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Detection and Classification of Plant Leaf Diseases in Image Processing using MATLAB

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***Abstract*: About 70% of the India economy depends on agriculture. Due to environmental changes such as rainfall, temperature, the crop yield gets affected severely. *Phaseolus vulgaris* L. is an important food legume crops and provide essential diet for millions of people across the world. It is affected by various diseases out of which Anthracnose are of major importance. Anthracnose disease is caused by fungus *Colletotrichum lindemuthianum*. *Camellia assamica* (J. W. Mast.) W. Wight is one of the most popular non-alcoholic beverage crops in the world. The leaf gets severely affected by fungus *Alternaria alternata*. Development of automatic detection system using advanced computer technology such as image processing help to support the farmers in the identification of diseases at an early or initial stage and provide useful information for its control. Therefore the present study was carried out on automatic disease detection of plant leaf of *Phaseolus vulgaris* (Beans) and *Camellia assamica* (Tea) using image processing techniques. It involves image acquisition, image preprocessing, image segmentation, feature extraction and classification.**

***Keywords: Phaseolus vulgaris, Camellia assamica*, image acquisition, image segmentation, feature extraction.**

I. INTRODUCTION

About 70% of the India economy depends on agriculture [1]. Due to environmental changes the crops get heavily affected and characteristics symptoms such as leaf spot, dryness, color change and defoliation occurs. Development of automatic detection system using advanced computer technology such as image processing help to support the farmers in the identification of diseases at an early or initial stage and provide useful information for its control [2]

Detection of leaf spot disease using following techniques such as image acquisition, image pre-processing, disease spot segmentation, feature extraction and disease classification were carried out by various workers [3]-[4]. [5] Proposed methodology like K-mean clustering, texture and color analysis for plant disease detection in *Malus domestica*. The authors [2] reviewed various symptoms and diseases of banana leaves. Algorithms were used for the detection of disease. They also explained the importance of pattern classification for disease identification. [6] Made study on the disease severity of leaf using image processing techniques. They used feature extraction such as threshold and triangular threshold methods. Identification of diseased leaf of blast and brown spot of rice using image processing techniques were carried out by [7]. They used zooming algorithm, SOM neural network for disease detection. The authors [8] made investigation on Early scorch, Ashen mould, Late scorch, Cottony mold and Ting whiteness diseases of plants using K-Means clustering, Back propagation algorithm and CCM. [9] Made study on chilly diseases using image processing techniques which involves morphological processing, color clustering, LABVIEW IMAQ Vision. Leaf disease detection of orchid leaf such as Black leaf spot and Sun scorch was carried out by [10]. They applied border segmentation and pattern classification techniques for detection of diseased leaf.

The present work has been carried out for the automatic disease detection of plant leaf of *Phaseolus vulgaris* (Beans) and *Camellia assamica* (Tea) using image processing techniques.

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Phaseolus vulgaris L. is an important food legume crops and provide essential diet for million of people across the world [11]. It is affected by various diseases out of which Anthracnose are of major importance. Anthracnose disease is caused by fungus *Colletotrichum lindemuthianum*. Symptoms are sunken, elongated and circular lesions appears on the leaf petiole and veins and on the under surface of the leaves [12].

Camellia assamica (J. W. Mast.) W. Wight is one of the most popular non-alcoholic beverage crops in the world [13]. The leaf gets severely affected by fungus *Alternaria alternata*. Disease symptoms first appear as greyish, brown patches around the tip and margin of young leaves. The lesions extend towards the midrib, resulting in leaf curl, death and defoliation [14].

II. MATERIALS AND METHODS

The following are the steps for plant leaf disease detection and classification using image processing:

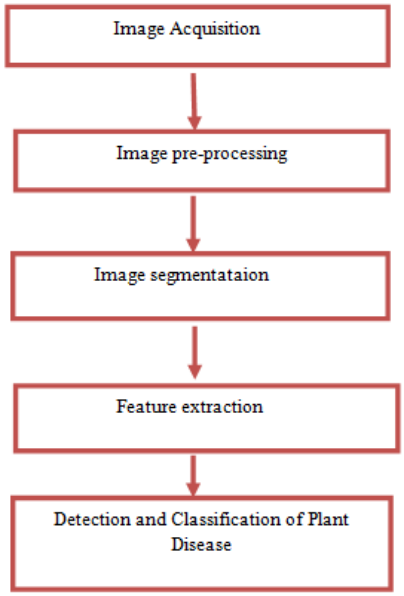

Figure 1: Block diagram of basic steps for plant disease detection and identification

Image acquisition

Image acquisition involves capturing the images with the help of digital camera. Our study focussed on the diseased images of leaf of *Phaseolus vulgaris* and *Camellia sinensis* which were stored in digital media for further MATLAB operations.

