GRADING AND QUALITY TESTING OF FOOD GRAINS USING NEURAL NETWORK

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Abstract

The quality of food grains is referred to the every aspect of the profit of supply and marketing. The varietals purity is one of the factors whose inspection is more difficult and more complicated than that of other factors. In the present grain-handling system, grain type and quality are rapidly assessed by visual inspection. This evaluation process is, however, tedious and time consuming. The decision-making capabilities of a grain inspector can be seriously affected by 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. The farmers are affected by this manual activity. Hence, these tasks require automation and develop imaging systems that can be helpful to identify quality of grain images. A model of quality grade testing and identification is built which is based on appearance features such as the morphological and colour with technology of computer image processing and neural network. The morphological and colour features are presented to the neural network for training purposes. The trained network is then used to identify the unknown grain types, impurities and its quality.

Keywords: *Grain quality, image processing, neural network*

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1. INTRODUCTION

Grains are the prime crop for our country's peasants to increase their agricultural income. The automation level of testing grain quality is low and most work is done by manpower. The workload is so mass that it will lead to workers‟ fatigue and need them to have ample testing experience. And it also makes the testing more costly and long to be made. With the development of import and export trade this contradiction is more and more outstanding [1]. During grain handling operations, information on grain type and grain quality is required at several stages before the next course of operation can be determined and performed. The varietals purity is one of the factors whose inspection is more difficult and more complicated than that of other factors. In the present grain handling system, grain type and quality are rapidly assessed by visual inspection. This evaluation process is, however, tedious and time consuming. The decision-making capabilities of a grain inspector can be seriously affected by 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. [2].The farmers are affected by this manual activity. Hence, these tasks require automation and develop systems that can be helpful to identify grain images, rectify it & then being analyzed.

1.1 Problem Definition

In the food industry there are various food stuffs in the form of grains. The food grain types and their quality are rapidly assessed through visual inspection by human inspectors. The decision-making capabilities of human-inspectors are subjected to external influences. A model of quality testing and identification is built which is based on appearance features such as the shape and color with technology of image processing and neural network. The system will take an image of grain and identifies the grains and impurities if any and gives the quality of the grain.

2. DESIGN AND IMPLEMENTATION DETAILS

2.1 System Architecture & Design

The work finds application in grain handling operations at Agriculture Produce Market Committee (APMC), which is an important organization that deals with farmers, produce, measures quality and finally values the produce [3]. Different food grains like wheat, horse gram, corn and rice are considered in the study. Considering example of rice, rice is one of the most important cereal grain crops. The quality of rice has distinct effect on the yield of rice, so the proper inspection of rice quality is very important. During grain handling operations, information on grain type and grain quality is required at several stages before the next course of

operation can be determined and performed. The varietals purity is one of the factors whose inspection is more difficult and more complicated than that of other factors. In the present grain handling system, grain type and quality are rapidly assessed by visual inspection. This evaluation process is, however, tedious and time consuming. The decision-making capabilities of a grain inspector can be seriously affected by 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. Hence, these tasks require automation and develop imaging systems that can be helpful to identify rice grain images, rectify it & then being analyzed [5].

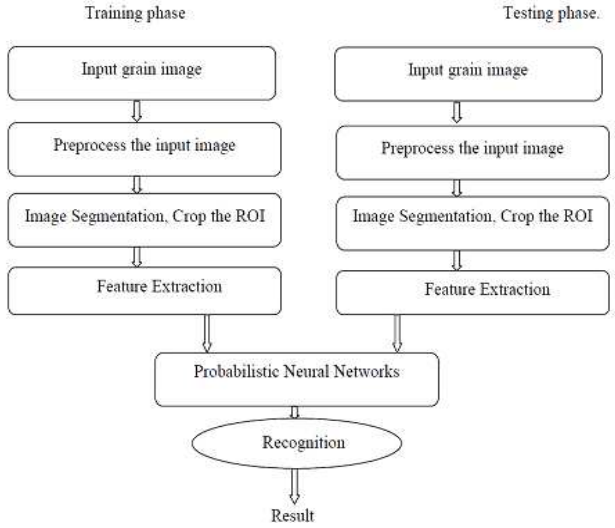

Fig -1: Block diagram

2.2 The Work Process of System

- Capturing the image of grains/ images acquisition
- Image pre-processing
- Image Segmentation and Identifying region of Interest
- Feature Extraction
- Training and Testing

