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Plant Disease Detection and Pesticide Control Using Image Processing Technique

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Abstract: Majority of village people depend on agriculture for their live hood. Majority of farmers lag in technical knowledge and are adopting manual cultivation. The plants reduce its production if they get diseases. The diseases in plants are mainly through their leaves that effect the production of plant growth. Thus the identification of the disease in premature stage is the key for the plant growth for high yield of plant growth. To detect the disease manually, it needs more expertise, more knowledge and labor. The plant leaf identification is done by observing the visually patterns on the leaf. In this paper, the detection of plant diseases is done using image processing algorithms. The segmentation and exact algorithms are used in detection of plant disease. The plant leaves are taken as input for testing the disease. The diseases are detected with the help of high accuracy of 90 percent.

Index Terms **- K-means clustering, Image acquisition, Segmentation, feature extraction, SVM algorithm.**

I. INTRODUCTION

In our country, about 70 percent of economy depends on agriculture. If the crops get damaged then the economy can get affected. In the plant, the leaves are the sensitive part where the disease gets affected very soon. The symptoms of the disease [1] are first shown on the leaves. The plants need to be observed carefully from early stage till they are harvested. Olden days, the plants were observed with naked eye for disease which needed an expert for finding the disease and getting the correct treatment for it which was extremely [2] time consuming process. In the past few years, there had been many techniques for plant disease detection which were semi-automatic and automatic. These techniques were better and more accurate than the farmers [3] observing manually. The researchers are still behind deploying a fully automatic which don't need human intervention. The plant leaves check-up must be done properly for curing the plant disease within a short time by providing correct treatment to it. For disease detection image processing can be most helpful technique. In this paper, automatic detection for the plant detection at early stages is done. We have a used MATLAB based automatic detection for diseased leaves. The leaves are used as input for the disease detection. The image processing algorithm is applied on the leaf image for identification of diseased plant accurately.

Section II describes about the work done in the recent years on the plant disease detection. Section III tells about design methodology involved in the proposed system. Section IV explains about the proposed work. Section V explains about the results of the proposed system. Section VI explains about the conclusion of proposed system and the future scope.

II. PREPARE YOUR PAPER BEFORE STYLING

This section describes about various approaches for plant disease detection. Bashish et al. selected k-means segmentation for the leaf image partitioning into clusters [4] of four. This technique used feature extraction for co-occurrence color method. Later, neural network algorithm was applied. The whole method of detection of disease and its classification achieved an accuracy of 93 percent. Bhange M et al. used a tool which was based on web [5] for identification of the fruit diseases by using the image of fruit as input. The extraction of features for leaf was done using the colour coherence vector. By using the K-means the clustering was done. The Support Vector Machine (SVM) algorithm was used for classification of the leaves. The design could achieve disease detection with the accuracy of 82 percent for pomegranate plant. Singh V et al. used genetic algorithm [6] for automatic detection of plant diseases. The classification of the plant disease was done with image segmentation technique. The colour-co-occurrence method was applied for the extraction of the features for lemon, banana, rose and beans by texture and colour features. The SVM classified the diseased leaves with 95 percent accuracy and using K-means it could achieve 86 percent. Kiani.E et al. proposed a method [7] for detection of diseased leaves in strawberry plants using fuzzy decision maker. The accuracy was 97 percent in segmentation and detection of the disease. The time required for processing was 1.2 seconds. Ali H et al. used an algorithm [8] of colour difference for separating the affected areas in the disease. The system used the textual features and colour histogram for classification of diseases. Saradhambal G et al. designed [9] a system for automated detection plant disease. They used K-means algorithm and Otsu classifier for detecting the plant disease. The texture and shape features were extracted. Abirami D et al. used MATLAB [10] for illness detection in plants using image processing algorithm for supporting farmers for disease detection at early stage.

Using these literature review papers as base, we have designed a mobile application for farmers because most of the farmers know how to operate the basic mobile operations. This is done for continuous monitoring of the plant.

