MYANMAR RICE GRAIN CLASSIFICATION USING IMAGE PROCESSING TECHNIQUES

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Abstract

Modern technologies are being used in agriculture such as quality control and classification of grains that are very important for more productive and sustainable production. Classification of the similar small rice grains can be also made with the help of image processing techniques.

This paper studies different characteristics of Myanmar rice grains and their varieties. The classification of various varieties of rice grains is made by using image processing techniques and algorithms. Five types of rice grains in Myanmar such as Paw San Hmwe, Lone Thwe Hmwe, Ayeyarmin, Kauk-Nyinn-Thwe and Kauk-Nyinn-Pu are considered for present study in classifying the rice seeds and quality. Firstly, each grain image is preprocessed to enhance the grain image and then segmented by using the edge detection methods such as thresholding method. Five morphological features are extracted from each grain image. This system emphasizes on the development a computer vision-based system that is combined with proper heuristic algorithms for automatic classification of Myanmar's rice grain samples. This research is very significant in Myanmar because Myanmar is great producer of different qualities of rice grains and therefore the study and basic implementation would greatly help the researchers, agriculturist and other stakeholders of agricultural growth.

Keywords - Image Processing, Enhancement, Segmentation, Classification, Rice grain, Myanmar.

1. INTRODUCTION

Rice is the main staple food in Myanmar and is grown on over 8 million ha, or more than half of its arable land. Myanmar is the world's sixth-largest rice-producing country.

Therefore, in our country, it is very important to improve and become automated these agricultures by using the advanced and new technology [8].

The analysis of grain quality and types can be rapidly assessed by visual inspection of experts [8]. However, as the different shapes and appearances of rice samples, specialists may have difficulties to manually identify and classify the various rice grains. Therefore, it is still a challenging task to select and find a particular type of rice among varieties of rice grains [7].

In the present work, a digital image processing has been devised in order to investigate different types of characteristics to identify the rice varieties. In this system, images of five different varieties of rice samples are captured by using Canon PowerShot SX60 HS camera. Each grain image is segmented by using the edge detection methods. After image segmentation, the primary five features are created based on some shape, size and color features which are the quality indices to distinguish rice among bulk of rice samples. To have high classification accuracy, it is necessary to select the best classifier. This study emphasizes to develop a computer vision-based system combined with appropriate meta heuristic algorithms for automatic recognition and classification of bulk grain samples.

2. RELATED WORK

Zhao-yan et al. (2005) suggested an image analysis based research work to identify six types of Zhejiang rice grain. This system was based on seven colors and fourteen morphological features to classify and analysis the rice seeds. In this system, 240 kernels were used as the training data set and 60 kernels as the testing data set in neural network. The identification accuracies were between 74% and 95% for six varieties of rice grain. The robustness was however missing in this research [3].

Ozan AKI et al. (2015) studied the classification of rice grain by using image processing and machine learning techniques. In this study, four types of rice grain in Turkish were considered for classifying. Each grain image was segmented and six attributes were extracted from each grain image related to its shape geometry. Weka application was used for evaluation of several machine learning algorithms. For real time quality assessment of rice grain, nearest neighbor with generalization algorithm achieved the classification accuracy 90.5% [4].

Kaur et al. (2015) proposed a method that extracted seven geometric features of individual rice grain from digital images. The varieties of rice grains were classified into three different classes. Calibration factor was calculated to make a method without depending of camera position. In this method, it was tested on five varieties of grain. The proposed method compared with the experimental analysis that was used by digital vernier caliper and the error rate of measuring the geometric features of rice grains was found between -1.39% and 1.40% [10].

Birla et al. (2015) presented an efficient method for the quality analysis of Indian basmati Oryza sativa L rice grain by using machine vision and digital image processing. Machine vision proved as an automatic tool for reliable quality assessment of seeds instead of the analysis of human inspectors. This proposed algorithm used the perfect thresholding, object detection and Object classification to calculate the number of chalky rice and broken rice with the improved accuracy [6].

