SawitSCAN - SAWIT (FFB) SPECTRAL CAPTURE AND AUTOMATIC SCANNING

NU'MAN ABDUL HADI; MUHAMMAD ABID AMER; CHE RAHMAT CHE MAT; NOR FAIZAH JALANI; NASRIN ABU BAKAR; MOHD SHAZLAN MOHD ANWAR and MOHD NORHISHAM CHE SOH

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MPOB INFORMATION SERIES • ISSN 1511-7871 • JUNE 2026 MPOB TT No. 698

Oil palm fresh fruit bunch (FFB) grading at palm oil mills is still largely performed manually by human workers, making the process highly dependent on labour and often subject to disputes over grading results. Typically, only 50 to 100 samples are assessed, which are assumed to represent the entire consignment of 5 to 20 t of FFB; amounting to just 0.1% to 0.4% of the total load. The current grading process also involves double handling of the FFB consignment, which not only increases inefficiency but also contributes to uncounted losses of palm oil on the ramp floor. Additionally, the repeated handling increases bruising of the FFB, which in turn deteriorates the quality of oil produced.

With current technological advancements, images of FFB can be captured and analysed across a wide range of spectral bands, enabling more precise assessment of bunch characteristics. When combined with further processing through machine learning techniques, these imaging methods significantly enhance the ability to determine ripeness with high accuracy. This integration of imaging and artificial intelligence offers a more reliable, efficient, and objective alternative to manual grading, reducing disputes and improving overall oil quality.

THE TECHNOLOGY

SawitSCAN provides a solution for FFB ripeness grading by employing computer vision applications integrated with machine-learned models to characterise ripeness categories with greater precision. It consists of an FFB conveyor that transports the bunches through the inspection line, where a dual-image capture system records both visible (RGB) and near-infrared (NIR) spectral data (*Figure 1*). An inline weighing system simultaneously measures the weight of each bunch, while a central controller equipped with a machine learning program processes the captured images and weight data to determine ripeness categories with high accuracy (*Figure 2*). A bunch sorter automatically rejects unripe FFB, while the software also generates grading results for the user's reference.

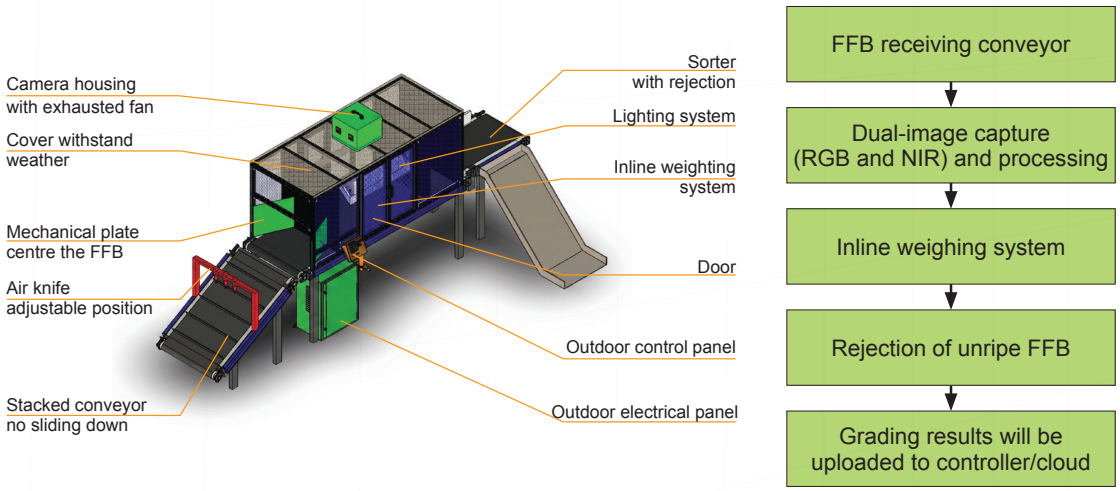

Figure 1. Working mechanism of SawitSCAN.

