博 士 論 文 の 内 容 の 要 旨

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論文題目	Oil palm fruit maturity evaluation with inductive coil and fruit battery method （誘導コイルと果実電池法を用いたオイルパーム成熟度評価）

（博士論文の内容の要旨）

The purpose of this thesis is to look into two distinct sensor applications for pre- and post-harvest evaluation. A sensor that determines the maturity of oil palm fruit bunches through the use of a triple flat-type inductive sensor concept based on a resonant frequency technique is implemented for preharvest evaluation, which consists of weekly assessments. Post-harvest evaluation employs a fruit battery method that yields immediate results suitable for use at the mill, immediately prior to the extraction process.

Traditionally, an oil palm fresh fruit bunch (FFB) is inspected for ripeness using a human grader, which can be inconsistent and inaccurate. Numerous new methods for grading the ripeness of oil palm FFB have been proposed, and this research aims to propose an alternative to the oil palm maturity detection method by utilizing the coil inductance and fruit battery method. The purpose of this research is to develop a triple flat-type coil inductive-based oil palm fruit maturity sensor with two distinct structure parameters that are either constant in length or in number of turns. The results revealed a relationship between the change in peak resonance frequency and fruitlet capacitance and the moisture content of the fruit sample, which could be used to determine its ripeness stage. The inductive oil palm fruit sensor's sensitivity is increased through analysis of the triple resonant frequencies generated by the triple flat-type air coil structure. The triple series technique, depending on the coil configuration, can increase or decrease the sensitivity of the results obtained in comparison to the single flat-type coil structure. As the fruit ripens, the inductance-frequency curve's peaks move closer to the air's peak curve. Triple coils with the same number of turns but different lengths (Triple I) perform better than triple coils with the same size but different number of turns (Triple II). The development of this sensor demonstrates the inductive element's capability to be used as a detection element for determining the maturity stages of oil palm FFB during the preharvest stage.

Human vision has traditionally been the primary method for determining the ripeness of postharvest oil palms at the mill. However, relying on human evaluators to grade the ripeness of oil palm FFBs in the traditional manner may result in inaccuracy, resulting in a decrease in the rate of oil palm fruit oil extraction (OER). This study emphasized the fruit battery method for determining the ripeness stage of oil palm fruit FFBs by determining the load resistance voltage and its moisture content resolution. Additionally, computer vision is tested on the same samples using a color feature to compare the accuracy score obtained with a support vector machine (SVM). The fruit battery's accuracy score, computer vision's accuracy score, and a combination of both methods' accuracy scores are evaluated and compared. After testing the ripe and unripe samples for load resistance voltages ranging from 10 Ω to 10 kΩ, three resistance values were selected and tested for moisture content resolution evaluation. A 1 kΩ load resistance demonstrated the highest moisture content resolution, and the results were compared to computer vision accuracy scores. According to the obtained results, the combination method has the highest accuracy, followed by the fruit battery and computer vision methods.