Classification and Identification of rice grains using Neural Network

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ABSTRACT: An Agricultural industry is too oldest and most widespread industry in the world. Classification and quality evaluation of rice grains is a challenge since manual classification that are being usedin this industry which may not be objective or efficient. All important decisions about variety of rice grain are based on the different features of rice grain. An automated system is introduced which can be used for rice grain type identification and classification where digital imaging is recognized as an efficient technique to extract the features from rice grains in a non-contact manner. Images are acquired for rice using camera. Image Pre-processing techniques, Segmentations, Feature extractionare the checks that are performed on the acquired image. The morphological features are extracted from the image are given to Neural Network Pattern Recognition Tool. This effort has been proposed to categorize and identify the specified rice sample based on its morphological features.

KEYWORDS: Poaceae, Rice grains;oryza sativa; oryza glaberrima;Smoothing,;Segmentation;NeuralNetwork;Backpropagation.

I. INTRODUCTION

Rice is a grass cereal belonging to the Poaceae family. It is a seed belongs to the grass type calledoryza sativa or oryza glaberrima. Rice is produced in several areas throughout the world. India is the second leading producer of rice in the entire world, preceded by China. Commercial value, genetic characteristics and quality depend on the rice variety type. The grade and price of rice is decided by these factors, hence development and dissemination of new technology is an important factor determining the future of agriculture.

An accurate identification of rice seeds is very important when classifying rise verities.Manual classification methods are being used largely by local industry to differentiate rice grains on basis of geometric parameters.The exactness of classification scrutiny via human assessment scheme is different from person to person according to the inspector's physical status such as working hassle, point of view.This work proposes a method that processes the captured still digital image of rice grains and extract the relevant features. Morphological features of rice grains are used to check the types of rice.Image processing techniques are applied to extract various features of rice grains and classifies the grains based on morphological features. The collected features are then used in Neural Network Pattern Recognition system for categorizing of rice granules.

II. RELATED WORK

Substantial work for classifying and grading of rice grains has been reported. Neelamegam et al., [1]described a method for gradation and classification of different rice grains.An artificial neural network approach is used in the Identification and classification of the rice grain samples. Sukhvir Kaur et al., [2] presented a work on Geometric Feature Extraction of Selected Rice Grains using Image Processing Techniques.
Analysis of Rice Granules using Image Processing and Neural Network Pattern Recognition Tool is been implemented by Abirami et al [3]. Priyankaran Tanck, Bipan Kaushal [4] presented the paper proposes a digital method which can be

used to evaluate the quality of rice for the present Agmark Standards formulated with the help of digital image processing technique on MATLAB. G Ajay et al [5] presented an automatic evaluation method for the determination of the quality of milled rice.

Veena.H et al [6] presented an automatic evaluation method for determination of quality of milled rice. An automated system is introduced which is used for grain type identification and analysis of rice quality (i.e. Basmati, Boiled and Delhi) and grade (i.e. grade 1, grade 2, and grade3)]using Probabilistic Neural Network by Megha R. Siddagangappa et al [7].Paper proposed a new principal component analysis based approach for classification of different variety of basmati rice by Rubi Kambo et al [8]. Vidya Patil et al [9] proposed a work where image processing technique was used as an attempt to automate the process which overcomes the drawbacks of manual process. This paper provides the quality assessment of rice grains based on its size. Harpreet Kaur et al [10] made a study the showed the use of support vector machine inclassifying and grading the rice grain.

