Rice Quality Analysis Using Image Processing Techniques

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***Abstract* – In agricultural industries grain quality evaluation is very big challenge. Quality control is very important in food industry because after harvesting, based on quality parameters food products are classified and graded into different grades. Grain quality evaluation is done manually but it is relative, time consuming, may be varying results and costly. To overcome these limitations and shortcoming image processing techniques is the alternative solution can be used for grain quality analysis. Rice quality is nothing but the combination of physical and chemical characteristics. Grain size and shape, chalkiness, whiteness, milling degree, bulk density and moisture content are some physical characteristics while amylose content, gelatinization temperature and gel consistency are chemical characteristics of rice. The paper presents a solution of grading and evaluation of rice grains on the basis of grain size and shape using image processing techniques. Specifically edge detection algorithm is used to find out the region of boundaries of each grain. In this technique we find the endpoints of each grain and after using caliper we can measure the length and breadth of rice. This method requires minimum time and it is low in cost.**

***Keywords* - Grain quality, rice characteristics, image acquisition, image processing and analysis, grain evaluation, etc.**

I. INTRODUCTION

The agricultural industry is oldest and most widespread industry in the world. Traditionally quality of food products is defined from its physical and chemical characteristics by human sensory panel [2]. Physical parameter includes grain size and shape, moisture content, chalkiness, whiteness, milling degree and bulk density. Moisture content is nothing but the water content in the grain. For better storage purpose moisture content should be in between 12-14%. Different methods are used for moisture analysis like standard moisture meter and hot air oven method. Chalkiness is the white spot present in the rice endosperm. Chalky grain is defined as half of the grain is white in color and brittle in nature. Because of its brittle nature chalky grains break during milling so it affect on milling degree of rice. On the basis of chalkiness rice grains are classified as white belly, white center and white back. Chalky rice reduces the palatability of cooking products so presence of chalkiness more than 20% is avoided in worlds market. Magnifying glass and photographic enlarger used for chalkiness detection. The paper focused on grain size and shape analysis using image processing techniques. For the measurement of grain size and shape dial micrometer, graphical method and grain shape tester are used. But all these methods are time consuming and some of them are costly. To overcome these limitation image processing techniques is an alternative and best solution [4].

The main objective of the proposed method is to provide an alternative solution for quality analysis which minimizes the required time and cost. Image processing is very important and advanced technological fields where significant developments have been made. Efforts are being geared to replace the traditional human sensory panel.

The paper represents a solution for the problems faced by agricultural industries. Section II discusses the particular problem for the evaluation of rice seeds on the basis of size and shape. Manual methods used for the measurement of grain size and shape are also discussed in the same section. Section III talks about the method proposed for calculating parameters like length, breadth and length-breadth ratio. Section IV discusses the evaluation for the quality of rice grains based on image processing and analysis. It also includes results based on quality analysis for length, breadth and length-breadth ratio. Section V provides the conclusion of the proposed method.

II. PROBLEM DEFINITION

In agricultural industry quality analysis of product is very important. Quality of grain seeds is analyzed visually by experienced technician. But the outcome of such measurement is relative, varying in results and time consuming. The quality also gets affected by the mood of technician; so to overcome the shortcomings occurred due to traditional methods new and advanced technique i.e. image processing technique is proposed.

A. Rice quality and classification

Grain quality is very important factor in whole world. For the purpose of import or export of any food grains, its quality analysis should be done. For exportation purpose, while analyzing quality of grains there are some standard database which has to be satisfied by each verity of grain. But many times quality is analyzed by manually which includes many disadvantages and shortcomings, so to overcome these problems new and developed techniques are to be designed. [3]

The traditional methods used for grain size and shape measurement are dial micrometer, grain shape tester and graphical method, but these methods are very time consuming. In dial micrometer and grain shape tester we can measure length and breadth of single grains at a time. The outcome of this analysis is also relative, time consuming, having variable results and costly. So it requires high degree of accuracy to satisfy customers need and to overcome limitations of manual inspection new and advanced method is proposed which is image processing techniques [1].

