Analysis on Feature Extraction and Classification of Rice Kernels for Myanmar Rice Using Image Processing Techniques

Thae Nu Wah, Pann Ei San, Thandar Hlaing
Department of Electronic Engineering, Technological University (Thanlyin)
Republic of the Union of Myanmar

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Abstract— The paper presents the analysis on feature extraction and classification of rice kernels for Myanmar rice using image processing techniques. There are seven steps to analyze the image processing techniques. The classification of export-rice quality is a great challenge in agricultural industries. The development of modern technology-based methods for rice quality classification is currently necessary to provide a reliable and consistent rice quality to consumers. An image processing algorithm has been implemented the analysis and classification the rice kernels in Myanmar. The proposed method is based on real-field feature and KNN classifier. Then, a series of measurements were done using image processing techniques on three classes of Paw-San rice in Myanmar. The real-field feature of Paw-San rice is percentage of broken rice contained in the batch. At 30 tests are conducted for each class of Paw-San rice. The simulation results show that the proposed method can confirm the classification accuracy in the range of 83~100% for the three grades.

Keywords *– Feature extraction, Image segmentation, KNN classifier, Rice quality classification*

I. INTRODUCTION

With the development of computing methods and computing devices, digital image processing technology become a popularly-used technology in nation security area, biomedical field, robot science and quality control of product in industries. Myanmar is the world's sixth-largest rice-producing country. However, it will be some years before the country can regain its former position as one of the world's largest rice exporters [1] .The rice industry is the oldest and most widespread industry in Myanmar. Traditionally, the quality of rice is defined from its physical and chemical characteristics by human vision.

The use of tradition rice quality inspection technique is normal. Quality inspection by human is neither objective nor proficient because sometimes of the results may not be reliable due to human errors or inexperienced inspectors. Besides, it is time-consuming. Therefore, to overcome the shortcomings occurred in traditional methods modernized and advanced technique i.e., automatic rice quality classification systems are being developed and efficient and reliable image processing techniques are being proposed.

Thus, there have been many researches in which computer vision is applied to estimate rice quality. Computer vision is a novel technology for acquiring and analyzing an image of a real scene by computers and other devices in order to obtain information or, to control machines or processes [2]. Figure 1 show automatic rice quality inspection using flatbed scanning (FBS) for classification and grading of rice [3].

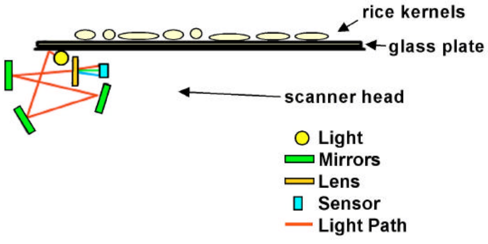

Figure 1. Rice quility test using flatbed scan

Agustin used image processing to analyze rice kernel using six features such as shape descriptors determine the quality of head rice, broken kernels, and brewers in rice samples base on flatbed scan using six features [4]. Bhagyashree Mahale presented a solution of grading and evaluation of rice grains on the basis of grain size and shape using image processing techniques [5]. Verma reported that an image analysis (IA) method using the back propagation through time to sort the rice into chalky, sound, cracked, broken and damaged kernels [6]. Liu Guangrong detected rice chalkiness based on image processing technique [7]. Mingyin Yao developed an inspection system of rice exterior quality [8]. Pabamalie and Premaratne focused on providing a better approach for identification of rice quality by using neural network and image processing concepts [9]. The proposed method applies KNN classifier for Paw-San rice classification based on flatbed scan (FBS).

The objective of this paper is to present an image processing method for classification of rice quality which minimizes the required time and cost. Section II discusses classes of Paw-San rice for export quality. Section III talks about the method proposed for classifying parameters such as number of grain, area ratio and percentage of broken rice. Section IV includes results and discussion based on quality analysis for number of grain, area ratio and percentage of broken rice. Section V provides the conclusion of the proposed method.

II. CLASSES OF PAW-SAN RICE

There are three classes of export quality of Paw-San rice in Myanmar. These rice types are normally exported to Africa (Ivrycost), Turkey, Singapore, Japan, Philippines, India, Bangladesh. Mostly, the export rice are classified and tested by traditional method. The visual natures of three classes getting from this method are shown in Figure 3. Class A is shown in Figure 2 (a), Class B and Class C are shown in Figure 3 (b) and (c).