Silva Ribeiro (2016) proposed to use methods of data analysis of shape, color and texture extracted from digital images for grain classification. From the results obtained it was demonstrated that the use of patterns of morphology, color and texture extracted from images using the digital imaging processing techniques are effective for grain classification. The LBP texture pattern proved the most efficient information among the three, and with it alone was possible to reach a 94% hit rate. Combining addition to the pattern shape of LBP information with FCC and color with HSV was possible to improve the success rate to 96% [11].

Based on extensive literature survey of classification of different types of grains, both national and international level; few major challenges were reported as limitations in existing research contributions, few of them are:

- In most of the works, the implementation is not robust;
- There is less work for color images of rice grains; and
- Most importantly, limited research was found on Myanmar rice grains.

The above limitation, especially last one has been major factor for taking up the present research work as classification of Myanmar rice grains.

3. MYANMAR RICE GRAIN

Actually, there are varieties of rice grains in Myanmar and in fact, Myanmar exports huge quantity of rice to other neighboring counties. Though, few prominent rice grains have been considered for this research work so that generalization of this work could be applied to develop a framework of image processing tools or techniques for classification of rice grains. Five varieties of Myanmar rice grains such as Paw San Hmwe, Lone Thwe Hmwe, Ayeyarmin, Kauk-Nyinn-Thwe and Kauk-Nyinn-Pu were used for classification in this study. The rice grain samples were collected from a local market. Grain samples are shown in Fig. 1.

(a) (b) (c) (d) (e)

Figure 1. Myanmar Rice Grains: (a) Paw San Hmwe, (b) Lone Thwe Hmwe, (c) Ayeyarmin, (d) Kauk-Nyinn-Thwe and (e) Kauk-Nyinn-Pu

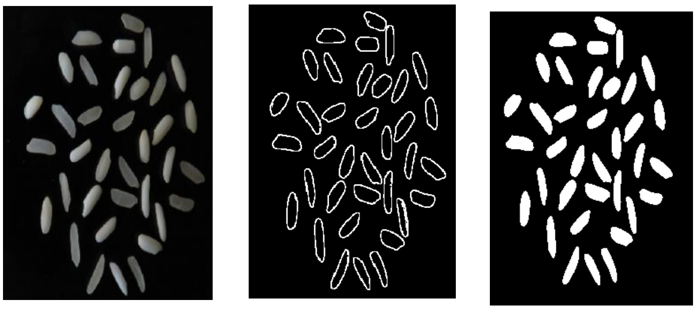
4. The Proposed Method

The classification of rice grain requires several important stages of image processing, such as image acquisition; image enhancement; image segmentation; image feature extraction and classification. The stages can be seen in Fig. 2. These stages are briefly explained below.

Figure 2. System Flow for Rice grain Classification

- **Image Acquisition and Pre-processing:** In this study, image acquisition is the first step. The image acquisition was collected by using Canon PowerShot SX60 HS camera under uniform lighting setup. Rice grain is placed on the black sheet of paper to get the black background to the image that is used to helps in parameter extraction from the image. The camera is placed at the fixed location and mounted on stand to get grain images. Images were captured and stored in JPG format. Color representation is RGB type and horizontal and vertical resolution is 180dpi. All the grains in the sample image were arranged in arbitrary direction and position.
- **Image Enhancement:** After acquisition step, all images will inevitably contain some amount of noise. Image enhancement step improves the visual quality and clarity of images. Firstly, the grain image is converted to gray scale image. A median filter is a non-linear digital filter and is very effective in removing salt and pepper noise. Therefore, median filter with 5x5 kernel size is used in this present work as the pre-processing to smooth and remove noise from each image. Sobel edge detection technique is also used to preserve the edges of the image during noise removal. Then binary image is produced by using convolution method with proper creation mask. Optionally, image opening operation is applied for break the touching grain images.

