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Grading of Rice Using Image Processing

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***Abstract*—This paper is focusing about the methods used for rice grading using image processing. Various approaches have been applied by previous researchers to solve different types of difficulties in grading the quality of rice. Machine vision has been used in most application of rice grader to differentiate rice grade based on special features such as shape, length, chalkiness, color and internal damage of rice. RGB color model, histogram, edge detection are some ways which have been used to differentiate and analyzed degree level of rice. In this paper, we are also discussing and suggesting another method in rice grading for Malaysia's type of rice using image processing method based on several features which is length, colour and shape.**

***Index Terms*— Rice grading, machine vision, image processing.**

I. Introduction

Rice is main food crops that all human consumes in all over the world, especially in Asia, regardless types of rice in each country they have. It is primarily classified according to its grain shape. There are various grain shape and specialty rice categories. Rice that has been harvested from the plant with its hull (husk) intact is known as rough or paddy rice. Sometimes, the hull is burned for use as an energy source since it is not eaten by humans. When the hull is removed from paddy rice it is known as brown rice. However, not all rice with the hull removed is brown in color. The bran and germ that gives brown rice its color can vary from light yellow to red to dark purplish black. Rice bran and germ contains greater amounts of dietary fiber, vitamins, minerals and other health- related components than the white center portion of the kernel (endosperm). But those outer portions of the kernel also contain more lipid (fats) material, making brown rice more susceptible to becoming rancid. It therefore has a shorter shelf life compared to milled white rice. Storage under cool conditions will lengthen its shelf life. Cooked brown rice is chewier in texture than its white rice counterpart and is described as having a slightly nutty flavor. Rice that has had its bran and hull layers removed by milling is called milled rice. White rice cooks faster than brown rice and has a longer shelf life. However, within the grain shape categories there are differences in qualities. In ordered to get good quality of rice, first the rice must be filtered through certain procedure before machine vision can do its job. Rice quality inspection using naked eyes is inefficient; therefore there are many system and technologies available to do the identification of rice. The rice classification can be classified by many feature of the rice itself such as the physical shape, length, width, color, number of foreign matter, amount of nitrogen [1], moisture content, internal broken and many more [1-32]. Those features can be detected using technologies that have been already developed such as Vision Builder, Computer image analyses, remote-sensing technology, image processing techniques, machine vision, neural network and digital imaging. This project paper will analyze few classifiers using image processing in grading rice quality. From the analysis and result obtained, it will display how machine vision able to sorting rice in effective performance by applying some algorithm calculation and image filters.

II. Objectives

There are several objectives for this project to achieve:

- To do research on the existing technology used for the rice grading
- To build a system to do the rice classification using image processing.
- To develop the exist method used in the industry

III. Problem Statement

Demand for rice nowadays increasing tremendously, hence producing and sorting of rice becoming more faster than usual requirement. Based on previous research [3], for a conventional rice sorter to recognition percentage is below 90 percent if the rice flow exceeds few thousands [kg/h]. Recognition ability will be limited and hard to differentiate between good and bad quality of rice. Moreover, since huge amount of rice need to be sorted, there might be some overlooked rice during sorting process. Quality of rice will not be preserved if grading performance is not been developed wisely. Rice grading scope is very large; it can start with rice grading or mapping area [29-30], infected diseases on rice leaf detection [20, 32], nitrogen or moisture status of rice [1,4] and etc. All these scope can be covered or solve by using machine vision, however they are still some problems will occur or might affect the grading process. Below are the difficulties faced in image processing in getting good quality of rice:

- Large varieties in types of rice around the world
- Changing of moisture in rice content (for moisture detection)
- Presence of foreign materials between rice
- Blur image if object moves really fast motion