The work focused quality analysis on the basis of the measurement of physical parameter i.e. grain size and shape using image processing techniques. Basmati rice is used for quality analysis. Basmati rice is classified as extra long, long, medium and short. The image processing technique is used for counting the number of rice seeds and classifies them on the basis of length, breadth and length-breadth ratio. Length is the average length of rice grain while breadth is the average breadth of rice grain and length-breadth ratio is calculated as;

L/B = [(Avg. length of rice) / (Avg. breadth of rice)]*100

B. Image acquisition and processing

Image is captured using a color camera. The image should be 640 X 380 pixels in size, which is shown in fig.1. The captured image stored in the desktop using USB cable. After storing the image on desktop image processing algorithms are applied on it.

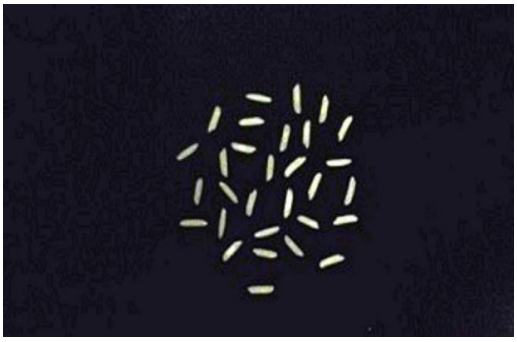

Fig. 1 Original image

III. MATERIALS AND METHODS

NI labVIEW software is used to implement image processing algorithms for the analysis of grain quality. Vision and motion toolbox is used to implement and design image processing algorithms. Color camera is used to capture image and using USB cable captured image can be stored in desktop. Then after that using labVIEW image processing algorithms are designed to evaluate quality of rice grains.

The flow of image processing algorithm is shown in fig. 2 which consists of some basic steps. Rice seeds are randomly placed on black background for image acquisition. Image is acquired and stored for further analysis. In first pre-processing step image registration takes place and noise is removed from the image by using filter. Shrinkage algorithm used for segmenting the touching kernels which is second step. In third step we perform edge detection to find out the region of boundaries. In forth step rice seed measurement is done and in the same step length, breadth and length-breadth is also measured. In the fifth step of the algorithm rice is classified according to its size and shape.

Fig. 2 Flow Diagram for Image Processing Algorithm

A. Image pre-processing

We capture image using color camera which is saved in the three dimensional RGB (red, green, blue) color space. The captured image acquired in desktop using USB cable which is shown in fig 3. Filter is applied to remove noise which occurs during the acquisition of image. Filter also sharpens the image. Threshold algorithm is used to

segment the rice grains from the black background. Using color extractor color image get converted into gray image which is shown in fig 4.

