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LEAF DISEASE IDENTIFICATION AND CLASSIFICATION USING K-MEANS CLUSTERING

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ABSTRACT

Agricultural productivity is something on which economy highly depends. Plants are main source of food. This is the one of the reasons that disease detection in plants plays an important role in agriculture field, as having disease in plants are quite natural. If proper care is not taken in this area then it causes serious effects on plants and due to which respective product quality, quantity or productivity is affected. It is very difficult to monitor the plant diseases manually. It requires tremendous amount of work, expertise in the plant diseases, and also require the excessive processing time. Detection of plant disease through some automatic technique is beneficial as it reduces a large work of monitoring in big farms of crops, and at very early stage itself it detects the symptoms of diseases i.e. when they appear on plant leaves. So, we introduced a modern technique to find out disease related to leaf. Hence, image processing is used for fast and accurate disease detection of plant. Disease detection involves the steps like image acquisition, image pre-processing, image segmentation, feature extraction and classification. We developed k-means clustering algorithm with multi SVM algorithm in MATLAB software for disease identification and classification.

Keywords: *Plant disease, Multi SVM algorithm, k-means clustering, MATLAB software*.

I. INTRODUCTION

Agriculture is the backbone of Indian economy. Most of the population in India is engaged in cultivation of crops. 70% of Indian economy depends on agriculture but leaf infection phenomena causes the loss of major crops results in economic loss. Plant diseases can increase the cost of agricultural production and may extend to total economic disaster of a producer if not cured appropriately at early stages. There is the most challenging question for farmer to select the crops for cultivation to earn the maximum profit within the available environment. Even after selecting the appropriate crops for the suitable environment, it's a problematic task to prevent the crops from diseases. The cultivation can be improved by technological support. Disease is caused by pathogen in plant at any environmental condition. In most of the cases diseases are seen on the leaves, fruits and stems of the plant, therefore detection of disease plays an important role in successful cultivation of crops. Sometimes unhealthy environment include soil and water is also responsible for diseases in plants. The leaf infections may occur due to environmental condition changes such as huge rain fall, drastic changes in temperature or may be due to improper maintenance and some insects and pesticides .Once the disease causing organisms such as bacteria, virus etc, entered into the leaf tissue, they starts multiplying and decreases the strength of the leaf and degradation starts. There are lots of techniques to detect the different types of diseases in plants in its early stages. The old and classical approach for detection and recognition of plant diseases is based on naked eye observation, which is very slow method also gives less accuracy. Using digital image processing method, the disease detection in plant is efficient, less time consuming and accurate. This technique saves time, efforts, labours and use of pesticides. Different authors propose different techniques with the help of digital image processing for accurate plants disease identification. Lots of algorithms have developed by different researchers for image processing. The method for detection and classification of leaf diseases is based on masking and removing of green pixels, applying a specific threshold to extract the infected region and computing the texture statistics to evaluate the diseases using MATLAB.

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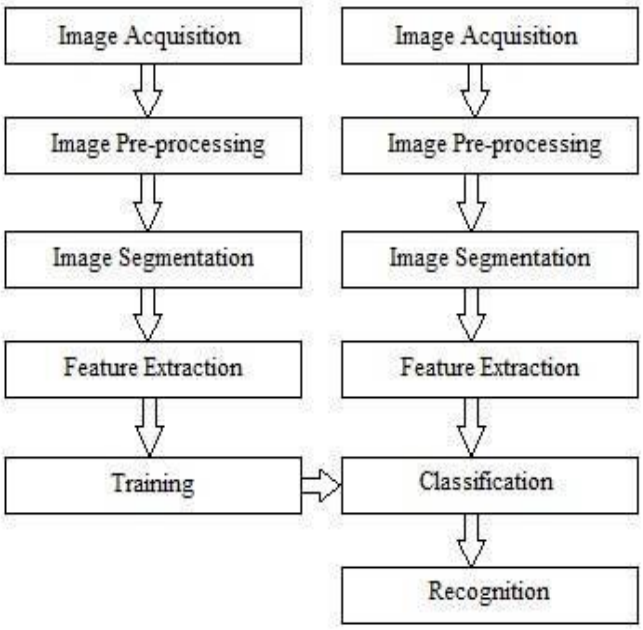
The MATLAB image processing starts with capturing of digital high resolution images. Healthy and unhealthy images are captured and stored for experiment. Then images are applied for pre-processing for image enhancement. Captured leaf images are segmented using k-means clustering method to form clusters. The proposed system is a software solution for automatic detection and classification of plant leaf diseases. The scheme consists of four main steps, first a colour transformation structure for the input RGB image is created, and then the green pixels are masked and removed using specific threshold value followed by segmentation process, the texture statistics are computed for the useful segments, finally the extracted features are passed through the classifier. In classifier the disease can be identified.

