CHAPTER 1

INTRODUCTION

India is a cultivated country and about 70% of the population depends on agriculture. Farmers have large range of diversity for selecting various suitable crops and finding the suitable pesticides for plant. Disease on plant leads to the significant reduction in both the quality and quantity of agricultural products. The studies of plant disease refer to the studies of visually observable patterns on the plants. Monitoring of health and disease on plant plays an important role in successful cultivation of crops in the farm. In early days, the monitoring and analysis of plant diseases were done manually by the expertise person in that field. This requires tremendous amount of work and also requires excessive processing time. The image processing techniques can be used in the plant disease detection. In most of the cases disease

Symptoms are seen on the leaves, stem and fruit. The plant leaf for the detection of disease is considered which shows the disease symptoms. This paper gives the introduction to image processing technique used for plant disease detection.

The existing methodology for disease detection is a just optic observation by specialists through that identification and detection of plant diseases is completed. Fordoing thus, an oversized team of specialists still as continuous watching of specialists are needed, that prices terribly high once farms are massive. At an equivalent time, in some countries, farmers don’t have correct facilities or maybe concept that they'll contact specialists. Because of that consulting specialists even price high still as time overwhelming too. In such condition, the advised technique proves to be helpful in watching massive fields of crops. And automatic detection of the diseases by simply seeing the symptoms on the plant leaves makes it easier still as cheaper.

India is eminent for Agriculture that means most of the people are engaged towards agriculture industry. The agriculture industry act as a significant role in the economic sectors. Most of the plants are infected by variant fungal and bacterial diseases. Due to the exponential inclination of population, the climatic conditions also cause the plant disease. The major challenges of sustainable development are to reduce the usage of pesticides, cost to save the environment and to increase the quality. Precise, accurate and early diagnosis may reduce the usage of pesticides. Data mining is termed as extracting the relevant information from large pool of resources. The advents of data mining technologies have been adopted in the prediction of plant diseases. Rice is one of the major crops cultivated in India. Nowadays, technology iswidely used for plant disease prediction. The management of perennial leaf requires close monitoring system especially for the diseases that affects production and post-harvest life. The concept of image processing with data mining technologies assists us in following purposes:

1) Recognizing infected leaf and stem
2) Measure the affected area
3) Finding the shape of the infected region
4) Determine the color of infected region
5) And also influence the size and shape of the leaf.

The user is to select a particular diseased region in a leaf and the cropped image is sent for processing [4].This paper intends to study about the prediction of the plant diseases, at an untimely phase using k-mean clustering algorithm. Specifically, we concentrate on predicting the disease such as Alternaria Alternata, Anthracnose, Cercospora Leaf Spot and Bacterial blight. It would be useful for identifying different diseases on crops [5].It provides various methods used to study crop diseases/traits using image processing and data mining. In addition, the infected area and affected percentage is also measured. Back Propagation concept is used for weight adjustment of training database [6].

CHAPTER 2

LITERATURE SURVEY

The vegetation indices from hyper spectral data have been shown for indirect monitoring of plant diseases. But they cannot distinguish different diseases on crop. Wenjiang Huang et al developed the new spectral indices for identifying the winter wheat disease. They consider three different pests (Powdery mildew, yellow rust and aphids) in winter wheat for their study. The most and the least relevant wavelengths for different diseases were extracted using RELIEF-F algorithm. The classification accuracies of these new indices for healthy and infected leaves with powdery mildew, yellow rust and aphids were 86.5%, 85.2%, 91.6% and 93.5% respectively [1].Enhanced images have high quality and clarity than the original image. Color images have primary colors red, green and blue. It is difficult to implement the applications using RGB because of their range i.e. 0 to 255. Hence they convert the RGB images into the grey images. Then the histogram equalization which distributes the intensities of the images is applied on the image to enhance the plant disease images.

Monica Jhuria et al uses image processing for detection of disease and the fruit grading in [3]. They have used artificial neural network for detection of disease. They have created two separate databases, one for the training of already stored disease images and other for the implementation of the query images. Back propagation is used for the weight adjustment of training databases. They consider three feature vectors, namely, color, textures and morphology [3]. They have foundthat the morphological feature gives better result than the other two features. Zulkifli Bin Husin et al, in their paper [4], they captured the chilli plant leaf image and processed to determine the health status of the plant. Their technique is ensuring that the chemicals should apply to the diseased plant only. They used the MATLAB for the feature extraction and image recognition. In this paper pre-processing is done using the Fourier filtering, edge detection and morphological operations. Computer vision extends the image processing paradigm for object classification. Here digital camera is used for the image capturing and LABVIEW software tool to build the GUI. The segmentation of leaf image is important while extracting the feature from that image. Mrunalini R.Badnakhe, Prashant R. Deshmukh compares the Otsu threshold and the k-means clustering algorithm used for infected leaf analysis in [5].

