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Cotton Leaf Disease Detection & Classification using Multi SVM

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Abstract: Agriculture is an important source of livelihood where 65% population is depend on it. The crop loss due to disease is increasing day by day which affects on the quality and productivity of crop. As diseases on the crop are certain, the early disease detection of the crop plays major role to control the loss in agriculture. In the proposed disease detection system, the work is carried out on cotton leaves. Initially the infected region is captured and pre-processed by converting captured RGB image to other color space. During segmentation, leaf as well as diseased part is segmented using Otsu's global thresholding method and different features are extracted such as color and texture with the help of color-co-occurrence method. Finally classification technique is used for detecting the diseases with the help of Multi SVM (Multi Support Vector Machine) classifier.

Keywords: crop, disease, color, feature, Multi SVM.

I. INTRODUCTION

Cotton is one of the most important fiber crop which is used as raw material in textile industries. But, now-a-days cotton is facing number of problems related to the healthy growth of crop due to diseases. These diseases are reducing the productivity of cotton crop and farmers are getting suffered financially due to this crop loss. Mainly occurring diseases on cotton crop leaves are:

1. Red Spot Disease (Lalya Rog) - Leaf affected by red and brown color spots.
2. White Spot Disease (Pandhari Mashi) - Leaf affects by white and yellowish color spots.
3. Crumple Leaf Disease (Kokada) - Leaf gets curled upward or downward.

These are the diseases which affect the cotton crop in large amount. To reduce the loss of cotton crop due to these diseases, it is important to detect the disease in early stage. Thus, the major objectives of the proposed disease detecting system are to study different types of diseases and its detection techniques for developing simple, robust and less computational time algorithm. The system should be automatic with more accurate disease detection.

II. LITERATURE SURVEY

As the crops are facing number of challenges due to the affect of disease on it, it is very important to detect the disease in early stages to avoid the further loss.

[1] This disease detection is mainly done by three ways i.e. Visual Analysis, Image Processing and Optical Sensor. By using these three methods, the system can be developed to detect the disease earlier. But as we go through these methods, we come to some advantages and challenges. Disease detection by Visual analysis does not give the accurate output while in case of optical sensor, the system becomes more complex and costly. So, image processing is the only way to build the simple, robust and accurate disease detection system.

[2] While working with image processing, the database collection is the most challenging task. For database collection, it is important to collect the basic information about the crop and its diseases. A deep study should be done on the types of disease, their symptoms on crop and the patterns of disease. By observing the patterns of disease, the system will get designed.

The mainly occurring diseases on cotton crop are Bacterial disease, Fungal disease, Viral disease and diseases due to insects. The paper gives the detailing of these diseases.

[3] After the selection of image processing technology and types of disease, the proposed system is designed stepwise. Generally the image processing technique is based on 5 important steps i.e. Image Acquisition, Image Pre-processing, Image Segmentation, Feature Extraction and Classification. In this paper, all the steps are described in detail.

[4] During image pre-processing, it is very important to convert the original image to other color transform such as grayscale, binary, YCbCr, HSI and CIELAB. The proper

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selection of color transform is necessary for the post-processing. All the color transform techniques are explained in this paper.

[5] Post-processing mostly consists of two section, feature extraction and classification. Color, shape and texture are main features in the image processing for further classification.

[6] Classification is the final step to identify the disease. Artificial Neural Network (ANN), Decision Tree (DT), Support Vector Machine (SVM) and Fuzzy Classification are the classification techniques which can be employed for image classification. The comparative study of detection techniques is important.

III.PROPOSED SYSTEM

The proposed disease detection system is mainly divided in five steps. Each step performs some significant task.

Step 1: Image Acquisition
This is very first step for proposed disease detection system. In this step, the database images of cotton leaves are collected to process on it. These database images are captured through the high resolution camera and stored in jpg format. In the proposed system, the leaves are collected from Majalgaon, Chikhali and Aurangabad. Total 103 image samples are captured of four classes namely Red Spot Disease, White Spot Disease, Crumple Leaf Disease and Healthy Leaf. From these, 28 images are of Red Spot Disease, 26 are of White Spot Disease, 26 are of Crumple Leaf Disease and 23 are of Healthy Leaf.

Step 2: Image Pre-processing
The collected database is then processed through the computer system for pre-processing. Captured images stored in RGB format are then cropped and resized to some standard size. These resized RGB images are then converted to YCbCr format. YCbCr gives the luminance and chrominance information of the input image.

The luminance information of the image is stored in "Y" component and chrominance information is stored in "Cb", "Cr" components. "Cb" gives the difference between blue component and reference value while "Cr" gives the difference between red component and reference value. The YCbCr color space is defined as

$$Y = 0.299R + 0.587G + 0.114B$$
$$Cb = -0.169R - 0.331G + 0.500B$$
$$Cr = 0.500R - 0.419G - 0.081B$$

Step 3: Image Segmentation
Image segmentation step is used to segment or separate the object of interest by suppressing the unwanted part. In this step, the leaf part of image and diseased part of image is separated from background by thresholding on Y and Cr plane respectively.

