Grading of Rice Grains Quality using Image Processing

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Abstract— The purpose of this paper is to find the percentage purity of rice grain sample by image processing technique. The most common test is done on the basis of size of the rice grain. Traditionally the grain types and their quality were promptly measured through visual assessment by human inspectors, whose decisions are subjected to exterior influences such as tiredness and is also time consuming. Machine vision is an alternative to an automated, cost-effective and non-destructive technique. This method proposes a method for rice seeds using image processing. This technique begins by acquiring images of rice samples which are converted to gray image and then to binary image by using thresholding. The rice grains area is measured using regionprops property of Matlab.
Keywords- Image Processing; Quality Grading; Thresholding; Regionprops; Matlab.

I. INTRODUCTION

Image processing is a common tool for applications in particle characterization, metallurgy, agriculture, biotechnology, etc. Digital imaging systems have found increasing use in such analysis as they are economical, fast and accurate. One of the areas of digital imaging applications is in testing the quality of food materials. There are methods like morphological methods which are used for efficient segmentation of images where physical parameters like length, width, perimeter etc. are key features.

Currently, the quality of rice has been determined subjectively and manually through a visual inspection by human. The results, sometimes, may not be reliable due to human errors or inexperienced technicians. Moreover this manual inspection is complicated and time consuming. Therefore a quick and more reliable rice quality evaluation system is needed.

II. LITERATURE SURVEY

Machine vision provides as a substitute for an automated and cost-effective technique. Here Morphological Operation and regionprops are used to determine the size of the rice grain.

2.1 Morphological Operation

Features and components of an image can be extracted using morphology. It is used to pre-process or post-process images to simplify analysis. In morphology, structuring element is transformed through the image during the course of processing. Some mathematical tasks are performed on the image with the use of structuring element to generate the processed image.

A. Dilation

Dilation is a method that grows objects in a binary image. The thickening is controlled by a small structuring element.

B. Erosion

Erosion contracts or thin out objects in a binary image. After erosion the only pixels that are left are those where the structuring element fits completely in the foreground.

C. Opening and Closing

Morphological operations can be combined to help remove several artifacts present in images. After segmenting an image it is very beneficial. Opening is erosion followed by dilation. It smoothes

object outlines, breaks thin connections and removes thin protrusions. After opening, all objects smaller than the structuring element will be removed. Closing is a dilation followed by erosion. Closing joins narrow breaks, fills long thin gulfs, fills holes smaller than the structuring element and smoothes object outlines.

2.2 Regionprops

All the shape measurements are computed by regionprops. With a grayscale image, regionprops also returns the pixel value measurements.

A. Syntax

STATS=regionprops(BW, properties)
STATS=regionprops(CC, properties)
STATS=regionprops(L, properties)
STATS = regionprops(..., I, properties)

B. Description

STATS = regionprops(BW, properties) measure a gtset of properties for each connected component in the binary image, BW. The image BW is a logical array; it can have any dimension.

STATS = regionprops(CC, properties) measures a set of properties for each connected component in CC, which is a structure returned by bwconncomp.

STATS = regionprops(L, properties) measures a set of properties for each labeled region in the label matrixL. Positive integer elements of L correspond to different regions. For example, the set of elements of L equal to 1 corresponds to region 1; the set of elements of L equal to 2 corresponds to region 2; and so on.

STATS = regionprops(..., I, properties) measures a set of properties for each labeled region in the image I. The first input to regionprops—either BW, CC, or L—identifies the regions in I. The sizes must match size(I) must equal size(BW), CC.ImageSize, or size(L).

STATS is a structure array with length equal to the number of objects in BW, CC.NumObjects, or max(L(:)). The fields of the structure array denote different properties for each region, as specified by properties.