III. PROPOSED METHODOLOGY

An architecture of proposed rice grain identification system is shown in Fig 1.An objective of the project is to design a rice grain classification and identification system using its morphological features, which classifies the type of rice grains using Neural Network.
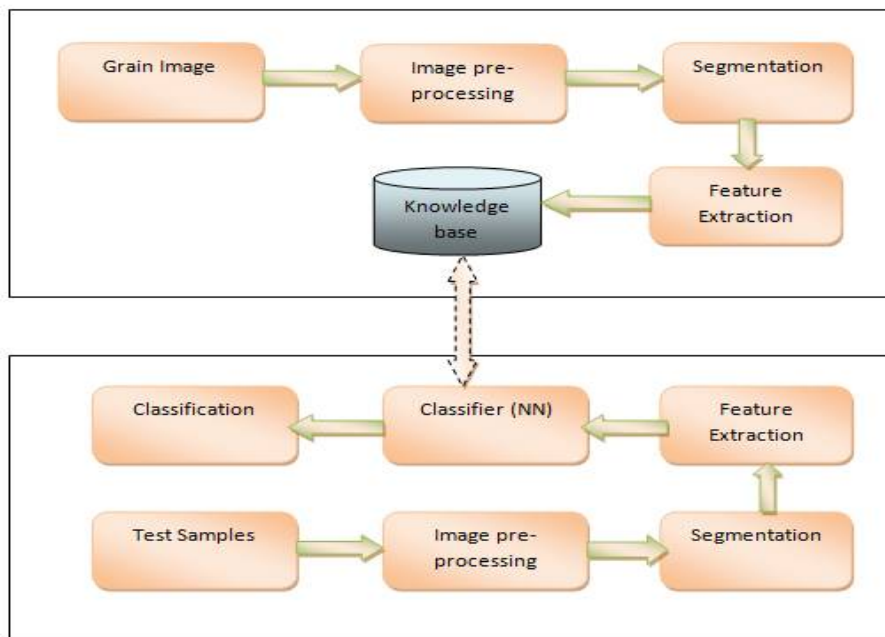

Fig1 An architecture of a system

    Fourrice varieties were selected as experimentalgrain materials shown in Fig 2.These varietieswere grown in different zones in India. Rice grains samples considered are: Sona masuri Rice, Parboiled Rice, Basmati and Jeera rice.The image acquisition was carried out with a NIKON D7000 digital camera. The camera was mounted on a fix stand. Grains were arranged in non-touching pattern and images were acquired and stored in JPG format for later analysis.Size of the image was reduced into 448 x 336px.

Fig 2 Rice grain samples

Image Pre-processing

The aim of pre-processing is an improvement of image data that suppresses unwanted distortion or enhances some image features for further processing. For human viewing, Image Enhancement improves the quality and clarity of images. Removing noise and blur, rising contrast and enlightening details from images are example of enhancement operation.Pre-processing stepscarried out in this work are using matlab tools:

 i. Gray scale conversion.
 ii. Smoothing using median filtering.
 iii. Background subtraction.
 iv. Image segmentation.
 v. Area opening
 vi. Labelling of regions.

Grey Scale Image

Grey scaledigital image is an image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this sort, also known as black-and-white, are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest. = rgb2gray(RGB) converts the true color image RGB to the grayscale intensity image I. rgb2gray converts RGB images to grayscale by eliminating the hue and saturation information while retaining the luminance.

Median Filtering

Median filtering is a nonlinear process useful in reducing impulsive, or salt-and-pepper noise. It is also useful in preserving edges in an image while reducing random noise. In a median filter,[11] a window slides along the image, and the median intensity value of the pixels within the window becomes the output intensity of the pixel being processed. Median filtering smooth the image and is thus useful in reducing noise.Unlike lowpass filtering, median filtering can preserve discontinuities in a step function and can smooth a few pixels whose values differ significantly from their surroundings without affecting the other pixels.

Background subtraction

It is also known as Foreground Detection,[7] is a technique in the fields of image processing wherein an image's foreground is extracted for further processing (object recognition etc.). Generally an image's regions of interest are

objects in its foreground. Background subtraction provides important cues for numerous applications in computer vision. Background of an image may not be not homogeneous,(the top is brighter than the bottom) such cases the background is set to zero. Then, each row will be updated by subtracting its minimal value.

Image segmentation

The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images.This work carried out segmentation of an image into foreground and background using global threshold.Segmentation using a global threshold where binary image is computed B by threshold. Fig 3shows segmentation of input image using global threshold at threshold value 55.

In this case, $B(i,j) = 1$ if $I(i,j)>th$, else $B(i,j) = 0$. Ideally, $B(i,j) = 1$ if the pixel (i,j) belongs to the rice region, and it is 0 if it belongs to the background.
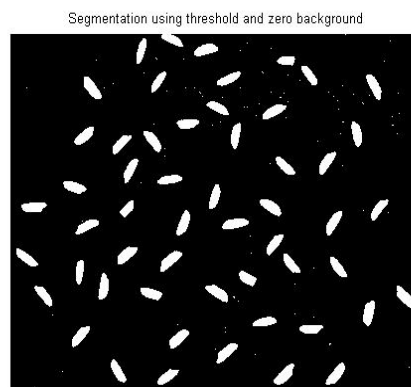

Fig 3 Segmentation of rice image at threshold =55

Area opening

It is also known as elimination of small regions or isolated pixels. The new segmentation image might have isolated pixels. They correspond to noise in the background. In this part, those pixels are eliminated using the function bwareaopen(BW, P) removes from a binary image all connected components (objects) that have fewer than P pixels.

