Grain Quality Assessment for Smart Rationing System

Safa¹, S V Krubha Shankari², Sandra Diana Monteiro³, Naksha C Naik⁴, K Aarya Shri ⁵

¹,²,³,⁴Department of Electronics and Communication Engineering, St Joseph Engineering College, Vamanjoor
²Assistant Professor, ⁴Department of Electronics And Communication Engineering, St Joseph Engineering College, Vamanjoor

Abstract— Manual Inspection is the normal method for determining grain quality which is considered as an inefficient way and can result in inconstant outcomes. In order to overcome this and to achieve uniform standard quality and precision, automated machine vision is used. Usually, the grain images are acquired by a scanner which resulted in the non-uniform distribution of grain samples. It is also difficult to measure and memorize all individual parameters manually. To overcome this issue, the grain image is first captured using a high-quality camera and the parameters such as size, area, major axis length, minor axis length and centroid of the grain sample are evaluated. These features of grain are extracted from the image of the grain sample. Here, grading and evaluation grains is based on the physical features such as area, size, and shape of the grain, centroid. To find out the region of boundaries of each grain, Canny’s edge detection algorithm is used as it has a Gaussian filter. The quality, as well as percentage of the good quality grain based on the area, is displayed using a Graphical User Interface. An automatic smart rationing system will give precise outputs and it utilizes minimum time and is low in cost. As the centroid of each grain is plotted it makes it easier to calculate the number of grains in the sample. Canny’s edge detection algorithm used help in the removal of noise from the grain sample image resulting in accurate output. This system can be carried further for detection of infection like fissures and chalkiness of the grain which have better accuracy.

Keywords— Grain, Image Processing, Edge Detection

I. INTRODUCTION

The significance of measurement of grain quality has been felt since way back to a century old. Cereal grains play an imperative role in meeting the nutrient needs of the human population. The aim of the project is to design a grain recognition and quality analysis system using its geometrical features, which classifies the type of grain and its quality and grade for Rice. The grains can be classified into grades depending on their quality. By image processing techniques, maximum numbers of parameters are to be measured for quality analysis. Though tedious, but it is very important to measure the individual kernel’s qualitative analysis. 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-based techniques are evolved. Techniques are evolved which eliminate the need for inefficient manual inspection and a system based on machine vision is developed which enabled the evaluation grain quality. The quality analysis should be done for the purpose of import or export of any food grains.

Classification parameters vary based on consumer preferences. Grain quality depends on individual kernel features. Kernel’s features can be measured by either compositional analysis or structural analysis. The structural analysis focuses on the outer part analysis. The structural analysis covers the visualization aspect like measurement of size (length, width, and height), color and glossiness. Various applications in Image processing are seen in the field of agriculture, biomedical engineering, and many others. Expansion of this work can target to design a system that can be used for detection of infection like fissures and chalkiness of the grain.

II. PROPOSED SYSTEM

A. Literature Review

Grain characteristics such as smell (aroma), size, cooking characteristics, color, nutritional value and percent whole grains form the factors for quality assessment. The quality of a grain is not easy to define as it depends on the consumer and the intended end use of the grain. All consumers want the best quality product that they can afford. Always there is a demand from the consumer for better quality grain such as rice, wheat etc. Grain quality is not just dependent on the variety of rice, but the quality
also depends on the crop production environment, harvesting, processing and milling systems.

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. Grain quality can have a different meaning to different people depending upon the type of grain or seed and its intended use. Lower quality grain in daily food can cause serious diseases. Sometimes the lower quality grain is mixed with good quality grain to get a higher price. The product made from this kind of mixture can lead to poor quality foods. This kind of adulteration must be identified while the selection of grain.

For any grain seed, there are many parameters which are very important and directly mapped with grain quality. Rice quality is primarily assessed based on physical properties.

The important attributes that determine the class of the rice is length and width of a rice grain. Based on grain length short, medium and long are the three main classes of rice. Long grain brown rice fluffs up readily and tends to separate while cooking. It also has a firmer, dryer texture and feels in the mouth. That means rice will fall apart, rather than stick together. Medium-grain varieties are stickier and a good choice. Short-grain brown rice has a bit creamy texture that lends itself well to dishes. Chalky grains are softer than translucent grains and have more tendency to break during the milling process. Cracking decreases the cooking quality of the grain.

B. Block Diagram and Flow Chart

1. Image Acquisition: Acquiring a digital image is the first step in using a machine vision system.

2. Background Subtraction: Background subtraction or Foreground Detection is a technique in image processing where foreground of an image is extracted for further processing.