They have concluded that the extracted values of the feature sare less for k-means clustering. The clarity of k-means clustering is more accurate than other method.The RGB image is used for the identification of disease. After applying k-means clustering techniques, the green pixels are identified and then using otsu's method, varying threshold value is obtained. For the feature extraction, color co-occurrence method is used. RGB image is converted into the HSI translation. For the texture statistics computation the SGDM matrix is generated and using GLCM function the feature is calculated [6].

2.1 IMAGEPROCESSING

Image Processing is defined as the process of improving and enhancing the raw images that are taken through digital cameras, sensors, and many other sophisticated means such as Satellite, space probes and aircrafts for various applications. When someone suggested thousands of years ago that "a picture speaks a thousand words", probably the idea of computing was limited to basic number crunching. Above adage still has significance to computing with images. Most researchers in computer vision and image processing aim at deriving effective and better tools as well as proper approaches that give different ideas on the same image by providing means to comprehend not only the content of the image but also gives meaning, and significance of the image. There is no way image processing can be compared or matched with the human eye in terms of accuracy, but it can outperform it easily on observational consistency, and ability to carry out detailed mathematical operations. Again, image processing can be used to compute and find solutions to simpleorstructured tasks by providing reliable, consistent and cheap results. Unlike some years back, researches conducted based on image processing in recent years have been broadened widen to cover a large range of information ranging from simple and basic pixel based low-level operations to high-level analysis that now includes the use sophisticated tools including techniques like artificial intelligence for the purposes of interpretationand understanding of the image. These new and modern techniques for processing images are being developed to get a better meaning and understanding of images based on the relationship between its components, its context, and its history if it is a part of sequence, and a prior knowledge gained from a range of images.

2.2 IMAGE PROCESSING METHODS

There are two main methods of image processing. Analog image processing is the first method. This method refers to the changes, modification and adjustment of image through electrical means. A typical example of this method is the image produced by the television. The television transmits signals in a form of voltage which varies in amplitude to represent brightness through the image. The writer continues with the second method which he identified as digital method of processing image. In this case, supposed image will be change or converted to digital form through a device known as scanner digitizer for further processing.

2.3 IMAGE PROCESSING TECHNIQUES

2.3.1. Image segmentation

(Ballard and Brown, 1982) defined image segmentation as the process of dividing or breaking an image into different parts based on certain characteristics. The parts usually conform to something that human beings can easily separate, view and analyze as individual objects. The digital computer as we know does not have the ability to recognize objects intelligently on their own; this is why different researchers have come out with different approaches and methods to segment images. Images are usually segmented depending on the various characteristics and features found in the image. These features may include color information which is used to create histogram, information about pixels that indicate boundaries and textureinformation.In the case of computers, image segmentation can be defined as the process of dividing digital image into several parts or components (a set of pixels that can also be referred to as super pixels). The purpose of segmenting any image is to simplify (make the image easier or less complicated) and change the representation of the image into something meaningful for the purposes of easier analysis.Image segmentation is usually used to detect and discover characteristics, objects and boundaries such as curves and lines in images. Image segmentation can simply be defined as the process of assigning some description to every pixel in an image to identify pixels with similar and unusual characteristics. The outcome of the segmentationprocess depends on a set of components that together the entire image or a set of outcome deduced from theimage.

2.3.2 Image Thresholding

Image Thresholding refers to the process of creating a binary image (bitonal) by setting a starting point which serves as the base value of the pixel intensity of the original image. Thresholding technique is usually performed on grayscale images; however, thresholding may be applied to original (true color) image. The threshold value of every image can either be set manually or automatically using a specific software or application. In this case, all pixels that fall below that set threshold value are converted to black which represents bit value of zero whilst any other pixels above the threshold value are changed to white representing a bit value of one. The thresholding can also be described as the process of breaking an image apart in order to get foreground values as well as background values (black and white). Thresholding can be simple or complex depending on the threshold value. Thresholding is said to be simple if there is only one threshold value set for all the pixels in the image for no matter the difference or variations in contrast. On the other hand, complex and sophisticated thresholding (adaptive thresholding) takes number of regions of the image and set the threshold value accordingly. It should be noted that, quality cannot be compromised in thresholding especially when dealing with scanning images with Optical Character Recognition (OCR) systems. The simplest form of segmentation is by means of thresholding. This is because you only need to define a threshold then examine all pixels in the image by comparing them with the threshold value. All pixels found above the threshold value are considered as foreground, whilst the pixels located below the threshold value are considered as background. Often, the threshold represents the intensity or the color value of the image. Other forms of thresholding permit different or variable threshold values throughout the image. In this case, the threshold is permitted to undergo through several changes throughout the entire image. Thresholding is said to be a primitive technique because it works for most operations that need segmentation.

