IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 7, Issue 2, February 2018

Identification Rice Grains Using Image Processing Techniques

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Abstract: Agriculture is the backbone of a nation, in India the majority of the population mainly depends on agriculture as their main source of income. Some of the major crops grown in India are rice, wheat, maize, jowar etc. In developing countries like India, the increasing standard of living in society leads to high expectation of food products having high quality and healthy standards because of these reasons there is a demand for finding accurate, fast and objective methods to determine the quality of food grains. The capability to identify and describing features of rice grains for identification is desirable so that problems such as fraudulent adulteration and mislabelling of rice grain varieties can be identified and eliminated. This paper presents a solution for identifying different varieties of rice grains on visual features hence can be very fast, inexpensive and it also explores the possibility of determining the quality of the rice grains by using texture features. Commercially identification of rice grains is done by using biological methods (DNA technique etc...) and chemical methods (alkaline tests etc...) for the identification of rice grain seed varieties and quality. The methods used are very expensive and very time consuming. On the other hand the machine vision or the digital image processing is a non-destructive method, it is very fast and inexpensive process compared to the biological methods.

Keywords: Rice grains, mislabelling, identification, machine vision.

I. Introduction

Rice is a vital worldwide agricultural product. Total annual production figures are in hundreds of millions of tonnes. Varieties of rice grains are subtly different in size, color, shape and texture. Fraudulent labeling of one variety as another is a major concern in the food industry. The International Rice Research Institute (IRRI) and other organizations including the British Retail Consortium (BRC) discuss the appearance of rice as being critical to consumers. These organizations have established standards and regulations for rice grain varieties. These standards also grant special status to specific rice varieties such as Basmati due to their high market value. Some physical features like aspect ratio and minimum average length are specified explicitly in the standards.
India is one of the largest producers of rice in the world after china; India is imposing and administering the use of rice grain standards to assure that producers get paid maximum price for their grain according to the variety of the grain and consumer gets better quality product. The investigation of type of grain and its quality parameters is still carried out manually by skilled professionals. This strategy suffers from many drawbacks like, it is mostly subject driven and is influenced by human factors and working conditions, human perception can easily be influenced by external factors like his/her physical condition such as fatigue and eyesight, mental state caused by biases and work pressure, and working conditions such as improper lighting, climate, etc .that results in inconsistent results, the rate of cleaning and recovery of salvages is limited hence farmers are affected by this manual activity. For the above mentioned reasons, these tasks require automation and develop imaging systems that can be helpful to identify rice grain images, rectify it & then being analysed. The computer vision based methods can be used to analyse images and overcome above mentioned drawbacks [1].
Digital image processing is the method of using computer algorithms to perform image processing on digital images. Quality of the world's most important staple food crop can be determined based on the length, shape size and texture of the grain, these features can be extracted by using the available imaging techniques.

II. LITERATURE SURVEY

A D.M. Hobson et al., proposed image processing techniques for identifying the different varieties of rice based on their size, shape and color [5]. They successfully identified eight different Japanese varieties of rice grains. A commonly used static imaging approach is adopted here to capture images of rice grains; Rice grains were positioned beneath the focus of a camera against a contrasting matte background. The image analysis was centered on the shape and texture features of grains. The following parameters were determined for the presented work. Average Length (La) is the simplest feature considered. This per pixel area and length were determined through calibration. Shape features using diameter lengths are devised from the recorded chain code of each shape. Here, using pixels on opposing halves of the chain code as opposing diameter distances provided a reasonable standard of internal diameter, Aspect Ratio (Ra)

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feature is defined as the ratio between the shortest (dmin) to the longest (dmax) diameters, Compactness Ratio (Rj) returns values from 0 to 1 for shapes that are elongated to perfectly compact (spherical). Using these features they successfully identified eight different Japanese verities of rice grains.
R.Kiruthika et al., presented a work in which a digital imaging approach has been devised in order to investigate different types of characteristics to identify the rice varieties [6]. Two different common rice varieties were used in tests for defining. These include existing standards for rice length, area and aspect ratio features of rice. It successfully showed the effectiveness of compactness as its features.

The work includes following steps, image containing the rice grains were obtained, and converted to binary image, image segmentation were done to partition an image into meaningful regions, the segmentation is based on measurements taken from the images and might be grey level, color, texture, depth or motion. In this work edge based segmentation were used, blob analysis was done to obtain Region Props: It measures the properties of image regions, area, bounding box, and based on these parameters feature matching was done.

III. METHODOLOGY

The proposed system framework for identifying different varieties of rice grains is as shown in figure 3.1. This constitutes of following steps, collecting input image, pre-processing the input image for background subtraction, then the important features are extracted which are explained later in this architecture. Feature parameters of grains The image analysis here centers on the shape and texture features of grains which is as shown in figure 3.1. The following parameters are determined for the present work.