Labelling of regions and connected components

In order to perform a pattern recognition approach each isolatedregion is labelled using the command 'bwlabel'.L = bwlabel(BW, n) returns a matrix L, of the same size as BW, containing labels for the connected objects in BW. Function bwconncomp() [CC = bwconncomp(BW)] returns the connected components CC found in BW. The binary image BW can have any dimension. CC is a structure with four fields. bwconncomp uses a default connectivity of 8 for two dimensions.

Feature Extraction

Features of Rice grains are extracted usingthe function regionprops().The features extracted in this work are: Area, Major Axis Length, Minor Axis Length,Eccentricity and Perimeter.

Training of Neural Network

The nprtool leads through solving a pattern-recognition classification problem using a two-layer feed-forward patternnetnetwork with sigmoid output neurons[1].A three-layer feed-forward network, with sigmoid hidden and softmax output neurons, can classify vectors arbitrarily well, given enough neurons in its hidden layer.

Neural Network Architecture

The default network for pattern recognition problems is, patternnet, is a feedforward network which is created using a function patternet() with number of hidden layer size as an argument.
The pattern recognition neural network is built with

- Five neurons in input layer.
- 'n'neurons in the hidden layer where n>1
- Four neurons in the output layer.

The number of neurons in input layer depends upon the number of input elements(features) and number of neurons in output layer is equal to the number of elements in the target vector.The neural network training performance mainly depends on the number of hidden layer neurons. Usually as the number of hidden layer neurons increased performance of the neural network is also elevated. But consequence of increasing the number of neurons will complicate the network. This work has a provision for setting any number of hidden layer size during neural network training.

Five features considered are Area, Major axis Length, Minor axis Length, Eccentricity and perimeter. This work is carried out by considering 20 sample images of four types of rice grains i.e Basmathi, Sona Masuri, Paraboiled and Jeera rice. Each image contains approximately 50 grains. This system is also designed to take any number of sample images for input feature dataset creation.

Training Network

Asupervised learning backpropagation algorithm is used to find the function that best maps the set of inputs to its correct output and these are used to train feedforward network.The matlab neural network tool provides various backpropagation algorithms to train a pattern recognition neural network. These algorithms are implemented as a functions in matlab. These functions take network, Feature dataset and Target Dataset as input arguments. Yield of these functions are newly trained network (net) and training record (tr).

Input Vector: Input vector is a 5x1119 matrix, representing static data: 4 features of 1119 rice grains.
Target Vector: Target vector is a 5x1119 matrix, representing static data: 4 classes to which input data is mapped.

Present work provides anoption for selecting one among the twotraining functions listed below.

- Leven berg-Marquardt back propagation.
- Scaled conjugate gradient back propagation.

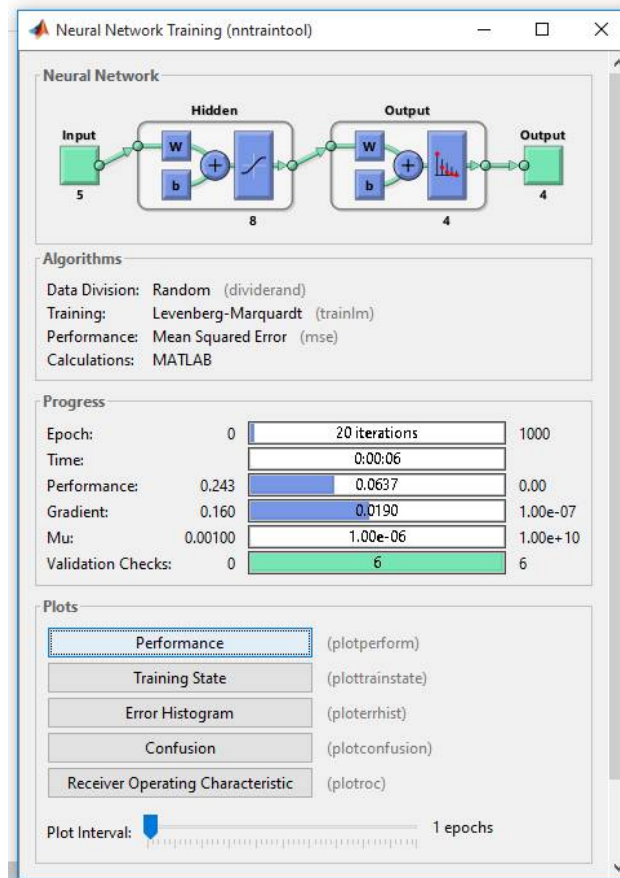The created neural network architecture and training in progress is shown in Fig 4

Fig 4An algorithm and its progression.