The segmentation is performed by using Otsu's global thresholding method. This global threshoding method assigns particular global threshold value to compare with each pixel of input image. The pixel which satisfies the threshold condition is considered as object and rest of the pixels are assigned to the background. The background pixels are assigned to zero (i.e. black) and object pixels to one (i.e. white).

$$g(x, y) = 1 \quad \text{for } i(x, y) \geq T$$
$$= 0 \quad \text{for } i(x, y) < T$$

where, $g(x, y)$ = Output image pixel, $i(x, y)$ = Input image pixel, T = Threshold value.

Step 4: Feature Extraction
In this step, the features of segmented image are extracted. In image processing, image features generally includes color, shape and texture. In proposed system, color and texture features are used.

For texture feature, Color-co-occurrence method is used in which the input image is firstly quantized according to the defined NumLevels. This quantized image is then converted to Gray Level Co-occurrence Matrix (GLCM) by defining the angle and distance between two pixels. Finally from this GLCM matrix, the texture feature values are extracted for further classification.

Step 5: Classification
After extracting color and texture features, the classification is performed by using Support Vector Machine (SVM). As the proposed system consists of 4 classes, the multiclass classifier is used for the classification.

For classification, the database is divided in training phase and testing phase according to 60-40 pattern for each class. All the training database images are processed through all these steps and finally feature vector is saved by labelling the class (type of disease). The test image also undergoes through same steps and its feature vector will get compared with the trained feature vector for the final disease.

IV. SYSTEM RESULTS

The goal of our proposed system is to develop the disease detection algorithm that achieves the high recognition accuracy & high recognition speed. Disease detection & classification is carried out using real time leaf image database of 103 samples. Some database images are shown in Fig. 1.

In Fig. 1, two images of each class are shown. The pre-processing and post-processing is carried out stepwise on these input RGB images. Finally, the detected disease with its name and required recognition time is displayed. The results of all diseases are shown in following figures:

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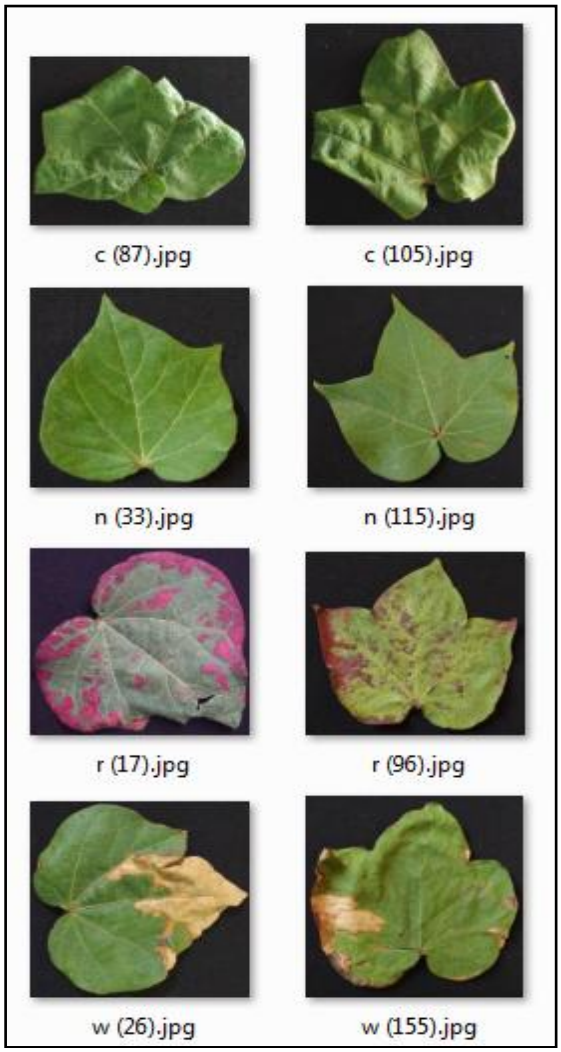

