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Enhancing Agricultural Efficiency and Security through Artificial Intelligence

By Ts. Inv. Dr. Teo Chee Loong, Agri Season Sdn. Bhd.

The agricultural industry is undergoing a significant transformation driven by technological advancements. Among all, artificial intelligence (AI) stands out as a pivotal force poised to revolutionise agricultural practices. By integrating AI into agriculture, critical challenges can be addressed, while operational efficiency, security and sustainability of food systems can be enhanced. This article explores the application and implementation of AI in agriculture, focusing on specific use cases and the potential benefits they offer.

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/chief editor's note

Salam Sejahtera!

In this 26th edition of TECHIES, we will once again present to you the importance of Artificial Intelligence (AI), particularly in the field of agriculture. We will see how it enhances and revitalises efficiency and productivity, which brings about transformative change, and how it offers innovative solutions to long-standing setbacks and challenges. By leveraging AI, farmers can detect plant diseases, optimise crop yields, reduce waste, and make more informed decisions - all leading to increased productivity and sustainability.

Robotics and automation, guided by AI, are streamlining labour-intensive tasks such as planting, harvesting, and sorting, addressing labour shortages and increasing overall adeptness. In essence, AI is illuminating the future of agriculture by making farming smarter, more efficient, and more resilient in the face of growing global challenges.

No doubt AI comes in timely and handy in the face of the global hunger crisis, where the widespread and severe lack of access to adequate resources result in chronic hunger and malnutrition for millions of people. Thank God we in Malaysia are spared such calamity, but we have to be prepared for whatever might come our way, no matter how remote it seems to be. Given the fact that approximately 733 million people are experiencing hunger as we speak, and that the hunger crisis is driven by a complex mix of factors including poverty, conflict, climate change, economic inequality, and weak agricultural systems, our farmers, scientists, and technologists must not rest on their laurels. We have to be equipped – come what may.

We welcome you to immerse yourself into the revolutionary future that AI will bring us. Happy reading!

Zuraidah Mohd. Zain

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Current Challenges in Agriculture

The agriculture sector faces numerous challenges, ranging from resource inefficiencies to security concerns. One of the most pressing issues is resource efficiency. Maximising the efficient use of resources such as water, fertilisers, and energy is essential to meet the growing demand for food. However, traditional farming practices often result in significant wastage and suboptimal resource utilisation. This inefficiency not only impacts the environment but also increases the cost of production, making it imperative to adopt more sustainable and efficient practices.

Another challenge is operational cost. Scaling agricultural operations from laboratory research to industrial production involves high costs, which can be particularly burdensome for small and medium-sized enterprises looking to adopt innovative technologies. The high initial investment required for advanced agricultural technologies is a significant barrier, limiting the ability of smaller farms to compete and thrive.

Data security is also a critical concern. With the increasing digitisation of agriculture, protecting sensitive information from cyber threats has become crucial. Ensuring data integrity and building trust with consumers through transparent supply chains are paramount. The agriculture industry needs robust cybersecurity measures to safeguard against potential breaches that could compromise sensitive data and disrupt operations.

To add, market integration presents significant challenges. Integrating new agricultural products such as bio-fertilisers and biofuels - derived from microalgae into existing markets - can be complicated due to regulatory hurdles and consumer acceptance issues. The regulatory landscape for agricultural innovations is complex, and gaining consumer trust in new products requires transparency and education.

> **"The agriculture industry needs robust cybersecurity measures to safeguard against potential breaches that could compromise sensitive data and disrupt operations.**

Innovative Applications of AI in Agriculture

AI offers innovative solutions to the challenges in agriculture through its ability to analyse vast amounts of data, optimise processes, and enhance decision-making. One prominent application - smart farming - leverages AI to monitor and manage agricultural activities in real time. By deploying Internet of Things (IoT) devices, farmers can collect data on soil health, crop conditions, and environmental factors. AI algorithms then analyse this data to provide actionable insights, enabling farmers to make informed decisions regarding irrigation, fertilisation, and pest control.

For example, AI-powered drones equipped with multispectral sensors can assess crop health and detect early signs of disease or pest infestation. This capability allows for timely interventions, reducing crop losses and minimising the use of chemical pesticides. Additionally, AI-driven precision farming techniques optimise the application of water and fertilisers, ensuring that crops receive the right amount of resources at the right time, thereby reducing wastage and enhancing yield.