III. DESIGN METHODLOGY

3.1 SYSTEM ARCHITECTURE

The main objective is to design a mobile application for the farmers with user friendly features by using the best algorithms available for plant [11] disease detection. The figure1 explains the block diagram of the disease detection for plants and classification of the disease.

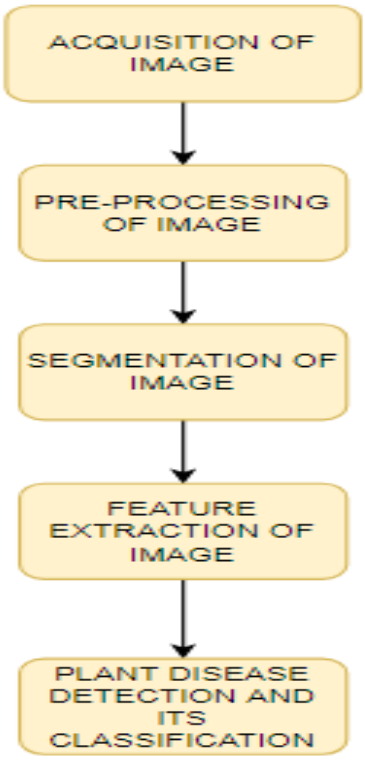


Fig1: basic block diagram disease classification and detection for plants

The basic steps for the classification and detection of diseases for plants are shown in figure 1.

1. *Acquisition of image:* The leaf images are captured by camera. The leaf image is transformed with RGB (Red, Green, Blue) image [12] of leaf. The final touches of tone and colour space transformation are applied for the acquired image.
2. *Pre-processing of image:* The redundant image parts are suppressed and enhancing the main features. The RGB image is converted to grey scale image by using the below equation.
   For boosting the disease part in the image, histogram equalization is used.

$$f(x) = 0.2989*R + 0.5870*G + 0.114.*B$$

3. *Segmentation of image:* The image after pre-processing is divided into segments. The segmentation filter out the bounding line and objects in the images. For border pixel labelling and spot [13] detection, K-means clustering algorithm is used which helps in getting the infected part of the leaf.

   K-means clustering: This algorithm collects the features of images into K number of cases. It also the total number of square gap between the cluster and the item. The steps for the algorithm are:
   a) The K cluster is centre is picked by heuristic or in random way.
   b) To minimize the space between cluster center and pixel, every pixel is assigned to the cluster within the image.
   c) Finally, averaging of the pixels inside the cluster is done to get cluster center. The above steps are repeated unless convergence is attained. It is explained in figure 2.

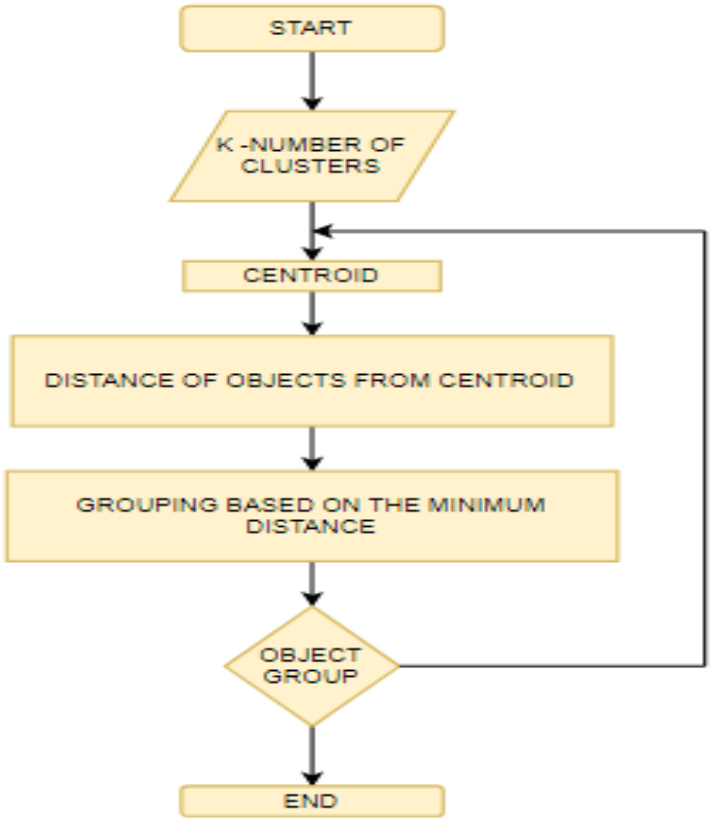


Fig 2: Flowchart of the K-means algorithm for clustering.