Fig. 1 Database Images

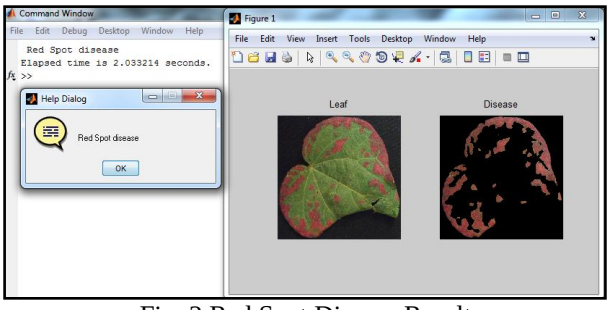

Fig. 2 Red Spot Disease Result

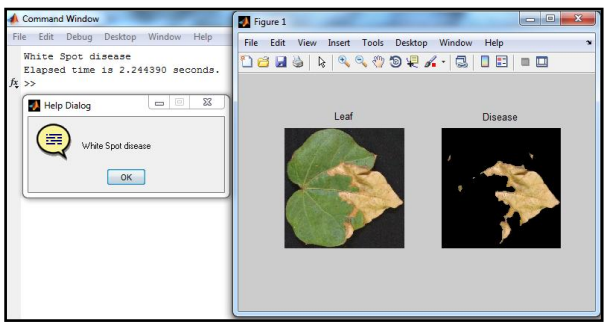

Fig. 3 White Spot Disease Result

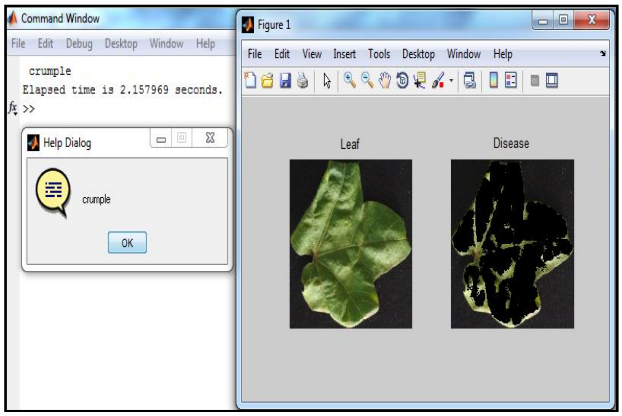

Fig. 4 Crumple Leaf Disease Result

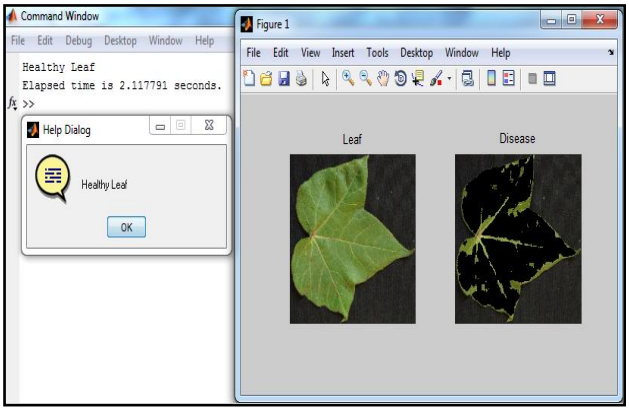

Fig. 5 Healthy Leaf Result

A. Recognition Accuracy

For the best recognition system, Recognition accuracy should be high. It is calculated as ratio of number of correctly recognized leaf image samples to the total number of samples used in testing. It is given as:

$$\text{Accuracy} = \frac{\text{No. of correctly recognized samples}}{\text{Total no. of test samples}}$$

The performance for the system is evaluated using those diseased sample images whose samples are not in data base. For each disease, 40% sample images of total images are considered. All the query images are tested with the system and following results are obtained:

TABLE I % RECOGNITION ACCURACY

Sr. No.	Class (Type of Disease)	% Accuracy
1	Red Spot Disease	100%
2	White Spot Disease	90%
3	Crumple Disease	60%
4	Healthy Leaf	100%
% Recognition Accuracy		**87.5%**

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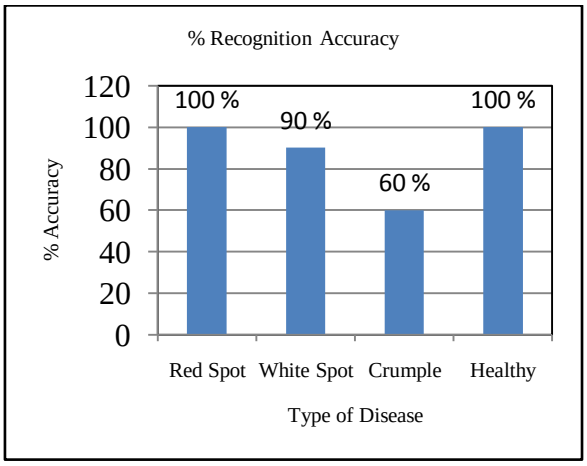

Fig. 6 Graph of % Recognition Accuracy of Disease

B. Recognition Time

The test/query image is given to the system initially. After that the system takes less than 2.1 sec to identify the type of disease. The Red Spot Disease takes averagely 2.01 sec, White Spot Disease 2.09, Crumple Disease 2.04 and Healthy Leaf 2.04 sec. Thus the average recognition time is less than 2.1 sec.

V. CONCLUSION

From literature, the study of three types of diseases and their detection techniques is done. After studying number of techniques, the method of GLCM for feature extraction and Multi SVM for classification is used in proposed system. The proposed system is tested on real time database of all types of leaves. The performance of the proposed method in terms of recognition accuracy and recognition time is obtained. It shows that the proposed method has high recognition accuracy which illustrates the robustness of the proposed system.

Automatic disease detection using Otsu's thresholding, GLCM and Multi SVM classifier gives good results for all diseases with very less recognition time upto 2.1 seconds. The recognition accuracy increases due to combination of GLCM and Multi SVM post-processes. The performance is evaluated by finding leaf wise accuracy for four different classes whose samples were not used in training data base. The overall recognition accuracy obtained for the system is 87.5%

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BIOGRAPHIES

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