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Clasificación de racimos de fruta fresca en la planta de beneficio de aceite de palma utilizando técnicas y tecnologías avanzadas

Fresh fruit bunches classification at the palm oil
mill using advanced techniques and technology



Malasia/ Malaysia



FFB Classification at the Palm Oil Mill Using Advanced Techniques and Technology

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Outline

- Current Problems in the Oil Palm Sector.
- Our research approach at Universiti Putra Malaysia
- Some promising results obtained
- Prototype Oil Palm Grader
- Proposed Integration of Scanner at Mill.



PROBLEM STATEMENT

- Current methods of grading FFB at the mill are based on visual inspection of a sample of the FFB per lorry load. There is obvious weakness in this approach as witnessed by disputes between buyers and sellers.
- This conventional grading system causes unripe and hard FFB to go into the milling system and causes greater wear and tear thus increasing maintenance cost.
- Due to the non-separation of the ripe and over ripe FFB, oil quality is also affected and this has detrimental effects on health as well as on profit margins.



OBJECTIVES

The major objective of this presentation is to propose a design an automatic grader that offers solutions to the above problem.

This design encompasses an automatic scanner which serves the function of a grader and a sorting system that separates between the different quality of FFB

Oil Palm FFB Scanning Technologies

Some of the technology developed at our laboratory at
Universiti Putra Malaysia

Visible Color Technology

**Hyperspectral and Near Infra Red
Technology**

Fluorescence spectroscopy

Thermal Imaging Technology.



Visible Color Technology

An automated grading system for oil palm bunches using the Red, Green, Blue (RGB) color model has been developed

The system distinguishes between the three different categories of oil palm fruit bunches.

Maturity or color ripening index was based on different color intensity.

This grading system employs a computer and camera to analyze and interpret images equivalent to the human eye and brain.

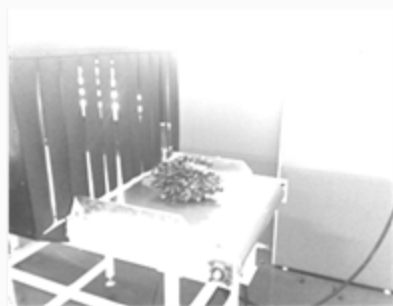
22 al 25 de septiembre de 2015



XVIII
Conferencia
Internacional sobre

**PALMA
DE ACEITE**

18th International Oil Palm Conference



FFB




Illumination



PC & Frame grabber



Camera & cable



**Let's Look at the Video
Clip:**

Oil Palm Grader



Hyperspectral and Near Infra Red Technology

A total of 469 fruits from oil palm FFBs (nigrescens, virescens, oleifera) were categorized as over ripe, ripe, and under ripe.

Fruit attributes in the visible and near- infrared (400 nm to 1000 nm) wavelength range regions were measured

Artificial neural network (ANN), classified the different wavelength regions on oil palm fruit through pixel-wise processing.

Our classification approach had an accuracy of more than 95% for all three types of oil palm fruits.

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Hyperspectral Imaging System