II. PROPOSED METHODOLOGY



2.1. Image Acquisition:
Image acquisition is the first method of digital image processing and it is described as capturing the image through digital camera and stores it in digital media for further MATLAB operations. It is also an action of retrieving an image from hardware. This image is in RGB (Red, Green and Blue) form. Colour transformation structure for the RGB leaf image is created, and then, colour transformation structure is applied.

2.2. Image Pre-processing:
The main purpose of image pre-processing is to improve the image data contained unwanted distortions or to enhance some image features for further processing. Pre-processing method uses various techniques such as changing image size and shape, filtering of noise, image conversion, enhancing image and morphological operations. In this work, we used various MATLAB code to resize image, to enhance contrast and RGB to greyscale conversion for further operations like creating clusters in segmentation. The RGB images into the grey images using colour conversion using equation (1).

F(x) =0.2989*R + 0.5870*G + 0.114.*B - - - - - - - - - - - - -

2.3. Image Segmentation:
Segmentation means partitioning of image into various parts of same features or having some similarity. The segmentation can be done using various methods like Otsu method, k-means clustering, converting RGB image into

HIS model etc.

2.3.1.Segmentation using Boundary and spot detection algorithm:
The RGB image is converted into the HIS model for segmenting. Boundary detection and spot detection helps to find the infected part of the leaf. For boundary detection the 8 connectivity of pixels is consider and boundary detection algorithm is applied.

2.3.2. K-means clustering:
The K-means clustering is used for classification of object based on a set of features into K number of classes. The classification of object is done by minimizing the sum of the squares of the distance between the object and the corresponding cluster.

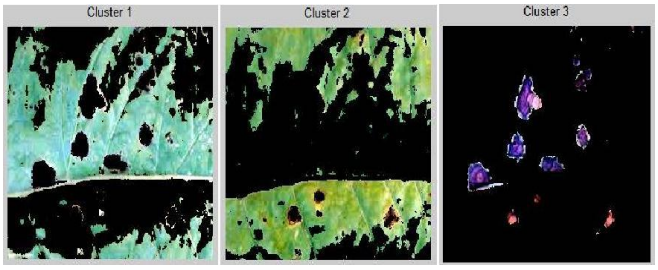
The algorithm for K –means Clustering:

1. Pick centre of K cluster, either randomly or based on some heuristic.
2. Assign each pixel in the image to the cluster that minimizes the distance between the pixel and the cluster centre.
3. Again compute the cluster centres by averaging all of the pixels in the cluster. Repeat steps 2 and 3 until convergence is attained.

2.3.3. Otsu Threshold Algorithm:
Thresholding creates binary images from grey-level images by setting all pixels below some threshold to zero and all pixels above that threshold to one. The Otsu algorithm defined as

i) According to the threshold, Separate pixels into two clusters
ii) Then find the mean of each cluster.
iii) Square the difference between the means.
iv) Multiply the number of pixels in one cluster times the number in the other.

The infected leaf shows the symptoms of the disease by changing the colour of the leaf. Hence the greenness of the leaves can be used for the detection of the infected portion of the leaf. The R, G and B component are extracted from the image. The threshold is calculated using the Otsu's method. Then the green pixels is masked and removed if the green pixel intensities are less than the computed threshold.
The following figure shows leaf image segmentation with three clusters formed by K-means clustering method.



