charging process is initiated

by AI through a request to block chain-based charging platform, including information such as the EV location and preferred charging time. Concurrently, charging stations continuously send queries to trading platform for new charging requests. Once a suitable match is found, a bidding process ensues and repeats until a mutually agreeable price is reached. Ultimately, AI displays a route map on consumer's mobile or tablet screen. A smart contract is executed between the EV owner and the charging station, with the record securely stored on blockchain platform.



Figure 3: Blockchain and Al-Based EV Charging Decentralised Platform (Source: pyimagesearch.com)

#### Challenges

Just like other domains which apply AI, electrical engineering also faces various challenges such as governance, transparency, security, safety, privacy, employment and economic impacts.

#### **Data Protection & Security**

Systems constantly share data with centralised authorities when connected to a digital system. Any system breach can leak confidential information which can be used against the consumer. A successful cyber-attack can be as damaging as a natural disaster. The world's first successful attack happened in Ukraine in 2015, leaving thousands without power.

Cybersecurity is becoming increasingly essential to protect AI-enabled electric grids from leaking customer data. The growing threat from hacking has become a matter of significant concern, mainly because smart metering and automated control represent a growing share of global grid investments.

#### **Power Consumption**

Processing large amounts of data consumes energy on its own. Therefore, when using Al-based systems in power plants, manufacturing, etc, it is crucial to analyse how to design energy-efficient data centres and manufacturing plants. In addition, engineers should keep in mind the physical proximity of data centres and renewable energy generation plants.

#### Conclusion

As the fields of electrical engineering and DL continue to evolve, embracing the potential of AI, ML and DL will open up new frontiers for innovation and progress. These technologies empower engineers to optimise electrical systems, enhance performance, improve manufacturing efficiencies, optimise resource allocation and ensure efficient and reliable operation.

By leveraging the AI ability to analyse vast datasets and extract meaningful insights, electrical engineers can pave the way for a more sustainable, interconnected and intelligent future. As we delve deeper into applications of AI in electrical engineering, we will witness unprecedented advancements and unlock the full potential of this groundbreaking discipline.

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## **Transforming Industries: AI Innovations in 6G Communication, Automotive Industry, Empowering SMEs, Indoor Navigation & Healthcare Solutions**

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n this era of rapid technological advancement, the potential of AI knows no bounds. Here's a review of AI innovations across various industry. In 6G communication, we will witness the remarkable fusion of Al and cutting-edge technology, driving next-generation connectivity like never before. Alongside its transformative impact, AI emerges as a powerful ally to empower small and medium-sized enterprises (SMEs) on a remarkable journey of growth and success. Shifting gears to the Malaysian automotive landscape, Al is revolutionising the industry through groundbreaking research and development, redefining the driving experience of tomorrow. Additionally, research paper is presented on Al-driven indoor positioning systems that usher in an era

of seamless navigation and, in the realm of healthcare, remarkable strides are being made, with the development of an AI-based risk indicator of cardiovascular diseases, leading the way towards proactive and personalised healthcare solutions. Embrace the potential, as AI stands poised to shape a future brimming with unprecedented possibilities.

#### **6G Communication**

5G will lay the groundwork for 6G with AI applications. 6G is envisioned to provide better connections for people and things as well as embrace the trend of a smart society, continuing the transformation from connected people and things to connected intelligence.



Figure 1: Expansion from IMT-2020 (5G) to IMT-2030 (6G) and Beyond

Al integration is expected to play a significant role from IMT-2020 (5G) to IMT-2030 (6G) and beyond (Figure 1). The network infrastructure may leverage Al capabilities to optimise network performance, resource allocation and user experience. Al-powered devices and applications can enhance personalisation, predictive analytics and contextual understanding.

6G is expected to bring computing capabilities closer to the network edge. This shift toward edge computing can be complemented by Al algorithms running directly on edge devices, enabling real-time processing, decisionmaking and data analytics. Al at the edge can support applications such as autonomous vehicles, smart cities and IoT devices by processing data locally and reducing reliance on centralised cloud infrastructure.

The management and optimisation of Quality of Service (QoS) are expected to benefit from Al-driven approaches where Al algorithms can analyse network conditions, traffic patterns and user demands to intelligently allocate network resources in real-time. Network faults, anomalies and performance degradations can be identified to trigger automated responses and self-healing mechanisms to mitigate the impact on QoS.

An example of use case AI for 6G is connected UAV (unmanned aerial vehicle). This can be interpreted as smart drones or aircrafts which can be remotely controlled and pre-programmed for specific tasks. Fragmented reference signal received power (RSRP) can cause radio link failure, frequent handovers and ping-pong handover events. To provide continuous UAV connectivity in the sky, reinforcement learning is a potential solution for aiding the development of optimal handover rules and ensuring stable communication at minimum handover cost.

By harnessing the power of AI, 6G communication systems can achieve intelligent and adaptive QoS management, leading to improved network performance, optimised resource utilisation and enhanced user satisfaction.

#### **Empowering SMEs**

The development of any intelligent system, be it predictive maintenance, autonomous system or digital twin simulation, generally involves algorithms and models. The algorithm development involves problem identification, data gathering, data cleaning and programming. This is a manpower-intensive process. Once the algorithm is developed and the model architecture identified, the next step is to train the model. The training process requires a large amount of dataset and a lot of computing power.

A large amount of data requires large computer resources such as computing power and storage. This involves large capital investments in computing infrastructure and human

resource planning which, unfortunately, is generally beyond the reach of SME industry players with limited resources. So, are there other options for SME industry players? Al algorithm marketplace and cloud computing can help.

The AI algorithm marketplace is a platform that connects developers and users, allowing them to buy, sell and share AI algorithms. SME industry players can take advantage of the vast collection of pre-built algorithms available in the marketplace and select one that best suits their use. This means huge savings as the algorithm need not be built from scratch and can be obtained at a fraction of the cost as compared to investing in extensive in-house development. These algorithms generally come with documentation and, in some cases, with Application Programming Interfaces (API) as well as tools for easy integration into the existing system or application. This greatly reduces the iteration cycles and speeds up the prototype to production deployment time. Examples of AI algorithm marketplaces are AWS Marketplace for Machine Learning, Google Cloud AI Marketplace, Microsoft Azure Marketplace, Kaggle and Algorithmia.

Cloud computing platform provides on-demand computing resources over the internet. The offers range from infrastructure as a Service (laaS), Platform as a Service (PaaS) to Software as a Service (SaaS) and allow users to access computing resources such as virtual machines, storage, databases, networking capabilities and development tools etc. without the need to manage or build the underlying infrastructure.

On-demand usage or pay-as-you-use model allows the user to pay for the computing resources' usage time. This is a fast and cheap alternative for any organisation to train its Al model using the cloud computing platform as compared to building an expensive computing infrastructure. The platform also provides scalability with the ability to scale the resources up or down, depending on the usage, ensuring optimal resource utilisation and cost efficiency. These platforms are generally highly reliable with high availability. Examples of cloud computing platform providers are Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform (GCP), INM Cloud, Alibaba Cloud or Alicloud and Nvida NGC Cloud.



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With a clear focus, strategic planning and a willingness to learn and adapt, SMEs can begin their AI journey and gradually unlock the benefits of AI for their businesses.