IV. Literature Review

Past research has been proven that methods such as color classifier [7] can differentiate by obtaining RGB value from acquired image and converted to HIS value. While other researcher doing rice quality grading by checking the internal broken of rice kernel [10]. Nowadays, there are a lots of technologies can be applied in rice grading and classification around the world. Most advanced technologies has been used is by using camera or machine vision technologies systems. Machine vision means a vision system which interfacing special hardware with camera and software to process all calculation or algorithm needed to obtain a final result [11]. One method to do rice grading is using image processing .Image of rice is needed before proceed to obtain final result. The image can be in static image or in video motion which can deal with real time classification. Every rice should be in the range in order to be good grade. If is have to differ from other that really shows it's not normal and can reduce the grade. First of all, sample of several good grade, medium grade, not good and worst grade rice is taken as a sample for the template matching, then after try several trial, the machine is learn to know how to classified between good, medium, not good and worst we named it as grade A, B, C, D and E respectively. Then try with another test image several times to make sure the process is work properly.

A. Rice Sorting Machine

Rice sorter machine as shown in Figure-3 has been used since 2002; this machine sorting two types of rice, the damaged rice will be blown away by an air gun shooter while the normal or good rice will continue to flow into a normal rice container [3]. Figure-4 shows a flowchart process on how rice is graded from initial stage to final stage.

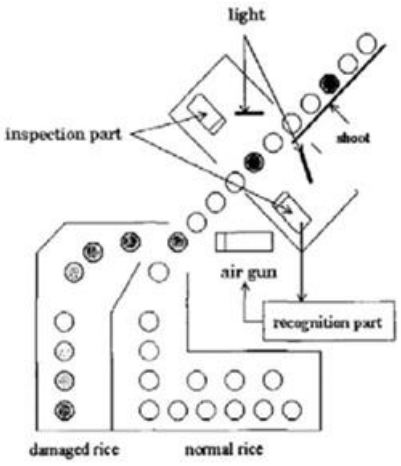


Fig. 1. Rice sorter machine

B. Static Image Setup

Static imaging approached is developed to capture static image of rice kernels [21, 27-28]. Actual imaging setup is illustrated in Figure-5 where a camera is used as machine vision and two LED light panel provide light source in the sealed box. Matte background is used as contrast to rice color. Next image processing will take place [1].

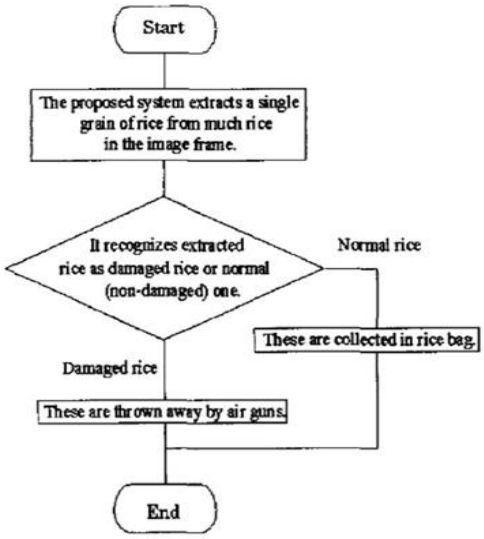


Fig. 2. Flowchart of sorting procedure

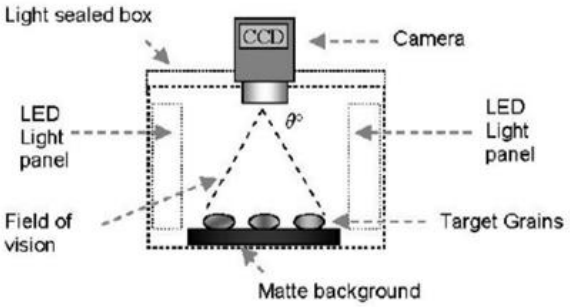


Fig. 3. Imaging setup

V. Rice Grading and Classification

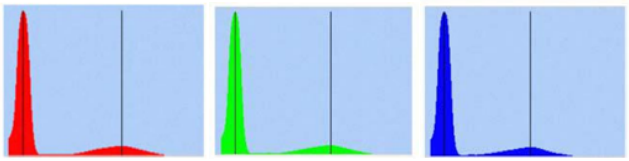
Rice grading can be done in varieties of ways based on its special features. For examples like color approach using filter, edge detection template, decision tree analysis and many more. However it is depends on the goal of classification that the user wants to obtain. For example for internal damage of rice kernel, edge detection template can be used [11]. While for other goal such as originality of rice, color and length features can be used [7]. Machine vision system development has been capable and helpful in sorting rice into chalky, cracked, broken and internal damaged kernels. These are some approach which can be used and helpful in rice classification and grading.