III. FEATURE EXTRACTION

In feature extraction desired feature vectors such as colour, texture, morphology an Structures are extracted. Feature extraction is method for involving number of resources required to describe a large set of data accurately. Statistical texture features are obtained by Gray level co-occurrence matrix (GLCM) formula for texture analysis and texture features are calculated from statistical distribution of observed intensity combinations at the specified position relative to others. Numbers of gray levels are important in GLCM also statistics are categorized into order of first, second & higher for number of intensity points in each combination. Different statistical texture features of GLCM are energy, sum entropy, covariance, information measure of correlation, entropy, contrast and inverse difference and difference entropy.

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3.1.Colour co-occurrence method:
In this method both colour and texture are taken into account to get a unique feature for that image. For that the RGB image is converted into the HSI translation.

$$H = \begin{cases} Theta & \text{if } B \le G \\ 360 - Theta, & B > G \end{cases} \text{ - - - - - - - - (2)}$$

$$(R + G + B) \text{ - - - - - - - (3)}$$

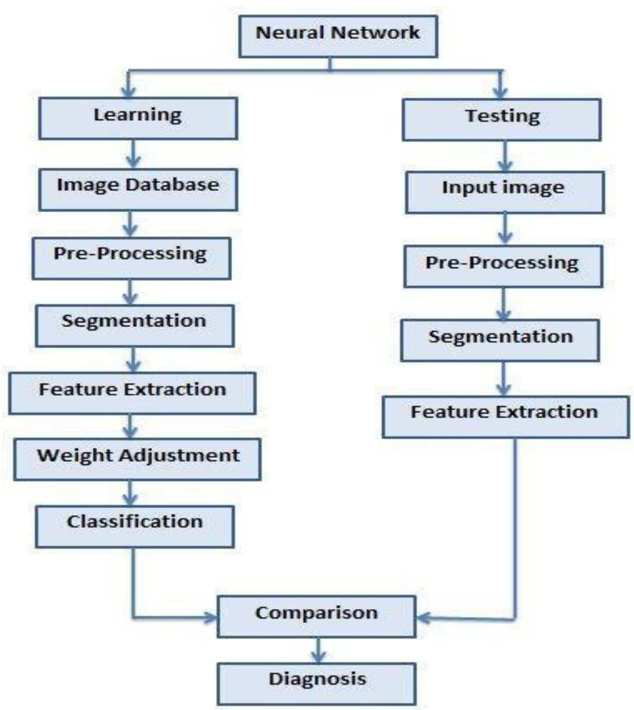
$$I = \frac{1}{3}(R + G + B) \text{ - - - - - - - - - - - - (4)}$$

3.2. Leaf colour extraction using H and B components:
The input image is enhanced by using an isotropic diffusion technique to preserve the information of the affected pixels before separating the colour from the background. An H and B component from HIS and LAB colour space is considered. A SOFM with back propagation neural network is implemented to recognise colour of disease leaf.

3.3 Classification:

3.3.1. Using ANN:
After feature extraction is done, the learning database images are classified by using neural network. These feature vectors are considered as neurons in ANN. The output of the neurons is the function of weighted sum of inputs. The back propagation algorithm modified SOM; Multiclass Support Vector machine can be used.

Working principle of ANN:



Testing of query images:

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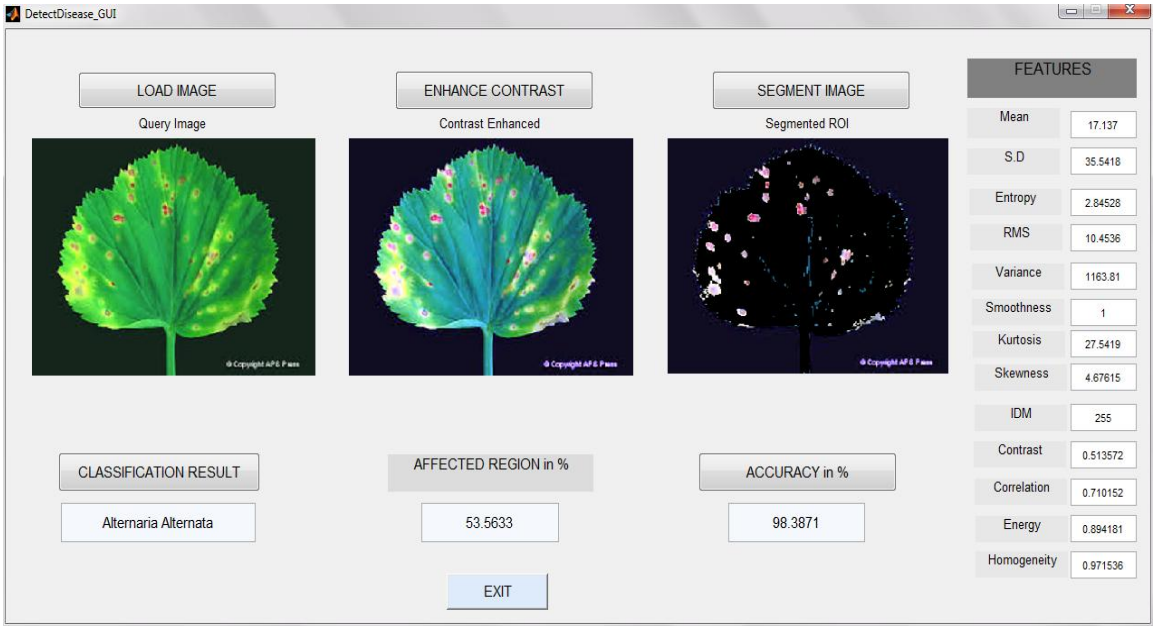
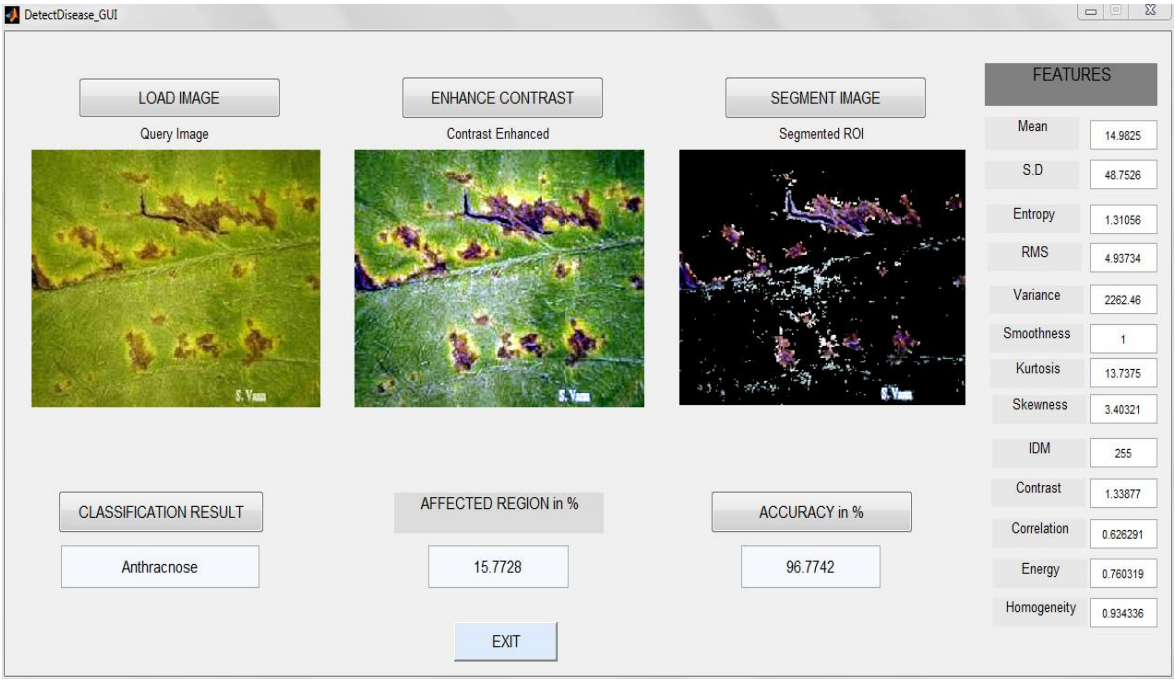
After getting the weight of learning database, then testing of query image is done. The above figure shows the flowchart for the testing of query image using the neuralnetworktechniques