#### **Revolutionising the Automotive Industry**

Al has emerged as a game-changing technology in various sectors and the automotive industry is no exception. In Malaysia, local companies, institutions of higher learning and government agencies have been actively researching and developing Al solutions to revolutionise the automotive industry. Their collaborative efforts are yielding promising results and driving Al innovation in the local automotive industry.

Automotive companies in Malaysia recognise the transformative potential of AI in revolutionising the industry. One of the key areas where local automotive companies are investing in AI research and development is vehicle safety. They are exploring advanced driver assistance systems which use AI-powered sensors and cameras to monitor the vehicle surroundings and to assist drivers avoid collisions, detect pedestrians and ensure safe lane-keeping.

Al-based autonomous driving systems can enable safer and more efficient transportation, reduce human errors and enhance overall road safety. Al also plays a pivotal role in optimising energy consumption and reducing emissions. By analysing driving patterns, road conditions and various vehicle parameters, Al can help in developing eco-friendly solutions that minimise the environmental impact of vehicles.

Another area where local automotive companies are exploring AI is predictive analytics. By analysing vast amounts of data collected from vehicles and various sources, AI can provide valuable insights into improving maintenance practices, optimising fleet management and enhancing overall operational efficiency.

Malaysian universities have also been at the forefront of AI research in the automotive sector. Research teams are focusing on developing intelligent systems for vehicle control, driver assistance and advanced driver monitoring. They are conducting experiments and simulations to optimise vehicle performance, enhance energy efficiency and minimise environmental impact. They are also actively engaged in interdisciplinary collaborations, combining AI expertise with automotive engineering to tackle complex challenges in smart transportation and mobility solutions.

The government, through its agencies, recognises the significance of AI in shaping the future of the automotive industry. Initiatives are underway to support research and development activities, foster innovation and create an ecosystem conducive to AI adoption in vehicles. Government agencies are providing funding, grants and incentives to encourage collaborations between industry and academia. They are also facilitating knowledge-sharing platforms, conferences and workshops to promote AI research and application in the automotive sector.

The collaborative efforts between local companies, universities and government agencies are yielding promising results and driving AI innovation in our automotive industry. These advancements are expected to bring numerous benefits, such as enhanced vehicle safety, reduced congestion, optimised energy consumption and improved mobility experiences.

#### **Indoor Positioning Systems**

An indoor positioning system (IPS) is used to determine the location of people or objects in an indoor environment. Indoor navigation systems provide route guidance in indoor environments, especially in large and complex spaces. The development of indoor navigation systems includes several components, such as generating an indoor map to be used as the basis of the navigation system, mapping points of interest (POI), indoor positioning to locate a user's current position and route guidance instructions to guide the user to the desired destination.

The ground floor of Block D at the Faculty of Engineering building in the University of Nottingham Malaysia was used to demonstrate the development.

Indoor mapping (Figure 2) using a ZED 2 stereo camera is used to reconstruct a 3D model of the indoor environment. The stereo camera consists of two identical camera lenses placed at a distance from each other, allowing the camera to capture two images of the same scene from slightly different perspectives. The resulting images provide 2D information about the environment, while the depth information is calculated using triangulation between the stereo images. The ZED 2 camera has built-in IMU, which allows tracking of the camera movement (also called camera trajectory). The camera trajectory is then combined with the stereo images to create a 3D model of the environment.



Figure 2: Overview of Proposed Indoor Navigation Framework

The generated 3D model eliminates the need to create the 3D map from the 2D floorplan and is useful for environments with no floorplans readily available. POI mapping is performed using object detection and optical character recognition (OCR), speeding up the process significantly. The indoor positioning system combines motion tracking and QR code repositioning. As for route guidance, augmented reality (AR) is chosen to visually guide the user by overlaying the path on top of the real-time camera feed from the user's mobile phone. The POI data is imported into Unity, a cross-platform game engine that supports AR development, to create an Android-based real-time indoor navigation system.

Figure 3 shows the path generated from the user's current location to the desired destination and a QR code next to the signage of Block D that is used to determine the user's starting location. When a QR code is scanned, the mobile application updates the user's current location based on the QR code and generates an updated path to guide the user to the selected destination (Figure 4).



Figure 3: Android-Based Real-Time Indoor Navigation Path



Figure 4: Real-Time Camera Feed with Path Overlay to Guide Users

In conclusion, AI-powered indoor positioning systems hold great promise for transforming the way we navigate and interact within indoor spaces. It is an exciting era for indoor positioning, driven by the ingenuity of AI and its potential to shape the future of indoor navigation.

#### **Risk Indicator of Cardiovascular Diseases**

Cardiovascular disease poses a significant risk to individuals but often goes undetected until symptoms become life-threatening. However, a medical AI-based system can indicate the risk of cardiovascular diseases, thus reducing the occurrence of severe cases and sudden death.

The data acquisition system involves the use of a wearable device with a pressure sensor on the wrist that acquires data non-invasively. The research obtains pairs of radial and aortic signals from existing databases, such as PhysioNet and HaeMod. To convert the radial waveforms to aortic waveforms, a newly-developed Electrical Impedance Function (EIF) is employed and compared to other conversion methods like Generalised Transfer Function (GTF), N-Point Moving Average (NPMA) and Adaptive Transfer Function (ATF). The EIF demonstrates comparable performance with the GTF and offers better

estimation compared to NPMA and ATF (Figure 5), as indicated by metrics such as average RMSE, MAPE, peak difference and computational time.



Figure 5: The Estimated Central Aortic Blood Pressure of All the 4 Methods Against the Corresponding Database's Central Aortic Blood Pressure Waveform. Highlighted is the Feature of the Database Aortic Waveform Captured by the EIF Method

The transformed signals are then used for risk indication by utilising Vincent Rideout's cardiovascular model to produce data for a Convolutional Neural Network (CNN). The study identifies 16 parameters from the model that significantly influence the aortic wave. A regression-based CNN is trained using aortic waveforms as inputs and their corresponding 16 parameters as outputs. When tested with aortic pulse waveforms in individuals with cardiovascular disease, converted from radial pulse waveforms using both EIF and GTF separately, two key parameters (RL2 and RA1) are observed to be indicative of cardiovascular diseases. These parameters are believed to relax simultaneously, allowing smooth blood flow in the closed-loop framework and reducing the resistance value.

Experiments conducted with the trained CNN revealed that the values of RL2 and RA1, when acclimated to cardiovascular conditions, were below certain thresholds. With EIF as the transfer function, the values were equal to or below 10.640691 g·s/cm<sup>4</sup> and 9.7667933 g·s/cm<sup>4</sup>, respectively. Similarly, when using GTF as the transfer function, the values were equal to or below 10.530969 g·s/cm<sup>4</sup> and 9.8313036 g·s/cm<sup>4</sup>, respectively. By using these threshold values as identifiers, an 80.0% classification accuracy was achieved with EIF and an 82.5% accuracy was achieved with GTF when applied to cardiovascular disease data.

Overall, the research demonstrates that the proposed system can identify cardiovascular disease with an 80% accuracy rate and a 60% accuracy rate for healthy signals. This performance is considered reasonably good and can increase the number of early detections, thereby helping individuals at risk of cardiovascular disease receive timely intervention.

## **Technical Visit to MRANTI Makers Lab**

Written and Prepared by:



Ir. Amir Hussein bin Jaafar

n an era defined by rapid technological advancements and a growing emphasis on entrepreneurship and solving immediate engineering related problem, the need for spaces that nurture innovation and creativity has become increasingly apparent. Enter the makers lab (also known as makers space), a dynamic and collaborative environment designed to inspire and empower individuals and industry professionals to bring their ideas to life. Combining elements of a workshop, a laboratory and a creative studio, the makers lab serves as a hub for makers, tinkerers, inventors and artists alike.