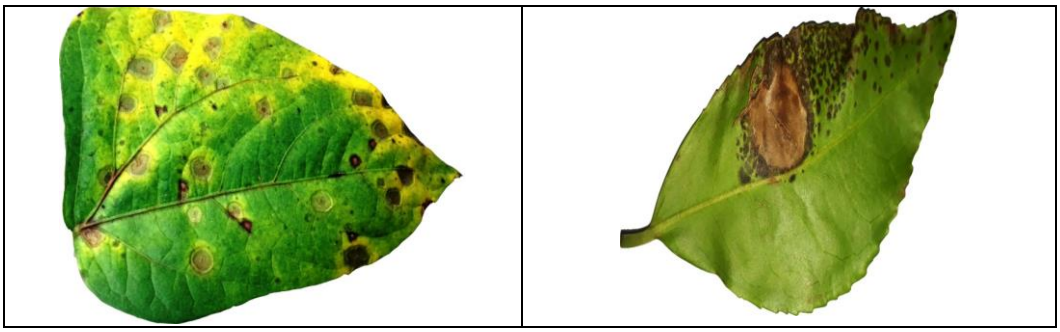

Figure 2: Original image of the diseased leaf of *P. vulgaris* and C. *sinensis*

Image Pre- processing:

Image Pre- processing is carried out to improve the quality of the image and remove the unwanted noise in image followed by clipping and smoothing of the image. The image enhancement is carried out to increase the contrast. The RGB images are converted into grey images using colour conversion by the following formula:

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$F(x) = 0.2989*R + 0.5870*B + 0.114*B$.....(1)

Then histogram equalization is applied in which the intensity of the image is distributed using cumulative distribution function [15].

Image Segmentation:

This method is used for the conversion of digital image into various segments having some similarity. Image segmentation helps in the detection of objects and boundary line of the image. In our study K- mean clustering is done for classification of objects based on a set of features into K number of classes. The classification is done by minimizing sum of squares of distance between data objects and corresponding cluster [1].

Feature Extraction:

In feature extraction method features such as color, texture, morphology and structure are used in plant disease detection. Color co-occurrence method is used in which the texture and color of the image are considered. The methods used in color co-occurrence are firstly the RGB image of the leaves are converted into HIS color space representation. For generation of color co-occurrence matrix each pixel map is applied which results into three color co-occurrence matrix one for each of H, S, I [1].

$X = 0.5 \{(R-G) + (R-G)\}$

$Y = \sqrt{(R-G)^2 + (R-B)(G-B)}$

$\theta = \text{acos}(\frac{x}{y})$

$H = \{\theta \quad \text{if } B<G\}$

$360-\theta \quad B>G$

$S = 1- \frac{3}{(R+G+B)} * [\min (R,G,B)]$

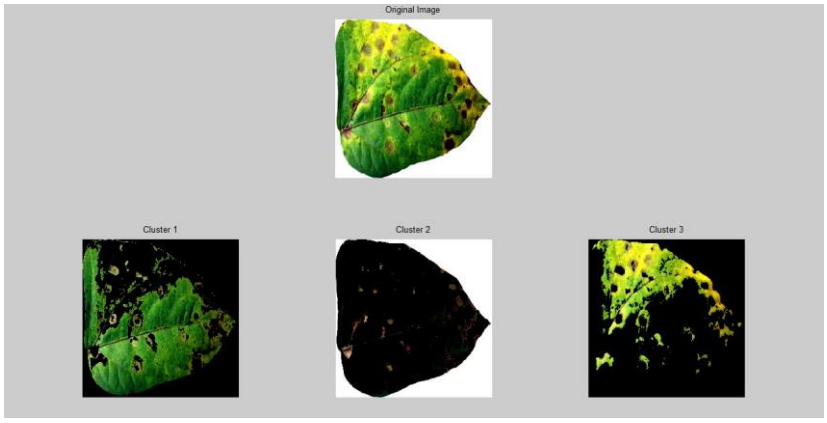
$I = \frac{1}{3}(R+G+B)$

Classification:

Classification is used in the interpretation of the extracted diseased region in an image which helps in the identification of the type of disease infection in leaves. In our analysis back propagation neural network (BPNN) is used which build association between known pattern of input and specific output. The input layer analyzes the diseased region while the output layer specifies the disease outcome of the affected region. A hidden layer occurs in between the input and output layer which provides connecting link between the input and output images. It is applied to obtain least error in the classification of disease of the affected region [2].