IV. EXPERIMENTAL RESULTS





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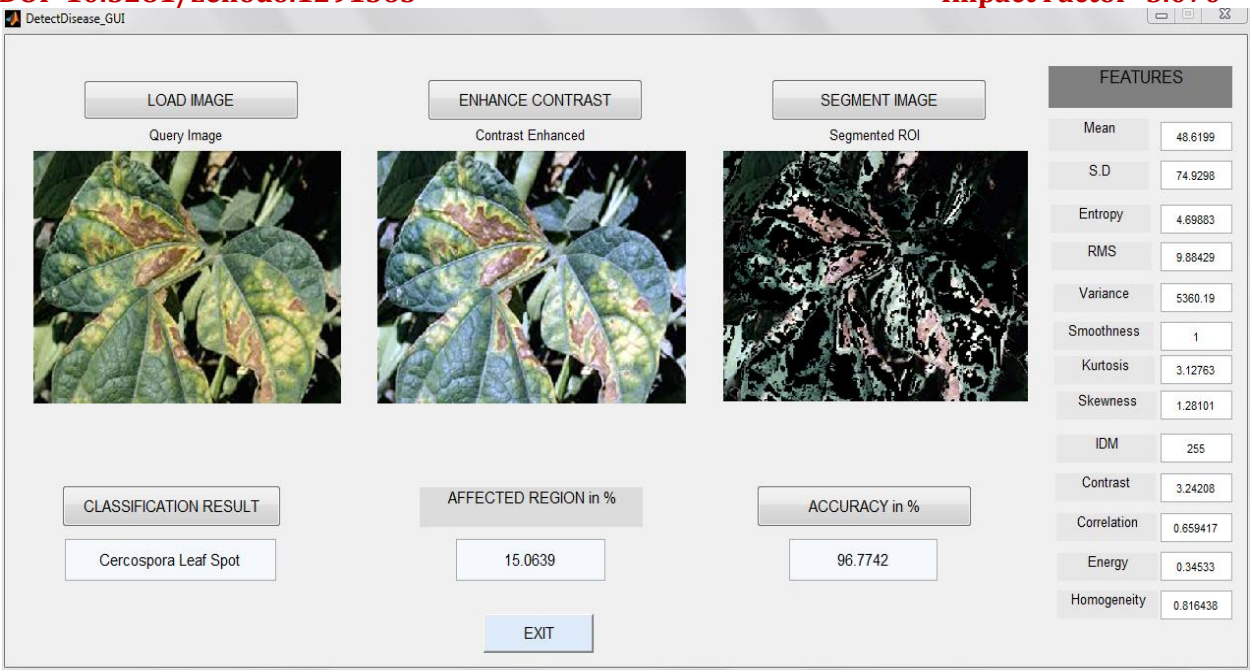