With Information and Communications Technology Special Interest Group (ICTSIG) taking the lead, The Institution of Engineers Malaysia (IEM) has set up an "IEM Maker Space" at Wisma IEM in 2019. In recognition of other well established maker spaces set up in Malaysia, ICTSIG also arranged for a technical visit to MRANTI Makers Lab on 9 May 2023.

Malaysian Research Accelerator for Technology & Innovation (MRANTI) formerly known as Technology Park Malaysia is Malaysia's central research & innovation commercialisation agency that accelerates ideas to market under Ministry of Science, Technology and Innovation (MOSTI). MRANTI Park is located in Bukit Jalil integrated with 4IR-ready infrastructures and facility for innovators and entrepreneurs to transform breakthrough idea into reality.

Situated within MRANTI Park, MRANTI Makers Lab is open to creators, innovators, school students, university students, youth and educators to give life to ideas with a variety of new-age technologies, tools and facilities. MRANTI Makers Lab on-site facilitators will provide guidance, whether assisting with project or giving demonstrations on using the Makers Lab state-of-the-art equipment.

On the day of IEM technical visit to the MRANTI Makers Lab, Mr. Mohd Rozaini Razman, Mr. Ramesh Pillai, Mr. William Alvisse and the MRANTI Makers Lab team welcomed the technical visit participants. MRANTI Makers Lab team introduced to the participants the state-of-theart tools and technologies, ranging from 3D printers, laser engraver, laser cutters and CNC millers to electronics components, prototyping equipment and hand tools. This comprehensive array of resources enables users to engage in a wide range of hands-on activities, such as designing and fabricating physical objects, developing interactive installations and experimenting with new technologies.

As explained by the MRANTI Makers Lab team, the MRANTI Makers Lab also provides consultancy and services on 3D modelling, technical advisory, customised production and programme development. Through these services, one would get technical guidance from MRANTI Makers Lab experts to upscale prototypes.

Besides that, for those wanting to explore new areas of knowledge and develop skills in various fabrication technologies, MRANTI Makers Lab organise workshops on 3D design, drones, programming, electrical, electronics and embroidery. According to the MRANTI Makers Lab team, details of these workshops can be found on MRANTI Makers Lab website.

The participants were then taken to the next agenda of the technical visit, besides the MRANTI Makers Lab. MRANTI Makers Lab also collaborates with Katapult on Scuttle Robot project. SCUTTLE™ is a modular, opensource robotics platform designed by "Makers" – students & engineering staff for a flexible, extensible, durable, and affordable platform to teach the mobile robotics engineering course. Scuttle Robot has strong autonomous capability, IoT connectivity and payload performance; backed by a supportive open-source community and easily available design documentation.



Figure 1: Scuttle Global Open Source Project

By the end of the technical visit, the participants understood more on the primary objectives of a makers lab, that is to democratise innovation. By providing access to cutting-edge tools and technologies, the MRANTI Makers Lab ensures that anyone with a passion for creation can participate in the process of invention, regardless of their background or expertise. This inclusivity fosters diversity and brings together individuals from various disciplines, including engineering, design, art and entrepreneurship, creating a vibrant community of makers who collaborate and learn from one another.

Moreover, the MRANTI Makers Lab serves as a catalyst for problem-solving and entrepreneurial endeavours. It offers a platform for individuals to prototype and iterate on their ideas, transforming them into viable products or solutions. By providing a supportive ecosystem of mentors, workshops, and networking opportunities, the lab nurtures the growth of start-ups and facilitates the transition from concept to market. This approach empowers individuals to become not just makers, but also innovators and entrepreneurs, driving economic growth and societal progress. By providing a physical space where imagination can thrive and ideas can be materialised, the MRANTI Makers Lab sparks innovation and inspires the next generation of inventors and creators.



Figure 2: High-End 3D Printers



Figure 3: IEM Participants and MRANTI Personnel



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9.00am - 9.15am	Introduction by Leader Solar Energy Sdn. Bhd.
9.15am - 10.00am	Technical Presentation
10.00am - 11.30am	Site Visit/Tour
11.30am - 12.00pm	Q&A session
12.00pm - 12.30pm	Round-up & Certificate Presentation



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AUGUST 2023 31

## Technical Visit to IIUM Centre of Unmanned Technologies, International Islamic University Malaysia

Written and Prepared by:



Ir. Dr Yasser Asrul bin Ahmad

he ICT Special Interest Group (ICTSIG) organised a technical visit to the Centre of Unmanned Technologies (CUTe) at the International Islamic University Malaysia on 8 March 2023.

CUTe is designed for advancing scientific studies and engineering development through human-robot collaboration. It was established through the collaboration of the Ministry of Investment, Trade & Industry (MITI), the Ministry of Higher Education (MOHE) and the International Islamic University Malaysia (IIUM).

Located in the Faculty of Engineering in IIUM Gombak, Selangor, its main function is to bridge the gap between researchers, industries and communities by developing and innovating unmanned technologies which can reduce human participation. CUTe is positioned to collaborate with industries in the areas of small/large scale prototype systems and validation of the unmanned system through system demonstration in real field. Figure 1 shows its Industry Academia Collaboration model.



Figure 1: Industry Academia Collaboration Model at CUTe



Figure 2: Visit to Large Unmanned Robotic and Surface Vessel Laboratory

All projects developed in CUTe are partnerships with local engineering corporations which aim to commercialise the system. The group from IEM visited the Unmanned Surface Vessel systems where unmanned boats or surface vessels were designed and developed through strategic collaboration with Hydrokinetik Technologies Sdn. Bhd. for an innovative autonomous survey vessel. Prior to this, surveys were done by humans using equipment on boats but these surveys were limited by weather conditions. The collaboration innovates the survey techniques by incorporating autonomous navigation system, obstacle avoidance and collision avoidance. The autonomous survey vessel is powered by electricity as a sustainable and environmentally friendly solution. Using the real time monitoring system, survey data can be collected in real time with accurate control and precise data. The survey can be conducted at any time (day or night) and in all weather conditions, including rain.

In the healthcare sector, MediBot, a robotic assistant for healthcare service providers during the Covid-19 pandemic was developed. MediBot helps healthcare workers and doctors interact with patients and takes noninvasive measurement of the patients.

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Another project was an Unmanned Aerial Vehicle for Hajj-crowd surveillance, a project carried out in cooperation with Saudi Arabia. There are many potential areas and opportunities for implementing smart and unmanned systems which can replace humans in risky and dangerous work such as traffic and toll management, environmental monitoring in risky areas in the oil and gas industry, healthcare services, food securities, plantation industries and defence & security.

The IEM group also visited other facilities in CUTe, including the Embedded AI lab, Maritime Robotic Lab, Aerial Robotic Lab, human machine interface and CNC machining facilities. The visit ended with token of appreciation handed over by Ir. Amir, Chairman of ICTSIG.



