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Rice Disease Identification using Pattern Recognition Techniques

Santanu Phadikar and Jaya Sil

Dept. of CSE, West Bengal University of Technology, Kolkata700064, India, sphadikar@yahoo.com
Dept. of CST, Bengal Engineering and Science University, Howrah-711103, India, jayasil@hotmail.com

***Abstract* ---- The techniques of machine vision are extensively applied to agricultural science, and it has great perspective especially in the plant protection field, which ultimately leads to crops management. The paper describes a software prototype system for rice disease detection based on the infected images of various rice plants. Images of the infected rice plants are captured by digital camera and processed using image growing, image segmentation techniques to detect infected parts of the plants. Then the infected part of the leaf has been used for the classification purpose using neural network. The methods evolved in this system are both image processing and soft computing technique applied on number of diseased rice plants.**

Index Terms -- **Fractional zooming , leaf blast(Magnaporthe grisea), brown spot (Cochiobolus Miyabeanus), rice diseases detection, SOM,**

I. INTRODUCTION

Research in agriculture is aimed towards increase of productivity and food quality at reduced expenditure and with increased profit, which has received importance in recent time. One of the vital components of crop management is accurate diagnosis and timely solution of the field problem. Diagnosis is a most difficult task to perform manually as it is a function of a number of parameters such as environment, nutrient, organism etc. With the recent advancement in image processing and pattern recognition techniques, it is possible to develop an autonomous system for disease classification of crops.

Use of various pesticides for controlling the diseases actually damages the rice field. Most common rice diseases are [1],[2],[12] *leaf blast* [5],[7] (Magnaporthe grisea), brown spot (Cochiobolus Miyabeanus), leaf blight, sheath rot, steam rot, kernel smart, etc. and most common pests includes yellow stem borer, rice leaf folder, rice bug. The visual symptoms of the damages caused by the pests vary with the severity of the diseases. We have restricted our work within the rice diseases only and considered the most two common diseases in the North East India, namely Leaf Blast (Magnaporthe grisea) and Brown Spot (Cochiobolus Miyabeanus).

Unprecedented growth in research in the area of image processing and computer vision has been observed during the last two decades, yet no remarkable application of the techniques found in the field of agriculture**.** However, the International Rice Research Institute (IRRI) has developed a software named Rice Doctor [2] that suggest name of the diseases by taking the manually observed information about the infected plant. In a recent project a prototype system of automatic identification of cotton insect pest and intelligent decision based on machine vision has been developed [3] while remote sensing technique is being used experimentally for farm pest management [6]. Another effort found in literature that tries to determine the mineral deficiency based on the color texture analysis of rice leaf [4].The proposed work is to identification of the pest and/or disease depending on the damage symptoms obtained from the infected parts of the plants using image processing and pattern analysis methods. Thus, the system will able to timely diagnosis the field problem and the suggestion helps the farmer to take the appropriate measures to increase the quality of crops and reduce the development cost, which save the environment too.

The paper has been divided into five sections. Section II describes the feature extraction methods that include region segmentation, boundary detection and spot detection of images. Section III narrates the proposed zooming algorithm used to interpolate points in the detected spots, which are subsequently applied for classification of diseases along with the results illustrated in section IV. Conclusions are summarized in section V.

II. FEATURE EXTRACTION

The samples of the infected rice leaves have been collected from different parts of East Midnapur, a major rice producing district of South Bengal, India.

The images have been grabbed using Nikon COOLPIX P4 digital camera in macro mode. The samples of the rice leaves affected by Blast and Brown spots are shown in the Fig.1.

A. Segmentation

Acquired images are enhanced by increasing brightness and contrast and then transformed to Hue Intensity Saturation (HIS) model for segmentation. Entropy based bi-level thresholding method [10] has been invoked for segmenting the images to facilitate identifying the infected parts of the leave. The segmented images are presented in Fig.2.