- **Image Segmentation:** The subsequent step is to segment an image which is the most important stage in image analysis. Image segmentation is that the image is subdivided into different parts or objects [2]. It can also be accomplished by using three different techniques such as edge detection, region growing and thresholding. In this study, thresholding is used for image segmentation. It is the simplest image segmentation method. Image binarization process is performed by using threshold value. Threshold is used to segregate the region in an image with respect to the object which is to be analyzed. This separated region is based on the variation of intensity between the object pixel and the background pixel. After separating the necessary pixels by using the proper threshold value, the binary image is produced as shown in Fig. 3.



(a) (b) (c)

Figure 3. Steps of Rice grain Classification: (a) Samples of Myanmar Grain that are mixed five different types of rice varieties, (b) boundary detection of rice varieties, (c) Threshold Image of rice varieties

- **Feature Extraction:** Extraction of quantitative information from segmented images is deal with Feature Extraction. Object recognition and classifications is done based on various algorithms of morphological features [1]. The following morphological features were extracted from images of individual basmati rice grains [9]:

  Area (cm^2): The method calculates the actual number of pixels of the boundary and pixels inside of the grains.

  Major Axis Length: The distance between the end points of the longest line could be measure through the seed. The major axis endpoints were found by computing the pixel distance between every combination of boundary pixels of seed and calculating the pair with the maximum length.

  Minor Axis Length: The distance between the endpoints of the longest line could be measure through the seed while maintaining perpendicularity with the major axis.

  Eccentricity: specifies the eccentricity of the ellipse that has the same second-moments as the region. The eccentricity is the ratio of the distance between the foci of the ellipse and its major axis length. The value is between 0 and 1.

  Perimeter: It was the total pixel that constitutes the edge of object. It helps in locate the object & provide information about the shape of the object i.e. counting the number of '1' pixel that have '0' pixel of neighbour.

  After performing the feature extraction on digital image, classification process is carried out in this work. Many features were highly correlated with one another and if one of the features was selected, the rest features cannot contribute significantly to the classification model [5]. The classification is mainly based on the assumption of the image processing under consideration many extracted features [1]. By depending on the basic five features, each classification of rice sample can be determined.

5. RESULTS AND DISCUSSION

In this research, five varieties of rice grain were tested to achieve the good classification accuracy. The system implemented to extract the features from the mixture grains image as shown in Fig. 3(a). This testing image with the total of 38 numbers of grains is carried out. Table 1 shows the testing result on the number of rice grain varieties. It gets the good result in Paw San Hmwe. However, the measure of Lone Thwe Hmwe is slightly similar with the measure of Kauk-Nyinn-Pu. Kauk-Nyinn-Thwe and Ayeyarmin are also very similar. Therefore, the good classification accuracy is very difficult. The measurements of extracted five features of testing image are shown in Table 2. The expected classification ranges of the extracted features (Area, Major axis length, Minor axis length, Eccentricity, Perimeter) for the five varieties of rice grain are shown in Table 3. The differences of major axis length between Kauk-Nyinn-Thwe and Ayeyarmin is very less and the major axis length between Kauk-Nyinn-Pu and Lone Thwe Hmwe do not differ much. Therefore, accuracy is defined as measuring the percentage of correct classification with respect to the overall data. Therefore, the system has resulted with 80% accuracy for myanmar rice samples using the extracted features.

Table 1. Testing results on the number of rice grain varieties

Rice Varieties	Actual numbers of rice grains in testing image	Testing results on the numbers of rice grains
Paw San Hmwe	6	6
Lone Thwe Hmwe	9	5
Ayeyarmin	8	12
Kauk-Nyinn-Thwe	7	3
Kauk-Nyinn-Pu	8	12
	Total=38	Total=38