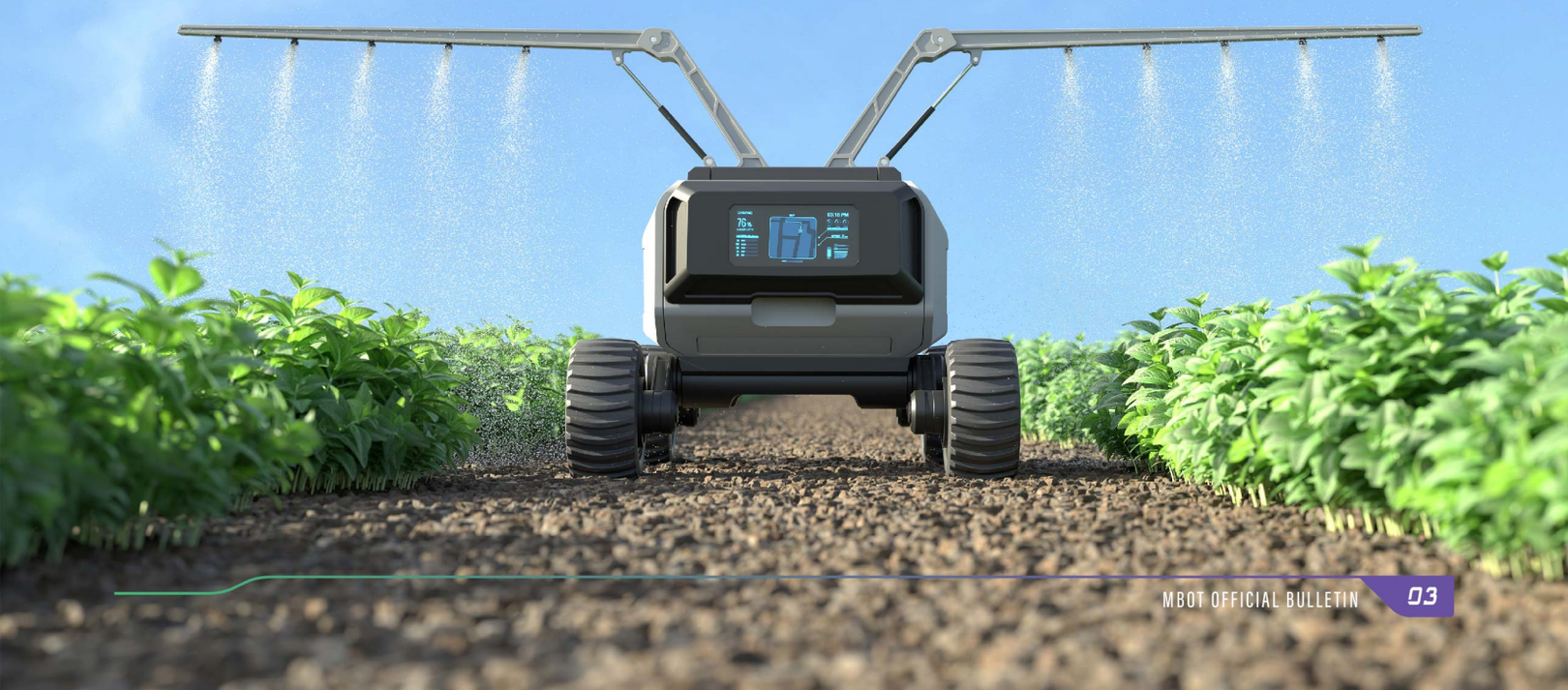
Another significant application is the integration of blockchain in bioprocess management. When combined with AI, blockchain technology can revolutionise the agricultural landscape. By recording every step of the cultivation and processing stages on a blockchain, data integrity is ensured, traceability is enhanced, and resource use is optimised. In microalgae cultivation and bio-fertiliser production, blockchain can track the entire production process - from sourcing raw materials to the final product. AI algorithms identify inefficiencies and suggest improvements, leading to higher efficiency and better product quality. Furthermore, blockchain enhances transparency in the supply chain, allowing consumers to verify the origin and quality of agricultural products.

AI and machine learning also play a profound role in crop management. These technologies can predict crop yields, detect diseases early, and recommend optimal farming practices. By analysing historical and real-time data, AI models can forecast weather patterns, soil conditions, and pest outbreaks, enabling farmers to take proactive measures. For instance, AI-based image recognition systems can identify plant diseases from photos taken by smartphones or drones. These systems can diagnose the disease, suggest treatment options, and provide guidance on preventive measures, hence, helping farmers manage crop health more effectively while reducing reliance on chemical treatments.

As agriculture becomes more data-driven, ensuring the security of this data is critical. AI plays a vital role in identifying and mitigating cyber threats. AI-powered cybersecurity systems can monitor network traffic, detect anomalies, and respond to potential breaches in real time. Moreover, AI can enhance data integrity by verifying the authenticity of data entries in the agricultural supply chain. By using machine learning algorithms, fraudulent activities can be detected and prevented, ensuring that consumers receive accurate information about the origin and quality of their food.