A. Color Approach (Color, Chalkiness)

Color is one of important measure in rice grading. Classification of color also helpful in determined the quality of rice which it obtained the maturity, grade and growth defect of rice grains. Liu Guang-rong, 2010 is using color inspection for rice classification. Two kinds of commonly used color model were RGB and HSI model. RGB color model is represented as histograms based on RGB channel of the rice image. Next the

model will be converted to HIS model for further algorithm calculation of HIS value. As HIS value was obtained, the rice grade can be known whether it is a fresh rice or old rice [7].

Figures shown below are three different color channels that an image has



(a) (b) (c)

Fig. 4. Histogram channel for RGB [7], (a) R value of histogram (b) G value of histogram (c) B value of histogram

In RGB color model system, the display color and the natural color are shown in equal way. The color model is conducive to the objective-accurate analysis of image. While for HIS color model, is more to human feeling way which is very easy to differentiate and understand the color of objects. Therefore, old researcher has selected this way to classify the types of rice.

Chalkiness is considered one of features or indicator that able to classify between good rice and bad rice. Dai Xiaopeng and Liang Yong, 2011 showed how to identify chalkiness in rice using image samples. Other parameter such as width of rice kernels also considered in this research [10].

Fig. 5. Original image of rice [7]

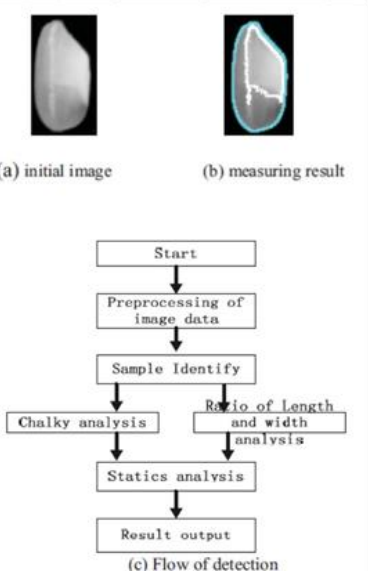


Fig. 6. Principle of chalkiness [10]

B. Shape Approach (Length, Area, Internal damage, etc.)

As rice is harvested, many physical and mechanical stresses are developed inside rice kernels. These defects or cracks can be easily detects if using machine vision system. Xu Lizhang, Li Yaoming, 2008 using image processing to detects internal damage of rice kernels. The methods which prefer are edge detection for the find internal cracks of rice. Various types of edge detection can be used to see the internal damage such as Sobel filter, Robert filter, Prewitt filter and many more [8].

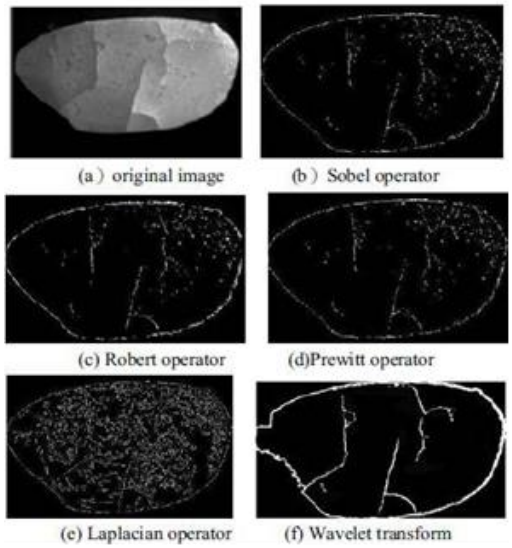


Fig. 6. Different methods of edge detection [8]

VI. METHOD

A. Measurement Parameter

Rice grading is needed to be evaluated from many difference parameters in order to get an accurate result of grading. The parameters are taken from the features of the rice. Every rices will have difference features maybe in term of but length, colour and shape. But the same group of rice will have almost the same range in every feature. From that difference we will classified them in several group namely A,B and C that indicated A as the good quality of rice, followed by group B and the worse class is group C.