CHAPTER 3

AIM & SCOPE

The main aim of the work is to provide a solution to the farmers for preventing the disaster of crops identify and prevent the diseases in plants using image processing and expert system to implement a fuzzy rule interface to identify and prevent the diseases in plant to develop an artificial intelligent based expert system using machine learning and deep learning with image processing techniques.

3.1 EXISTING SYSTEM

Leaf shape description is that the key downside in leaf identification. Up to now, several form options are extracted to explain the leaf form. However there's no correct application to classify the leaf once capturing its image and identifying its attributes, however. In plant leaf classification leaf is classed supported its completely different morphological options. a number of the classification techniques used are

1. Fuzzy logic
2. Principal component Analysis
3. k-Nearest Neighbor Classifier

3.1.1 Problems of Existing System

The naked eye observation of experts is the main approach adopted in practice for detection and identification of plant diseases. But, this requires continuous monitoring of experts which might be prohibitively expensive in large farms. Further, in some developing countries, farmers may have to go long distances to contact experts, this makes consulting experts too expensive and time consuming and moreover farmers are unaware of non-native diseases.

People at the service center cannot see the exact problem the farmer is facing. They cannot imagine the severity of the disease completely and hence at times it may result in wrong disease detection. This may also lead in destruction of the crop. Disadvantages of existing systems are

- Detecting of plant leaf disease detection getting low accuracy data
- Detecting of plant leaf disease detection More complexity in existing system
- Detection of images been classified with noise

3.2 PRPOSED SYSTEM

The block diagram of the proposed system is shown in below Fig 3.1. The step by step proposed approach consists of leaf image database collection, pre-processing of those images, segmentation of those images using k-means clustering method, feature extraction using ANN method and finally the training of system using Back propagation Network algorithm.

In this section, the basic steps for Detection and Recognition of Leaf Disease using Image Processing have shown (Fig 3.1).

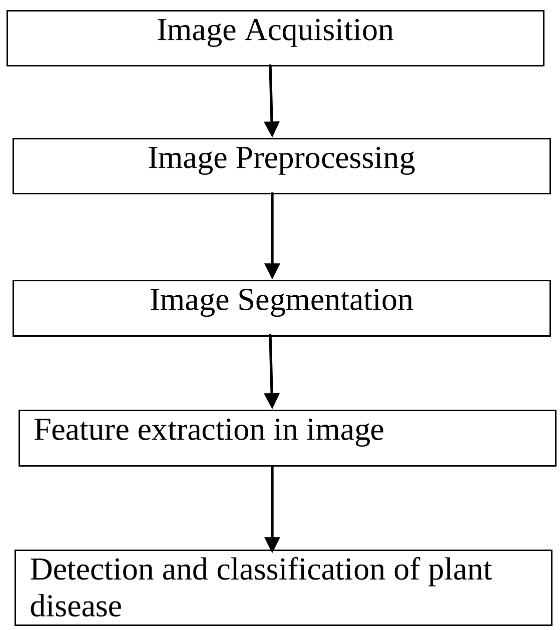


Fig 3.1: Basic steps for plant disease detection and classification

3.2.1 Image Acquisition

The images of the plant leaf are captured through the camera. This image is in RGB (Red, Green and Blue) form. Color transformation structure for the RGB leaf image is created, and then, a device-independent color space transformation for the color transformation structure is applied [6].

Fig 3.2: Original image of diseased leaf

3.2.2 Image Pre-processing

To remove noise in image or other object removal, different pre-processing techniques is considered. Image clipping i.e. cropping of the leaf image to get the interested image region.

Image smoothing is done using the smoothing filter. Image enhancement is carried out for increasing the contrast. The RGB images into the grey images using color conversion using equation (1).

$$F(x) = 0.2989*R + 0.5870*G + 0.114.*B \text{ - - - - - - - - - - - - - } (1)$$

Then the histogram equalization which distributes the intensities of the images is applied on the image to enhance the plant disease images. The cumulative distribution function is used to distribute intensity values [2].