The integration of AI into agriculture is not just a technological advancement but a necessity for sustainable and secure food production. By addressing resource inefficiencies, reducing operational costs, ensuring data security, and enhancing market integration, AI can transform the agricultural landscape. The application of AI in smart farming, bioprocess management, crop management, and data security demonstrate its potential to drive innovations and improve efficiency in agriculture.

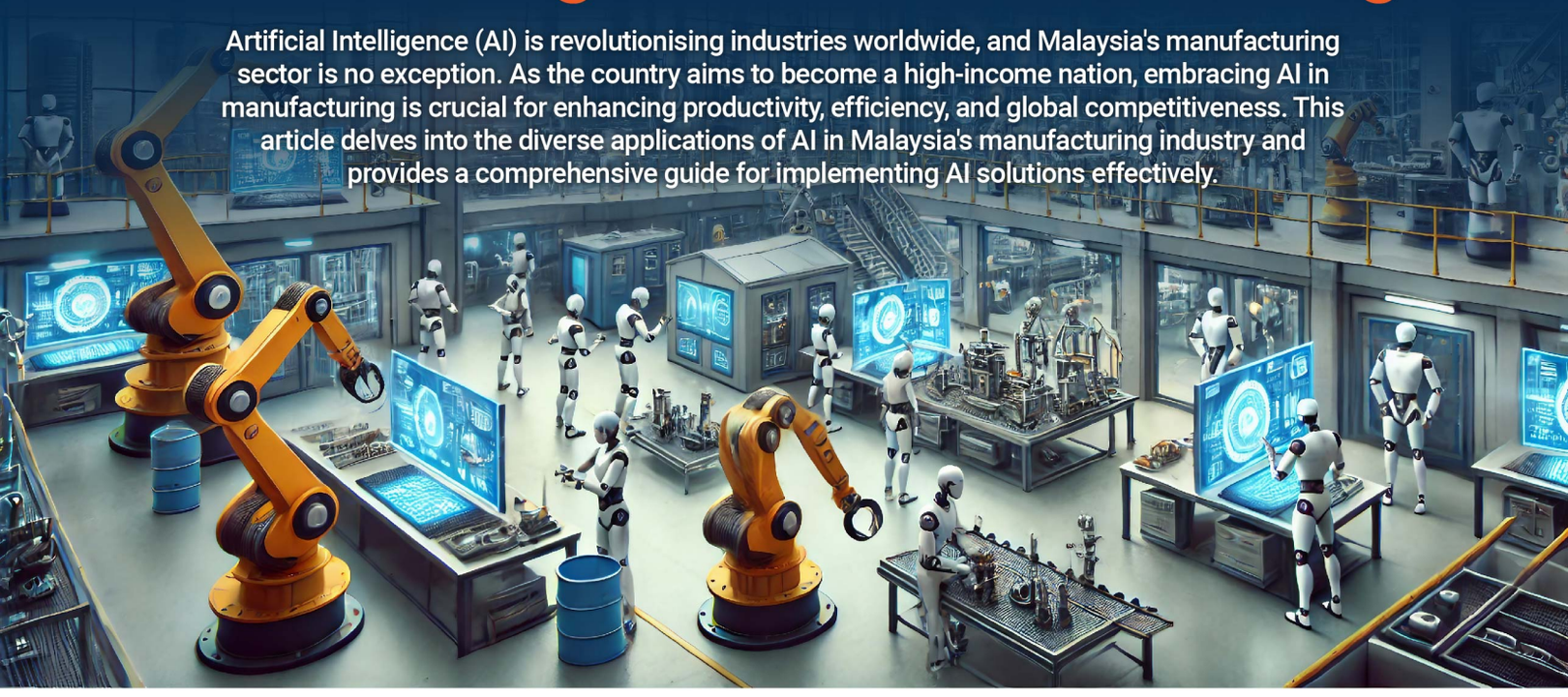
Moving forward, it is essential to foster collaboration between technology developers, farmers, and policymakers to ensure the successful implementation of AI in agriculture. By doing so, a more resilient and sustainable agricultural ecosystem that meets the demands of the growing global population can be created.



By Ts. Aidil Azlan bin Mohd Fitri, Industrial Quality Management Sdn. Bhd.

Revolutionising Malaysian Manufacturing: How AI is Transforming Efficiency and Productivity

Artificial Intelligence (AI) is revolutionising industries worldwide, and Malaysia's manufacturing sector is no exception. As the country aims to become a high-income nation, embracing AI in manufacturing is crucial for enhancing productivity, efficiency, and global competitiveness. This article delves into the diverse applications of AI in Malaysia's manufacturing industry and provides a comprehensive guide for implementing AI solutions effectively.



