Grading and Quality Testing of Rice Granules Using Neural Networks

E.Kavitha¹, D,Naresh Kumar², E. Kalpana³, R.Sharanya⁴, P. Pavankalyan Reddy⁵, T. Sai Vijaya Rekha⁶

¹Department of ECE, Vidy Jyothi Institute of Technology, Hyderabad, Telangana, India

ABSTRACT

In the grain-handling system, the type and quality of a grain are manually identified by visual inspection which is tedious, much time-consuming, and inaccurate. The expansion is required for a fast, accurate and objective system for determining the quality of food grains. Evaluation must be in an automatic manner to determine the standard of rice granules and identification of a grain type using a Probabilistic Neural Network. A model of quality testing and identification is made on geometric features by predicating and color features with technology of computer image processing and neural network. For the purpose of training these features are presented to the neural network. The trained network is then regulated to identify the unknown grain types and its quality. The rice sample grading is completed consistent with the dimensions of the grain kernel and presence of impurities. For the evaluation of rice quality this method gives a good lead.

Keywords: Rice grading, Grain quality, Image Processing, Probabilistic Neural Network.

I. INTRODUCTION

There is an increasing demand in the quality of food products in recent times. Increase in the rate of literacy in India is one of the reasons for increase in demand for qualitative food products. The second largest producer of rice grains is India as first being China. The shopkeepers are being cheated by the variety of traders so the demand for food grain quality is increasing. Selling such poor quality food grains which contain things like stones, sand, leaf, broken and damaged seeds etc. This sort of inferior rice is sold without being noticed and there is no special scheme to find out such poor quality grains. Therefore it has been a drag for both consumers and sellers.

Nowadays the type and quality of a grain are identified manually by visual inspection which is tedious, much time consuming and inaccurate. For the identification of rice grain seed varieties and quality the other method is a chemical method which uses a machine vision or the digital image processing system. Compared to the chemical method the proposed method is non-destructive, very fast and cheap and also an attempt to overcome the limitations of manual process.

The main purpose of grading and quality testing algorithms is to recognize and classify the food grains. These algorithms are not just related to identify the type of grain but also to do quality analysis of each grain. Grading and quality testing algorithms can be based on the two metrics: i) Recognition of grain sample ii) Quality analysis of grain type. The first metric focuses on recognition of food grains which identifies the type of grain by using the colour features of food grains. Second metric focuses on the quality analysis of each grain type and graded the grain type as grade 1 grade2 and grade 3 depending on size.

II. Objective

The proposed work focuses on quality analysis based on measuring physical parameters like grain size and shape using image processing techniques. Basmati rice and normal rice are taken as input. The image processing technique is used for counting the number of grains of rice and classifies them on the basis of length, breadth, area and aspect ratio. Image is captured using a camera. The captured image is stored in our web-portal database. After storing the image on a web-portal database image processing algorithms are implemented on it.
III. Existing model

In the existing models, only a few geometric features extracted using image processing and classification are either not done or done using some microcontrollers. In some models, the accuracy of quality detection is very low and very expensive. The captured image for input purpose is also not clear and in some cases, the rice granules must be aligned along rows and columns for clear analysis.

IV. Proposed System

The proposed system overcomes some of the problems of existing models. The image is acquired using a high quality 16MP camera under good lighting condition. The rice grains need not to be arranged in rows and column wise. The grains are detected using image processing and the features are extracted using probabilistic neural networks. The accuracy of the classification is much higher than other models. The model is also very cost efficient.

The acquired image is given for processing on a MATLAB platform. There the image is resized and converted into a gray scale image then into a binary image. The binary image is then sent for segmentation where the rice grains are isolated from the background. The parameters are extracted from the image and based on those parameters the quality of the grains are detected and graded using neural network technology.

V. Hardware and software

- Camera
- MATLAB software
- Neural networks
- Image processing system

VI. Block diagram

![Block diagram of proposed system](Figure 1: Block diagram of proposed system)
VII. System Design

1) Image Acquisition: Image Acquisition is the primary step in image processing. Acquisition is done by using a PCwebcam Camera. Smoothing is done using Median Filters. As the median filter preserves the edges of the image during noise removal we use it for pre-processing. Median filters are predominantly effectual towards salt and pepper noise.

![Fig2. Acquired image](image1)

2) Image Pre-Processing: In pre-processing the threshold image can be converted into a binary image. Absorption of light in their surfaces to characterize the regions of the image is the base of this technique. Threshold is used to separate the object pixels from the background pixels in an image. In our work we implemented histogram thresholding technique to perform thresholding. After properly separating the required pixels, to identify them we can set them with a specified value (i.e. we assign a value of 0(black), 255(white).