Fig 3.3: Contrast enhanced and RGB to gray converted image

3.2.3 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.

i) 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 as discussed in [9]. For boundary detection the 8 connectivity of pixels is consider and boundary detection algorithm is applied [9].

ii) 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 center 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 pixels and the cluster center.
3. Again compute the cluster centers by averaging all of the pixels in the cluster. Repeat Steps 2 and 3 until convergence is attained.

iii) 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 in is as follows:

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 color of the leaf. Hence the greenness o f 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.

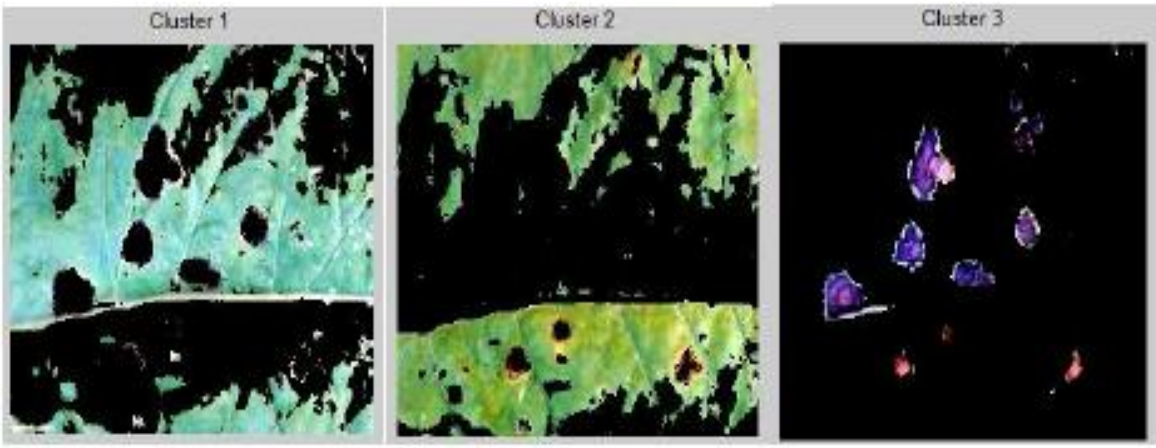


Fig 3.4: Diseased leaf image clusters

3.2.4 Feature Extraction

Feature extraction plays an important role for identification of an object. In many application of image processing feature extraction is used. Color, texture, morphology, edges etc. are the features which can be used in plant disease detection. In paper [3], Monica jhuria et al considers color, texture and morphology as a feature for disease detection. They have found that morphological result gives better result than the other features. Texture means how the color is distributed in the image, the roughness, hardness of the image. It can also be used for the detection of infected plant areas.

i) Color co-occurrence Method:

In this method both color and texture are taken into account to get unique features for that image. For that the RGB image is converted into the HSI translation.

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

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

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

For the texture statistics computation the SGDM matrix is generated and using GLCM function the feature is calculated.

ii) Leaf color extraction using H and B components:

The input image is enhanced by using anisotropic diffusion technique to preserve the information of the affected pixels before separating the color from the background [8]. To distinguish between grape leaf and the non-grape leaf part, H and B components from HIS and LAB color space is considered. A SOFM with back propagation neural network is implemented to recognize colors of disease leaf.

3.2.5 Classification

i) Using ANN:

After feature extraction is done, these feature vectors are considered as neurons in ANN [3]. The output of the neuron is the function of weighted sum of the inputs. The back propagation algorithm modified SOM; Multiclass Support vector machines can be used.

ii) Back propagation:

BPNN algorithm is used in a recurrent network. Once trained, the neural network weights are fixed and can be used to compute output values for new query images which are not present in the learning database. Back propagation is a generalization of the delta rule to multi-layered feed forward networks, made possible by using the chain rule to iteratively compute gradients for each layer. It is closely related to the Gauss–Newton algorithm and is part of continuing research in neural back propagation. To understand the mathematical derivation of the back propagation algorithm, it helps to first develop some intuition about the relationship between the actual output of a neuron and the correct output for a particular training example.

