

# Enhancing Efficiency and Sustainability of the Oil Palm Plantation Industry with Artificial Intelligence of Things (AIoT)

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## INTRODUCTION

Malaysia has a well-established palm oil industry and is one of the world's largest producers and exporters of palm oil. The industry plays a significant role in the country's economy, employing hundreds of thousands of people and contributing to the development of rural areas. However, like the global palm oil industry, Malaysia's palm oil industry has faced challenges due to labour shortage, tree height and uneven plantation landscape and land scarcity. Inexperienced workers may find it challenging to determine when the palm fruits are ready for harvest, leading to a situation where unripe palm fruits are picked, and ripe ones become overripe. This is often observed in oil palm plantations that rely heavily on manual labour to assess the readiness of harvest, a challenge exacerbated by Malaysia's shortage of skilled oil palm plantation laborers. One effective approach to reducing reliance on workers is to enhance automation in detecting the readiness of

fresh fruit bunches (FFB) for harvesting (Murphy *et al.* 2021). This can indirectly boost productivity per harvest by optimising the harvesting and evacuation routes.

## ARTIFICIAL INTELLIGENCE OF THINGS (AIoT) IN PALM FRUIT HARVESTING

Hexa IoT developed an Artificial Intelligence of Things (AIoT) solution - Luxio-AI. To aid workers in determining palm fruit harvest readiness with ease. The solution can automatically sort palm fruit harvest readiness by visual means (*Figure 1*). By implementing a visual inspection solution to scan each palm fruit plot, workers can efficiently identify ripe fruit that is ready for harvest, and with the help of Internet of Things (IoT) solutions, they can work effectively and increase their productivity. Additionally, the cloud-based software, Pandora Software, allows operators to access real-time data and digitise process logging. *Figure 2* shows the sample Pandora software dashboard.



Figure 1. Core integration of fresh fruit bunch (FFB) detection.

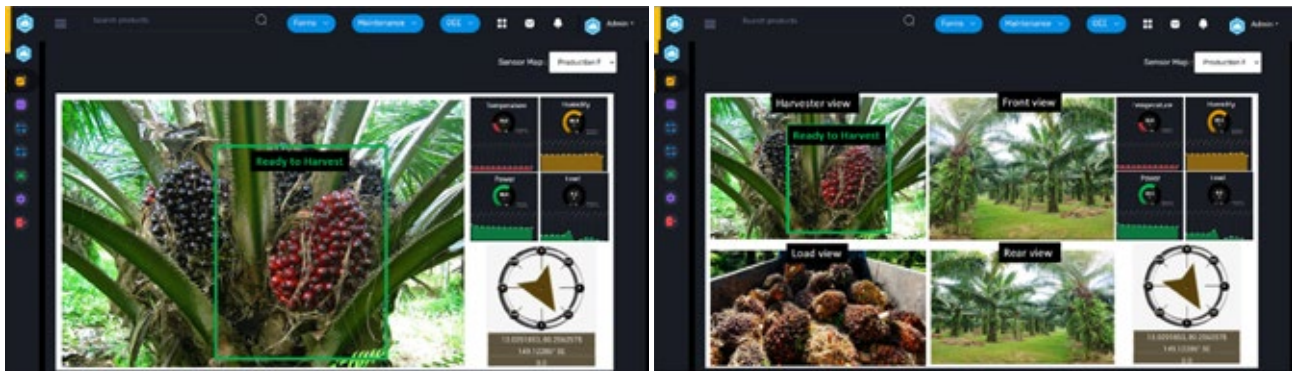


Figure 2. Sample Pandora software dashboard.

Pandora software features a user-friendly interface that can be easily understood by operators, and it can be accessed from a mobile device or laptop. Operators can monitor workers' working environment and conditions in real-time. In situation where ripe palm fruits are left on the ground by worker, Luxio-AI can automatically detect and trigger pre-set action to alert the operator. Other than that, operators can download historical data from Pandora Software for record-keeping purposes. The use of AIoT technology enables palm oil plantations to minimise rejection rates and reduce wastage.

The success of a plantation relies heavily on weather conditions. Where it plays a critical role in determining the growth and productivity of crops, as well as the overall health of the plantation (Kateryna, 2021). For example, a lack of rainfall can lead to drought conditions, which can cause soil moisture to become too low for optimal plant growth. This can lead to reduction in crop yield, as well as increase in water usage and irrigation costs. On the other hand, excessive rainfall or flooding can also be damaging to the plantation, as it can cause soil erosion, nutrient loss, and waterlogging, which can stunt plant growth or even lead to plant death. Temperature also plays a crucial role in the success of a plantation. Extreme heat or cold can stress the plants and negatively affect their growth and productivity. In addition, temperature fluctuations can lead to the onset of plant diseases or pest infestations, which can damage crops and lower yields.

To mitigate the risks associated with weather variability, operators can leverage IoT solution – Pandora Rival, to accurately determine upcoming weather conditions. With

this solution, the operator can proactively identify when it is going to rain or when hot weather is anticipated. Not just that, IoT solutions assist in various stages of the plantation process. IoT solution - Pandora Georgia, is able to detect soil quality such as soil nutrient level, soil temperature, soil humidity and soil pH level of palm trees, and the operator can easily check the quality of palm trees from anywhere and at any time. IoT solutions include an email alert function that notifies operators when a palm tree lacks water or nutrients, ensuring that all trees are growing ideally.

The use of above multi-parameter analytics in conjunction with the IoT can help the palm oil industry to overcome these challenges and achieve sustainable growth. Multi-parameter analytics can be used to monitor a range of environmental and operational factors, such as palm fruit readiness inspection, temperature, humidity, soil moisture, and nutrient levels. The data collected from these sensors can then be analysed using advanced analytical tools to identify patterns and trends that can reveal insights about the health and sustainability of the palm oil plantations.

Multi-parameter analytics in the palm oil industry are manifold. It can help plantation owners to monitor and optimise their use of resources such as fertilizer. By analysing multiple data parameters, can be identified areas where resources are being wasted or used inefficiently and take steps to address these issues can be taken. This can help in reducing environmental impact such as reducing carbon footprint during transportation and improve the sustainability of operations and ensuring the plantation has sufficient fertiliser.

### CONCLUSION

In conclusion, the palm oil industry is a significant contributor to the economy of Malaysia. However, the industry faces numerous challenges, including environmental impact, labour issues, and competition from other edible oils. AIoT technology can be applied to address these challenges and improve the efficiency and sustainability of the industry.

The use of AIoT in the palm oil industry can help plantation owners and managers to monitor and optimise key factors such as weather conditions, soil moisture, and plant health. This can lead to more efficient and effective crop management practices, higher yields, and reduced environmental impact. Additionally, AIoT can be used to monitor labour practices and ensure compliance with environmental and labour regulations.

Overall, the application of AIoT in the palm oil industry has the potential to improve the sustainability and profitability of the industry, while also addressing the concerns of consumers and environmental organizations. By leveraging advanced technologies, the industry can continue to thrive while also promoting sustainable and ethical practices.

### REFERENCES

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