4. *Feature extraction of image:* This block helps in object identification. The features like texture, edges, colour etc. are used for plant disease detection. These features are extracted by using Colour co-occurrence method. The RGB image is converted to HSI (*Hue*, Saturation, and Intensity) image.
5. *Classification of image:* the objects are separated into groups with the mean of the cluster [14] as their centroid. The classification of the data is the input which is the final centroid set. The Probabilistic Neural Network (PNN) is used for disease classification.

3.2 PROPOSED WORK

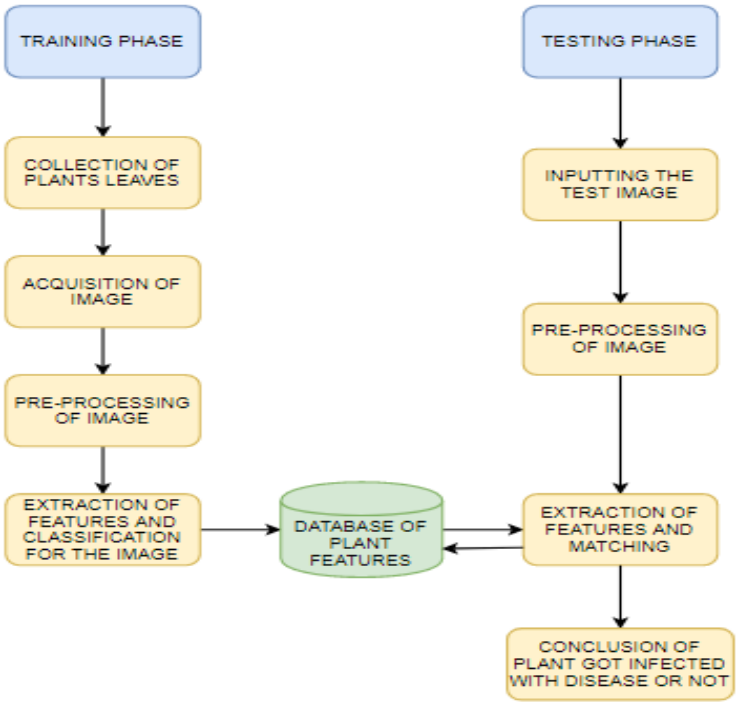


Fig3: the proposed system framework

The proposed system works in the following steps:

1) The images are captured from camera. The images captured are separated defective or non-defective sample leaf images. These images are stored in the database.

2) The pre-processing of the images is done for removing the noise and smoothing of the images. Using edge detection algorithm the leaf image is converted as a binary image.
3) Extract the important features and store the important features for training.
4) Use the PNN algorithm for the classification and training of images.
5) After the images are classified, the system detects the type of disease and recognizes it. The system also informs about the accuracy in the detection.

IV. RESULTS AND DISCUSSION

4.1 Results of Descriptive Statics of Study Variables

The proposed approach is used to test each image. The system is covered for four types of diseases. The diseases are Bacterial blight, altermaria altemata, cercospora and anthracnose.

Initially many kinds of different leaves are taken. Those images are fed for processing and segmentation and are separated into three clusters. Firstly, out of three clusters one of the cluster is selected. The prediction of disease is done for that particular cluster. The user is enabled for seeing the infected area and to calculating the area of infected place.

