Machine Vision based Quality Analysis of Rice Grains

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Abstract

It is great challenge to meet the needs of quality assessment on rice grains. Testing on quality is gaining importance in food industry for classifying and grading the grains. Since manual testing is time consuming, costly and inaccurate, machine vision based quality analysis of rice grains is preferred. In machine vision based testing, we take both physical (grain shape and size) and chemical characteristics (amylose content, gel consistency) for evaluation and grading of rice grains. Quality assessment is done by finding 1) the region of boundary and 2) the end points of each grain by measuring the length, breadth and diagonal size of grain. In this proposed image processing algorithm, quality and grading of rice grains were analysed using the average values of the features extracted and it was implemented in Mat Lab.

Keywords: Quality assessment, grain properties, machine vision and grain grading.

I. Introduction

Rice is the major cereal produced almost all areas in the entire world. India plays the vital role in the production of rice as it is the principle food of Indians and the Indian population is also growing at the rate of 1.2% [1]. It is grown on a majority of the rural farms. The quality of rice depends on the rice varieties which decide the grade and cost of the rice. So the correct assessment of quality of rice is the important task.

The analysis of grain type, grading and their quality attributes is still done by skilled persons manually. This method leads to complexity because it depends on several factors like human factors, working conditions and the rate of cleaning and recovery of salvage. This may be overcome by using image processing techniques.

As the technology is growing wider people are adopting the new technologies rather than using the old techniques. The growth in technology is making people more demanding towards the things they use and consume, this is the reason why everything is becoming automated [2]. The use of Image processing techniques for testing the quality of rice grains is inexpensive and is less time consuming. In this method, the quality of grain is tested based on its size and shape features.

Further, biological methods (DNA technique etc.) and chemical methods (alkaline tests etc.) can be used for the detection of rice grain seed types and quality. But these methods are more expensive and tedious. On the other hand the machine vision or the digital image processing is a non-hostile method (i.e., after assessment the grains can be used), it is a fixed and inexpensive process compared to the biological methods. AGMARK is an organization which is used in rating of these food products. There are different organizations which also involve in rating the quality of food grains like ISO, FDA etc. These organizations help the famers to provide certificates for the quality of grains they produce. This AGMARK laboratory is centrally located which acts as the testing and certifying centre for the food products. Various tests are conducted in these laboratories which include biological tests, alkaline tests, test for pesticide content etc. on products like groundnuts, maize, wheat, jowar etc.

II. Materials and Methods

Different types of rice grains were collected from various sources and record the images for rice granules of different sizes. A grader system is constructed on the basis of dimensions of the grains.. Further the rice grains are identified with diverse varieties by extracting the features like length, shape, colour and texture properties

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III. Image Analysis

This section discuss the various stages of proposed system

A. Input image

In an embedded imaging based system, images are acquired using CMOS/ CCD based image sensors. Sensors are then connected to necessary support electronics to continuously send pixel data to FPGA[3]. In this paper, images are acquired using a digital camera (includes image sensors) having high pixel resolution. The camera shall be located at a position normal to the object. It is known that there may be varying illumination or background characteristics while acquiring images during real time analysis. Accuracy of the system shall be high under these circumstances. Hence, this algorithm is tested on images placed under different illumination & background color characteristics.

Fig.1 Original image

A. Background subtraction:

As the input image may have different background & illumination characteristics, the algorithm performs a basic morphological opening operation (Eq. 1) on input image such that the size of structuring element is kept greater than the size of rice kernels. Then from the input image the resultant image is subtracted. This is done to remove the effect of poor illumination in background.

$$A \circ B = (A \ominus B) \ominus B \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

B. Binary Conversion:

Binary conversion of input image is achieved by determining its global threshold value. The input image with luminance greater than threshold has values of 1(White) and 0 (black) for all other pixels [4]. The resulting image is as shown in fig.2

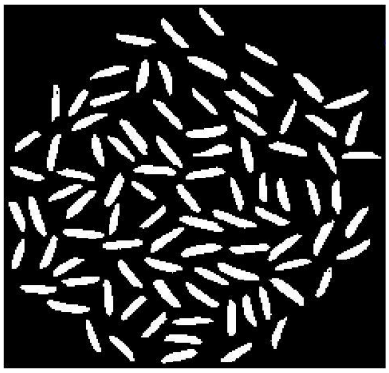

Fig.2 Binary Image

C. Edge Detection:

Edge detection is the process of detecting the boundaries of rice grains. The different types of edge detection method like differentiation, gradient, Perwitt, Roberts, sigma, Sobel and Canny method are available [5]. The proposed method used the Canny Edge Detection:

The main objectives of the canny edge detection are

1. Low Error rate: The probability of detecting all edge points should be found, with a minimum of spurious responses.
2. Localization: The detected edges should be as close as possible to the true edge points.
3. Number of responses: Only one should be detected for each real edge point.

Algorithm:

1. Smoothing Image: Gaussian filter is used to smooth the input image.
2. Computing gradient: Computation of the gradient magnitude and angle images.
3. Non-maxima suppression: Applying non - maxima suppression to the gradient magnitude image.
4. Double thresholding: Edges are detected and linked.