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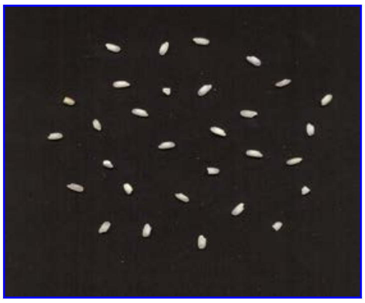
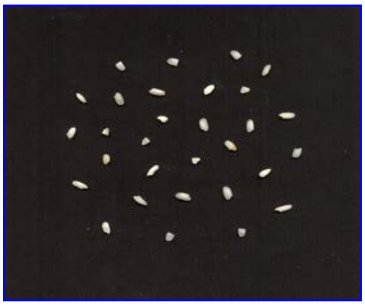
(a)



(b)



(c)

Figure 2. (a) Class A (b) Class B (c) Class C

Paw-San is defined as Class-A if the percentage of broken kernel is between 0 to 5% as Class-B if the percentage of broken kernel is above 20%. This information about rice broken and classify can be found in rice quality standards in 300 tons texture industry, MEC (Myanmar Economic Corporation).

III. Proposed Classification Algorithm

There are three varieties of Paw-San which were taken up for grading and classification. The block diagram of image processing algorithm is shown in Figure 3 which consists of some basic steps. At first, rice seeds are randomly placed on black-sheet background for image acquisition. Image is acquired and stored for further analysis. Before the image segmentation, the image is required for pre-processing. After preprocessing, the image is segmented into foreground and background. But it contains some noise in the background. Thus, the noise removal is performed. Then, specified features of the objects are extracted and classified the rice classes by using KNN (K-nearest neighbor) classifier.

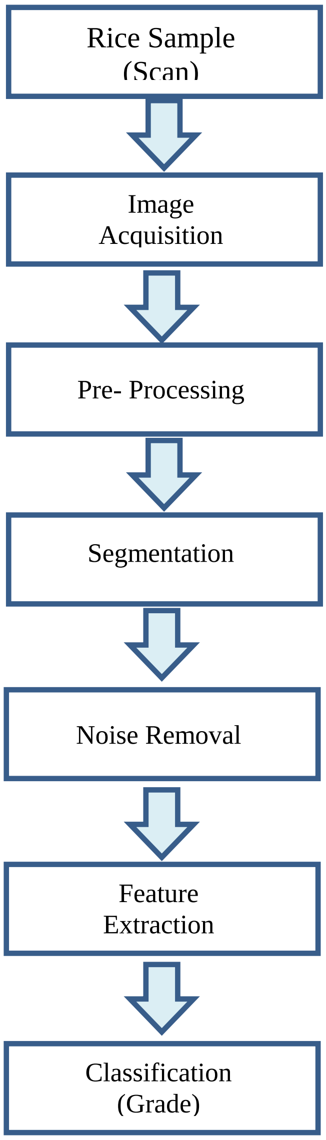


Figure 3. Block diagram of Classification and Grading Techniques

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A. Scanning and image acquisition

Images of the rice kernels are collected by a flatbed scanner (FBS) for classification and grading of rice which has the resolution of 200 dpi with USB interface to a PC.

A dull black sheet used to reduce the effects of reflection. Image is captured and stored in JPG format automatically. The images acquired are 1997 x 1504 pixels in size.

B. Image pre-processing

The acquired image was transferred from RGB to Gray scale image. It was a little large. The image as required is resized and cropped the image.

C. Image Segmentation

The color base segmentation and threshold base segmentation are available for image segmentation. In this research, since the images have two simple colors, threshold base segmentation is used. There are two threshold-base segmentation methods; global and local threshold methods. Global thresholding method is used in this work. The required threshold value is calculated by Otsu method of global thresholding. The optimum gray threshold value of this segmentation process is 0.4471.

$$Ibw = \begin{cases} 1, & T \geq 0.4471 \\ 0, & \text{Otherwise} \end{cases} \quad (1)$$

D. Noise Removal

During segmentation, the image is changed into black and white. The other researcher used the segmentation methods of containing objects in image processing usually include erosion, dilation, based on morphology and watershed transformation method [10]. In this paper, when getting black and white image, it can be seen white spot (noise) in background. It is necessary to remove noise for computation. So, bwareaopen (one of the morphological operation method) function in MATLAB is used as noise removal tool to get smooth image. The object which has less than 10 pixels is considered as noise and must be removed.

E. Feature Extraction

It is necessary to calculate each of the object grain to get area by the use of feature in classification. There is the percentage of broken rice such as 5% for Class A, above 10% for Class B, and above 20% for Class C. The object that is larger than the total amount of pixel over 35 must be put into normal rice. The amount of pixel value under 35 is assumed as broken rice. After assuming, the number of normal rice and broken rice must be calculated to get broken kernel.