2.2.1 Image Acquisition

Food grain images acquisition is considered as the most critical step of the grain recognition system, as it determines the final grain image quality, which has drastic effects on overall system performance. A total of around 400 food grain images are acquired. The images are acquired with a color Digital Camera. Sony cyber-shot DSCS750 digital camera is used to capture images. The acquired image is of 2592x1944 resolution. 2.5inch by 3.5 inch area is marked on background of maroon color. Food grains are positioned beneath the focus of a camera on that marked area of the background and the image is captured.

2.2.2 Image Pre-processing

The images acquired with a color Digital Camera is resized to a resolution of 640 by 480 saved as JPEG image. Further to remove noise the image is converted to black and white image and patches in an image are considered using matlab function bwlabel, Label connected components in binary image. The patches with size less than 70 pixels are assumed to be noise and are ignored. The other patches are the region of interest.

2.2.3 Image Segmentation and Identifying Region of Interest

Connected components labeling scans an image and groups its pixels into components based on pixel connectivity, i.e. all pixels in a connected component share similar pixel intensity values and are in some way connected with each other. Once all groups have been determined, each pixel is labeled with a gray level or a color (color labeling) according to the component it was assigned to. Connected component labeling works by scanning an image, pixel-by-pixel (from top to bottom and left to right) in order to identify connected pixel regions, i.e. regions of adjacent pixels which share the same set of intensity values V. (For a binary image Original image is converted to black and white image and patches in an image are considered using matlab function bwlabel, Label connected components in binary image. The patches with size more than 70 pixels are assumed to be the region of interest. Once the patches (grains and impurities) are identified the top, bottom, left and right is calculated to crop the segment from original image.

2.2.4 Feature Extraction

The color features such as mean value of R, the mean value of G, the mean value of B are calculated and four Morphological feature namely Area, Major axis length, Minor axis length and Aspect ratio are extracted and stored in knowledgebase, so a total of 7 features as listed in table 1 are stored suitably for later usage in training PNN.

Table -1: Morphological and color features used for grade and grain classification

Type of parameters	Parameter
Morphological	Area
	Major axis length:
	Minor axis length
	Aspect ratio
Color	Red mean
	Green mean
	Blue mean

2.2.5 Training and Testing Phase

Seven Morphological and color features are extracted from the images and are stored in the knowledgebase. A probabilistic neural network (PNN) is predominantly a classifier that maps any input pattern to a number of classifications. The probabilistic neural network is trained with eight different types of food grains namely Sonamasuri rice, Basmati rice, Horsegram brown, Horsegram white,yellow corn,Gujrat Wheat, OrangeCorn and Khapli Wheat, with 200 samples. Testing is the final step of the grain recognition system. In case of testing phase an image from the testing set (different from the training set) is selected and its features are extracted as training images. Then those features are matched with the feature from the database created for training image. It will compute the shortest distance between the trained images stored in the database and the image that was chosen for testing. Then the image with the shorted distance is chosen to be recognized. This process is repeated for all the testing images in order to know the accuracy of the system.

3. THE ALGORITHM: RECOGNITION AND CLASSIFICATION OF FOOD GRAIN

Input: Original Color Image

Output: Classified food grains along with Quality
Step1: Acquire the food grain images.
Step2: Enhance image to remove noise and resizing.
Step3: Identify Patches and Do the image segmentation.
Step4: Extract Color and morphological features.
Step5: Use these features to recognize and classify the food grain image samples using Neural network

4. RESULTS AND ANALYSIS

4.1 Training Phase

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Features Extraction (TRAINING PHASE)
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Enter Grain Type
1. Rice 2. Wheat 3.Corn 4.Horse Gram 5. Impurity 1
Enter Grain Grade
1. Basamati 2.Sona Masuri 1