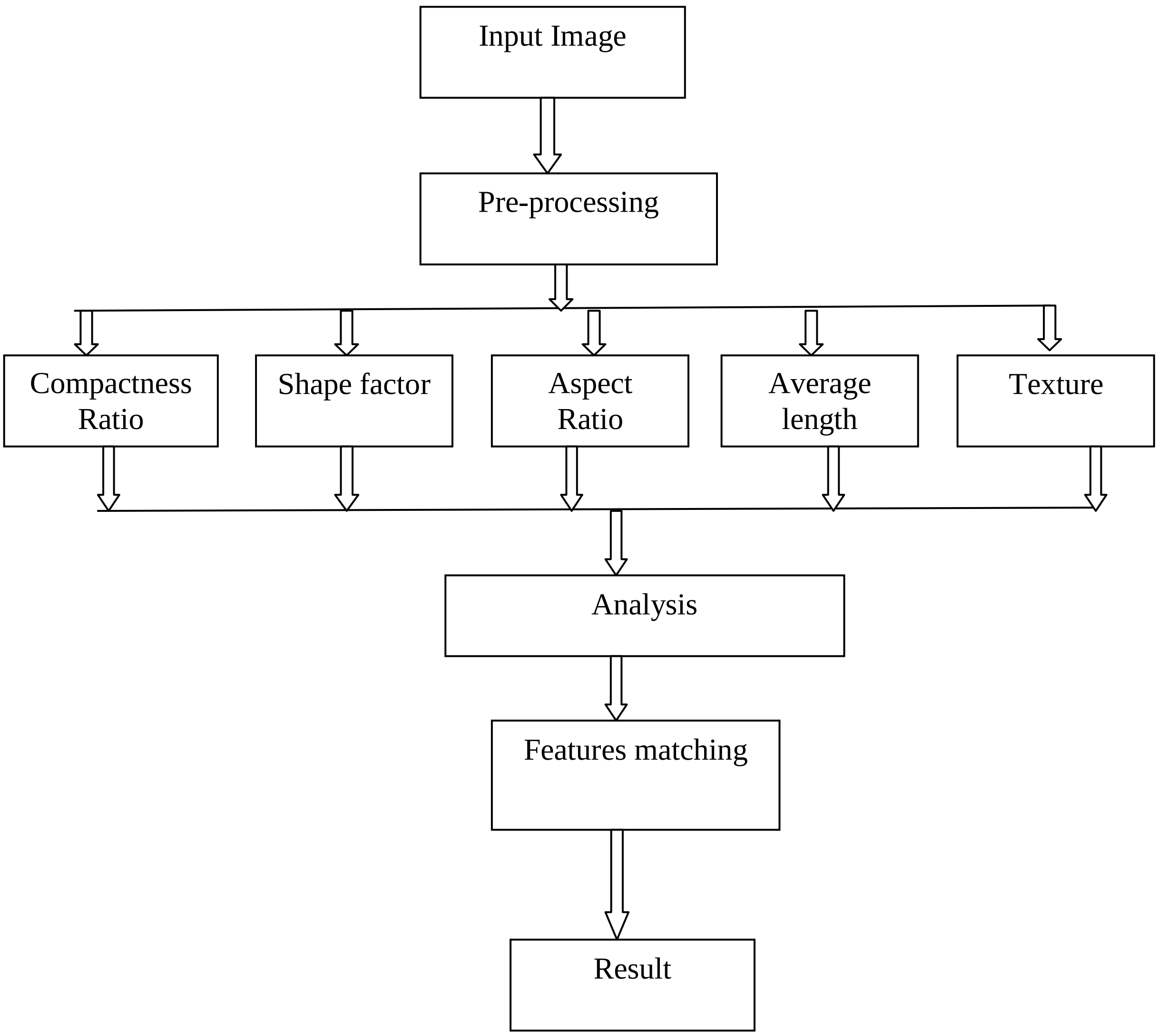

Fig 3.1 system architecture of identifying rice grains

- **Average Length (La):** Is the simplest feature considered. Using the per pixel length of the image it is possible to determine the absolute length of each grain. This per pixel area and length is determined through calibration. Lm is determined from the image by measuring the Euclidean distance between the two most distant points on the perimeter of the rice grain. Shape features using diameter lengths are devised from the recorded chain code of each shape. Here, using pixels on opposing halves of the chain code as opposing diameter distances provided a reasonable standard of internal diameter.

- **Area:** The area of any object in an image is defined by the total no of pixels enclosed by the boundary of the object.

- **Major axis length:** Of an image is defined as the length (in pixels) of the major axis of the ellipse that has the same normalized second normal movement as the region.

- **Minor axis length:** Of an image is defined as the length (in pixels) of the minor axis of the ellipse that has the same normalized second normal movement as the region.

- **Aspect Ratio (Ra)**: Feature is defined as the ratio between the shortest (d_{min}) to the longest (d_{max}) diameters: $R_a = d_{min} / d_{max}$.

- **Shape factors (S_f)**: Is defined as: $S_f = d_{rmsd} / d_{mean}$. Where d_{mean} is the mean diameter of the grain with root mean-square deviation (d_{rmsd}): drmsd = Sqrt (((dmax - dmean)^2 + (dmean - dmin)^2) / 2).