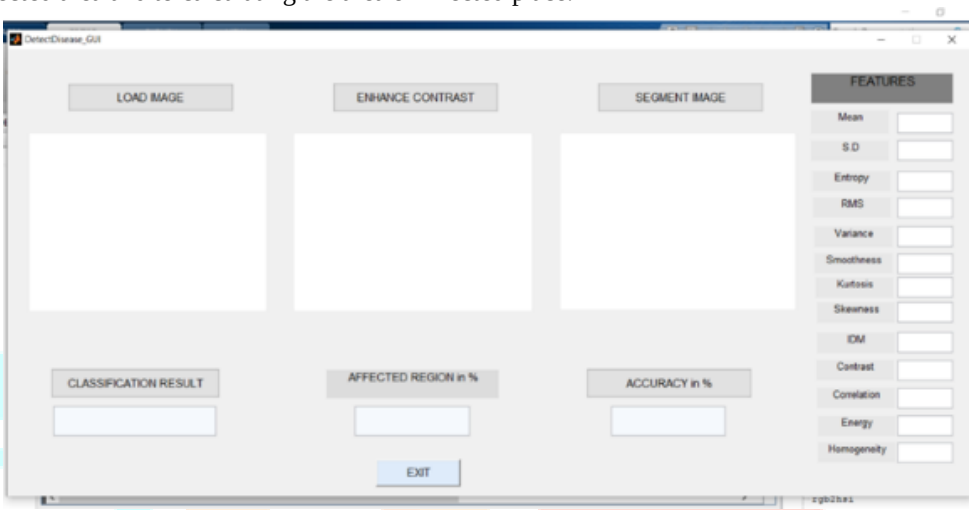


Fig 4: Main GUI of plant disease recognition system

The mobile application GUI (Graphical User Interface) is shown in figure 4. There is a user interface area with many special buttons for loading, enhancing and segmenting the image. The GUI is made for MATLAB. The button of loading the image let the user for image selection from the set of available images. The user can choose any image of the leaf, its loaded onto the GUI as shown in figure 5.

Fig 5. Loading the Image

Figure 5 shows the user image being loaded from the dataset of leaf images. The user can select any disease from and can be interfaced with the image. The old image can be replaced with the new one from the dataset by clicking the load button.

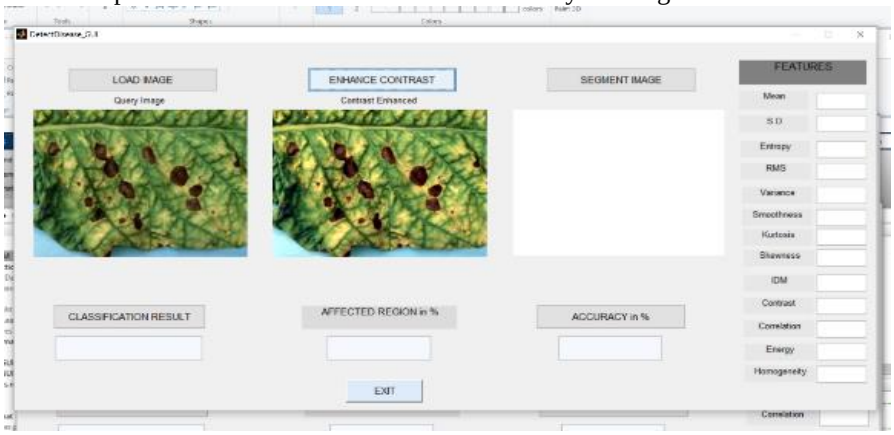


Fig 6. Enhanced Pre-Processing Image

The figure 6 shows the how the input image (query image) is enhanced. The diseased leaf dark spots get highlighted by enhancing the images. After enhancing the images it's easy to segment into many different clusters for predicting the plant diseases.