Select the Grain image for training phase

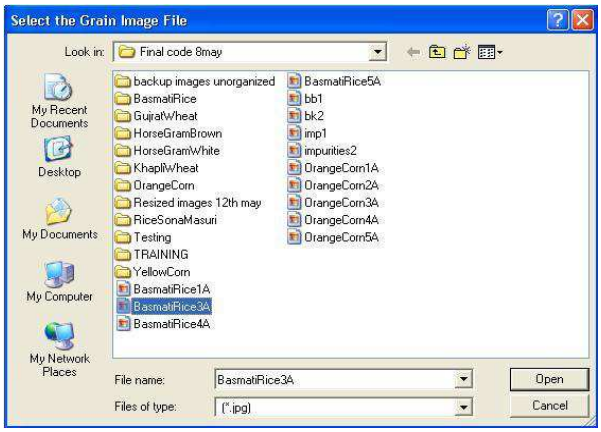

Fig.2 Snapshot to select the Grain image

Fig.3: Original Resized Image of basmati rice

Snapshot of the selected basmati rice image after Background subtraction

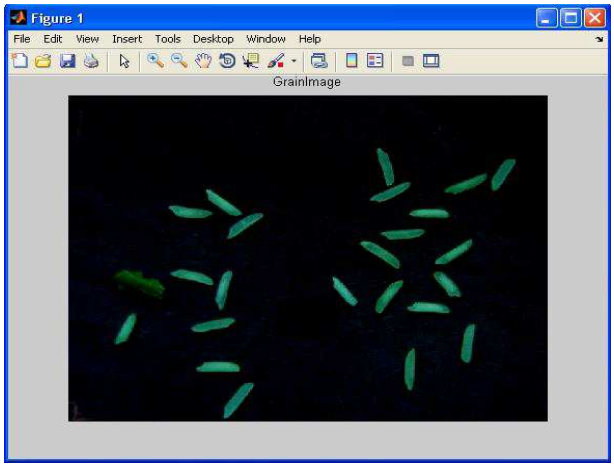

Fig.4: After Background subtraction

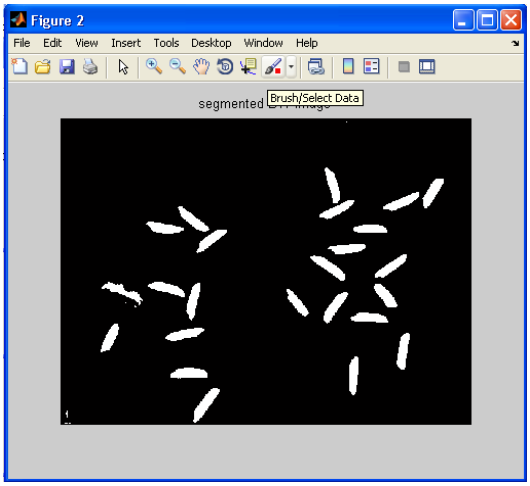

Fig.5: Black and white Image to find ROI

Snapshot of the selected basmati rice image after segmentation

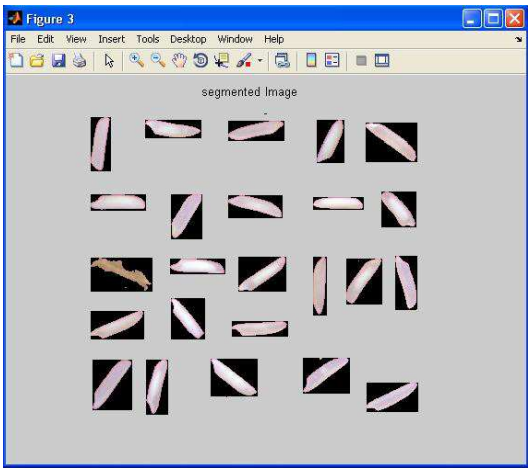

Fig.6: After Segmentation

The four Morphological feature namely and color features are extracted and stored in knowledgebase, so a total of 7 features for each segment of fig 6

