Rice Grain Quality Grading and Classification Using Random Forest Classifier

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Abstract— Rice is a staple food across many parts of the world. It is a major source of energy and nutrition to humans. Not only is the market value, the satiety also increases with good quality rice. Rice grain can be analyzed for quality by features like color, uniformity, shape, size, slenderness and whiteness. Automating the grading of rice saves time, provides testing transparency, and is more reliable. In this paper we present an approach for accessing the quality of rice grain by extracting shape features from the rice grain and grading them using Random Forest classifier.

Keywords: Rice grain, grading, Random Forest

I. Introduction

Rice cultivation can be observed in many parts of the world under varied climatic conditions. Dynamic environ- mental conditions, [2] differences in cultivation practice, post harvest processing, [3] types of fertilizers used and many other factors play important role on the quality of rice grain. As the quality of rice improves its commercial value also increases. Along with economic growth, consumers prefer high quality dishes, which includes dishes made of good quality rice. Food technologist, nutritionlist, agriculterist [1] and others are concerned about the quality of rice.

II. Literature Review

With advances in technology new techniques for grading of cereals are being adapted. Visual inspection of grain quality is prone to drawback and time consuming. These drawbacks can be overcome by automating the grading process.
In the following paragraphs some of the existing approaches for grading of rice quality are presented.

The authors in [5] initially enhance the image quality by histogram equalization and contrast enhancement. From the enhanced image, Canny edge detection method detects the rice granules edges. Features like major and minor axis, eccentricity are taken from the edged rice granules and used for computing the Length and breadth ratio. Based on the ratio the grains are classified as long, small and normal rice.

The author in [6]proposed a method for analyzing rice grain quality using Artificial Neural Network and Support Vector Machine classifiers. Features extracted from preprocessed im- age are fed to the classifiers to detect the quality of the rice granules and classify them as large, small, imperfect granules. In [4] the authors propose a method for classification of red basmati, white basmati, red samba, white samba variety of rice using color and shape features.

The authors propose in [7]a method for analyzing rice granules were the otsu's thresholding is used for segmenting the gran- ules. Features like major axis after contour detection, perimeter and others are obtained from Canny edge detected granules and fed to neural network for segregating the granules to different classes.

The authors grade the quality of rice based on the chalky area of rice in [8]Image is preprocessed by performing steps like median filtering and unsharp masking. From the processed image morphological operation are performed to extract the chalky area. The size of the chalky area is used for analyzing the grain quality.

In this paper we propose a method for grading of rice grain based on Random Forest. The next section presents details of the approach.

III. Proposed Approach

The proposed approach for grading of rice uses area, major axis and minor axis feature and Random Forest for classification of rice grains. The block diagram of the proposed approach is shown in Figure. 1. The modules that constitute the proposed approach is explained in the following paragraphs.

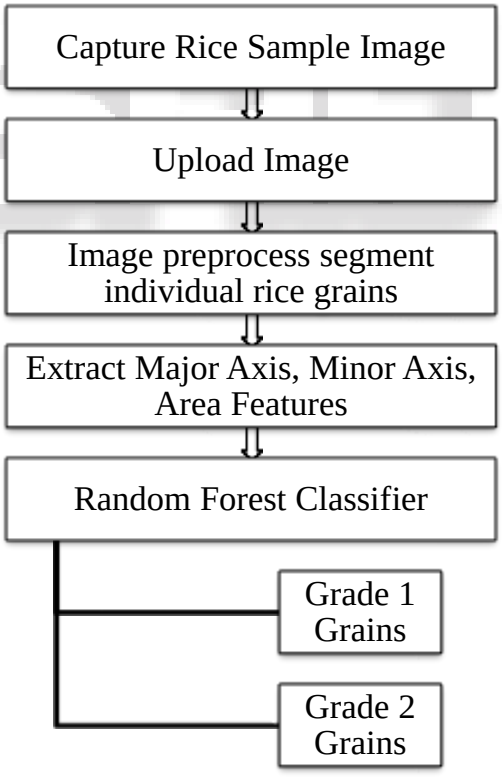

Fig. 1: Block diagram of the proposed approach

A. *Capturing the rice images*

Using a high quality camera or high end mobile camera with around 16MB pixel the images of rice to be graded are captured. The GUI assists in uploading the captured image from the camera to the knowledge base. Figure.2 shows samples of the captured image.