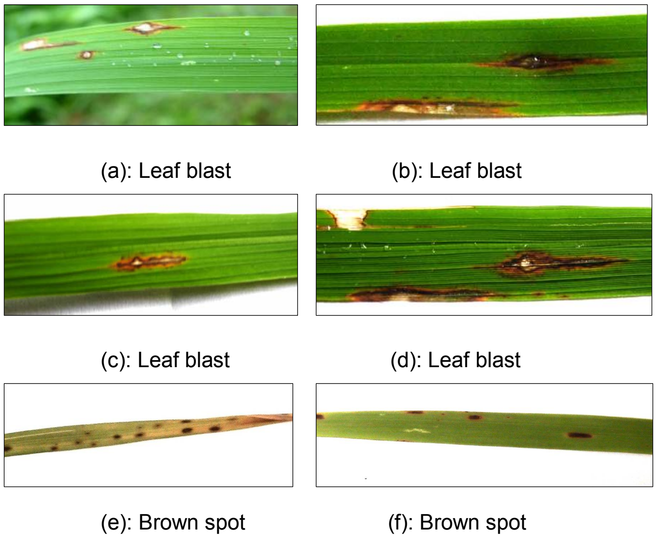

Fig. 1. Original images of infected rice leaves

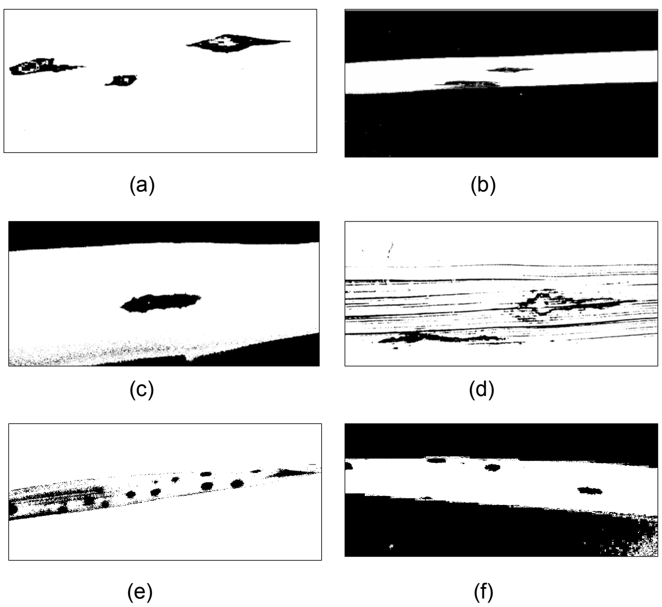

Fig. 2. Segmented Images Corresponding to Fig. 1

B. Boundary Detection

Boundary detection algorithm using 8-connectivy method [9] has been applied on the segmented images of figure 2(a) and (b), and outputs are shown in Fig.3.

C. Spot Detection

Boundaries of the segmented images are obtained with varying image sizes 300×300 to 1500×1500. The ratio of the

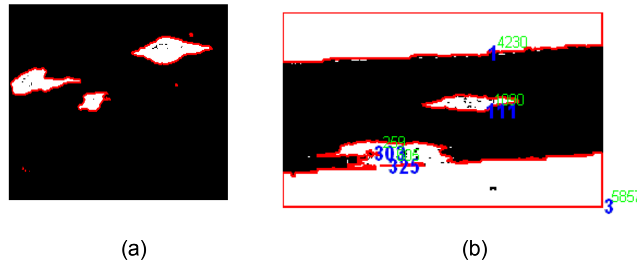

Fig. 3. Images after boundary detection

average value of the green components and intensity of the pixel lies in between 1.15 to 1.40 respectively and the measurement is used to identify the infected spots. The reason of selecting the green component is based on the observation that when the infection occurs in the leaf, the greenness of the leaf is affected most. Instead of considering only the green value we have taken the ratio of green component with the intensity to make the spot detection invariant of the brightness of the images and the age of the leave. The values have been determined heuristically based on the experiments of the hundred of infected leave, shown in Fig. 4.

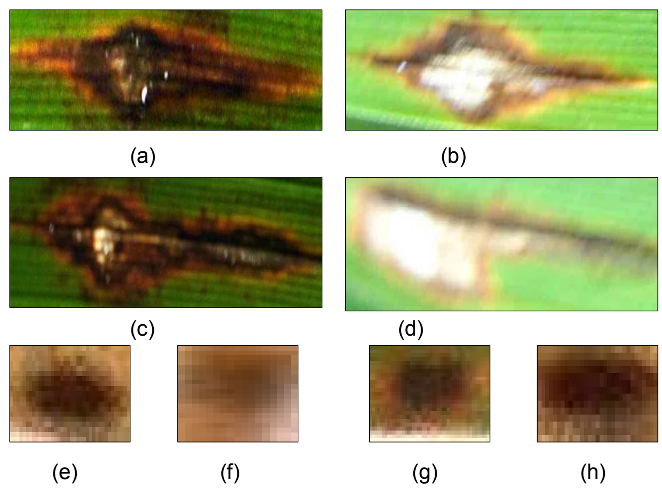

Fig.4. Label (a) to (d) represent the spots of blast and label (e) to (h) represent the brown spots.