Table 2. Measurements of extracted five features of testing image

Myanmar Rice Varieties		Area	Major Axis Length	Minor Axis Length	Eccentricity	Perimeter
Paw San Hmwe	Psm-1	0.1478	0.491	0.301	0.294	1.570
	Psm-2	0.1478	0.501	0.295	0.287	1.576
	Psm-3	0.1477	0.475	0.311	0.308	1.566
	Psm-4	0.1260	0.492	0.256	0.251	1.486
	Psm-5	0.1227	0.489	0.251	0.259	1.496
	Psm-6	0.0653	0.493	0.285	0.275	1.536
Lone Thwe Hmwe	Ltm-1	0.037	0.172	0.217	0.195	0.734
	Ltm-2	0.143	0.709	0.202	0.191	1.800
	Ltm-3	0.158	0.722	0.219	0.208	1.860
	Ltm-4	0.161	0.730	0.220	0.210	1.880
	Ltm-5	0.155	0.719	0.215	0.205	1.848
Ayeyarmin	Aym-1	0.122	0.671	0.182	0.180	1.702
	Aym-2	0.122	0.659	0.185	0.179	1.676
	Aym-3	0.118	0.664	0.178	0.173	1.674
	Aym-4	0.122	0.642	0.190	0.185	1.654
	Aym-5	0.128	0.675	0.182	0.181	1.712
	Aym-6	0.124	0.672	0.185	0.183	1.710
	Aym-7	0.118	0.655	0.180	0.178	1.666
	Aym-8	0.121	0.666	0.181	0.177	1.686
	Aym-9	0.127	0.649	0.195	0.190	1.688
	Aym-10	0.131	0.647	0.202	0.193	1.698
	Aym-11	0.127	0.646	0.197	0.191	1.686
	Aym-12	0.131	0.653	0.201	0.192	1.708
Kauk-Nyinn-Thwe	Kn-1	0.126	0.652	0.193	0.185	1.690
	Kn-2	0.127	0.649	0.195	0.190	1.688
	Kn-3	0.131	0.647	0.202	0.193	1.698

Kauk-Nyinn-Pu	Knp-1	0.155	0.685	0.227	0.205	1.780
	Knp-2	0.156	0.699	0.223	0.209	1.816
	Knp-3	0.158	0.689	0.23	0.207	1.792
	Knp-4	0.147	0.685	0.215	0.203	1.776
	Knp-5	0.156	0.693	0.225	0.208	1.802
	Knp-6	0.122	0.671	0.182	0.18	1.702
	Knp-7	0.122	0.659	0.185	0.179	1.676
	Knp-8	0.118	0.664	0.178	0.173	1.674
	Knp-9	0.122	0.642	0.19	0.185	1.654
	Knp-10	0.155	0.685	0.227	0.205	1.780
	Knp-11	0.156	0.699	0.223	0.209	1.816
	Knp-12	0.158	0.689	0.23	0.207	1.792

Table 3. Results of classification ranges of the extracted features

Myanmar Rice Grain	Classified range on Area	Classified range on Major Axis Length	Classified range on Minor Axis Length	Classified range on Eccentricity	Classified range on Perimeter
Paw San Hmwe	0.120 - 0.150	0.470 - 0.501	0.250 - 0.311	0.251 - 0.308	1.485 - 1.570
Lone Thwe Hmwe	0.143 - 0.161	0.710 - 0.730	0.202 - 0.220	0.195 - 0.210	1.810 - 1.880
Ayeyarmin	0.115 - 0.122	0.650 - 0.675	0.175 - 0.190	0.173 - 0.185	1.670 - 1.715
Kauk-Nyinn-Thwe	0.126 - 0.131	0.645 - 0.655	0.193 - 0.202	0.180 - 0.193	1.680 - 1.690
Kauk-Nyinn-Pu	0.145 - 0.160	0.680 - 0.701	0.215 - 0.227	0.203 - 0.210	1.770 - 1.820

6. CONCLUSION

Rice grain classification is a challenge because manual classification that is being used in the industry may not be efficient. The rice classification system is implemented for Myanmar rice grain varieties. In the present research, it is tested on five varieties of rice grains such as Paw San, Lone Thwe Hmwe, Aye Yar Min, Kauk Nyinn Thwe and Kauk Nyinn Pu. Deciding of variety of rice grain is based on five features of rice grain that are different. This system can properly apply in identification and classification of varieties of Myanmar rice using image processing. As the future work we will concentrate on the optimization of classification accuracy for real-time applications and to achieve the accurate results on bulk of Myanmar rice grain more than the present testing of five varieties.

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