F. Object Classification

In this research, KNN (K Nearest Neighbor) classifier is used to classify the class of rice. KNN is the one of the classification methods based on Euclidean distance. Euclidean distance is finding the nearest distance between the train data and the input data. Although KNN has the first nearest value, the second nearest value and the third nearest value, it used the first nearest value is assume k=1.In this research, minimum Euclidean distance value is chosen.

Euclidean distance method,

$$F = [F_1 \, F_2 \, F_3 \, F_4 \, _{.....} \, F_n] \quad (2)$$

$$D = \|F\| = \sqrt{F_1^2 + F_2^2 + F_3^2 + \cdots + F_n^2} \quad (3)$$

Above these equation, F means features vectors and D is Euclidean distance.

IV. Results And Discussion

The good results obtain after testing more than 100 times. To get grade A, 30 times true result from making 30 times. To get grade B, 28 times true result from making 30 times. To get grade C, 25times true result can show from making 30 times. Other differences were also examined repeatedly. To get the result of each grade, testing is done more than 30 times. For each test, different number of rice grain is used. Examining the first time for Paw-San rice, firstly, 10 grains are scanned and then gradually increased into 329 grains. When testing, the right number of rice could also be classified by broken rice. The results of testing maximum 329 seeds are shown in following step by step figures from 4 to 6.

Figure 4. Original RGB image of Paw-San rice

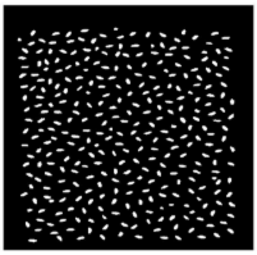

Figure 5. BW image of Paw-San rice

Figure 5 describes the foreground extraction of original frame by Otsu's method. The thresholding value is 0.4471 to segment the object.

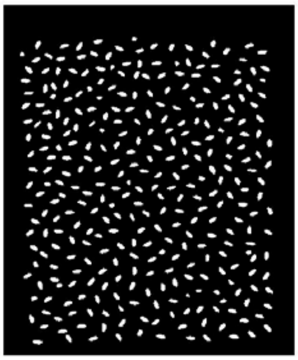

Figure 6. Result of Noise Removal from BW image

Figure 6 is resulted using a smoothing filter that included operations which can enhance and smooth images, and remove noise from an image. Most of these operations compute results based on the function bwareaopen. The operation is known as area opening. By comparing Figure 5 and Figure 6, better result can be seen that in figure 6 as there is almost no noise.

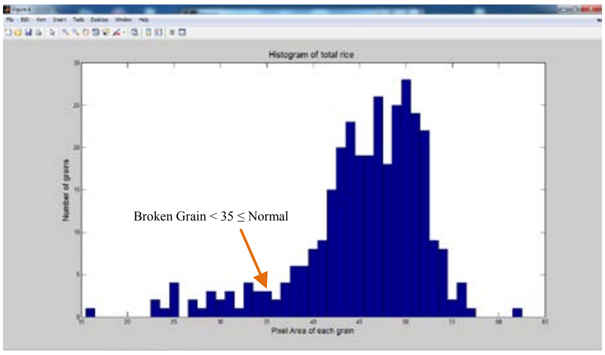

Figure 7. The histogram of number of broken kernel

In histogram of Figure.7, the area value of rice is on the horizontal axis and the numbers of rice grains is on the vertical axis. If the area value is less than 35, it is assumed that the rice is broken. If the total area of the object is move than 35, it is considered as normal (unbroken) rice grains.

```
n =

   329


Broken_rice =

    8.2067


Class =

    'Grade-B'

>>
```

Train data is applying to KNN clissifier, n means number of grain to be scanned. The result shows the percentage of broken rice whose values assigned with 0 to 5% for Class-A, smaller than 10% for Class-B and greater than 20% for Class-C. Due to the output of broken percentage is obtained 8.2067%, it is defined Class-B.

V. Conclusion

In this paper, an image processing algorithm is proposed for rice grading and it performance is tested with three grades (Class A, Class B, Class C) of Paw-San rice. For each grade of rice, at least 30 classification tests are conducted. When testing Paw-San rice into three classes, the accuracy for Class A is (100%), for Class (93%) and for Class C is (83%). Therefore, it is enough to test the classification and grading of rice quality. Also the classification of rice can be improved by using for using more distinct features. The results confirm that the feature extraction and classification of rice kernel based on image processing for Myanmar Rice.

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