Figure 3: IEM members posing with the Suraya I Autonomous Survey Vessel



Figure 4: Visit to the High Precision CNC Machining Equipment



Figure 5: Real Time & Positioning Control System Lab



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## **Introduction to Lean Manufacturing**

Written and Prepared by:



Ir. Dr Khor Jeen Ghee

he IEM Electronic Engineering Technical Division (eETD) held a webinar on Lean Manufacturing on 22 November 2022. The speaker was Assoc. Prof. Dr Yeap Gik Hong, the Head of Operations at UOW Malaysia, based at the KDU Batu Kawan campus in Penang. Dr Yeap is a multi-disciplinary engineer with a degree in Mechanical Engineering & Manufacturing Systems, a Masters in Advanced Materials and Manufacturing as well as a PhD in Electronic Engineering.

After a brief introduction by Ir. Dr Khor Jeen Ghee, Dr Yeap began his talk with an overview of what Lean Manufacturing means. In a nutshell, Lean Manufacturing is a philosophy of "doing more with less" – putting in less effort, less equipment and fewer resources – and doing this in the shortest time possible, which will result in less stress for the people. The aim is to focus on the elimination of waste in every area of the organisation. He provided examples where Lean Manufacturing principles may be applied, not only in the actual manufacturing process but also in other associated areas of business such as accounting and marketing.

After further explanation on the subject, Dr Yeap summarised Lean Manufacturing as a systematic approach to identifying and eliminating waste (or non-value-added activities) by regularly assessing and reviewing the

production flow processes. Often, this exercise is triggered by a request from the customer.

Next, he presented a brief history of Lean Manufacturing, starting from the work of Eli Whitney in the 1800s and Henry Ford's implementation of the production line in the 1910s-1930s to the early works of Japanese car companies by Eiji Toyoda, Shigeo Shingo and Taiichi Ohno in the 1950s. Later, in the 1990s, the practices of the Toyota Production System were introduced to the global audience via the seminal book, *The Machine That Changed the World*, by JP Womack, D.T. Jones and D. Roos. This book has made the term Lean Manufacturing into what it is known for today. Next, Dr Yeap went into the definition of waste by discussing the concept of Value-Added vs Non-Value-Added activities, the latter being waste.

Value-Added activities are those that increase the market form or function of a product or service. Conversely, Non-Value-Added activities are defined as activities that do not enhance market form or function, or as activities which are simply unnecessary. To further elaborate this, Dr Yeap cited examples from a furniture factory.

This was followed by an introduction of Muda, the Japanese term for "waste", as well as a discussion on the 7 major types of waste found within a value chain, namely transportation, inventory, movement, waiting, over-processing, over-production and defects. Each of the 7 wastes was then discussed in greater detail, with interesting examples provided to further the understanding of the different types of waste.

Over the course of the talk, Dr Yeap explained many of the Lean concepts in greater detail. These included the 5 principles (value, value stream, flow, pull and perfection) and tools such as *Jidoka*, *JIT*, *SMED*, *Kaizen*, *Poka Yoke* and *Hoshin Kanri*. The participants also learnt about the House of Lean, how *Heijunka* could be used to reduce production fluctuations and the calculation of *Takt* Time, as well as examined some examples of *Kanban* implementation.

	1	2	3	4	5
Principles	Value	Value Stream	Flow	Pull	Perfection
Tools	Voice of Customer	Process Flow Activity	Workplace Organization With 5S	Takt Time Control	Lean Diagnostic
	Quality Functional Deployment	Spaghetti Diagram	Quick Changeover (SMED)	Kanban & Pull System	Kaizen
		Learn to See	Total Productive Maintenance	Level Production (Heijunka)	
			Poka Yoke		
			1-Piece Flow		

Figure 1: The Five Principles and the Associated Tools

During the Q&A session, Dr Yeap and the participants had further discussions on the applications of Lean principles in construction, the impact of 4IR and how some engineers failed to devote enough time on *Gemba*. Overall, the talk was filled with detailed information and fascinating examples of Lean Manufacturing.



Figure 2: Dr Yeap Presenting the Lean Concepts

#### ANNOUNCEMENT

#### **NEWLY-ELECTED IEM BRANCH OFFICE BEARERS**

#### **IEM PAHANG BRANCH SESSION 2023/2024**

We are pleased to inform you that the 11th Annual General Meeting of The Institution of Engineers, Malaysia, Pahang Branch was held at PPAP, Kuantan on Saturday, 3rd June 2023. The new elected office bearers for the key positions in the IEM, Pahang Branch for session 2023/2024 comprise of :

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lr. Harzah Masni binti Ramli
Ir. Mohd Azrul Nizam bin Mohd Zahir
Ir. Dr Azhani binti Zukri
Ir. Dr Chin Siew Choo
Ir. Dr Asnul Hadi bin Ahmad Ir. Ts. Mohd Ridhuan bin Ismail
Ir. Dr Norazwina binti Zainol (Chemical) Ir. Mohd Yunus bin Yusof (Mechanical) Ir. Dr Muhamad Zahim bin Sujod (Electrical) Ir. Hj. Salimi bin Md Saleh (Civil) Ir. Ts. Aideelnorfahmee bin Mohamad (Civil)
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## IEM Sabah 45th Annual Dinner 2023

Written and Prepared by:



Ir. Wong Chen Jack

he IEM Sabah branch celebrated its 45th anniversary with a grand Annual Dinner on 18 June 2023. With an attendance of about 900 diners, the event was honoured by the presence of YB Datuk Ir. Shahelmy Yahya, the Deputy Chief Minister and Public Works Minister of Sabah.

Ir. Willy Chin Tet Fu, Chairman of IEM Sabah Branch, gave a welcome speech in which he emphasised the importance of reflecting on our rich engineering history, adapting to the present and envisioning a promising future. He encouraged collaboration with the government to tackle challenges such as power and water supply shortages.

IEM President Ir. Prof. Dr Norlida Buniyamin expressed gratitude to IEM Sabah branch for upholding the social image of the engineering profession. She stressed on the significance of learning from past experiences and applying them to the current context. She also highlighted



Picture 1: The IEM Sabah Committee Members alongside with the Deputy Chief Minister cum Minister of Works Sabah, Y.B. Ir. Datuk Shahelmey Yayha, and the President of IEM, Ir. Prof. Dr Norlida Buniyamin



Picture 2: The Young Engineers and Women Engineers Section of IEM Sabah, along with the Committee Members, after Successfully Organizing the Annual Dinner

the new Strategic Plan Actions designed to develop the engineering industry in Sabah and encouraged members to seize opportunities in engineering technologies and expertise emerging from Nusantara, Indonesia.

Datuk Ir. Shahelmy, who was also a former executive committee member of IEM Sabah, commended Women Engineers Section (WE) and Young Engineers Section (YES) for their active involvements to make IEM even more dynamic. He talked about the integration of innovation and expressed the government's commitment to improving infrastructure in Sabah by collaborating with organisations like IEM Sabah.

The event offered IEM members the opportunity to reflect on their achievements, anticipate future advancements and strengthen organisational bonds. It was a celebration of the collective journey of the engineering community in Sabah, marked by dedication and gratitude.

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## **Leaning Tower** of Teluk Intan

Written and Prepared by:

The Past Chairman of IEMNS and Director of Samsung SDI Energy (M). Sdn. Bhd.

Ir. Dr Oh Seong Por

leaning tower is a constructed structure that does not stand perpendicular to the ground and, when observe externally, appears tilted to one side. It can either be intentionally designed this way or caused, unintentionally, by other factors such as design error or unstable ground.