3. Edge detection and segmentation: The sharp separations in an image is found by using Edge Detection. The significant changes in pixel intensity determine the separations or barriers of objects in an image.

4. Image segmentation: This digital image is divided into multiple regions or sets of pixels. The principle of image segmentation is to divide image so that different objects in the image are marked.

5. Feature Extraction: In this technique, geometrical features of grain are extracted from the sample image.

The qualitative information are Area, Major axis length, Minor axis length, and centroid.

6. Analysis: Based on extracted features the analysis is done. The features extracted are compared with the features of standard quality grain sample. The quality is decided depending on the degree of matching.

Figure 1: Block Diagram for quality assessment.

Figure 2: Flow Chart
C. Methodology

1. **Image Acquisition:** A digital image is acquired using a digital camera. Proper illumination plays a very important role in order to obtain a good image. The camera used here has a resolution of 13MP. Fixed distance of 10 cm is maintained between the camera and the grain samples. The images are captured under natural light avoiding the direct sunlight for proper illumination. Uniform background of blue color is maintained. The grains are spread on a blue sheet randomly. The images are captured and are stored in JPEG format.

2. **Background Subtraction:** The Gaussian filter is used for image smoothening. Threshold method is used in order to eliminate background. Then the grayscale image is binarized. Once the image is binarized, morphological operations are performed. First, we use erosion operation to eliminate the shadow of the grains, this is followed by dilation to enhance the image after the erosion and improve the boundary sharpness. Erosion and dilation are the most basic morphological operations in image processing. The small-scale details from a binary image are reduced by erosion band it also reduces the size of regions of interest. Dilation has the opposite effect to erosion and it adds a layer of pixels to both the inner and outer boundaries of regions of an image.

3. **Edge Detection and Segmentation:** There are various edge detection techniques described in the literature, each designed for specific types of edges. Edge detection is a major issue in noisy images because the noise and edges both include high-frequency components. Efforts to reduce the noise will often result in damaged edges. The main objective of image segmentation is to divide image so that various objects in the image can be marked. Same texture or color are used to characterize the segmented objects. There are different methods proposed for edge detection in the last few decades. One of the most used technique is canny edge detection.

4. **Feature Extraction:** Extracted attributes are called features and a pattern is defined as a vector of such features. The various features that could be extracted are color features, geometrical features, and texture features.

III. **Result**

An efficient method to analyze grains quality by its size is the use of image processing algorithm. The benefit of the proposed method is it saves time. The setup used is also very common and easily available. It has more accuracy than the visual inspection by human beings. This approach can be used for different types of grains. Quality of rice is considered and each has been graded into three grades.

![Figure 3: GUI](image)

**Table I**

<table>
<thead>
<tr>
<th>Grain No.</th>
<th>Area</th>
<th>Within the range</th>
<th>Out of range</th>
</tr>
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<td>1</td>
<td>12829</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>14318</td>
<td>✓</td>
<td></td>
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<td>3</td>
<td>13041</td>
<td>✓</td>
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<tr>
<td>8</td>
<td>15358</td>
<td>✓</td>
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</tr>
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</table>
IV. CONCLUSION

In a ration shop, automation in food quality assessment is very important. The proposed system uses the image processing approach for grain quality assessment. Morphological Features of the grain sample is analyzed. It is more intuitive and easy to measure the grain size by using digital image processing techniques as a means of cereal grain research which would result in an accurate assessment of the cereal grain quality. The image processing algorithms are used to extract, segment and identify grains.

In most of the applications, higher resolution is desired to get detailed information of the captured image. This can be achieved either by better image sensors or advanced optics. With coding in Matlab software purity of the sample can be calculated.

The proposed system provides a better approach for identification of different types of grains and rice quality based on color and geometrical features. Firstly the image is preprocessed and segmented, then color and geometrical features that have been extracted from grain images. Different types of grains are considered for identification. Quality of rice is considered and has been graded into three grades.

V. FUTURE SCOPE

The proposed system can be further enhanced by using Image Processing technique for Classification and Grading of different varieties of cereal grains. Matlab programming can be used for determining morphological and color parameters that has better accuracy and provides less computational cost. It can be extended to be able to detect other quality of rice. It can use a closed system for image acquisition, with a high definition camera, this might help to avoid the grain shadow observed in the database acquired and will also give uniformity in the intensity of background color[5]. Also, various infections on food grains like fissures can also be identified further. The rate of accuracy can reach 100%, especially for bigger and very small grains. The future work may include the rice image acquisition in bulk amount and with varying backgrounds.

VI. REFERENCES