The Impact of AI on Malaysia's ManufacturingIndustry

AI integration into manufacturing processes has the potential to transform operations by automating tasks, improving quality control, and optimising supply chains. One of the key areas where AI is making a significant impact is in predictive maintenance. AI-driven predictive maintenance systems analyse data from sensors embedded in machineries to forecast when the equipment is likely to fail. By identifying potential issues before they become critical, manufacturers can schedule maintenance activities proactively, thereby reducing downtime and extending the lifespan of the equipment. This approach not only enhances operational efficiency but also lowers maintenance costs.

Another critical aspect is quality control. Ensuring that products meet stringent standards is essential in manufacturing. AI-powered inspection systems utilise machine vision to detect defects in real time, significantly improving the accuracy and speed of quality checks. These systems can identify minute imperfections that may be overlooked by human inspectors, ensuring that only high-quality produ

Supply chain optimisation is another area where AI algorithms are making a difference. By analysing vast amounts of data from various sources, AI can help manufacturers optimise their supply chain operations. Predicting demand patterns allows for optimal inventory levels, reducing the risk of overstocking or stockouts. Moreover, AI enhances logistics by identifying the most efficient routes and transportation methods, minimising both costs and delivery times.

Robotics and automation are also at the forefront of AI application in manufacturing. AI-powered robots can perform complex tasks with high precision and consistency, increasing production rates and reducing human error. Collaborative robots, or cobots, work alongside human workers to handle repetitive tasks, allowing employees to focus on more value-added activities.

Finally, AI is transforming product design and development processes. Generative design algorithms can create multiple design options based on specific parameters, enabling engineers to explore innovative solutions quickly. AI-driven simulations can test these designs under various conditions, which reduce the need for physical prototypes and accelerate the overall development cycle.

Implementing AI in Malaysia's Manufacturing Industry: A Strategic Approach

Successfully implementing AI in manufacturing requires a strategic and methodical approach. The first step is to define clear objectives for AI implementation. It is essential to identify specific pain points in manufacturing processes that AI can address. Whether the goal is to reduce downtime, improve product quality, or optimise supply chains, having well-defined objectives will guide the AI strategy and ensure alignment with business priorities.

Next, data readiness needs to be assessed, as data is the foundation of AI. The quality, volume, and accessibility of data must be evaluated to ensure that it is clean, well-organised, and representative of the manufacturing processes to be improved. Implementing robust data management practices will help maintain data integrity and security.

Choosing the right AI technologies is also crucial for successful implementation. The specific requirements of the target processes must be outlined so that the most appropriate AI tools and platforms can be selected. Popular AI technologies in manufacturing include machine learning algorithms, computer vision systems, and robotic process automation (RPA) tools.

After selecting the appropriate technologies, the next step is to develop and train AI models using data. This phase requires expertise in machine learning and data science. Collaborating with AI specialists or partnering with AI solution providers can ensure that the models are accurately trained and validated. Techniques such as cross-validation and hyperparameter tuning can be used to optimise model performance.

Starting with a pilot project allows for the AI solution to be tested in a controlled environment. This entails monitoring the performance of the pilot, gathering feedback and making necessary adjustments. Once the pilot proves successful, the AI solution can be scaled across other manufacturing processes and plants. It is vital to ensure that employees are trained and equipped to work with the new AI systems.

Lastly, AI systems require ongoing monitoring and maintenance to ensure continuous effective performance. Implementing monitoring tools to track key performance indicators (KPIs) and detecting any anomalies should be done. Regularly updating AI models with new data will help maintain their accuracy and relevance. Establishing a feedback loop is essential for continuously improving the AI systems.

Overcoming Challenges in AI Implementation

Implementing AI in manufacturing presents several challenges, including data quality issues, a lack of skilled personnel, and resistance to change. Addressing these obstacles requires a proactive and holistic approach. Investing in training and education is crucial. Upskilling the workforce through training programs and workshops on AI and machine learning will help build a knowledgeable and skilled team, which is essential for successful AI implementation.

innovation is important. Encouraging an environment that embraces change and innovation can significantly impact the adoption of AI. Highlighting the benefits of AI and involving employees in the implementation process will help gain their buy-in and support.

Collaborating with AI experts is another effective strategy. Partnering with AI specialists, consultants, or academic institutions can provide valuable insights and help overcome technical challenges. Such collaboration often grants access to cutting-edge AI technologies and best practices, facilitating smoother implementation.

The Future of AI in Malaysia's Manufacturing Industry

The future of AI in Malaysia's manufacturing industry is promising, with several emerging trends poised to shape its trajectory.

1. Smart Factories

The concept of smart factories, driven by AI and the Internet of Things (IoT), is gaining traction. Smart factories leverage interconnected devices and AI to create highly automated and efficient production environments. Real-time data from IoT sensors enables predictive maintenance, quality control, and energy management, optimising overall manufacturing performance.