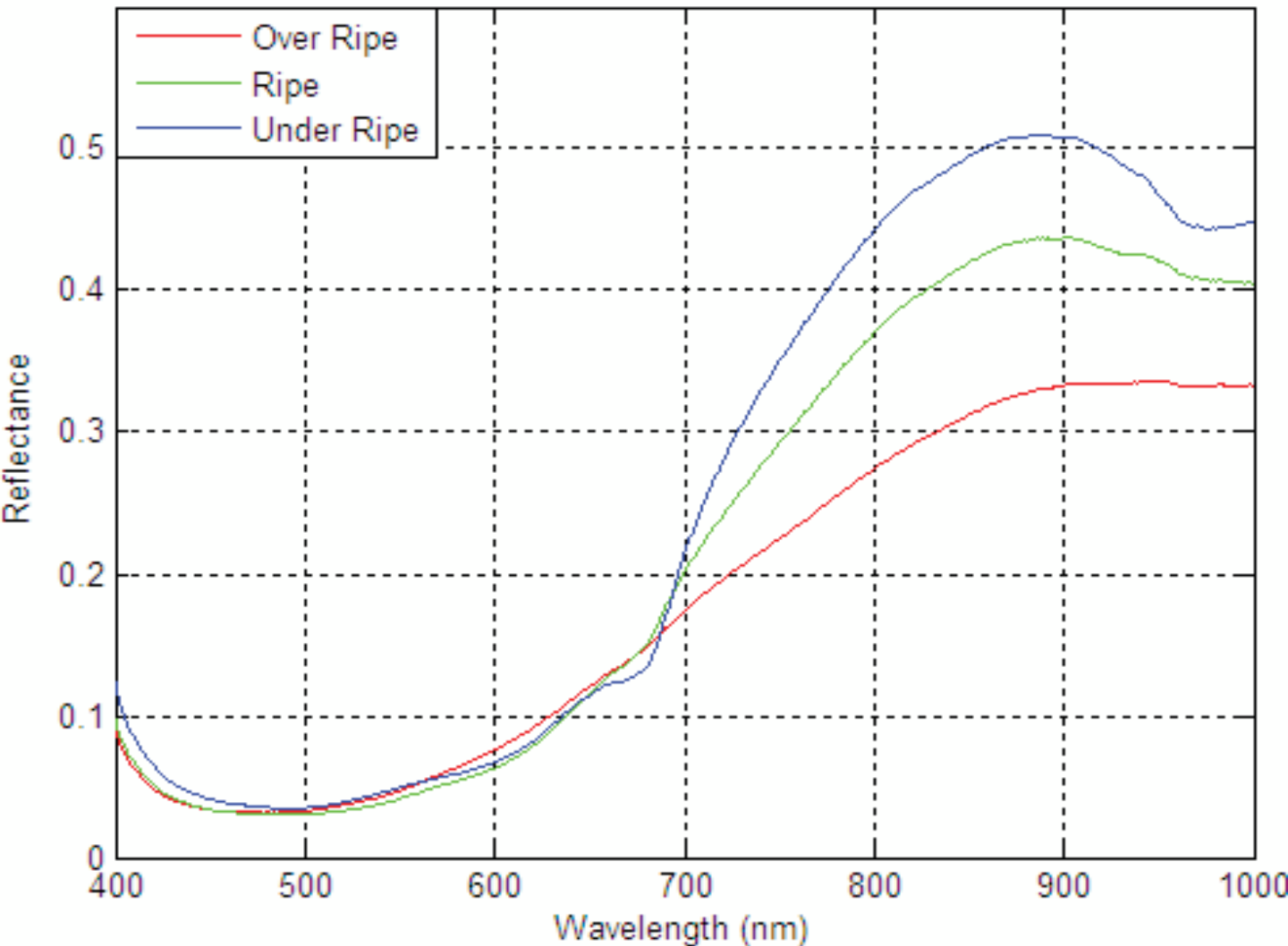
Showing a FFB Bunch on the Conveyor.



Spectral profile at different ripeness stages of nigrescens oil palm fruits.



Data set NIGRESCEN



Classification by Fluorescence Spectroscopy

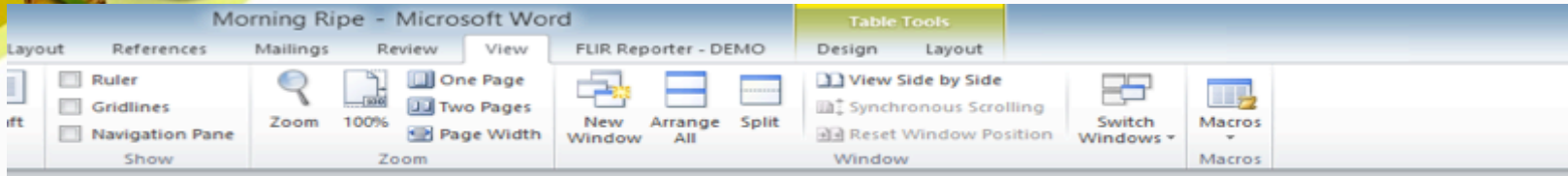
One hundred and eighty oil palm FFB samples; three maturity categories; ripe, under ripe, and over ripe.

Each sample was randomly scanned 10 times, both front and back using a hand-held Multiplex®3 multi-parameter fluorescence sensor.

Statistical analysis: significance difference between under ripe, ripe, and over ripe maturity categories.

The results shows that fluorescence highest overall classification accuracy was 87.7% using a Stochastic Gradient Boosting Trees model.