4.2. Testing Phase

Select the Grain image for testing phase

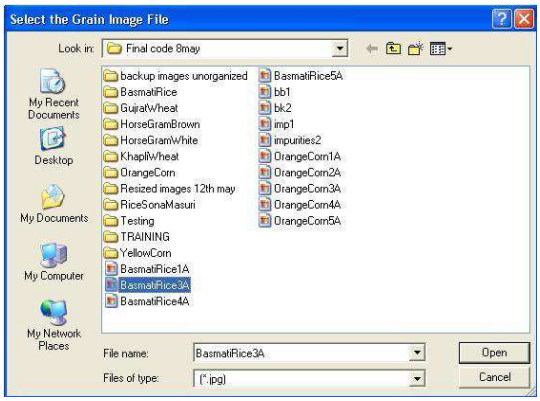

Fig.7 Snapshot to select the Grain image during testing phase

The selected image for rice with impurities for testing phase

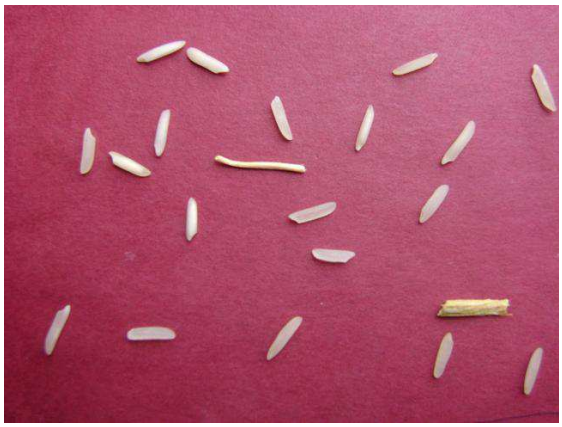

Fig.9: Original Resized Image of basmati rice

Output: The grain and the impurity is identified and its quality is

Fig 10: The result after testing

5. RESULTS

More than 160 images were used to test the system and it was found that accuracy of identifying grain and its grade is 100%.Where as the accuracy of identifying quality of grains was 80-90% accurate for each grain type. The testing results are as shown below in table 2. The result analysis is as shown in figure 11

Table 2: Consolidated results of all grains with accuracy of testing

Grain Type	Grain Grade	Total Images Tested	Total Images Correctly Classified	Accuracy %	Grains identified
RICE	BASMATI	20	17	85	100
RICE	SONAMASURI	20	16	80	100
WHEAT	GUJRATWHEAT	20	18	90	100
WHEAT	KHAPLI	20	17	85	100
CORN	ORANGE	20	18	90	100
CORN	YELLOW	20	17	85	100
HORSE GRAM	BROWN GRAM	20	16	80	100
HORSE GRAM	WHITE GRAM	20	17	85	100

It is very clear from the graph below that accuracy of identifying grain and its grade is 100%.Where as the accuracy of identifying quality of grains is in the range of 80-90% for each grain type.

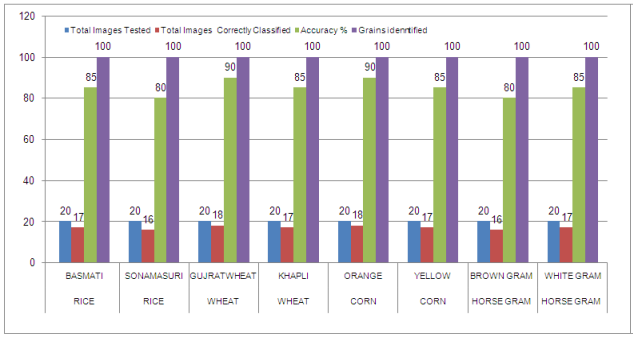

Fig 11: Results of all grains with accuracy of testing

CONCLUSIONS

The system identifies the quality of grains which is based on appearance features such as the shape and color, with technology of image processing and neural network. More than 160 Images were used to test the system and it was found that accuracy of identifying grain and its grade is 100%.Quality testing of grains was 80-90% accurate for each grain type. A very simple method is proposed for classification of food grains which require limited features and thus overcoming the disadvantages like tediousness and time consumption. The quality of food grain includes not only exterior quality but also the interior one such as the texture, the nutrient component, the protein, moisture of the grain and producing area. The latter is not researched in this work because of the limitation of machine vision. It is difficult to test the features by visual image.

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