Except for those intentionally designed, a leaning tower is, by engineering logic, considered unstable and likely to collapse. However, there are numerous leaning towers in the world caused by unstable foundations and these have continued to stand over long periods. Some are now protected heritage sites, appreciated by both scholars and visitors.

The most famous leaning tower is the Pisa Tower in Italy. In Malaysia, there is a century-old leaning tower in the town of Teluk Intan on the bank of Perak River. As I had always been fascinated by this structure, my family and I signed up for a day bus trip to visit the Leaning Tower of Teluk Intan in May 2023.

We arrived at the tower at around 1.00 p.m. As the bus was approaching the tower, I could see what looked like an ancient pagoda standing solitary in the centre of a flat terrain paved with bricks (Picture 1).

My son and I bought tickets to enter the tower while my wife, daughter and a friend stayed outside to take photos. Inside the tower are information boards on the history of the tower which was built by a Chinese architect named Leong Choon Chong. Construction began in 1885 and was completed in 1886. It was made of wood and bricks.

The design is greatly influenced by the Chinese pagoda architectural style. The internal part of the tower is divided into 3 levels but from the outside, it looks like an 8-storey pagoda with a total height of 25m. The foundation diameter is 13m and the tower tapers to a diameter of 8.2m at the top. The upper level is fitted with a large steel tank, measuring 5m in height. Initially, this was used to store water for community usage during drought or in case of fire. Later, local residents donated money to purchase a clock that was fitted to the tower. The clock was designed by James Wilson Benson. Thereafter, the structure began a new function as a clock tower.

Picture 2: Spiral Wooden Staircase



Picture 1: Leaning Tower of Teluk Intan

ALL DUNDER

Allumi

111111

Picture 3: View of the Tower from the Perak River

Due to its high elevation and strategic location, the tower also functioned as a beacon to guide boats entering the old Teluk Intan Port. During the Japanese Occupation in 1941, it was used as a watch tower to look out for enemy invasions. In 1896, Teluk Intan was hit by a massive flood and this softened the foundation.

tower has not collapsed. Its tilted condition not only defies the logic of engineering but it has also survived the devastations of flood and war over the years.

The leaning tower is the pride of the residents of Teluk Intan and it is commendable that it has been beautifully preserved.

Compounded with the heavy tank filled with water, the tower started to tilt to one side.

There are old photographs and numerous artifacts placed inside the tower for visitors to view. At every level, there is a spiral wooden staircase along the internal wall of the tower. While climbing the stairs, one can view the entire circular floor of the bottom level and upon reaching the upper level, one can see the whole round floor of upper level.

I was only able to climb to Level 2 because the staircase leading to Level 3 had been barricaded (Picture 2). At Level 2, I could see the curved bottom of the steel tank which formed part

> of the ceiling surface. Although it is more than a century old, the tank still looks solid except that now, it is empty and the bottom drain valve has been dismantled. At this level, visitors can walk around and enjoy a 360° view of Teluk Intan town.

> When standing on Levels 1 and 2, I did not get the feeling of standing on a slanted floor. The tilted condition is obvious only when viewed from the outside and even more significant when viewed from the direction of the Perak River (Picture 3). It is amazing that the tilting



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#### SENARAI CALON-CALON YANG LAYAK MENDUDUKI TEMUDUGA PROFESIONAL TAHUN 2023

Berikut adalah senarai calon yang layak untuk menduduki Temuduga Profesional bagi tahun 2023.

Mengikut Undang-Undang Kecil IEM, Seksyen 3.8, nama-nama seperti tersenarai berikut diterbitkan sebagai calon-calon yang layak untuk menjadi Ahli Institusi, dengan syarat bahawa mereka lulus Temuduga Profesional tahun 2023.

Sekiranya terdapat Ahli Korporat yang mempunyai bantahan terhadap mana-mana calon yang didapati tidak sesuai untuk menduduki Temuduga Profesional, surat bantahan boleh dikemukakan kepada Setiausaha Kehormat, IEM. Surat bantahan hendaklah dikemukakan sebulan dari tarikh penerbitan dikeluarkan.

#### Ir. Prof. Dr Zuhaina binti Zakaria

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74031	MOHAMAD SHAHRUL NIZAM BIN AHMAD KAMAL	BE HONS (UITM) (ELECTRICAL, 2017
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Institusi mengucapkan terima kasih kepada semua yang telah memberikan sumbangan kepada tabung Bangunan Wisma IEM. Ahli-ahli IEM dan pembaca yang ingin memberikan sumbangan boleh berbuat demikian dengan memuat turun borang di laman web IEM http://www.myiem.org.my atau menghubungi secretariat di +603-7968 4001 / 5518 untuk maklumat lanjut. Senarai penyumbang untuk bulan Jun 2023 adalah seperti jadual di bawah:

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116722	HO FUNG KEEN, JIREH	BE HONS (CURTIN UNI.)(CIVIL & CONSTRUCTION, 2021)
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116856	LEONG VENA	BE HONS (MONASH UNI.)9CIVIL, 2021)
116863	HUBERT CHAI TZINSIEN	BE HONS (SWINBURNE UNI. OF TECH.)(CIVIL, 2015)
116886	HII YII LING, CLEMENT	BE HONS (SWINBURNE UNI. OF TECH.)(CIVIL, 2020)
116869	GOLDON POH TZIQIANG	BE HONS (THE UNI. OF MANCHESTER)(CIVIL, 2018) MSc (IMPERIAL COLLEGE LONDON)(GENERAL STRUCTURAL, 2020)
116861	FONG YEW	BE HONS (UCSI UNI.)(CIVIL, 2021)
116701	CHAN CHEE KONG	BE HONS (UCSI UNI.)(CIVIL, 2021)
116888	WOO HUN VUI	BE HONS (UCSI UNI.)(CIVIL, 2021)
116689	CHRISTIANUS BIDAUN	BE HONS (UITM)(CIVIL, 2005)
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110005	ASRAF BIN MOHD ASSAN	ENVIRONMENTAL, 2018)
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116702		BE HONS (UTM)(CIVIL, 2013)
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116713	WONG CHING WANG	BSc HONS (SOUTH DAKOTA STATE UNL)(CIVIL, 1999)
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116877	YAP WEI-EN	ME HONS (THE UNI. OF NOTTINGHAM)(CIVIL, 2018)
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116853	MASITAH BINTI HASSAN	BE HONS (UTM)(BIO-MEDICAL, 2021)

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116691	NG YONG XUAN	BE HONS (CURTIN UNI.) (ELECTRICAL POWER, 2018)
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116698	ANNUAR BIN HJ BAHARUDDIN	BE HONS (UITM)(ELECTRICAL, 2001)
116884	SITI NOR AYU BINTI SHAHARUDIN	BE HONS (UiTM)(ELECTRICAL, 2012)
116718	SHAHRIZAN BIN JABAR	BE HONS (UITM)(ELECTRICAL, 2012)
116705	MICKLEY YAHYA	BE HONS (UITM)(ELECTRICAL, 2014)
116731	MOHD SYAZWAN BIN MOHAMAD KHAIRUDIN	BE HONS (UITM)(ELECTRICAL, 2016)
116849	SYAMZAMAN BIN SAAD	BE HONS (UITM)(ELECTRICAL, 2017)
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116841	KU SHONG CHING, CALVIN	BE HONS (UNITEN) (ELECTRICAL POWER, 2016)
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116684	MOHD AZRI BIN ABU HASAN	BE HONS (USM)(ELECTRICAL, 2015)
116862	MUHAMMAD FARHAN BIN WAN JAMALUDIN	BE HONS (UTeM)(ELECTRICAL - INDUSTRIAL POWER, 2013)
116706	MUHAMMAD FIRDAUS BIN YAHYA	BE HONS (UTM)(ELECTRICAL - INSTRUMENTATION AND CONTROL, 2008))
116866	ANIS IDZUREEN BINTI AZMI	BE HONS (UTM)(ELECTRICAL - INSTRUMENTATION AND CONTROL, 20141)
116703	MOHD HAFIZI BIN HASHIM	BE HONS (UTM)(ELECTRICAL, 2017)
116843	LEE XING WEI	BE HONS (UTP)(ELECTRICAL & ELECTRONICS, 2020)
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116895	MOHAMMAD RIZAL	BE (SHIBAURA INST. OF
116874	Dr. SIM ZEE ANG	BE HONS (CURTIN UNI.