- **Compactness Ratio (Rj)**: Returns values from 0 to 1 for shapes that are elongated to perfectly compact (spherical): $R_f = 4\pi A / P^2$. Where A and P represent the area and perimeter length of the grain, respectively. The specifics of this function Compensate for scale variance of the area/perimeter ratio. When interpreting perimeter length from the chain code, recognition of diagonal perimeter connectivity is important. Straight connectivity is approximated as distance 1 with diagonal connectivity approximated as the square root of 2.

- **Edge-to-area ratio:** $R_e = (E / A)$, the value of E is the sum of detected edge pixels from the canny edge operation, as detected within the area region each connected component. Features may be recorded for individual grains. Then the mean and standard deviations per sample can be determined. By comparing the extracted features such as length of a grain, aspect ratio (Ra), shape factor (Sf), compactness ratio (Rf) and edge to area ratio (can be obtained while finding texture features) can be compared with the available standard values of the different verities of rice grains.

- **Texture:** Texture analysis refers to the characterization of regions in an image by their texture content. Texture analysis attempts to quantify intuitive qualities described by terms such as rough, smooth, silky, or bumpy as a function of the spatial variation in pixel intensities. In this sense, the roughness or bumpiness refers to variations in the intensity values, or gray levels. Texture analysis is used in a variety of applications, including remote sensing, automated inspection, and medical image processing. Texture analysis can be used to find the texture boundaries, called texture segmentation. Texture analysis can be helpful when objects in an image are more characterized by their texture than by intensity, and traditional thresholding techniques cannot be used effectively.

Some of the texture features used in the project is as follows.

- Co-occurrence Matrices: Spatial gray level co-occurrence estimates image properties related to second-order statistics. The ‘G * G’ gray level co-occurrence matrix P_d for a displacement vector d = (d_x, d_y) is defined as follows. The entry (i, j) of P_d is the number of occurrences of the pair of gray levels I and j which are a distance‘d’ apart. Formally, it is given as.

  $$P_d (i, j) = \{((r, s), (t, v)): I(r, s) = i, I (t, v) = j\}.$$
- Contrast: Measures the local variations in the gray-level co-occurrence matrix.
- Correlation: Measures the joint probability occurrence of the specified pixel pairs.
- Energy: Provides the sum of squared elements in the GLCM. Also known as uniformity or the angular second moment.
- Homogeneity: Measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal.
- Range filter: Calculates the local range of an image.
- Entropy filter: Calculates the local entropy of a grayscale image. Entropy is a statistical measure of randomness.
- Standard filter: Calculates the local standard deviation of an image.

These statistics can characterize the texture of an image because they provide information about the local variability of the intensity values of pixels in an image. For example, in areas with smooth texture, the range of values in the neighborhood around a pixel will be a small value; in areas of rough texture, the range will be larger. Similarly, calculating the standard deviation of pixels in a neighborhood can indicate the degree of variability of pixel values in that region [Matlab].

V. RESULTS

- Images are acquired using Flat Bed Scanning (FBS); this process uses the desktop scanner. In this the rice grain is placed on the glass plate of the scanner and covered with a black sheet of paper. The images acquired were of resolution 1200 dpi (dots per inch). Images were captured and stored in JPG format automatically. Through data cable these images has been transferred and then stored in disk. Images obtained from flatbed scanning are as shown above.
- We have collected twenty five different varieties of rice grains, scanned five image samples for all varieties separately (in total 125 images) for the problem of identification.
- We picked only full length grains to make the image samples since we can extract exact features of grains.
- Extracted properties of the grains such as area, major axis length, minor axis length, perimeter etc... And calculated the following features for each grains present in the sample, computed features such as aspect ratio, compactness ratio, average length, edge to area ratio, and some texture features.

Successfully identified 19 different varieties of rice grains such as 64ration, egg rice, gamsale, ganga Kaveri, ankur sona, sri ram sona, jaya dosa, kampli sona, mamul sona raw, mamul sona, mangalore boiled, nellur sona new, prakash sona, rajmudi, salem, sona masoori end quality, sona masoori steam fine, basmati, Mangalore rice.

VI. CONCLUSION

For the problem of identification out of 25 different rice varieties 19 rice varieties are successfully identified and due to over lapping of features 6 rice varieties could not be identified. Successfully identified 19 different varieties of rice grains are 64 Ration, Egg rice, Gamsale, Ganga Kaveri, Ankur sona, Sri Ram Sona, Jaya dosa, Kampli sona, Mamul sona raw, Mamul sona, Mangalore boiled, Nellur sona new, Prakash sona, Rajmudi, Salem, Sona masoori end quality, Sona masoori steam fine, Basmati, Mangalore rice. 6 rice varieties which could not be identified are Sona, Nellur sona, Malebennur sona, Sona raw, Sona raw and Kampli sona. Expansion on this work may target identification of rice based on more specific guideline requirements for certain rice varieties, such as Basmati, Gamsale, Selam, Sona etc. Also the use of surface texture and intensity features can be explored for the identification of white area in milled rice, a factor in defining grain chalkiness which is used as a factor in determining cooking quality of rice, this is not considered in our project. And there is a need to identify some more features using which all rice varieties can be differentiated and identified.

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