AI can help manufacturers reduce their environmental impact by optimising energy consumption, minimising waste, and improving resource efficiency.

2. AI-Driven Sustainability

Sustainability is becoming a key focus in manufacturing. AI can help manufacturers reduce their environmental impact by optimising energy consumption, minimising waste, and improving resource efficiency. AI-driven sustainability initiatives align with global trends towards greener and more sustainable manufacturing practices.

3. Advanced Robotics

Advancements in robotics, powered by AI, are leading to more sophisticated and versatile robotic systems. Future robots will be capable of handling complex tasks, collaborating seamlessly with human workers, and adapting to dynamic manufacturing environments. This will further enhance productivity and flexibility in manufacturing operations.

Closing

The application of AI in Malaysian manufacturing industries holds immense potential to drive innovation, efficiency, and competitiveness. By adopting a strategic approach to AI implementation and addressing associated challenges, manufacturers can unlock significant benefits and position themselves for success in the global market. As AI technologies continue to evolve, staying informed about the latest trends and best practices will be crucial for technologists and professionals in the Malaysian manufacturing sector. Embracing AI responsibly and ethically will ensure its positive impact on the industry and contribute to Malaysia's economic growth and development.

LEADING THE CHARGE: **Women in Tech Breaking Barriers**

An Interview with

Prof. Madya EUR. ING. Ts. Ir. Dr. Syuhaida Ismail

Director (Research)

Maritime Institute of Malaysia

(Recipient of MBOT Woman Leadership Award 2024)

What inspired you to pursue a career in technology and become a technologist?

My journey into technology began in childhood. As an only child for the first 9 years of my life, I often found myself drawn to creative pursuits rather than conventional play. While other children might gravitate towards Barbie dolls, I was captivated by LEGO. I spent hours constructing imaginative structures, including my own "tyred house," a whimsical invention for a seven-year-old. I vividly recall visiting shopping malls and being fascinated by the intricate details of model houses on display. This early passion for building and design ignited a curiosity about how things work, even though I had no family background in technology or engineering.

When I entered high school, I chose the Technical stream over the Science stream as I recognised that my strengths were in technical drawing and engineering concepts. Alhamdulillah, I excelled in these subjects, often outpacing my peers despite the male-dominated environment. This experience solidified my understanding of my interests and potential in building and engineering. Consequently, I pursued a degree in civil engineering, which eventually allowed me to blend my creativity with technical skills and set the foundation for my future career in technology.

What does leadership mean to you, especially as a woman in tech?

To me, leadership transcends the traditional notion of authority. Leadership embodies the ability to empower others, particularly women, to rise and become leaders in their own right. My vision of leadership is not about fostering competition but creating an environment where everyone can thrive. It is about inspiring others to surpass their own expectations and cultivate their unique strengths.

True leadership involves earning respect through genuine connections and influence rather than instilling fear. A leader is often required to make tough decisions that may not be popular but ultimately serve the greater good. I believe it is essential to differentiate between a leader and a manager. While management skills can be taught in classrooms, leadership is an intrinsic quality that are honed through experience and a commitment to continuous personal development.

As a woman in technology, I recognise the unique challenges we face in this predominantly male field. I strive to lead by example, demonstrating that leadership is attainable for anyone, regardless of gender, through hard work, resilience, and a dedication to making a positive impact.

Could you share some of your most significant accomplishments and contributions in the field of technology?
Throughout my career, I have been fortunate to achieve several milestones that reflect my commitment to advancing technology and engineering. By the time I turn 45 in the next three years, I will have published over 400 articles, contributing to the body of knowledge in my field. Additionally, I have secured more than 100 technical projects, both locally and internationally, which have made a significant impact on the industry and society at large.

A notable aspect of my career has been my transition from civil engineering and project management research to maritime economics. Within a remarkably short time—just 22 months—I have become one of the recognised references in the ASEAN maritime sector, leading over 10 projects and publishing more than 40 articles on maritime issues. My work has engaged various stakeholders, including government ministries and international funders, reflecting my adaptability and commitment to leveraging my expertise for the betterment of society.

Despite more than 60 research and professional awards I received thus far, this year alone, I have been honoured to receive two prestigious awards: the MBOT Women Leadership Award and the IEM Woman Engineer Award. These awards not only acknowledge my contributions but also reinforce my commitment to supporting and empowering women in technology.

How do you think this recognition will impact your career, moving forward?
Receiving recognition as a leader in my field carries a profound sense of responsibility. It motivates me to continue advocating for and empowering more women to take on leadership roles in technology and engineering. The networks and connections I have cultivated through this experience have opened new doors, hence undeniably creating opportunities for collaboration and knowledge sharing.