Fig. 2: Samples of captured images

B. Pre-processing of the rice image

The captured image is binarized using threshold value. Now the rice seed is represented in white and the background in black. Figure. 3 shows the binarized image. Next the rice grain is segmented from the background Figure.4 shows the rice region and the major and minor axis for a rice grain.

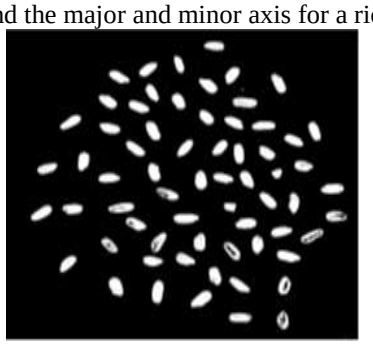

Fig. 3: Binarized image

C. Feature extraction from rice seed

From the rice images following features are extracted. Area: This represents the number of pixels inside the rice grain, including the boundary. Major axis and Minor axis: The distance between the end points of the longest line. Rice seeds have elliptical contour, hence major and minor axis are computed as features.

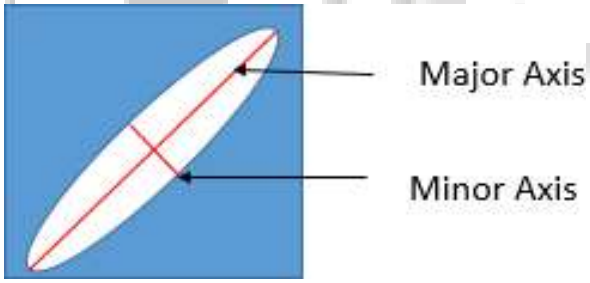

Fig. 4: Major and Minor axis.

D. Random Forest Classification

Random forest reduces over fitting as the classification is made by voting the prediction from different decision trees on sampled data. The accuracy from random forest is also good. The features are then subjected to Random Forest classifier, which classifies the rice grain into either grade1 or grade2.

IV. Experimental Analysis

The experiment is conducted by capturing the images containing varying number of rice grains. The rice grain is classified to two different grades.

Grade 1: Premium, with no impurities and whole kernels
Grade 2: Poor quality, with broken kernels

For testing, basmati rice grain is considered. Basmati rice has elongated structure. This makes it easier to separate the rice seeds from other impurities. In this experiment the image contains 50 rice seeds. Out of the fifty grains, thirty nine seeds are of grade1 and eleven seeds are of poor quality with broken kernel (grade2). The observed result is shown in Table.1. The proposed approach was able to classify 35 out of 39 correctly. The confusion matrix is shown in Table 2

	Actual	Observed
grade1	39	35
grade2	11	15

Table. 1: Result obtain using the Random Forest classifier

		Predicted	
Actual		(grade 1) Positive	(grade 2) Negative
	grade1 (Positive)	TP=35	FN=4
	grade2 (Negative)	FP=0	TN=11

Table. 2: The confusion matrix for rice grain grading.

From the confusion matrix we get Precision = 100%
Recall = 89.7%
Accuracy = 92%
F1-score= 94%

Comparison with existing techniques that have used varying features is given in Table. 3.

text Author	Feature used	Techniques	Accuracy
Tank & Kaushal [12]	Morphological	Machine Vision	90%
Kambo and Yerpude [13]	morphological	KNN classifier	79%
Ajay [10]	Morphological	Computer vision	75%
wah [11]	real field	knn classifier	92%
Proposed method	Major, minor axis, area	Random Forest	92%

Table. 3: Comparison with some existing techniques

V. Conclusion

Rice is a major source of energy and nutrition to mankind. In this paper we made an attempt to assess the quality of rice grains using Random Forest classification method. The high accuracy obtained demonstrates that Random Forest is suitable for grading of rice granules.

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