EJUI	RUTERAAN ELEKTI	RONIK
6895	MOHAMMAD RIZAL BIN ARIFFIN	BE (SHIBAURA INST. OF TECH.)(ELECTRONIC, 2001)
6874	Dr. SIM ZEE ANG	BE HONS (CURTIN UNI. OF TECH.)(ELECTRONIC & COMMUNICATION, 2015) PhD (CURTIN UNI.)(2020)
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6716	SHERRY MITCHELLE RINGO	BE HONS (UNITEN) (ELECTRICAL & ELECTRONICS, 2020)
6885	MUHAMMAD ADIB IZZUDDIN BIN MOHD HAIRE	BE HONS (UPNM) (ELECTRICAL & ELECTRONIC (COMMUNICATIONS), 2018)
6711	WONG SIE WOO	BSc HONS (UTM)(ELECTRICAL 2002) ME (UTM)(ELECTRICAL, 2012)
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6890	DR. FARIHAHUSNAH BINTI HUSSIN	BE HONS (UITM)(CHEMICAL, 2008) MESc (UM)(2013) PHD (UM)(2018)
6694	MOHAMAD SALIHI BIN RAMLI	BE HONS (UMP)(CHEMICAL, 2015)
6855	CHONG JIA WEN	ME HONS (THE UNI. OF NOTTINGHAM)(CHEMICAL, 2019)

#### **KEJURUTERAAN KOMPUTER** 116870 TAN SHIE CHOW

R/ 116855 CH

BE HONS (UNIMAP) (COMPUTER, 2021)

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16685	CHEOR WAI LOON	BE HO
		(COMN
16857	RAJKUMAR A/L	BE HO
	MANIAM	(COMN

NS (UNIMAP) IUNICATION, 2014) BE HONS (UNIMAP) (COMMUNICATION, 2021)

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116871	MOHD IZZAT BIN SAMSUDIN	BE (UMP)(MECHANICAL, 2011)
116879	AIMAN JOHAN BIN AHMAD JAAFAR	BE (VANDERBILT UNI.) (MECHANICAL, 2014)
116720	MOHAMAD ANIZAN BIN AWANG	BE HONS (IIUM)(MECHANICAL - AUTOMOTIVE, 2015)
116727	TAN HUI SEAN	BE HONS (INTI INTERNATIONAL UNI.) (MECHANICAL, 2019)
116847	TAN KOK HON, GARY	BE HONS (INTI INTERNATIONAL UNI.) (MECHANICAL, 2021)
116688	LIM CHENN YANG	BE HONS (INTI INTERNATIONAL UNI.) (MECHANICAL 2021)
116889	Dr. KUBERAN A/L ANANDARAJAH	BE HONS (LOUGHBOROUGH UNI.)(MECHANICAL, 2001) PhD (LOUGHBOROUGH UNI.) (2006)
116686	LEE KHEN HSIEN	BE HONS (MONASH UNI.) (MECHANICAL, 2021)
116659	TAN WEI FENG	BE HONS (MONASH UNI.) (MECHANICAL, 2021)
116854	CHUA HAN JIE	BE HONS (TARC) (MECHANICAL, 2021)
116721	KESAVARAJ	BE HONS (UCSI UNI.)
440004	M.APPADURAI	(MECHANICAL, 2014)
110091	IKMALNOR BIN	(MECHANICAL, 2018)
	MUSTAFA KAMAL	
116707	ADAM ADZHAR BIN	BE HONS (UITM)
440000	JOHARI	(MECHANICAL, 2020)
116883		- AUTOMATIVE, 2012)
116728	YOGES RAO	BE HONS (UNITEN)
116892	RUSLI MAJUMA@	BE HONS (USM)(MECHANICAL
116844	EU HOCK SENG	BE HONS (USM)(MECHANICAL
116845	MOHD SYAZWAN BIN	BE HONS (USM)(MECHANICAL 2014)
116699	WAN MOHD ALIMIE	BE HONS (USM)(MECHANICAL 2017)
116708	ROY HANSON ANAK	BE HONS (UTeM)(MECHANICAI
	JIMIT	- PLANT & MAINTENANCE, 2015)
116882	PRAKAASH A/L	BE HONS (UTM)(MECHANICAL
116715	RAMAKRISHNAN TAN HONG KIAT	- AERONAUTICS, 2005) BE HONS (UTM)(MECHANICAL
		2009)
116867	MUHAMMAD AIZUDDIN BIN ISMAIL	BE HONS (UTM)(MECHANICAL 2011)
116842	THOMAS XAVIER A/L NEPOLEAN	BE HONS (UTM)(MECHANICAL 2021)
116851	ABDULLAH BIN JADID	BSc HONS (WEST VIRGINIA UNI.)(MECHANICAL, 2017)
116852	JIN KHEN ISAIAH LIEW	ME HONS (THE QUEEN'S UNI. OF BELFAST)(MECHANICAL, 2017)
116850	SIEW ZHI TAO	ME HONS (THE UNI. OF MANCHESTER)(MECHANICAL, 2021)
KE		RONIK
116692	Dr. VASANTHAN	BE HONS (UniMAP)
	MARUTHAPILLAI	(MECHATRONIC, 2011) PhD (UniMAP)(MECHATRONIC, 2017)
KEJUI	RUTERAAN MIKROI	ELEKTRONIK
116730	Dr. LOW FOO WAH	BE HONS (UNIMAP) (MICROELECTRONIC, 2010) MSc (UNIMAP) (NANOELECTRONIC, 2013) PhD (UM)(ENVIRONMENTAL.
		2018)

#### **KEJURUTERAAN PEMBUATAN** ADV. DIP. IN TECH 116864 YAP PARK WAH ADV. DIP. IN TECH (TARC)(MECHANICAL & MANUFACTURING, 2014) BE HONS (SHEFFIELD HALLAM UNI.)(MECHANICAL & MANUFACTURING, 2014) ME (UPPM)(MANUFACTURING SYSTEMS, 2018) BE HONS (UMP) 116894 NASRAH BINTI MOHD BE HONS (UMP) AZMI (MANUFACTURING, 2018) BE HONS (UPM)(BIOLOGY & 116719 CLYNE HARDY ANAK RAYMOND SAKOR AGRICULTURAL, 2004)

#### PERMOHONAN MENJADI AHLI 'INCORPORATED'

No. Ahli	Nama	Kelayakan
KEJU	RUTERAAN ELEKT	RIKAL
116939	BAVENTHIRAN	BE HONS (UNI. OF
	BARATHARAJAN	BRADFORD)(ELECTRICAL 8
		ELECTRONICS, 2013)