![Fig3. Pre-processed image](image2)

3) Image segmentation:
Segmentation is the method of separating a digital image into multiple segments. The segmentation changes the representation of a picture into something more meaningful and beneficial to research. To locate objects and limits we use image segmentation. To perform edge detection, sobel method is applied. It increases the image intensity at each point from light to dark. Edge areas represent strong intensity contrasts which are either darker or brighter.
4) Feature extraction:

Using the MATLAB programming language, algorithms were developed in the Windows environment to extract morphological features of individual rice seeds. The following morphological features were extracted from images of individual rice seeds. Colour Feature Extractions of the red (R), green (G), and blue (B) colour bands of a picture, hue (H), saturation (S), and intensity (I) were calculated using the subsequent equations. Colour features play an important role within the classification process. We have extracted three colour features from the captured image, i.e. the mean values of the RGB colours.

\[ \mu = \frac{1}{N} \sum_{l=0}^{N-1} X_l \]

5) Training and Testing phase:

During the testing phase, an image from the testing set is selected and its features are extracted as training images. Then all those features are matched with the features from the database created for training images. It will calculate the shortest distance between the trained images stored in the database and the image that was selected for testing. This process is repeated for all the testing images in order to understand the accuracy of the system. The Probabilistic neural network is trained with different kinds of rice grains with a large number of samples. A probabilistic neural network (PNN) is a classifier that maps an input pattern to a variety of classifications. The input layer contains N nodes, one for every of the N input for every class that is recognized by the PNN as follows features of a feature vector. The hidden layer has a node for every training vector. The hidden nodes are collected into one group for every K class. The output layer features a node.

\[ g_i(x) = \frac{1}{n_i} \sum_{k=1}^{n_i} e^{-\frac{(x-x_k)^2}{\sigma^2}} \]

where

\[ x= \text{unknown input} \]
\[ x_k= \text{‘}k\text{‘ th sample} \]
\[ \sigma = \text{smoothing parameter} \]

VIII. Methodology

In this project a 16MP camera is used to capture an image of the rice granules. The acquired image is pre-processed and converted into a binary image using basic adaptive thresholding. The binary image is segmented using sobel edge detection where the rice grains are separated from the background. The grains are highlighted by the green coloured border which is significant for the next step. Probabilistic neural network is used to extract the features of the rice granules and classify them based on the geometric features. The quality of the grains is estimated and grading of grains is done like grade1, grade2 and so on.
IX. Results and discussion

Image Acquisition: The image can be captured using a digital camera. Proper illumination plays a vital role to obtain a clear image so the images are captured under natural light to avoid direct sunlight for proper illumination. The image is captured as below

![Acquired image](image1.png)

**Fig5. Acquired image**

**Image Pre-Processing:** Here the image is resized according to a convenient size of pixels. The resized image is the converted into a binary image using basic adaptive thresholding technique. The image formed by this method can be given as below

![Pre-processed image](image2.png)

**Fig6. Pre-processed image**

**Image Segmentation:** Sobel method is used to perform edge detection. It increases the image intensity at every point from light to dark. Edges areas represent strong intensity contrasts which are darker or brighter. Individual grain analysis: The features of individual images are calculated and classified based on their shape and size. The analysis is shown in the figure

**Overall result:** After all the stages of the process the final stage is the grading of the rice granules which we take. Using neural networks we classify rice grains into different grades. There are grains like grade 1, grade 2. The rice grains are also further divided into basmati and normal rice.

The image of one such rice grains samples is taken and classified as grade 1 by the above process.
X. Conclusion

This project is meant to produce a far better approach for identification of different varieties of rice grains and quality by color and geometrical features using concepts of Probabilistic neural networks and image processing. Different rice grains like basmati, normal rice are considered within the study. More than 120 images were wont to test the system and it had been found that there was 100% accuracy in identifying grains. Whereas the accuracy of identifying quality of rice grains will be 92% and 91% accurate for every grain type. Though the matter which has been worked upon is not completely new, the previous approaches employed a very little amount of colour, textural and morphological features which made the algorithm extremely slow due to the
intensive computation. This method is proposed for grading of various food grains which necessitates limited features and thus overcoming the limitations like tediousness and time consumption. These works can be further strengthened by concentrating on different sampling methods, sample sizes, sample pre-processing techniques, different features and different neural network models to go with the requirements of the rice industry.

REFERENCES
1. Sambalpur University, Burla, India “Rice quality evaluation based on Image Processing : A Survey “, August 2019
2. Gujarat Technology University Ahmedabad, “Grain quality analysis using image processing Approach”, December 2017
7. SanjivaniShantatya, Mrs.UzmaAnsari,”Identification Of Food Grains And Its Quality Using Pattern Classification”, Special Issue of IJCCT ,Vol. 2 2010