C. Properties

Properties can be a comma-separated list of strings, a cell array containing strings, the single string 'all', or the string 'basic'. There are various properties like 'Area', 'Centriod', 'Eccentricity', 'Perimeter', 'MajorAxisLength', 'MinorAxisLength' properties can be a comma-separated list of strings, a cell array containing strings, the single string 'all', or the string 'basic', etc.

2.3 Thresholding

Segmentation involves separating an image into regions (or their contours) corresponding to objects. We usually try to segment regions by identifying common properties. Or, similarly, we identify contours by identifying differences between regions (edges).

The simplest property that pixels in a region can share is intensity. So, a natural way to segment such regions is through thresholding.
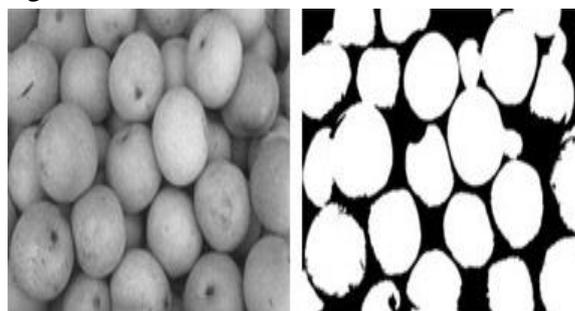

Figure 1. Thresholding using Otsu's method

Thresholding creates binary images from grey-level ones by turning all pixels below some threshold to zero and all pixels about that threshold to one. If g(x, y) is a thresholded version of f (x, y) at some global threshold T. g is equal to 1 if f (x, y) ≥T and zero otherwise.

It is a simple, yet effective, way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting grayscale images into binary images. Image thresholding is most effective in images with high levels of contrast. Common image thresholding algorithms include Histogram, Multi-level Thresholding, and Ostu Method.

III. IMPLEMENTATION

Our Rice classification based on size consists of morphological processing and thresholding. We can detect the rice grains by subtracting the background from the original image which is done using thresholding.
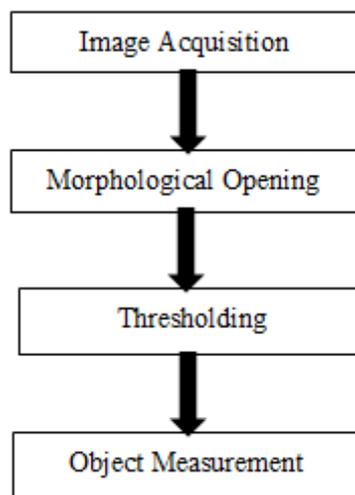
Figure 2. Flow diagram of the algorithm

Here we used different functions of matlab to obtain the area of the rice grain. After image acquisition thresholding is done and regionprops property is used to get the size of the rice grain which is stored in and array.

Operating Procedure for the proposed system:
1   Spread the seeds uniformly on the Tray to avoid overlapping of seeds.
2   Capture image of seeds using camera.
3   Process and analyze the image in computer using   the method stated in flow diagram.
4   Display the area of the image.
5   Repeat above steps for 10 to 15 samples.

3.1 Image Acquisition
Take the rice sample and place it separately on a black paper and then capture the image using camera. Here we are taking image having single grain as well as image with multiple grains which are placed at some distance i.e. rice grains should not be joined.

3.2 Morphological Opening
Opening is erosion followed by dilation. It smoothes object contours, breaks thin connections and removes thin protrusions. After opening, all objects smaller than the structuring element will disappear.
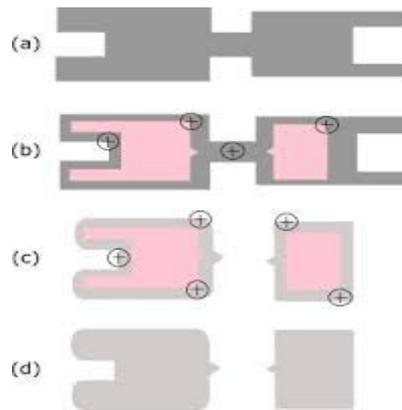
Figure 3. Morphological Opening

In Fig 2 (a) is the original image A, (b) is the erosion of image A by kernal B, (c) is the dilation of result (b) by the same kernal B and (d) is the image A after opening.

