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Oil Palm Fruit Maturity Grading System using Computer Vision Technique

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Abstract

Nowadays, an automated fruit grading system has gained much attention since the technologies in upgrading the quality of food products are now acknowledged. This also includes the palm oil fruit sector. Palm oil fruit or *Elaeis guineensis*, is a species of palm that commonly called African oil palm, which is the principal source of palm oil [1]. They are used in commercial agriculture in the production of palm oil (which is the most widely traded edible oil in the world [2]) and the palm oil itself can be used to produce other food products.

The technology in the palm oil industry has grown in parallel with the increase in production. However, some tasks in palm oil processing require skilled labor so that the tasks run smoothly and can increase the production. Normally, in some developing countries such as Malaysia, the palm oil fruit grading is done manually by the labor or grader. However, at a certain time, grading mistakes can be occurred. This is because of the human's eyes perceive colors differently and this often lead to dispute between graders and sellers. There might be inefficiencies and time-consuming using this method.

In this paper, the palm oil fruit maturity grading system using computer vision technique is presented. The palm oil fruit bunch images are categorized into three classes which are under-ripe, ripe and unripe. A palm oil fruit is said to be ripe when the mesocarp color is reddish orange and the bunch has 10 or more empty sockets of detached fruitless. Another category which is under-ripe fruit bunch, it has yellowish orange with less than 10 empty sockets, while an unripe bunch has yellow mesocarp with no empty sockets [3]. A total of 90 images of oil palm fruit bunch (which 30 images for each group) are used for the system simulation. All oil palm fruit bunch images that were used in this experiment had been taken at Felda Kemahang Oil Mill, Pahang. The image acquisition process was supervised by experienced and skilled grader. Images of oil palm fruit bunch were taken using a digital camera under direct sunlight. Figure 1 shows image samples of ripe, under-ripe and unripe oil palm fruit bunch.

Figure 1: Image samples of oil palm fruit bunch (a) ripe, (b) under-ripe and (c) unripe.

To develop this grading system, the palm oil fruit bunch image has to be processed using image processing methods, which are the combination of color intensities, and filtering technique to cluster the pixels with red color. In this work, the simulation of grading system is developed by using MATLAB software. In this paper, the process is divided into three parts, which are image acquisition, image analysis and feature extraction, and decision making. Figure 2, shows a flowchart for the whole process.

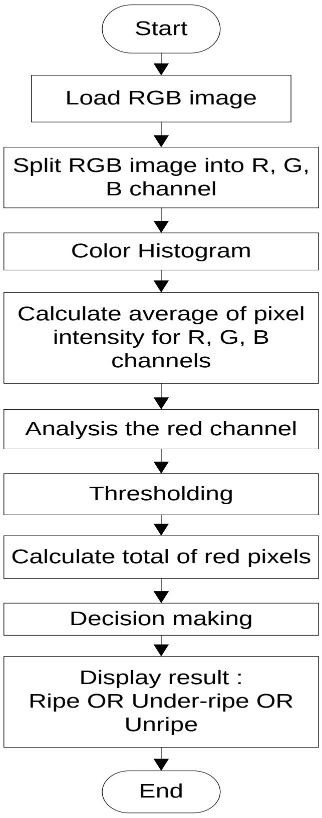

Figure 2: Flowchart of the oil palm fruit maturity grading system

The result shows that the accuracy of this system is 91%. Table 1 shows a confusion matrix of palm oil fruit classification. The ripe and unripe fruit bunch images are successfully classified into their classes with 100% accuracy. However, there are 7 under-ripe fruit images miss-classified into unripe class and 1 image miss-classified to ripe class. Some under-ripe fruit images are failed to classify into its actual class because the color of the fruit has a little yellowish color or reddish color and it is difficult to extract. Overall, the results show that this method is successful in classifying the palm oil fruit bunch.

Actual class	***Predicted class***		
	Ripe	Under-ripe	Unripe
Ripe	**30**	0	0
Under-ripe	1	**22**	7
Unripe	0	0	**30**

Table 1: Confusion matrix of palm oil fruit classification

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