III. RESULTS

The results of the leaf disease detection are as follows:



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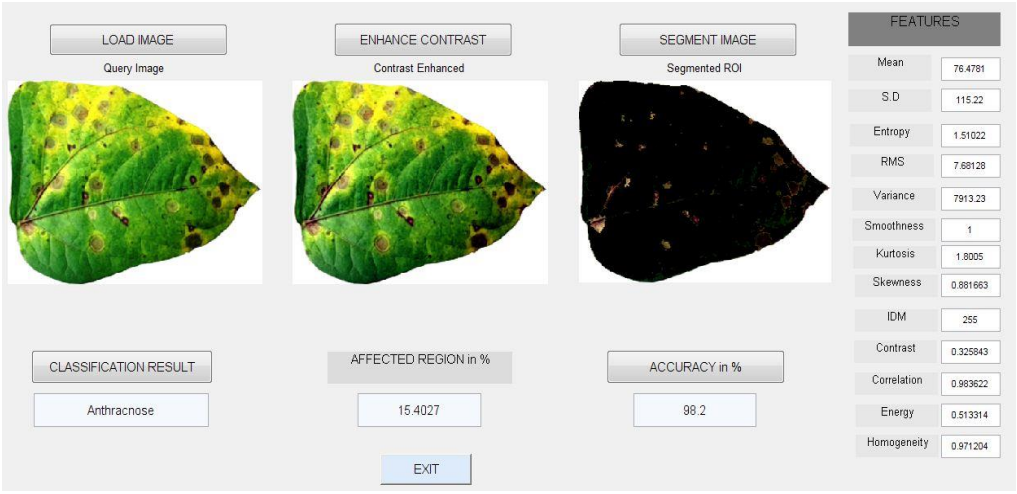

Figure 3: System shows leaf disease detection of *P. vulgaris* using digital image processing techniques

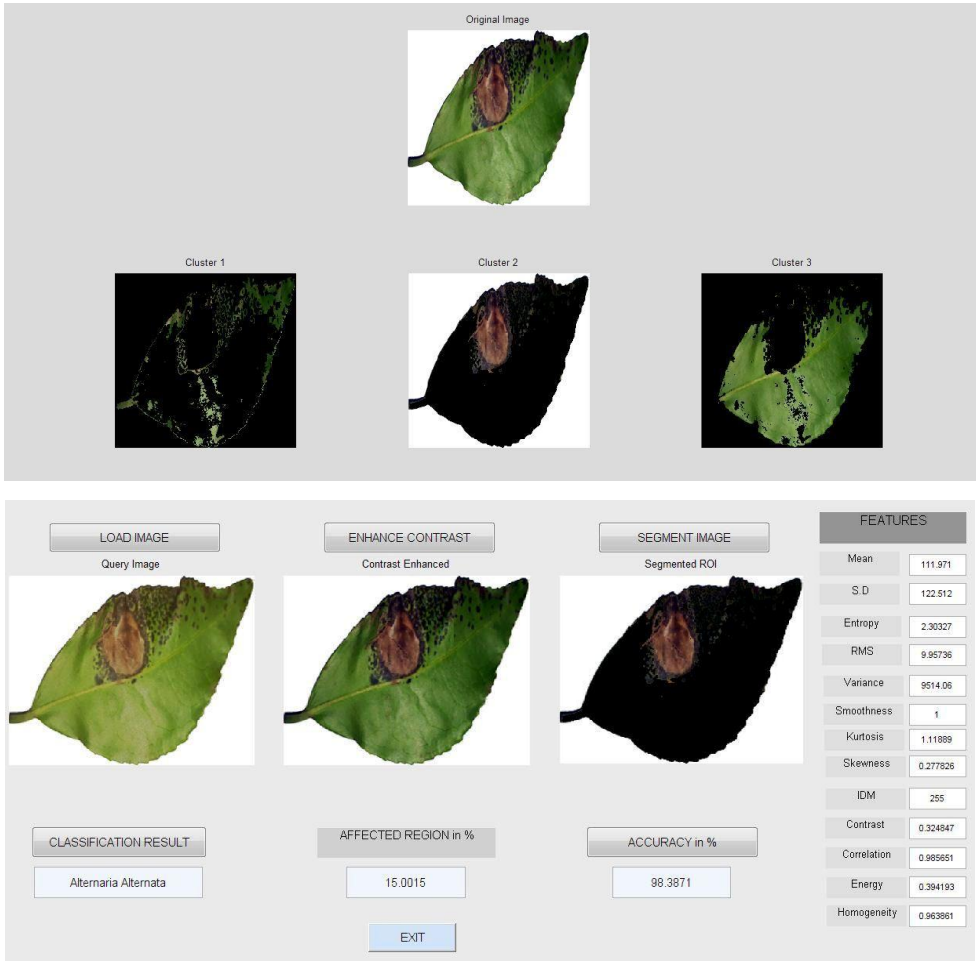

Figure 4: System shows leaf disease detection of *C. assamica* using digital image processing techniques

IV. CONCLUSIONS

The present study deals with automatic disease detection of plant leaf of *Phaseolus vulgaris* and *Camellia assamica* using image processing techniques. It involves image acquisition, image preprocessing, image segmentation, feature extraction and classification. Development of automatic detection system using advanced computer technology such as image processing help to support the farmers in the identification of diseases at an early or initial stage and provide useful information for its control. We would like to extend our work further on more plant disease detection.

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