As I move forward, I aim to leverage these connections to further my career while simultaneously contributing to the growth of others. I believe that my experiences can serve

This recognition is not just a personal achievement. It is a platform from which I can inspire and uplift others in their own journeys.

as a guide for aspiring leaders, demonstrating that with commitment and the right support, we can all achieve our goals. This recognition is not just a personal achievement. It is a platform from which I can inspire and uplift others in their own journeys.

What innovations or technologies do you believe will have the most profound impact on society in the next decade?
Looking ahead, I believe that artificial intelligence (AI) will significantly shape our society, with its potential to revolutionise various sectors. However, it is crucial that we address the existing biases inherent in AI systems. For instance, algorithms often associate certain professions with specific genders—using "she" for "nurse" and "he" for "engineer." This gender bias perpetuates stereotypes and limits opportunities for individuals based on preconceived notions.

As we continue to develop AI technologies, we must prioritise inclusivity and representation to ensure that they reflect the diversity of our society. By doing so, we can create more equitable opportunities for everyone, regardless of gender or background. I advocate for initiatives that promote gender-neutral programming and the involvement of diverse voices in technology development, as this will ultimately lead to more robust and fair solutions for society.

What advice would you give to young women interested to pursue a career in tech research?
For young women aspiring to enter the field of tech research, my primary advice is to seek out role models and mentors who can guide and inspire them. Today, there are many accomplished women at both national and international levels who are willing to share their experiences and insights. Platforms such as Facebook, Instagram, and LinkedIn provide excellent opportunities to connect with these individuals, so take advantage of these resources.

Throughout my career, I have had the privilege of mentoring many women, both young and mature, and I can attest to the importance of community and support in achieving one's goals. I encourage everyone to reach out, ask questions, and learn from the journeys of others.

Additionally, remember that the current educational environment is more supportive than ever. According to recent data from the Ministry of Education, we have achieved the highest STEM enrolment of 50.83% amongst upper secondary school students since the 60:40 Policy was introduced. This is a significant milestone that reflects a changing landscape in education and opportunities.

Be resilient, believe in yourself, and do not hesitate to pursue your passions. If I can navigate my path in this industry, there is no reason why you can't. Your journey may have its challenges, but with commitment and perseverance, you can achieve great things.

By Devi Sri Shanmugam

Monitoring Mango Leaf Diseases Using Teachable Machine

In the rapidly evolving field of agriculture, the integration of Artificial Intelligence (AI) and object detection technologies is revolutionising traditional farming practices. Among many advancements, AI is the most critical tool for enhancing crop health and yield. This article discusses the application of AI and object detection in agriculture green technology, with a particular focus on the use of Teachable Machine to monitor mango leaf diseases.

The Role of AI in Agriculture

AI technology has significantly transformed various sectors, and agriculture is no exception. The application of AI in agriculture involves using machine learning algorithms to analyse data and make informed decisions. This technological intervention aids crop management, optimises resource use, and increases agricultural productivity.

The Challenge of Mango Leaf Diseases

Mangoes are a vital fruit crop in many tropical and subtropical regions. However, mango trees are susceptible to various diseases that can affect their leaves, fruits, and overall health. Common mango leaf diseases include powdery mildew, anthracnose, and bacterial leaf spot. These diseases can lead to significant yield losses if not detected and managed promptly. Traditional methods of disease detection often rely on manual inspection, which can be time consuming and inaccurate.

The Teachable Machine, developed by Google, is an innovative tool that allows users to create machine learning models without any prior coding experience. This tool leverages the power of AI to enable users to train models using their own data. By using Teachable Machine, farmers and researchers can develop custom models to detect specific plant diseases, such as mango leaf diseases. By uploading more than 100 pictures of various diseases of mango leaves, accurate detection of the diseases is made possible.

The process of using Teachable Machine to detect mango leaf diseases involves several steps. The first step is data collection, which entails gathering images of both healthy and diseased mango leaves, ensuring that the images cover various stages and types of diseases. This diversity is crucial for the model to accurately identify different conditions. Next is training the model. The collected images are uploaded to Teachable Machine, where users label them according to their categories, such as 'healthy', 'powdery mildew', 'anthracnose', and 'bacterial leaf spot'. The model learns to recognise patterns associated with each category by processing the labeled images.