The Canny edge detection output is shown in fig.3

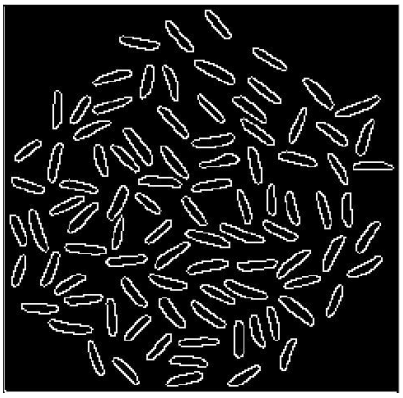

Fig.3 Output of Canny edge detection

C. *Feature Extraction:*

Morphological features were extracted from image by using its contour images. A collection of connected points represents a grain boundary. The extracted features from images of rice grains are area, length, breadth and diagonal using region labeling [6] [7] which is shown in fig. 4. The grading of grains was performed from the collected images. The flowchart of grading process is shown in Fig..5.

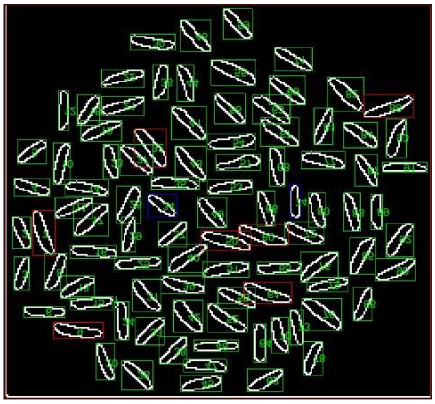

Fig. 4 Labeled Image

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Flow Chart:

The above mentioned process is depicted in the following flow chart which gives a complete information of the total process.

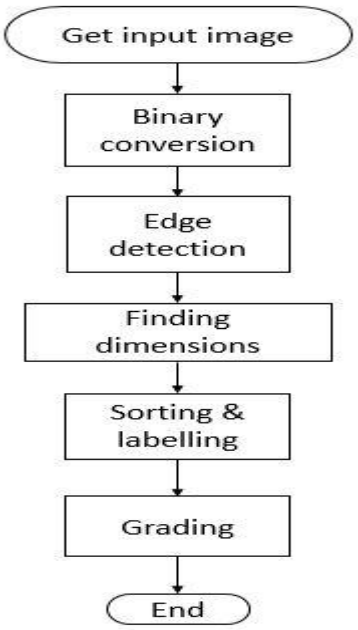

Fig. 5 Complete flow chart of the process

Algorithm:

Step1: Pre-processing the images of rice to remove background noise by image subtraction.
Step2: Converting the preprocessed image into binary image.
Step3: Edge detect the components in the image and counting of the grains is done.
Step4: Region label the binary image.

Step5: Extract the geometric features such as length, breadth & diagonal of all the individual grains.
Step6: Perform analysis on the quality using the average values of the features extracted.

IV. RESULTS & DISCUSSION

The designed code has been executed for several other image samples and their results were compared with the manual work which provided the percentage of accuracy greater or much equally to the manual work. Figure 6 shows the performance chart.The performance analysis is given in Table.1.

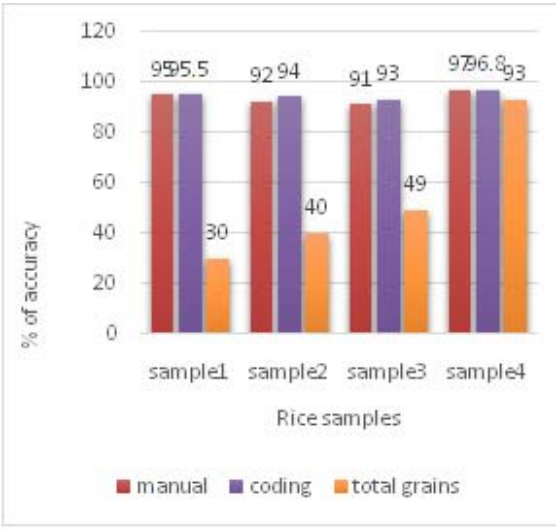

Fig. 6. Performance chart

S.NO.	Grain count	Long length rice	Medium length rice	Short length rice
1.	30	8	22	0
2.	40	9	25	6
3.	49	8	30	11
4.	93	8	83	2

Table 1. Performance Analysis

V. Conclusion

The proposed algorithm used simple morphological image processing methods and it can be used to perform various image based analysis. Majority of the operations used in this algorithm are based on MATLAB commands. All these operations can be described using HDL. Once the operations are designed using HDL, it is implemented on MATLAB to realize a real time imaging application with high accuracy. The use of such a system will not require heavy machinery setups as used in NIR spectra based grading system. Also the proposed algorithm is suitable to grade large number of grains efficiently, which otherwise will consume lot of time in manual analysis. This feature will be used to save lot of time & human effort.

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