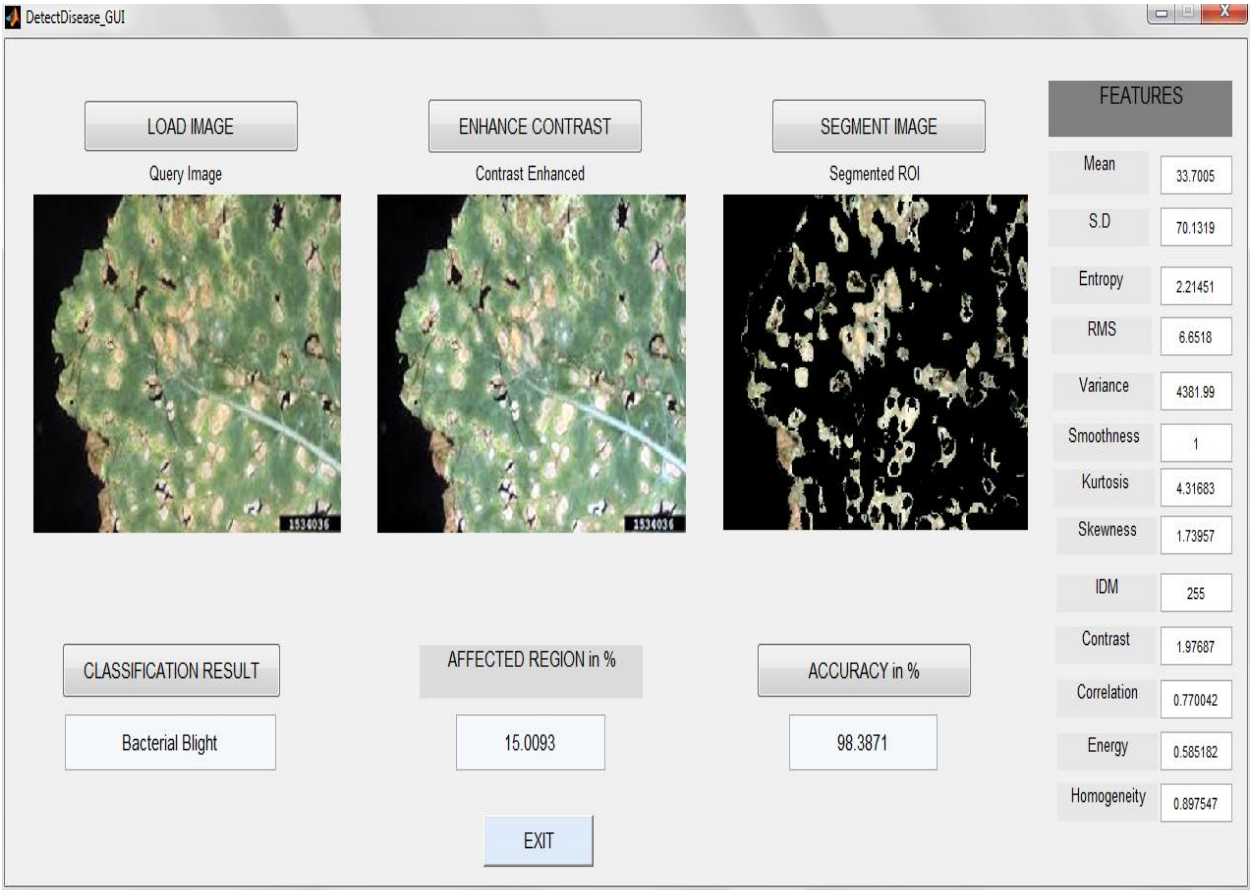

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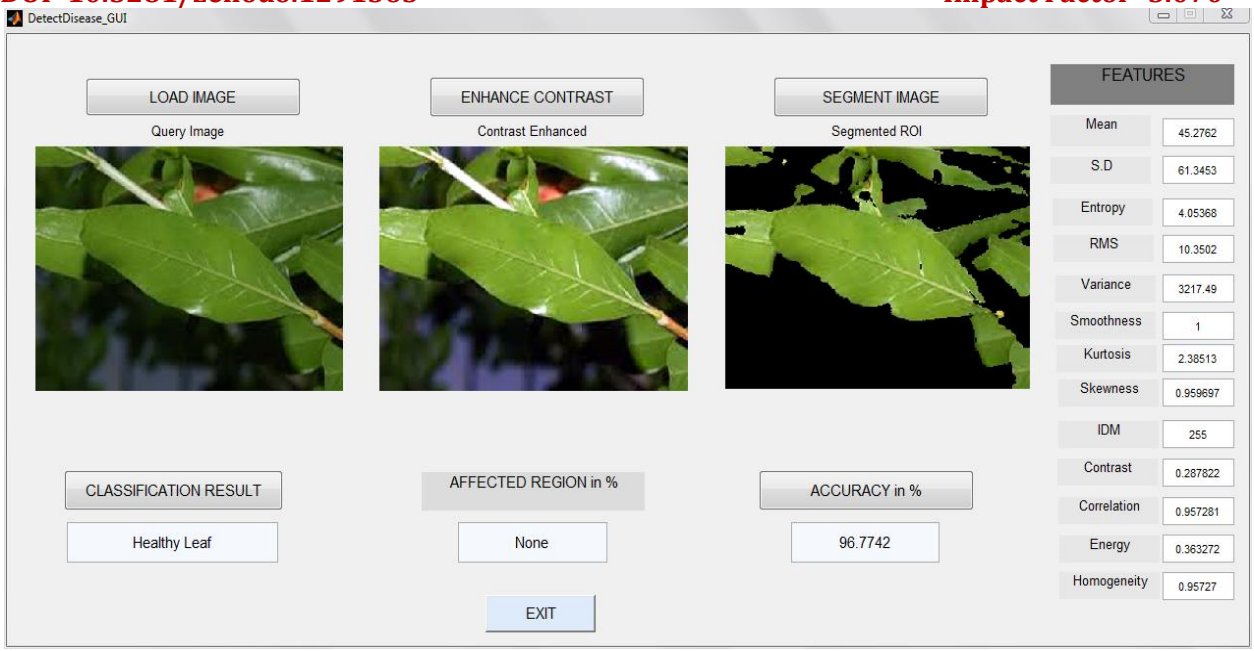