ISSN 1511-7871
9 771511 787001

Head of Innovation Commercialisation Centre, Malaysian Palm Oil Board. 6, Persiaran Institusi, Bandar Baru Bangi, 43000 Kajang, Selangor, Malaysia.
Tel: 03-8769 4575 E-mail: tot@mpob.gov.my Website: www.mpob.gov.my

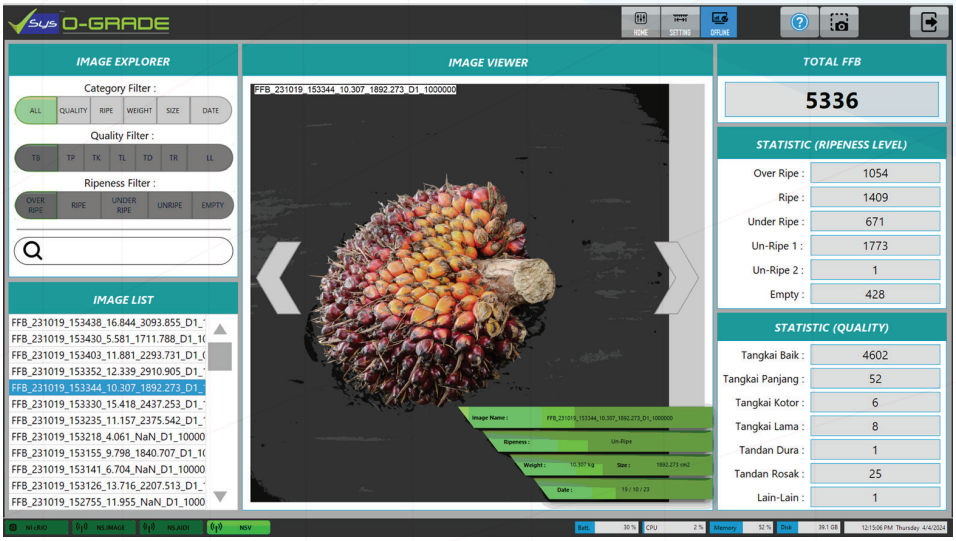

Figure 2. Customisable, user-friendly software for processing FFB images and identifying the ripeness category.

Unlike manual grading, the technology is capable of assessing up to 100% of the FFB consignment, delivering automatic rejection and instant grading results. The processing speed is estimated at 1 FFB s^{-1} (approximately 10–20 kg s^{-1}), reflecting operational efficiency that enables grading of a 5 t consignment to be completed within 5 to 10 min. For a 30 t hr^{-1} mill that typically receives 300 to 500 t of FFB daily, this translates into a total processing time of 5 to 9 hr, offering a scalable, digitalised and highly efficient solution for modern palm oil mills.

NOVELTY OF THE TECHNOLOGY

The system offers a dual-camera setup that captures both visible (RGB) and near-infrared (NIR) spectra, supported by a dataset of more than 20,000 images collected during the development study. This robust foundation has enabled the model to achieve an overall accuracy of 80% in average ripeness determination and up to 90% accuracy in identifying unripe bunches.

BENEFITS AND ADVANTAGES

- Reduce reliance on manual (labour) grading, disputes and inconsistencies.
- Automatically rejects unripe bunches, improving oil recovery at the mill.
- Capable of processing up to 100% of FFB consignments, compared to conventional sampling of only 0.1%–0.4%.
- Acceptable operational efficiency to cater daily FFB receiving and processing on the same day.
- Integration of computer vision and machine learning ensures consistent, dispute-free grading outcomes.
- Minimises double handling and bruising, reducing oil losses and improving overall oil quality.

ECONOMIC ANALYSIS

While the capital investment is substantial, installation of the system is expected to yield labour savings of up to RM96,000 per year and generate additional revenue of RM144,000 from improved oil recovery. This translates into a 24% of yearly return on investment (ROI) with a payback period of four years. With approximately 450 palm oil mills operating in Malaysia, the technology offers significant market potential, positioning SawitSCAN as a scalable solution that can deliver both economic and operational benefits across the industry.

IP STATUS

The technology is filed for a patent. Patent application number: PI2024006006

CONCLUSION

SawitSCAN offers a practical step forward in automating the grading of FFB, while reducing

reliance on manual labour and introducing greater consistency. By using cameras and smart software, it helps minimise disputes, improve oil recovery, and make daily FFB receiving and processing more efficient, making it a viable option for mills seeking to modernise their operations.

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