Thermal Imaging



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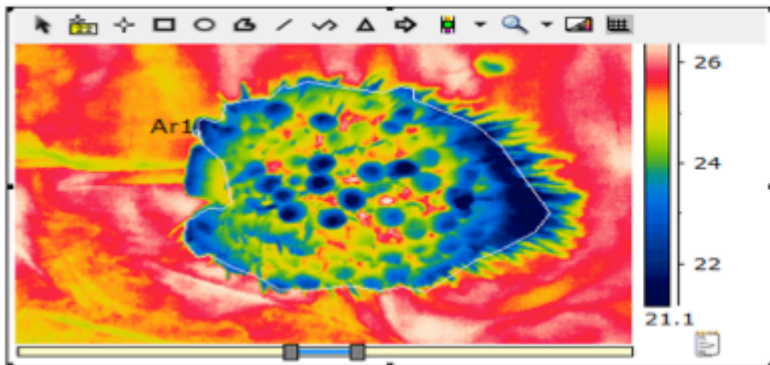


Image File Name: IR_R4.jpg

| | |
|-------------------------|---------|
| Ar1 Max. Temperature | 26.6 °C |
| Ar1 Min. Temperature | 20.4 °C |
| Ar1 Average Temperature | 23.8 °C |



Mean temperature of FFB thermal created by 'FLIR Reporter'

Temperature Trend for Oil Palm Fruitlets: Analyzed Under Room Temperature

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Temperature of Oil Palm Seeds Under Room Temperature