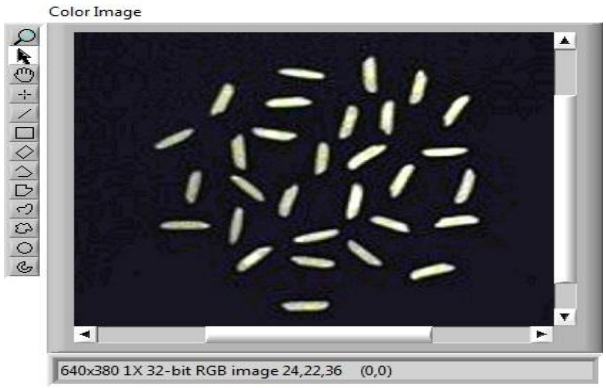

Fig. 3 Color Image

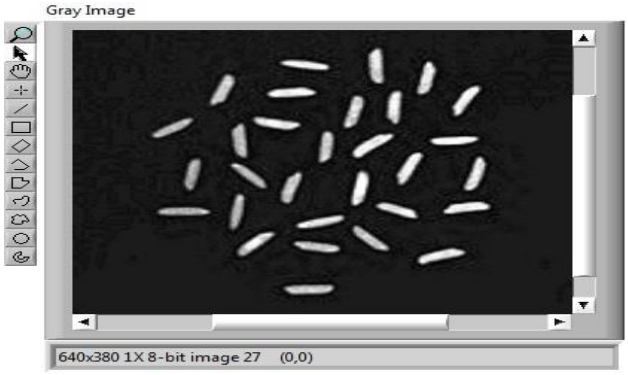

Fig. 4 Gray Image

B. *Shrinkage morphological operation*

Rice grains are randomly spread on black background. It can be seen in fig.1 that grains are not pointing in the specific direction. In case of touching grains we can classify them using morphological operation. Touching grains are divided into two types as point touching and line touching. Morphological operation consists of the combination of dilation and erosion. Erosion is applied to separate the touching features of rice grains without losing the integrity of single feature. Dilation process follows erosion process. The goal of dilation is grow the eroded features to their original shape without re-joining the separated features [6].

In vision and motion toolbox, different types of morphological operation are available which are as;

i. AutoM: Auto median,

ii. Close: Dilation followed by an erosion,

iii. Dilate: Dilation (opposite of erosion),

iv. Erode: Erosion that eliminates isolated background pixels,

v. Open: Erosion followed by dilation,

vi. Pclose: A succession of seven closings and openings,

vii. Popen: A succession of seven openings and closings.

C. *Edge detection*

Edge detection helps to find out the region of boundaries of rice grains as shown in fig. 5. There are six methods are available for edge detection in vision and motion toolbox like differentiation, gradient, perwitt, Roberts, sigma and sobel. The method specifies the type of edge detection filter to be used. We used sobel method for edge detection in proposed methodology.

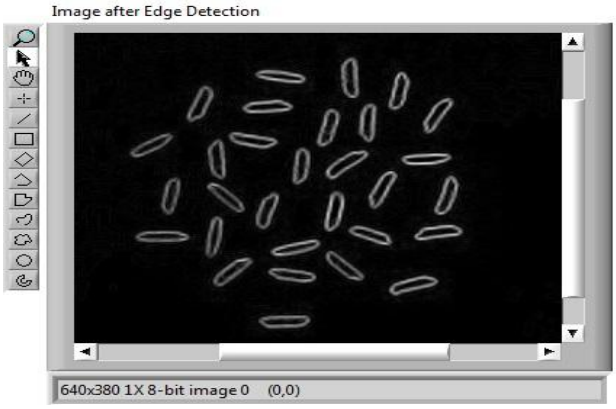

Fig.5 Edge detection operation on rice grains

D. *Object measurement*

Measurement indicates the count of rice grains which is shown in fig. 6, which shows the counting of each grain with number indicated in red margin. After getting the count of rice grains, edge detection algorithms applied on the image and outcome of the applied algorithm is we get endpoint values of each grain. We use caliper to join the endpoints and measure the value of length and breadth of each grain. After getting the value of length and breadth we can calculate length-breadth ratio.

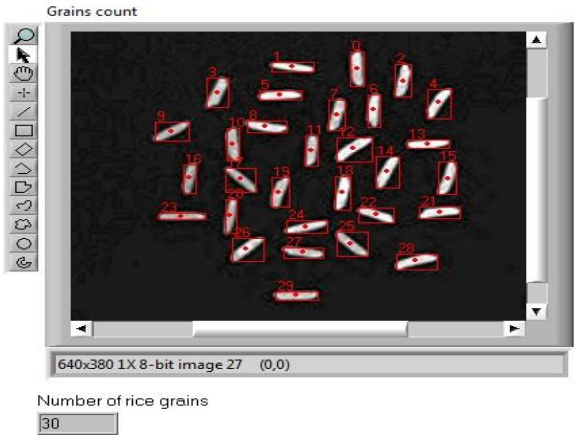

Fig. 6 Number of rice grains

E. Object classification

Classification requires all standard, measured and calculated results. The standard database for rice size and shape measurement is referred from laboratory manual on rice grain quality, Directorate of Rice Research, Rajendranagar, Hyderabad. [9]

The classification of rice grains as per the standard database is shown in following tables. Table 1 indicates classification of rice grains on the basis of length and length-breadth ratio. Table 2 shows classification of grains on the basis of length, which decides size of the specific grain. Table 3 gives classification on the basis of length-breadth ratio, depending on grains are classified as slender, medium, bold and round; which decides shape of that grain. The given tables are used for classifying the rice grains into different types.