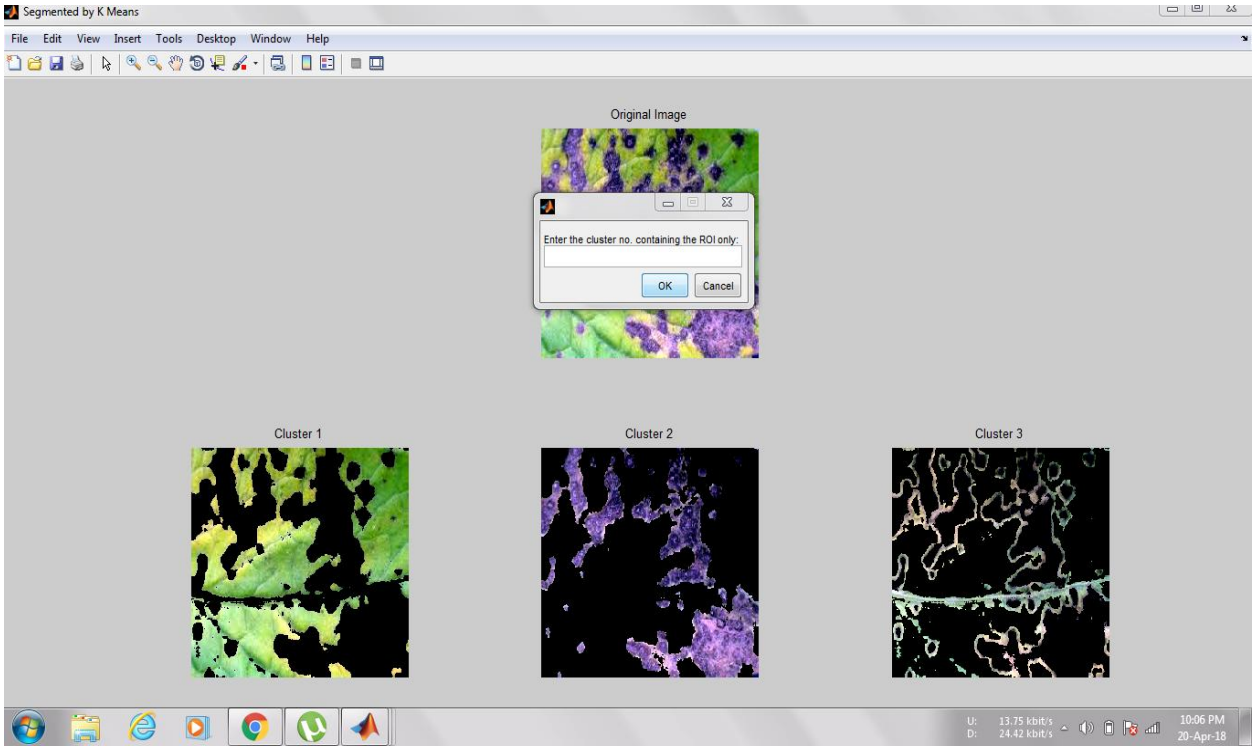

V. CONCLUSION

The accurately detection and classification of the plant disease is very important for the successful cultivation of crop and this can be done using image processing. The various techniques to segment the disease part of the plant and some Feature extraction and classification techniques to extract the features of infected leaf and the

classification of plant disease are discussed. The proposed methodology depends on K-means clustering are configured for both leaf & fruit disease detection. The MATLAB software is ideal for digital image processing. K-means clustering and provides high accuracy and consumes very less time for entire processing. In future work, we will extend our database for more plant disease identification.

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