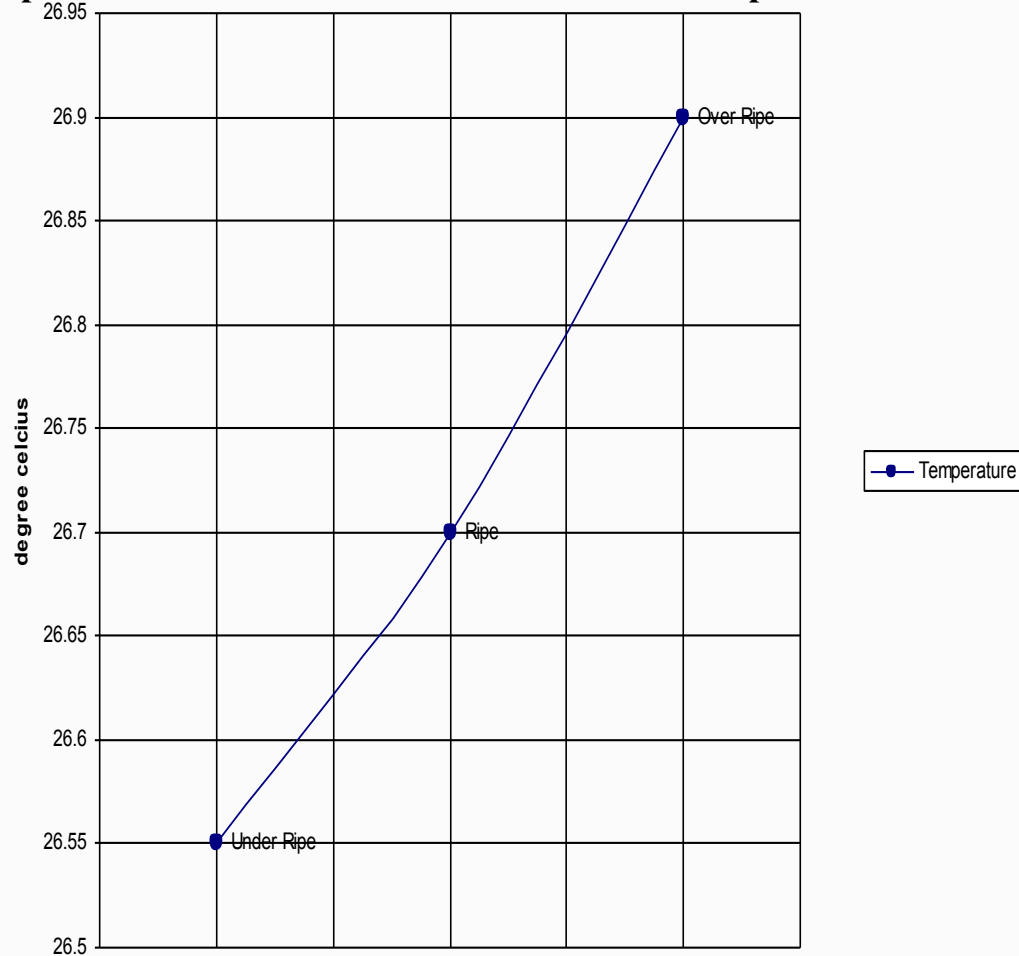


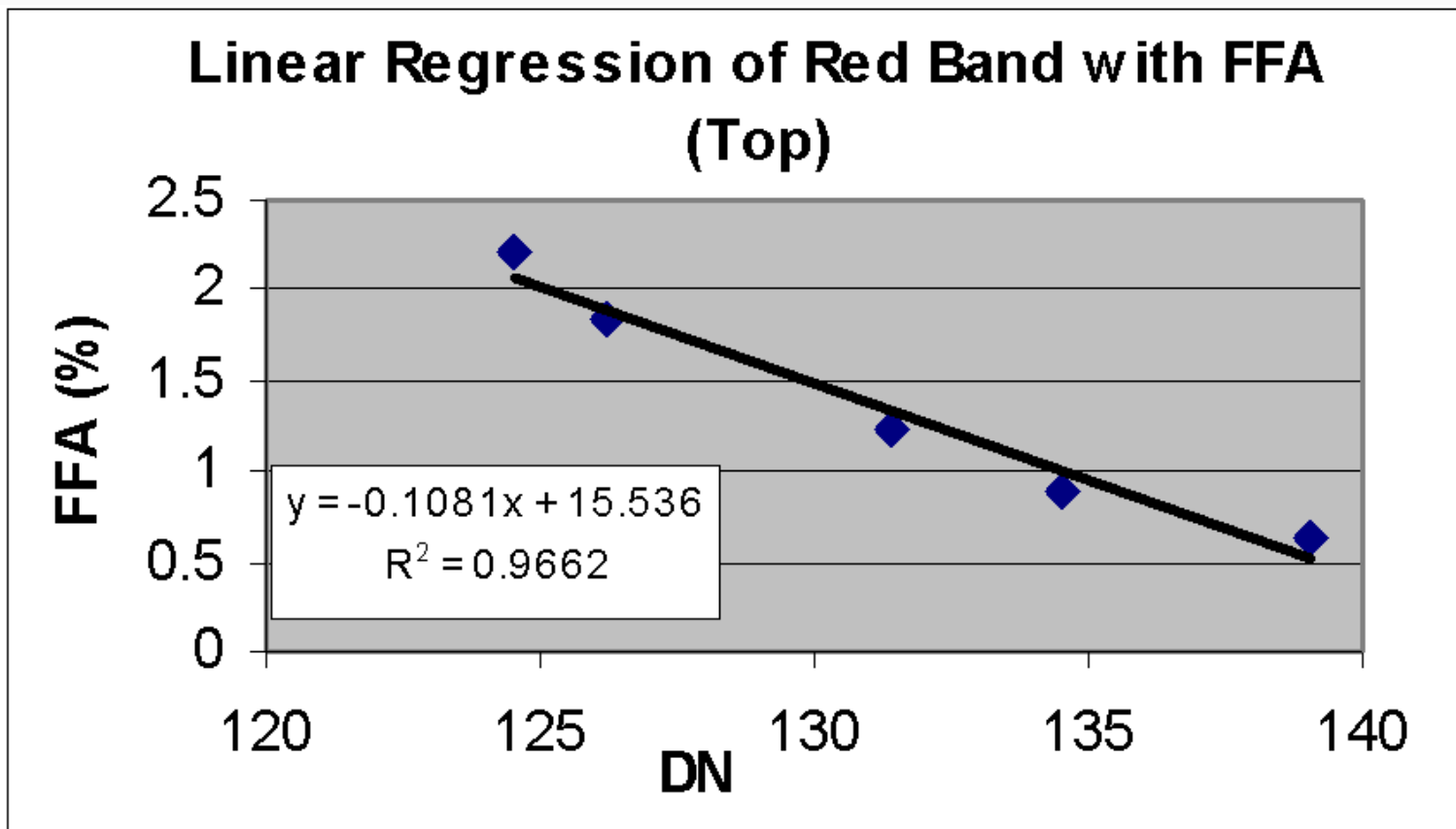
Figure above shows a relationship between oil palm ripeness and its temperature. Further research is ongoing



Summary for Thermal Analysis

- The result showed that there was significance difference of variance across the temperature of the Under ripe, Ripe and Overripe samples and showed that the **immature** bunches has **higher temperature** than the mature one.
- The overall value of Pearson's correlation coefficient, $r^2 = -0.88$ showed that there was a strong relationship between temperature and Oil content, during the maturity process.