III. ZOOMING ALGORITHMS

Self organizing map (SOM) neural network has been employed for classification [8], [11] of the images where gray value of the pixels of spot images are fed as input. Segmented spots have been normalized to the 100×80, which is determined by the average size of the spots, detected in the previous section to apply it in SOM. There are two possible methods to make the input vector of same size. First one is the padding of zeros in the input vector and the second one is the interpolation of missing points to make the input vector of same size. Since there is wide difference amongst the spot sizes, the missing points are often more than the original points, which may cause a significant effect in the classification process, if the former method is opted. Thus, interpolation method has been applied for fractional zooming to normalize the spots size.

The interpolation algorithm works as follow:

Step 1. Determine the scaling factor s_x=100/m and s_y=80/n where $m \times n$ is size of the original image.

Step 2.

(i) All points of the original image located at (i,j) position are placed in the ((i*s_x – s_x/2), (j*s_y - s_y/2)) position as shown by yellow points, with gray values a, b, c and d (figure 5).

(ii) Scan first row wise, then column wise and calculate the gray value of intermediate points, like x (shown in figure 5) by using equation (a*d_1+b*d_2)/(d_1+d_2) where d_1 and d_2 is the distance from a to x and x to b respectively.

(iii) Scan row wise and any points with gray value y, which not computed yet (figure 5) is calculated as the average value of its four neighbor. Note that, only the points whose gray values are already computed in the previous steps, used to compute the gray value of y.

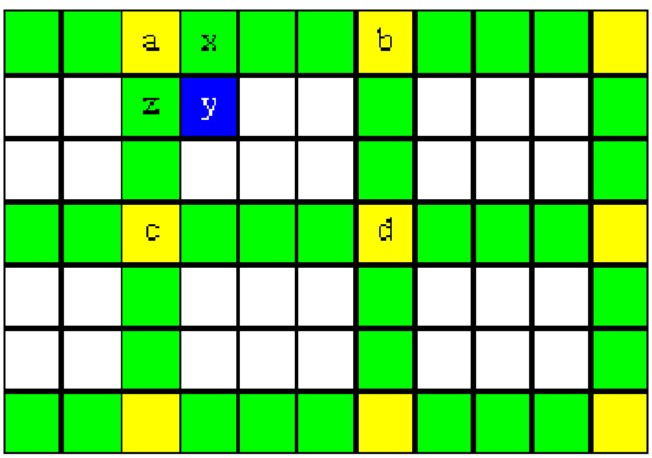

Fig. 5. Illustration of zooming algorithm

The results obtained after zooming, shown in Fig. 6.

IV. Classification using SOM

After obtaining spots of uniform size, unsupervised learning technique SOM is used. Here we have used 100×80 input nodes and 2 output nodes, 300 training patterns and 50 epochs to train the network. Here the gray values of the pixels are applied as the input vector. After performing training with the above mention datasets and 50 epochs, we

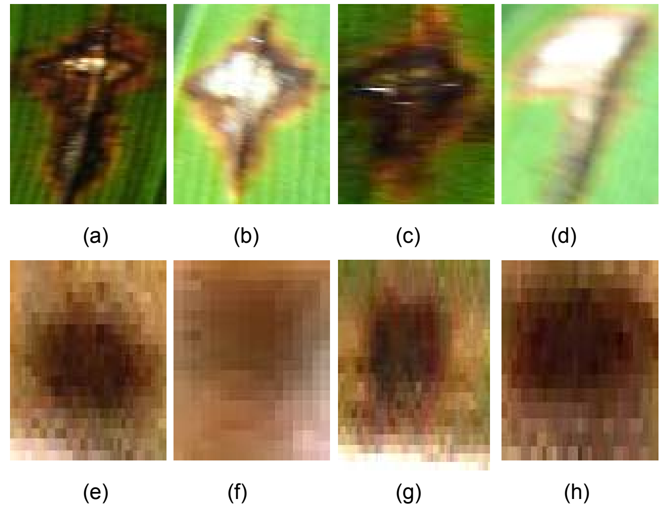

Fig. 6 Zoomed images corresponding to Fig.4

have tested the system with 300 input datasets for each of the cases separately, given below :

Case 1: Use the RGB of the spots for classification.
Case 2: Use the Fourier transform of the spot.
Case 3: Use the Arbitrary rotation of the 50% spot.
Case 4: Use the Fourier transform of the 50% rotating spots.

The result has been shown below obtained after applying.

TABLE I
Classification Results

Category	Percentage of successful classification
Case1	92%
Case2	84%
Case3	82%
Case4	70%

V. Conclusion

In the paper, the diseased rice images are classified using SOM neural network where train images are obtained by extracting features of the infected parts of the leave while four different types of images are applied for testing purposes. The zooming algorithm extracts features of the images using simple computationally efficient technique, which results satisfactory classification for test images. It has been observed that the transformation of image in the frequency domain does not yield a better classification compare to the original image.

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