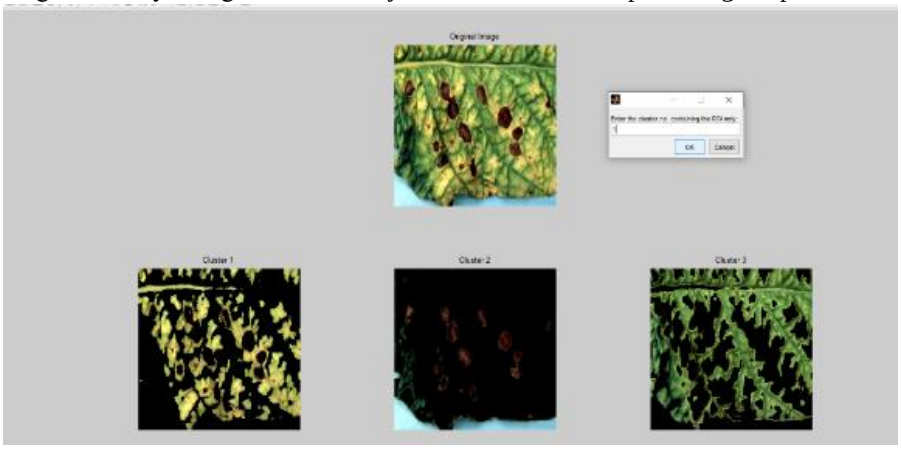


Fig 7: Segmented Image Clusters

After enhancing the images, the clusters are segmented for the input image. For the query image, is separated into three different clusters as shown in figure 7. The interested cluster for the user can be selected by entering the number from 1 to 3. User can choose the image with the maximum separation of colours.

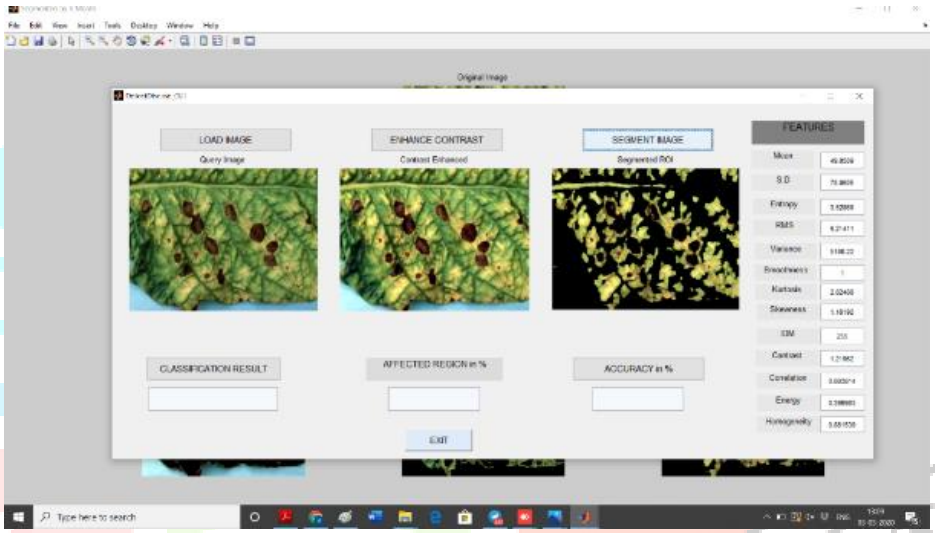
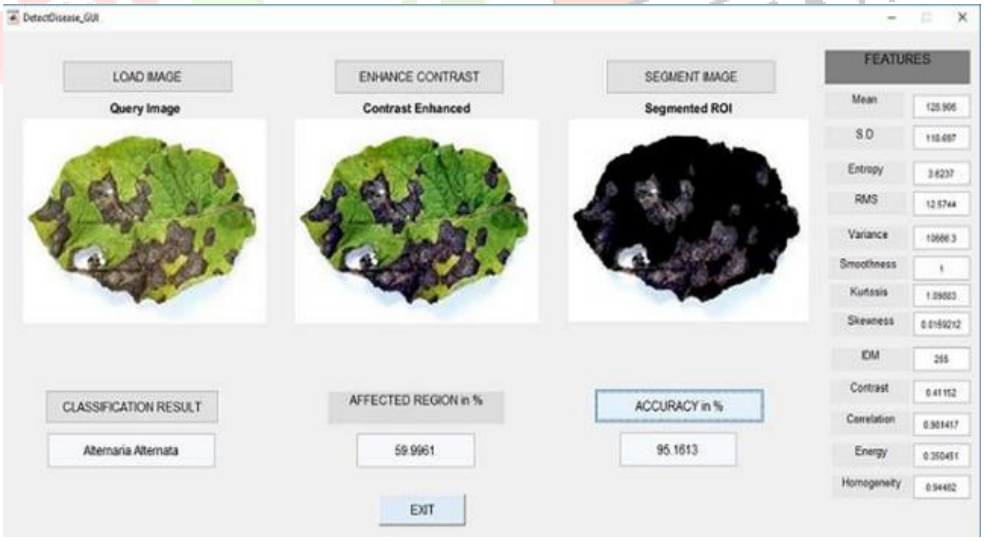