CORRELATION BETWEEN FFA IN OIL PALM AND THE COLOR OF THE OIL PALM FRUIT



METHODOLOGY

Design and renovation of mill for automatic grading system requires research and observation from various aspects for example:

- **Loading Ramp Design**

- Loading ramp for automatic grading system is different from manual grading

- **Sterilization design**

- Sterilizer that will propose to use is **Oblique** sterilizer types

- **Conveyor type**

- Scraper/Belt Conveyer



22 al 25 de septiembre de 2015

Video Time: Let's Look at the Integrated Scanning System



DISCUSSION

• Loading Ramp

- New modification, FFB grading will be done using a scanner.
- The FFB inserted onto the loading ramp will be taken via a conveyor to the scanner for grading purposes.
- The graded FFB will be separated according to the category determined, namely ripe, unripe, overripe and black.
- FFB categorized as ripe, underripe and overripe will be loaded onto another loading ramp for the next process whereas FFB graded as black will be returned to the supplier.



Sterilization

Existing Palm Oil Mill

- Older mills usually implement horizontal sterilizer system where it is made up of one or two doors and requires cages to carry the FFB in the sterilizer.
- For the FFB graded as ripe, the duration in the sterilizer will be longer as compared to the overripe FFB.
- The modification made on the part is by conducting the separated sterilization process for the overripe category.
- The separation will indirectly save valuable time for the sterilization process where the overripe FFB requires less time as compared to the ripe FFB.



Newer Palm oil Mill

- New mills usually do not use cages to insert the FFB into the sterilizer
- Conveyors are used for FFB insertion into the sterilizers.
- Also separated sterilization process for the overripe FFB and only one sterilizer is needed.
- Alternatively current sterilizer can be scheduled to accommodate ripe and overripe FFB separately.



Alternative Design

- Overripe FFB will be separately processed from the beginning of grading using a scanner to produce CPO.
- The design of Overripe FFB separation is not usually practiced in Malaysian palm oil mill because it involves expensive machineries and tools and also puts a heavy burden on skilled workforce to ensure smooth operation.
- The outcome shows that the revenue from mills that conduct overripe separation is higher than mills with normal processor.
- This is because Ripe CPO has more economic value than normal CPO even though overripe CPO is of lower quality.

Discussion

Economics of Separation of Ripe and Overripe FFB

Example: 40 ton mill

Practices separation of ripe and over ripe FFB

Able to generate an additional revenue of RM 3,027,400 or USD 756,850 per year over a conventional oil palm mill that processes both ripe and over ripe FFB together.

(@ 1 USD = RM 4.00 and CPO Ripe = RM 2500 (USD 625)

CPO Overripe = RM 2250 (USD 562.50) per year over a conventional oil palm mill that processes both ripe and over ripe FFB together.

CONCLUSIONS

- Modifications on the loading ramp will allow 100% of the FFB to be graded by using a scanner.
- OER for each mill depends on the quality of the produced FFB and the beginning of the process is in the loading ramp where the FFB is graded according to the standards set by MPOB.
- For the new and old mills, the design on the loading ramp is the same which is the modification on the loading ramp with the upgrade of the grading system by implementing a scanner.



CONCLUSIONS(2)

- Sterilization for overripe FFB can be separated or shared for both types of the mills.
- Alternative design will ensure overripe FFB are processed separately at each station.
- The biggest beneficiaries of the scanning technologies will be people: the oil palm sector and consumers

A photograph of a tropical landscape featuring several tall palm trees with dense green fronds. In the foreground on the left, there are large, heart-shaped green leaves. The sky is bright and clear. The text 'THANK YOU' is overlaid in the center in a bold, red, sans-serif font.

THANK YOU



My students