TABLE 1

CLASSIFICATION OF RICE GRAINS [9]

Long Slender (LS)	Length 6 mm and above, L/B ratio 3 and above
Short Slender (SS)	Length less than 6 mm, L/B ratio 3 and above
Medium Slender (MS)	Length less than 6 mm, L/B ratio 2.5 to 3.0
Long Bold (LB)	Length 6 mm and above, L/B ratio less than 3
Short Bold (SB)	Length less than 6 mm, L/B ratio less than 2.5

TABLE 2

CLASSIFICATION ON THE BASIS OF LENGTH [9]

Grain size	**Length (mm)**
Extra-long	>7.5
Long	6.61 – 7.7
Medium	5.51 – 6.6
Short	5.5 or less

TABLE 3

CLASSIFICTATION ON THE BASIS OF L/B RATIO [9]

Grain shape	**L/B ratio**
Slender	Over 3
Medium	2.1 – 3
Bold	1.1 – 2
Round	1 or less

IV. RESULT AND DISCUSSION

The results which occurred by implementing image processing algorithms are shown in table 4. The results indicate length-breadth ratio of each grain.

TABLE 4

RESULTS FOR L/B RATIO

Sr. no.	**Number of grain**	**L/B ratio**	**Sr. no.**	**Number of grain**	**L/B ratio**
1	Grain 0	3.04	16	Grain 15	3.16
2	Grain 1	3.52	17	Grain 16	3.05
3	Grain 2	3.24	18	Grain 17	3.36
4	Grain 3	2.95	19	Grain 18	3.27
5	Grain 4	3.26	20	Grain 19	3.04
6	Grain 5	3.16	21	Grain 20	3.77
7	Grain 6	3.14	22	Grain 21	3.01
8	Grain 7	3.18	23	Grain 22	3.02
9	Grain 8	3	24	Grain 23	3.68
10	Grain 9	3.2	25	Grain 24	3.37
11	Grain 10	3.11	26	Grain 25	3.39
12	Grain 11	2.96	27	Grain 26	3.02

13	Grain 12	3.07	28	Grain 27	3.17
14	Grain 13	3.42	29	Grain 28	3.1
15	Grain 14	3.28	30	Grain 29	3.2

The image analysis algorithms are applied on image in which rice grains are randomly placed and spread in one layer. If the error occurs like touching kernels shrinkage operation works efficiently for separating the connecting part from point touching kernels. Edge detection is performed to find out the region of boundaries and endpoints of each grain; and then after that using caliper length and breadth can be measured. After getting the values for length and breadth, length-breadth ratio is to be calculated.

V. CONCLUSION

In this study, the image processing algorithms are developed to segment and identify rice grains. From the obtained results, it can be concluded that the use of image processing algorithm is an efficient method to analyze grains quality by its size. The main benefit of proposed method is it requires minimum time; cost is less and gives better results compared with manual results or traditional methods.

VI. FUTURE WORK

For quality analysis, maximum numbers of parameters are to be measured by image processing techniques. Expansion on this work can target to design such a system which can classify rice grains on the basis of each parameter which can used to enhance the quality of rice. The cost of such system should be less and minimize time requirement for quality analysis.

ACKNOWLEDGMENT

The financial support and software facilities provided by Instrumentation and Control department, College of Engineering Pune (India) are gratefully acknowledged. We also thankfully acknowledge Regional Agricultural Research Station situated at Karjat in Maharashtra (India), for their great support and valuable guidance.

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