The first parameter to classify the rice is length. The longer the rice shows that the rice get enough nutrient while growing and have no defect. The ideal length for the rice is 8mm to 10mm which suppose be the range for group A. Group B range of length is 8mm to 4mm and below than that is range for group C.

The second parameter used is colour. When we talk about rice, the common colour of rice that will come in mind is always white. There is also rice in other colour but our main concern for this research is the white rice. The whiter the rice shows the better the quality.

The third parameter used is the shape. The ideal shape of the robot is shown as the diagram below. If the shape more than 80

percent likes the ideal shape then the rice is categorized as group A. The range for group B is between 79 percent until 50 percent while the rest is group C.

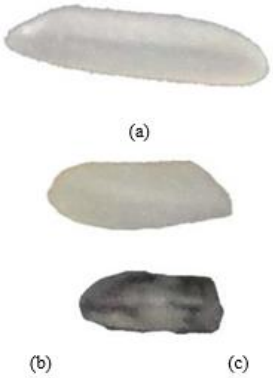


Fig. 8. Ideal length, color and shape for the rice of group (a) A (b) B and (c) C

B. *How the System Work*

There are several method used in the project. First classification used naïve baize to classify the class of the rice based on the parameter. Naïve baize method is the easiest method to use as our want to classify the length, colour and shape. Software use for this is method is MathLab. The system are programmed in the MathLab will do the scanning part of the rice image for the classifying the process. For length, the size of the rice is measured while for colour, RGB colour space determine the class and for shape, edge detection is used to determine the shape.

The program is the supervised learning based where we need to train the system to identify the image. 60 image of rice from each class is used to train the image so that the system can recognize every pattern of each class based on the discussed features. Then 40 images using new image that not include in the training images are tests to see the accurateness.

VII. Difficulties

While doing this project, many problems are faced as the rice picture must be at the same dimension, brightness and angle. The rice is also difficult to classify using single rice.

VIII. Result

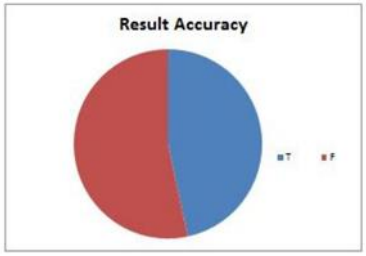


Fig. 9. Pie chart of result accuracy

The system is tested using testing image to measure the accuracy of the system. After the system being tested, the result gain is 46.6 percent when the image is trained with 285 items of rice images.

The pie chart above shows the accuracy of the result. The blue colour represent 46.6 percent of the accuracy result. ` While the red colour shows the 53.4 percent of the false accuracy. This accuracy is not really accurate due the problem faced in getting the right image of rice.

Diagram below shows the diagram of the system during testing process.

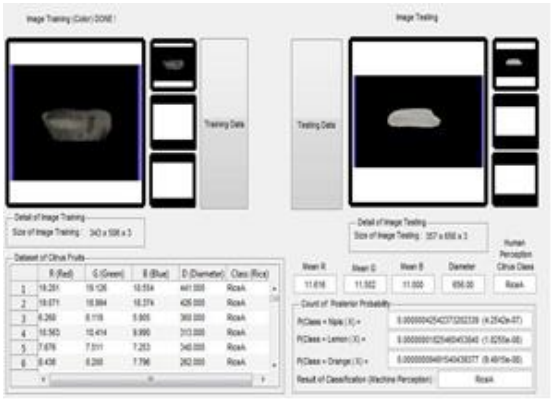


Fig. 10. Result during testing

IX. Conclusion

As a conclusion, there are many method can be used to grade the quality of rice in the industry. Image processing using machine vision has been proven helpful in differentiate rice category. More advanced sorting machine will be developed using more intelligence software. The method and technology can always be advance together with the development of other technology as the technology give big impact on the method use.

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