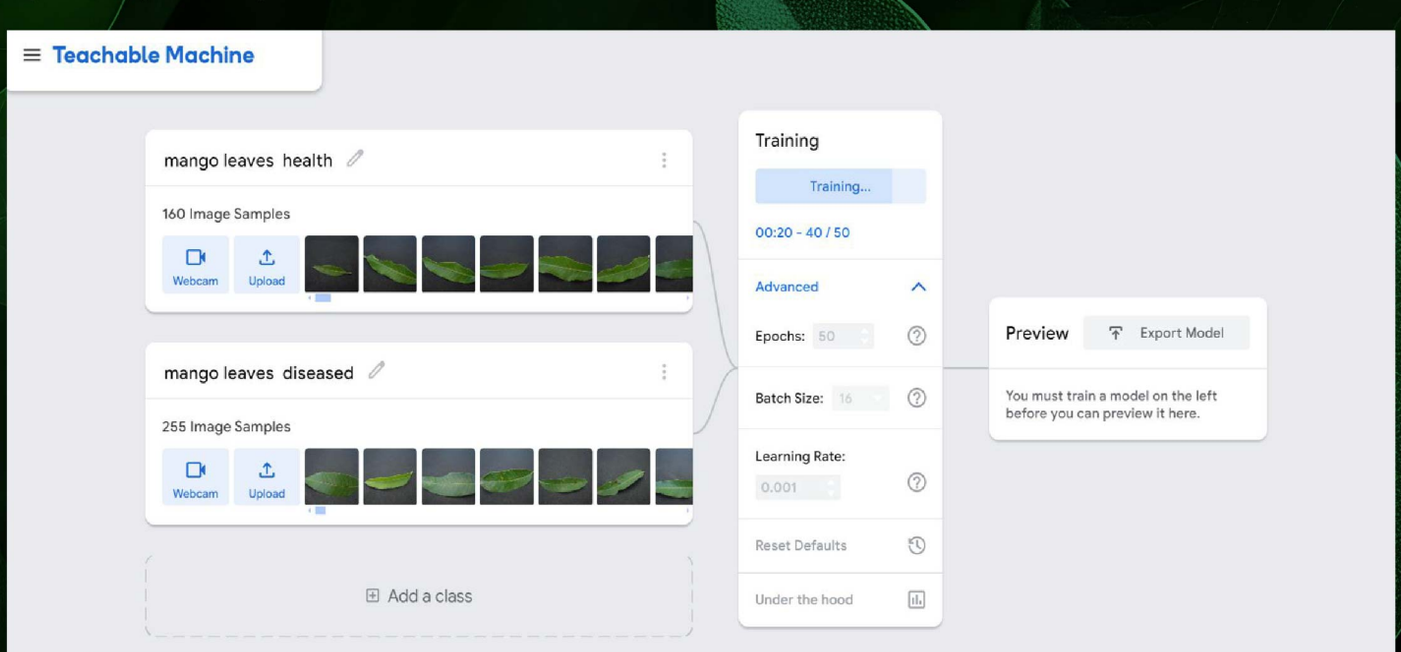


Figure 1: Training data.

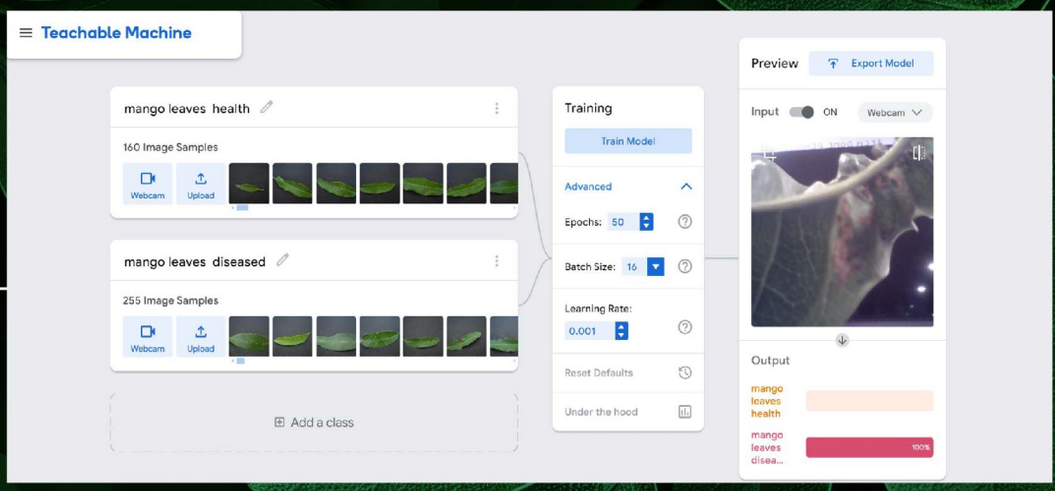


Figure 2: Mango leaves disease accuracy data.

