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Rice Grain Quality Grading Using Digital Image Processing Techniques

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Abstract *— Quality of grain is of great importance for human beings as it directly impacts the human health. Hence there is a great need to measure a quality of grain and identifying adulteration or non-quality elements and analyzing the grain sample manually is more time consuming and complicated process, and having more chances of errors with the subjectivity of human perception. In order to achieve uniform standard quality and precision, machine vision based techniques are evolved. 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. This paper obtained all physical features and graded the rice grains using canny edge detection.*

Keywords- Rice Grading, Machine Vision, Image Processing, Canny Edge Detection.

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I. Introduction

A new scientific era has emerged with great grain quality image processing instruments which can help in the categorization of grain samples and get an attractive price from consumers for the food industry, especially in Asia. Machine vision and image processing are widely used in biological and agricultural research with the improvement of computer technology and significant reduction of the cost of hardware and software of digital imaging. Many researches applied machine vision to estimate rice appearance quality inspection. There are various food varieties like rice, wheat, potato, soya bean and maze. The rice and wheat being commodity crops are important among all the grains.Grain shape is evaluated with length, width, and the ratio of length and width of rice grains. At present, the length and width of rice grains are usually measured by an inspector using a ruler or a micro-meter. For measuring quality of grain sample, examiner needs to get few seeds from sample and do the analysis. But for measuring length and width of even few seeds, by placing them in one grain tray and measure the length and width of each seed one by one, is very tedious task and takes lots of time. Rice chalkiness is also estimated by the naked eyes of an inspector. Outcomes from different inspectors or inexperienced inspectors may vary at an unacceptable range. So it is a neither objective nor efficient way in evaluating rice appearance quality relying upon manual method.

These researches provided some new ideas and image processing methods for evaluating rice appearance quality. The effectiveness and accuracy of inspections have been improved through these methods. But some factors might affect the outcomes of inspection for rice appearance quality using machine vision and still remains unsolved. For example, the inspection environment, light source, image processing method could result in an inconsistent and low accuracy of inspecting outcomes.

In this context number of author proposed their work and is what follows. Kaur and Verma, [1] have proposed computer vision techniques for grading of rice kernels based on their sizes (full, medium, half). The images are acquired using a digital camera having high pixel resolution. The camera is located at a position normal to the object. This algorithm is tested on images placed under different illumination & background colour characteristics. The poor illumination effects were removed from the background and the image is converted to binary image, then successive erosion and dilation operations are performed to separate the touching kernels. By labeling the connected components the grains were counted and area of each connected components is found using region props, the maximum grain length found is used as a structuring element and morphological operations were performed to extract the grains which have length less than the structuring element. Then finally grading formulae is applied which gives the percentage of full length grains in the given sample. The grading formula & standards were acquired from the analysis procedure for grading rice followed in India.

II. Related Work

Various applications in image processing are recorded in the field of agriculture, biomedical engineering, food and drug industry and many others. Food application mainly caters the qualitative aspect of various food and dairy producers. Image processing techniques were developed to classify plants and background pixels in images of rice plants acquired in a field experiment. So forth, measurement of grain quality and cereal research with commodity crop such as rice, wheat, barley, corn, maize (Xu, et al. 2010) is wide research areas nowadays. Rice is one of the leading food crops of the world and is produced in all continents. Rice is comparatively high in caloric value and rice protein has a good balance of the essential amino acids. Historically and now through planned breeding, each grain type is associated with specific milling, cooking and processing characteristics. There are a number of varieties of each grain type in commercial production and new ones are continually in the process of being developed and released. Techniques are evolved to measure grain sample's quality based on it; samples can be classified in terms of productivity and price. Sample quality has also proven its significance in cereal breeding.

From the literature it is evident that the moderate amount of work is visible is found to be on identification of different types of food grains but very less amount of work has been reported on the grading of rice. Hence it is essential that a automated process is essential to replace manual process of grading rice is required to be replaced with an automation therefore I define the problem statement as "To design and implement a method for grading (full, medium, small) and identification of different varieties of rice grains by extracting the features of the grain such as colour, length, shape and texture properties from the images obtained from flat bed scanning of the grains by using digital image processing technique"

III. Proposed Methodology

Good quality of rice must contain same shape, same weight, same chalky area, grain length, stickiness and aroma. Digital Image Processing Techniques are used in MATLAB, already predefined functions are there, here we just going to use it for our work. Before going to start our work, for all digital image processing we need to do the following flow shown in figure 1.

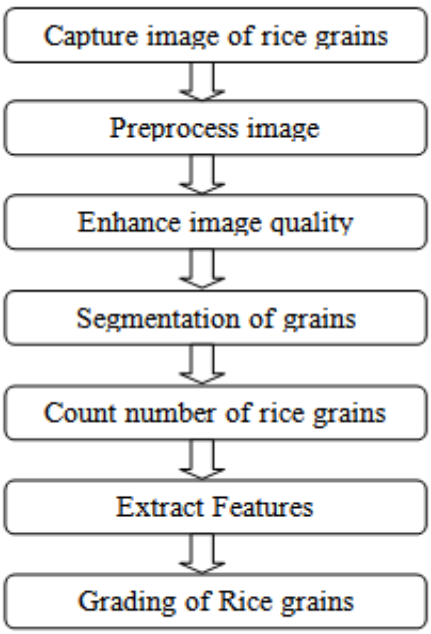

Figure 1: Steps in Program Development

Image Pre-processing steps any Image in Digital Image Processing. The first step is we need to create a background approximation image for that, by using morphological opening we must remove the entire foreground shown in figure 2.