IV. EXPERIMENTAL RESULTS

Experiments are carried out with 20 sample rice images each containing 50-100 rice grains. These sample images are used to create the input feature dataset. Once training feature dataset and Target dataset is created the feedforward pattern recognition neural network is created and trained.

In this work there is a provision for selecting neural network training algorithm and also the number of hidden layer size.An experiment is carried out with approximately 1119 rice grains Basmati, Sona masuri, Paraboiled andJeera rice with 320,273,232 and 294 grains of each type respectively. Input feature dataset is created using these images to train a neural network. The result of training a neural network using different algorithm and hidden layer sizes are shown in below table.The result of classification is obtained by confusion matrix in the form of percentage of classification accuracy. Table1 shows the percentage of successful classification of input sample rice grains for two types of training algorithms with various hidden layers ranging from 4 to 8.

Table 1 Rice Classification Result

Training Algorithm Performance					
Algorithm	4	5	6	7	8
Levenberg-Marquardt	74.4	74.9	82.1	85.4	91.3
Scaledconjugate gradient.	72.8	73	80.1	82.33	88.6

Once the network is trained it is used to identify the type of the rice. It is clear from the Table 1 that network trained with Levenberg Marquardt with 8 hidden layer neurons is well trained.Based on this training performance, the best trained network is used for identification of rice type. Fig 5 shows the result of experiment where Parboiled rice image was taken as test input and it was successfully identified by the system.Given any new rice image the trained network is able to identify the type of rice successfully.
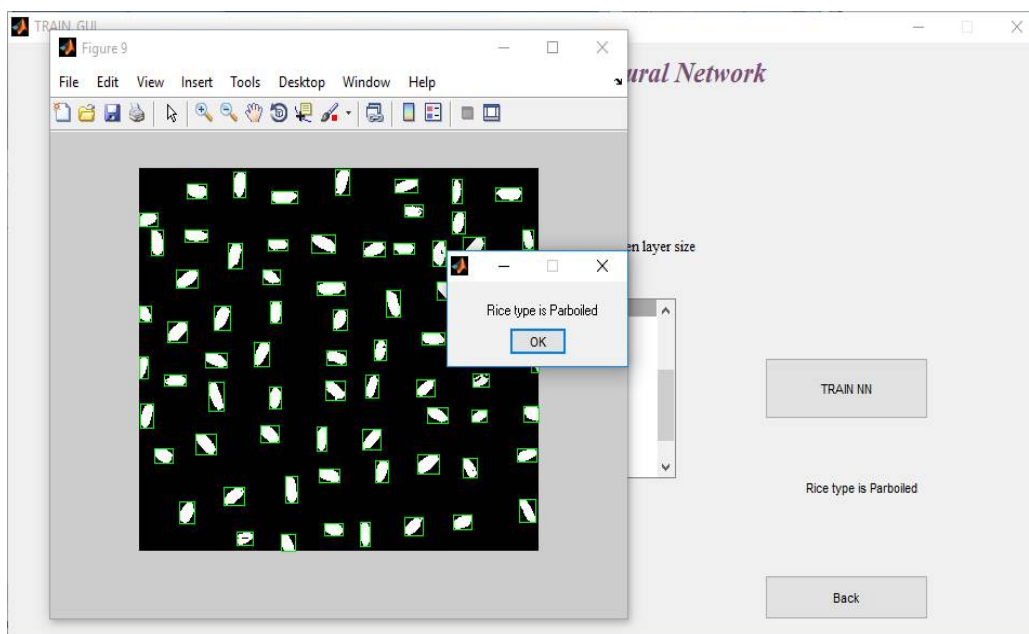

Fig 5 Experimental Result

V. CONCLUSION AND FUTURE WORK

The processing of imagery and the vigilant assortment of the variety measured in this effort for extracting features from rice granules significantly abridged the intricacy of the classification problem. This work presents classification accuracies for rice grains obtained through image processing with neural network architecture. Neural Network Pattern Recognition Tool is lucratively applied in grading rice granules. The developed Neural Network is adapted for classifying and identifying added grains with the accuracy of 91.3%.

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

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BIOGRAPHY

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