3.3 Thresholding Process

Here we take a threshold value for the given image. The initial threshold value is used to separate the image into two regions object and background. The pixel values which are greater than that threshold value are taken as background and the remaining pixels as object. Thus, we have two sets of values, one is for the object and another is for the background.
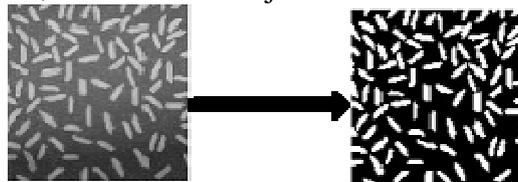

Figure 4. Thresholding Process

3.4 Object Measurement

We use regionprops which is used to measure the properties of image regions.

STATS = regionprops(L,*properties*) measures a set of properties for each labeled region in the label matrix L. Positive integer elements of L correspond to different regions. For example, the set of elements of L equal to 1 corresponds to region 1; the set of elements of L equal to 2 corresponds to region 2; and so on. The return value, STATS, is a structure array of length max(L(:)). The fields of the structure array denote different measurements for each region, as specified by *properties.*
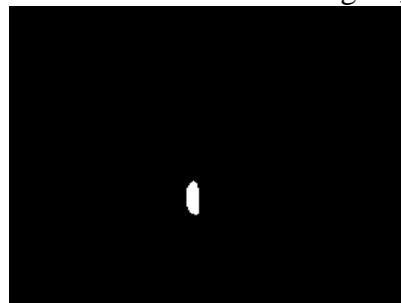

Figure 5. Regionprops example

s = regionprops(bw,'Area');
s =   Area: 194

For above figure we use the function regionprops which is used to measure the property of image regions. Here by using Area property we get the area for the rice grain.

IV. RESULTS

We take Image of rice grains and perform morphological opening and thresholding on it then we calculate the area by using regionprops. We get the area for each individual rice grain stored in an array. The Classification is done based on following table:

Table 1. Classification table

Size	Area
Large	A>=260
Medium	259>A>201
Small	A<200

If the rice grain size is large than it is considered as a good quality basmati rice, if the rice grain size is medium then it is medium quality rice like kolam, masoori etc. and if the size of the rice grain is small then it is not so good quality rice.

Second Classification can be done on the base on the overall percentage of good quality rice grains i.e. if greater than 90% of grains are of large size than the quality of rice is good. If it's between 80 to 90 % than the quality is medium and Grains that have less than 80% grains of area less than 260 than they are considered to be of poor quality.

Figure 6. Sample 1

Table 2. Output of sample 1

Sr. No	Area
1	438
2	434
3	439
4	189
5	410
6	104

From the output of sample 1, we can see that 2 grains are of bad quality and 4 of good quality considering the size shown in Table No. 1 these sample are considered as medium quality grains.

Figure 7. Sample 2

399

Output of Sample 2

s = Area: 275

From table 2, we can say that the quality of sample 2 is good based on the size parameter.

Figure 8. Sample 3

Table 3. Output of sample 3

Sr.No	Area
1	243
2	232
3	51
4	108

From the output of sample 3, we get 2 grains which are of medium quality and 2 grains that are of bad quality. Thus rice grains in sample 3 are of bad quality.

CONCLUSIONS

It is concluded that quality grading of rice samples can be done effectively with the use of image processing technique. With the method discussed in this paper we can grade the rice samples. The setup used is Matlab which is very common and easily available. This is more accurate than the human visual inspection which leads to better grading of the quality of the rice.

The work presented in this paper could be further enhanced by focusing on different sampling methods, sample sizes, sample pre-processing techniques, different features and neural network and fuzzy logic models to match the requirements of the rice industry.

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