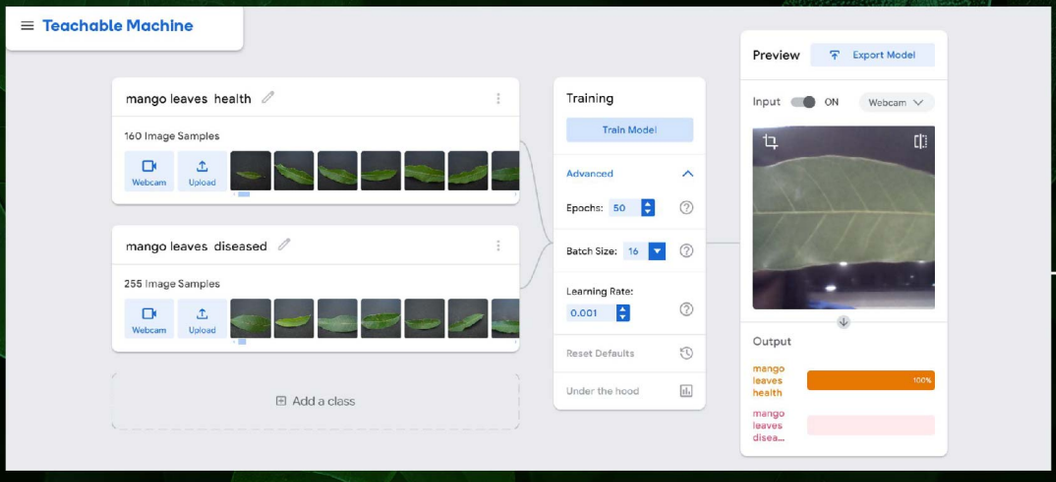


Figure 3: Mango leaves health accuracy data.

After training, the model undergoes testing and validation using separate sets of images to assess accuracy and effectiveness. Based on the test results, adjustments are made to enhance the model's performance. Once the model achieves satisfactory accuracy, it is deployed in the field. Farmers can use smartphones or other camera-equipped devices to capture images of mango leaves. The trained model then analyses these images in real-time, identifying any signs of disease.

Closing

The integration of AI and object detection technologies in agriculture offers several benefits. One of the primary advantages is early disease detection. AI models can identify diseases at an early stage, allowing for timely intervention and management, which helps prevent the spread of diseases and minimises crop losses. Increased accuracy is another significant benefit. AI models can analyse images with high precision, reducing the chances of misdiagnosis. This ensures that appropriate measures are taken to address specific diseases effectively.

Additionally, the automation of the disease detection process leads to cost savings for farmers. By reducing the need for manual labour and extensive field inspections, farmers can achieve more efficient operations. Scalability is also a key advantage of AI. The models can be easily scaled to monitor large agricultural areas, making it feasible to manage extensive farms and plantations efficiently.

Finally, AI technology contributes to sustainability in farming practices. By optimising disease management, healthy crops require fewer chemical inputs, which reduces the environmental impact of agriculture.

The future of AI and object detection in agriculture holds immense potential. Advances in AI algorithms, combined with the increasing availability of high-quality data, will further enhance the accuracy and reliability of disease detection models. Additionally, the integration of AI with other technologies such as drones and IoT devices will enable comprehensive monitoring of crop health at the granular level.

NAVIGATING THE AI LANDSCAPE: MALAYSIA'S PATH TO THE FUTURE

KUALA LUMPUR, 2 OCTOBER 2024 - The Malaysia Board of Technologists (MBOT) organised a collaborative forum in partnership with Universiti Kuala Lumpur - Malaysian Institute of Information Technology (UniKL MIIT) at Dewan Bestari, UniKL MIIT, Kuala Lumpur. Themed

"Navigating the AI Landscape: Malaysia's Path to the Future," the event brought together 120 participants, including industry experts, MBOT members, and academics to explore the nation's journey in Artificial Intelligence (AI).

The forum commenced with a keynote address by Dr. Jun-E Tan from Khazanah Research Institute, who provided a comprehensive overview of the AI landscape in Malaysia and the steps required to position the country to be a leader in this transformative field.

Ir. Airull Azizi bin Awang Lah, Principal Assistant Secretary of the Strategic Technology and Application S&T Division at the Ministry of Science, Technology, and Innovation (MOSTI), also delivered a remark, emphasising the government's role in fostering AI development.

A panel discussion followed, featuring Assoc. Prof. Ts. Dr. Mohd Nizam Husen (UniKL MIIT), YBrs. Ts. Nurul Haszeli Ahmad (SIRIM), and Ts. Johari Jalaludin (PLUS Malaysia). They discussed the role of AI in the academia, digital services, and cybersecurity, including its challenges and opportunities. The session was moderated by Assoc. Prof. Ts. Dr. Bazilah A. Talip, Deputy Dean, International, Industrial & Institutional Partnership (UniKL MIIT).

The event underscored the critical need for continuous collaboration between academia and industry to ensure that Malaysia is well-prepared to navigate and thrive in the future AI landscape.

/mbot registration

- **53,215** Graduate Technologists
- **11,445** Qualified Technicians
- **24,020** Professional Technologists
- **3,221** Certified Technicians

91,901 Total MBOT Registrants (As of September 2024)

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