Fig 8: Segmented ROI

The interested cluster out of 3 is loaded in the segment box. The image is later passed through the PNN classifier to predict the disease for the leaf.



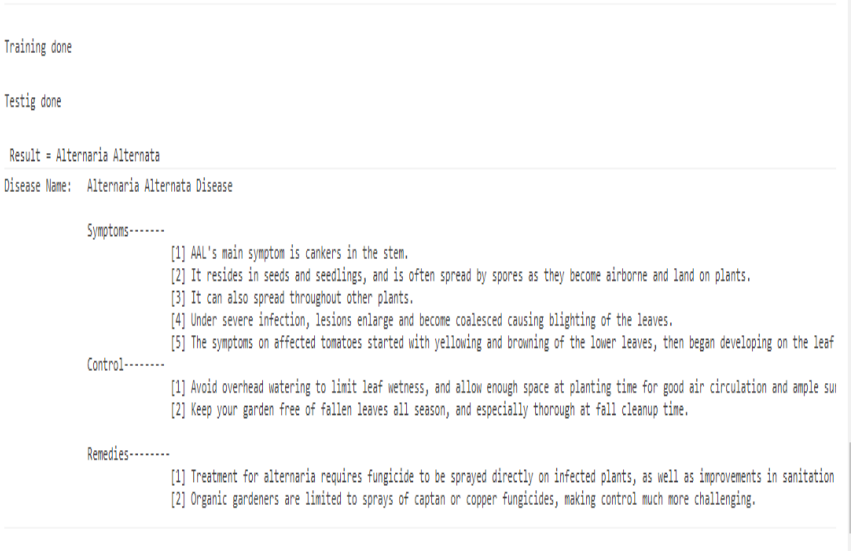


Fig 9: Disease Result

The figure 9 describes about the result that is got for altermaria altemata disease. The symptoms and the control are described for that particular disease.

Table 1: Descriptive Statics

Type of disease	Number of the images	Clustering time (s)	Area of the affected region (%)	Accuracy (%)
Alternaria Alternata	22	18	15.0062	95.1613
Anthracnose	23	17	15.3035	96.7742
Bacterial Blight	6	18	15.0077	96.7742
Cercospora leaf spot	9	19	15.5600	95.1613
Healthy leaves	15	20	None	96.7742

The table1 describes about the sample images for the various disease with average clustering time, average area being effected and the average accuracy achieved .The proposed system can be further enhanced by using artificial intelligence and machine learning algorithm for image processing. Using these algorithms higher accuracy can be achieved. The mobile application can still be enhanced by making it user friendly by decreasing the complexity.

V. CONCLUSION AND FUTURE SCOPE

The exact detection of the disease is important for the cultivation of crop. In the paper, the system was proposed and developed for disease recognition. The diseases for the various plants are identified and the affected area is also observed. We extracted many features of the leaf with their numeric values. Within twenty seconds, almost 90 percent of images clustering were done. A plant leaf was chosen. The leaf after performing the preprocessing, enhancement and segmentation, the disease detected is Altermaria. The infected area region is also shown in percentage. It tells how much area is infected with respect to the whole leaf. For checking the accuracy of proposed system, a five hundred iterations are done. The image every time is chosen with the different clusters then accuracy is predicted. Later the proposed system was tired for the many leaf images and the details are given in the table1 for the estimation of area, timing and the accuracy.

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