PEMINDAHAN/PENUKARAN KEPADA AHLI "ENGINEERING TECHNOLOGIST GRADUATE MEMBER"			KEJU 116928	KEJURUTERAAN AWAM           116928         KONG TZE CHENG         B TECH HONS (UniMAP)(CIVIL, 2018)		Na	PERMOHONAN MENJADI AHLI 'ASSOCIATE'			
No.	Nama	Kelavakan	KEIII				Nama	Kelayakan		
Ahli		····· <b>·</b> ,·····	116925	LEE LI PING	BE (UNI OF ABERDEEN)	KEJURUTERAAN AWAM				
KEJURUTERAAN ELEKT 112781 SAM CHI MING		RIKAL BSC (ROBERT GORDON			(ELECTRICAL AND ELECTRONIC, 2007)	116838	FONG CHING KONG	Adv. Dipl. (JAMES WATT COLLEGE) (BUSINESS & MANAGEMENT, 2008)		
		ELECTRICAL ENGINEERING,	KEJU	RUTERAAN MARIN			-			
		1998)	116322	RHITISHWARAAN A/L	B TECH HONS (UNIKL-MFI)	KEJU	RUTERAAN PEMBI	NAAN		
				THAYALAN	(MARINE ENGINEERING,	116670	CHAM PEI FUNG	Dip. E. Tech (WAWASAN		
PEI	RMOHONAN KEPAD TECHNOLOGIST GI	A AHLI "ENGINEERING RADUATE MEMBER"	116929	ROHAIZAD BIN ROOSLI	COC MARINE CLASS 2 (JABATAN LAUT M'SIA.			OPEN UNI.) (CONSTRUCTION MANAGEMENT, 2019)		
No.	Nama	Kelayakan			2016)	KEJURUTERAAN ELEKTRIKAL				
Ahli			KE.III		VIKAI	116669	FAWWAZ QAWIEM BIN	Dipl. (UNITEN)(ELECTRICAL,		
KEJU	RUTERAAN AEROA	NGKASA	116926	MUHAMMAD FADHU	B TECH HONS (UNIKI -MEI)	446007				
116672 AZLAN SHAH BIN METHAR SHAH		DCAM Part 66 AIRCRAFT MAINTENANCE LICENSE	110020	BIN MAKHTAR	(NAVAL ARCHITECTURE & SHIPBUILDING, 2013)	110037	ROSNAN	DIDI. (UTNI)(ELECTRICAL, 2019		
	WITH TYPE RATING (2019)		116927	116927 NOR HAZIRAH BINTI B TECH HONS (UNIKL-MIAT) ABDUL HALIM (MECHANICAL, 2019)			KEJURUTERAAN ELEKTRONIK			
116676 SURESH MAHARAJAH		DCAM Part 66 AIRCRAFT MAINTENANCE LICENSE CATEGORY B1/B2 HOLDER-	116673	HANIS SYAMIM BIN CHE AB KARIM	B TECH HONS (UNIKL-MSI) (MECHANICAL-AUTOMATIVE, 2020)	117103	BOH MUN KIT	EDUCATION)(ELECTRONIC, 1987)		
		WITH TYPE RATING					KEJURUTERAAN MARIN			
		(2013)	KEJU 440074				KABINDREN	Dipl. (RANACO MARINE SDN		
KE.III			110074	ZAHARUDIN	(MECHATRONICS, 2019)		CHANDRASEGARAN	BHD)(SHIP ENGINEERING)		
116671	DESMOND ANTONY	DCAM Part 66 AIRCRAFT			(,,,			(2018)		
MAINTENANCE LICENSE CATEGORY B1/82 HOLDER- WITH TYPE RATING (2018)			PEF	PERMOHONAN KEPADA AHLI "ENGINEERING TECHNICIAN GRADUATE MEMBER"						
			No.	Nama	Kelayakan					
KEJU	RUTERAAN AUTON	IOTIF	Ahli		-					
116675	MOHD IRWAN AFENDI	B TECH HONS (UNIKL-MSI)	KEJU	RUTERAAN MEKA	NIKAL					
	BIN MOHD SHOHAIMI	(MECHANICAL-AUTOMATIVE, 2017)	116677	Mohd Hazlami bin Abd Aziz	DIP (PSA) (MECHANICAL ENGINEERING-PACKAGING, 2008)					

#### **PERMOHONAN BARU / PEMINDAHAN AHLI**

Persidangan Majlis IEM yang ke-**432** pada **18 Julai 2022** telah meluluskan sebanyak **1046** ahli untuk permohonan baru dan permindahan ahli. Berikut adalah senarai ahli mengikut disiplin kejuruteraan:

	GRED KEAHLIAN											
DISIPLIN	FELO	SENIOR	AHLI	SENIOR GRADUATE	SISWAZAH	"ENGINEERING TECHNOLOGIST GRADUATE MEMBER"	"ENGINEERING TECHNICIAN GRADUATE MEMBER"	"INCORPORATED"	"AFFILIATE"	"ASSOCIATE"	SISWA	JUMLAH
Aeroangkasa					1	1	1				15	18
Automotif						1					1	2
Biokimia											3	3
Kimia			1		21	1					97	120
Awam			34	1	80			2		2	146	265
Komunikasi											3	3
Komputer					1						1	2
Sistem Komputer											4	4
Pembinaan											1	1
Elektrikal & Elektronik							1				78	79
Elektrikal			22	1	48	2		1		2	59	135
Elektronik			5		10		1				46	62
Alam Sekitar			3		2						1	6
Proses					1	1						2
Geoteknik			2									2
Pembuatan					1						6	7
Marin					1							1
Bahan			1								25	26
Mekanikal	1		24		47	3		2		2	164	243
Mekatronik			1	1	7					1	32	42
Sumber Mineral											3	3
Arkitek Naval											1	1
Petroleum			2		2					1		6
Polimer											10	10
Struktur											1	1
Telekomunikasi			1								1	2
JUMLAH	1		96	3	222	9	3	5		8	698	1046

Senarai nama ahli dan kelayakan adalah seperti di bawah. Institusi mengucapkan tahniah kepada ahli yang telah berjaya.

Ir. Prof. Dr Zuhaina binti Zakaria

Setiausaha Kehormat, Institusi Jurutera Malaysia, Sesi 2022/2023

PEF

KE.IIII

PEM

No.