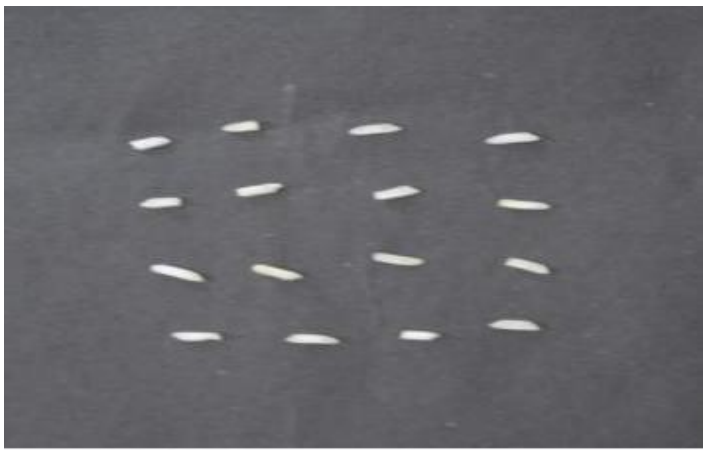

Figure 2: Captured image

The opening operation has the effect of removing objects that cannot completely contain the structuring element. For good result we enhance the image by using Histogram equalization, wiener filter, Linear contrast adjustment, generally Gaussian filtering we were applied and its result shown in figure 3.

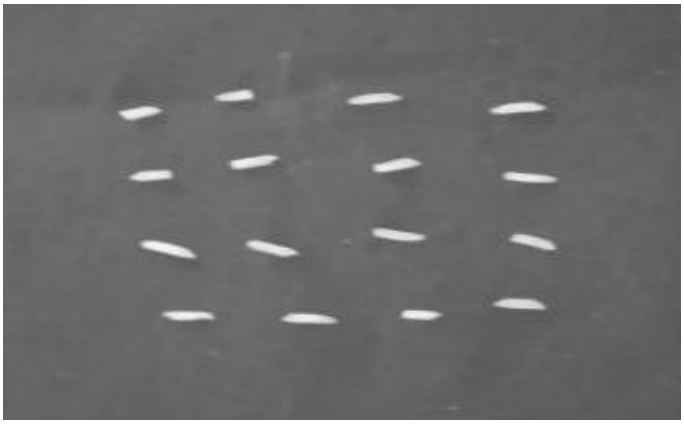

Figure 3: Filtered output

Canny edge algorithm is used to segment the rice grains from the black background, which is shown in figure 4.

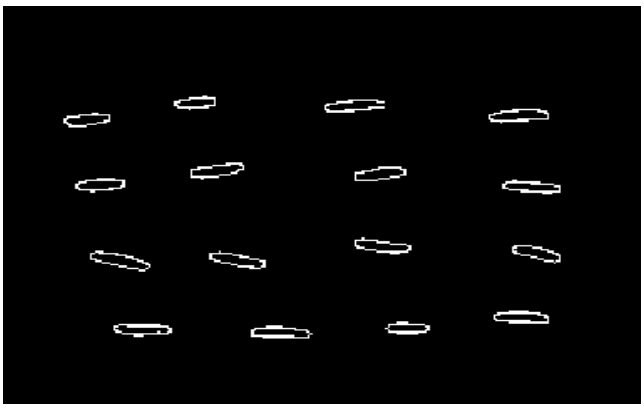

Figure 4: Canny edge detection output

A. Feature Extraction

First, the number of pixels was calculated in 1cm*1cm for calibration. Number of components was calculated from binary image. Then, the features extracted from image of rice grains are as follows:

- Major Axis Length: Number of pixels between the extreme points of longest line along the length of the rice grain.

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

- Minor Axis Length: Number of pixels between the extreme points of longest line along the width of the rice grain.
- Eccentricity: The eccentricity is calculated by fraction of the number of pixels between the major axis length and foci of the ellipse. The value of eccentricity is between 0 and 1.
- Perimeter: Total number of pixels which makes the boundary of rice grains.
- Area: Total number of pixels in rice grain image.
- Orientation: The angle between horizontal axis and major axis.
- Aspect Ratio: It was the major axis length divided by minor axis length.

B. Classification

Based on the major axis length the grains percentage of long, medium and small was calculated. Largest value of major axis length was stored to extract the particular rice grains. The percentage of largest value above which, grain was extracted taken from dialog box. The grains of greater value of major axis length than the percentage of largest grain were displayed. 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: Classification 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

Quality analysis of Indian Basmati rice grains can be done based on assessment of parameters like Major Axis Length and Minor Axis Length. Table 4 shows the calculated parameters values using MATLAB 17a tool for each and every grain in the selected sample images. Thus, by comparing the calculated parameter values with the threshold values, we can easily classify the rice grains as Normal, Long and Small rice grains.

Table 4: Results for l/b ratio

Number of grain	L/B ratio	Number of grain	L/B ratio
Grain_1	3.04	Grain_9	3.45
Grain_2	3.52	Grain_10	2.98
Grain_3	3.24	Grain_11	3.76
Grain_4	2.95	Grain_12	3.98
Grain_5	3.79	Grain_13	3.12
Grain_6	3.0	Grain_14	2.98
Grain_7	3.01	Grain_15	3.56
Grain_8	4.1	Grain_16	3.23

V. Conclusion and Future Works

Today's consumers are very quality conscious about the food grains they buy and consume as more and more adulteration in the food grains are reported in the media. In this paper an attempt is made to grading of rice grains based on morphological techniques using image processing. The image is initially subjected to preprocessing and the individual grains are segmented. The geometric features of the grain such as area, major axis length and the minor axis length are extracted and are subjected to classification The result are found to be encouraging. Based on the length of the grain the rice is graded. The work in future can be extended by finding other quality features of rice grains and working on moving image.

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