Ahli

KF.IU 58825

KEJU

20964 50961

32886 43109

76195

45550

112704

39770 112646

26866

26296

73064

74307

39187 93708

KEJU 64744

37917

18773

No. Ahli BE HONS (UTM) (MECHANICAL, 2010) ME (UTM) (BIOMEDICAL, 2013)

ME (01M) (BIOMEDICAL, 2013) PhD (UTM) (BIOMEDICAL, 2017) BE HONS (UMS) (MECHANICAL, 2010)

(MECHATRONICS, 2012) MSc (UTeM) (MECHATRONIC, 2016)

BE HONS (MALAYA) (TELECOMMUNICATION, 2004)

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RMINDAHAN AHLI	KEPADA AHLI FELLOW	115482	KALAIVARNNAN A/L	BE HONS (UNITEN)	KEJU	RUTERAAN MEKA	
Nama	Kelayakan	66517	LIM WEI HONG	BE HONS (MMU) (ELECTRICAL, 2015)	112483	AB AZIZ BIN MOHD YUSOF	MECHANICAL, 2010)
	JIKAI	51077	LING SU CHING, IVY	BE HONS (USM) (ELECTRICAL,			PhD (UTM) (BIOMEDICAL, 2
MUI KAI YIN	BE HONS (UNL OF			2015)	42282	AMAR BIN ABDUL	BE HONS (UMS)
	SUNDERLAND)(MECHANICAL, 1996)	93780	MAHYARUDIN BIN MOHD	BE HONS (UTM) (ELECTRICAL- INSTRUMENTATION AND CONTROL. 2008)	81455	CHAI KAO KHY,	(MECHANICAL, 2010) BE HONS (MMU) (MECHANICAL, 2013)
	MSc (UNI. OF WARWICK) (ADVANCED MECHANICAL, 1998)	114709	MOHD ASRI BIN ARSHAD	BE HONS (MIDDLESEX) (ELECTRONIC, 1997)	54190	CHUNG YEE YONG	(MECHANICAL, 2010) BE HONS (UTAR) (MECHANICAL, 2016)
	PhD (ATLANTIC UNI.)(2003)			CONVERSION (UNITEN) (ELECTRICAL, 2011)	62060	KHO SAN WEI	BE HONS (MONASH) (MECHANICAL, 2013)
INDAHAN AHLI KE	PADA AHLI KORPORAT	72676	MUHAMMAD JAMILUL NA'IM BIN MOKHTAR	BE HONS (UKM) (ELECTRICAL AND ELECTRONIC, 2015)	96036	LIEW CHUAN ONN	BE HONS (UTAR) (MECHANICAL, 2013)
Nama	Kelayakan	102377	MUHAMMAD SHAHRUL IZWAN BIN	BSc (ALBERTA) (ELECTRICAL, 2015)	102265	LOW TSU JIN, KURTWIN	BE HONS (MONASH) (MECHANICAL, 2012)
RUTERAAN ALAM	SEKITAR	116178	NABILA SILAM BINTI	BE HONS (UTM) (ELECTRICAL,	42319	MOHD NASIER LEE BIN NOORJALIH LEE	BE HONS (UMS) (MECHANICAL, 2013)
YAP YI SHEN	BE HONS (UTAR) (ENVIRONMENTAL, 2017)	114783	NUR AZLIN BINTI	BE HONS (UPM) (ELECTRICAL	58027	MOHD RIDHUAN BIN ISMAIL	BE HONS (UTHM) (MECHANICAL, 2006)
			MOHD YUSOFF	& ELECTRONICS, 2003) MSc (LEEDS) (ELECTRICAL	108283	MUHAMMAD NABIL BIN IMRAN	BSc (OHIO STATE) (MECHANICAL, 2016)
ASNILAH BINTI ABDULLAH	BE HONS (UTM) (CIVIL, 2000)			RENEWABLE ENERGY	88979	SIEW KOK KHION	BE HONS (UTAR) (MECHANICAL, 2010)
CHONG TECK NAN CHUA KIM ENG	BE HONS (USM) (CIVIL, 2014) BE HONS (UNIMAS) (CIVIL,	93862	RUEBAN A/L ANTONY	BE HONS (UNITEN) (ELECTRICAL AND	58175	TAN CHEE NIAN	BE HONS (UTeM) (MECHANICAL-DESIGN
LAU SEE HUNG	2011) BE HONS (UNIMAS)	73772	SUNTHARARAJU A/L	ELECTRONICS, 2011) BE HONS (UNITEN)			MSc (UTeM) (MECHANICAL
	(CIVIL, 2008) ME (UNIMAS) (2010) PhD (UNIMAS) (2015)	71105	SELVATHORAY THIAN KEE FONG	(ELECTRICAL POWER, 2013) BE HONS (UNIMAS) (ELECTRONICS & COMPUTER,	55294	TEO YEN BIN	BE HONS (UTHM) (MECHANICAL, 2016)
LAU ZI THIAM	BE HONS (UMP) (CIVIL, 2014)			2009)			-
LEOW CHEE SIN MOHD FAIZAL BIN MOHD NORDIN	BE HONS (USM) (CIVIL, 2014) BE HONS (UTM) (CIVIL, 2006)	112188	WOOI CHIN LEONG	BE HONS (UMS) (ELECTRICAL & ELECTRONICS, 2011) ME (UTM) (ELECTRICAL 2013)	75257	MUHAMMAD RAZMI BIN RAZALI	BE HONS (UTeM) (MECHATRONICS, 2012)
MOHD GHAZALI BIN SEMAIN	BE HONS (UITM) (CIVIL, 2006)			PhD (UTM) (ELECTRICAL, 2017)			MSc (UTeM) (MECHATRON 2016)
MUHAMMAD BIN A.	BE HONS (NOTTINGHAM	KEJU	RUTERAAN ELEKT	RONIK			
BAKAR	TRENT UNIVERSITY) (CIVIL, 2006)	36254	HAJAR BINTI JA'AFAR	BE HONS (UTM) (ELECTRICAL-	KEJU		
NOOR EFFARIZAN BIN ISMAIL	BE HONS (USM) (CIVIL, 2000)			MSc (UITM) (TELECOMMUNICATION	79320	SOW CHIA SHEN	(ALBERTA) (PETROLEUM, 2011)
NOOR NASHAIRIE BIN MOHD NASIR	BE HONS (UITM) (CIVIL, 2008) MSc (UITM) (STRUCTURAL, 2018)			& INFORMATION, 2012) PhD (UITM) (ELECTRICAL,			
SUAHAIMI BIN MATUSIN	BE HONS (UTM) (CIVIL, 2017)	59954	MOHD ZAMRI BIN HASAN	BE (MIYAZAKI) (ELECTRICAL & ELECTRONIC, 2005)	KEJU 107629	SITI ZURAIDAH BINTI	BE HONS (MALAYA)
TANEIZ CHELVAM A/L SELVARAJAH	BE HONS (UTM) (CIVIL, 2012)			ME (MIYAZAKI) (ELECTRICAL & ELECTRONIC, 2007)		IBRAHIM	(TELECOMMUNICATION, 20 ME (UTM) (ELECTRICAL- COMMUNICATION, 2008)
TEOH KAH WAIE WONG WENG HONG	BE HONS (UTM) (CIVIL, 2003) BE HONS (UNITEN) (CIVIL, 2014)	99175	YAP CHEE HAUR	BE HONS (UKM) (ELECTRICAL, ELECTRONIC & SYSTEMS, 2002)			PhD (QUEENSLAND) (ELECTRICAL, 2012)
RUTERAAN ELEKT	RIKAL	KEJU	RUTERAAN GEOTE	KNIKAL	Note	e: Continuation would b	e published in August 2023.
AHMAD SHAHRIR AZWAN BIN ZAKARIAH	BE HONS (UTM) (ELECTRICAL, 2012)	35656	LIM SUEGIN, KELLY	BE HONS (UNITEN) (CIVIL, 2009)	For OF 3	the list of approved "AD STUDENT", please refe	MISSION TO THE GRADE
HAMIZAH FARHAH BT	BE HONS (UTM) (ELECTRICAL, 2008)	94004	WONG HSUI HAN	ME HONS (EXETER) (CIVIL & ENVIRONMENTAL, 2016)	http:	//www.myiem.org.my.	



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