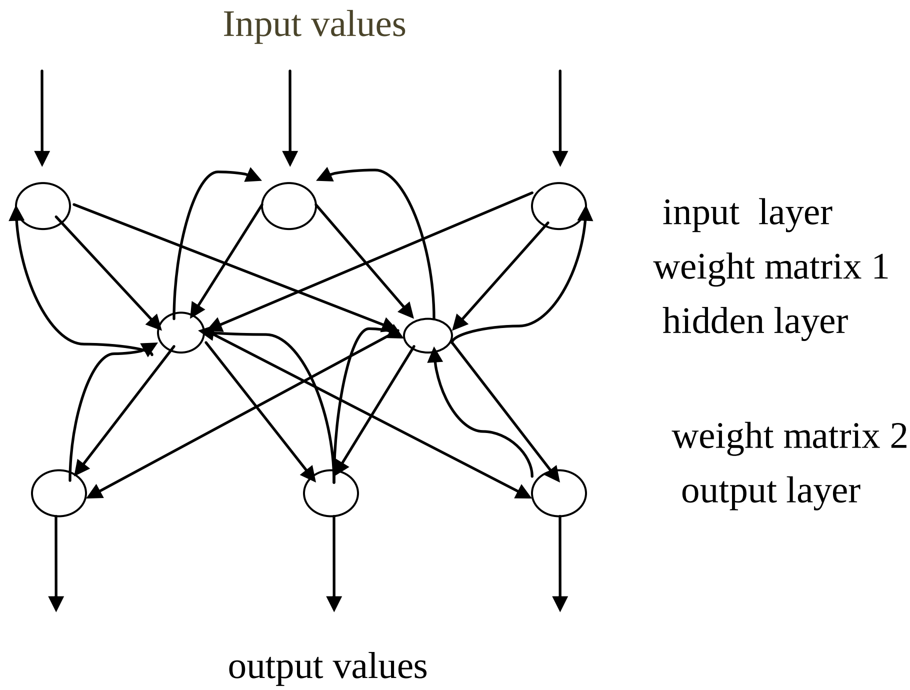


Fig 3.5: Back propagation Network

3.2.6 Advantages of proposed systems

- Detecting of plant leaf disease detection getting high accuracy data.
- Detecting of plant leaf disease detection using less complexity.
- Detection of images been classified without any noise.

3.3 FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

3.3.1 Economical feasibility

3.3.2 Technical feasibility

3.3.3 Social feasibility

3.3.1 Economical Feasibility

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

3.3.2 Technical Feasibility

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

3.3.3 Social Feasibility

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

CHAPTER 4
CONCEPTS AND METHODS

4.1 PROBLEM DESCRIPTION

One of the important sectors of Indian Economy is Agriculture. Employment to almost 50% of the countries workforce is provided by Indian agriculture sector. India is known to be the world's largest producer of pulses, rice, wheat, spices and spice products. Farmer's economic growth depends on the quality of the products that they produce, which relies on the plant's growth and the yield they get. Therefore, in field of agriculture, detection of disease in plants plays an instrumental role. Plants are highly prone to diseases that affect the growth of the plant which in turn affects the ecology of the farmer. In order to detect a plant disease at very initial stage, use of automatic disease detection technique is advantageous. The symptoms of plant diseases are conspicuous in different parts of a plant such as leaves, etc. Manual detection of plant disease using leaf images is a tedious job. Hence, it is required to develop computational methods which will make the process of disease detection and classification using leaf images automatic.

4.2 PROPOSED SOLUTION

Despite of the challenges given in the problem statement plant disease detection is still an active area of research. Numerous approaches have been proposed over the years. In traditional systems approach for detection and differentiation of plant diseases can be achieved using Support Vector Machine algorithms. This technique was implemented for certain diseases and depending on the type and stage of disease, the classification accuracy was between 65% and 99%. Another approach based on leaf images and using ANNs as a technique for an automatic detection and classification of plant diseases was used with K-means as a clustering procedure. ANN consisted of 10 hidden layers. The number of outputs was 6 which was the number of classes representing five diseases along with the case of a healthy leaf.

4.3 SOFTWARE USED

4.3.1 MATLAB

MATLAB (**mat**rix **lab**oratory) is a numerical computing environment and fourth-generation programming language. Developed by Math Works, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, and Fortran. MATLAB is used in vast area, including signal and image processing, communications, control design, test and measurement, financial modeling and analysis, and computational. Add-on toolboxes (collections of special-purpose MATLAB functions) extend the MATLAB environment to solve particular classes of problems in these application areas.

4.3.2 Features of MATLAB

- High-level language for technical computing.
- Development environment for managing code, files, and data.
- Interactive tools for iterative exploration, design, and problem solving.
- Mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, and numerical integration.
- 2-D and 3-D graphics functions for visualizing data.
- Tools for building custom graphical user interfaces.
- Functions for integrating MATLAB based algorithms with external applications and languages, such as C, C++, FORTRAN, Java™, COM, and Microsoft Excel.

4.4 SYSTEM REQUIREMENTS

4.4.1 Operating Systems

- Windows X

MATLAB performance is similar on Windows®, Mac OS® X, and Linux®, although differences can occur among platforms for the following reasons:

i) Works builds its products with a different compiler on each platform, and each has its own performance characteristics.
ii) Math Works incorporates third-party libraries into its products that may perform differently on each math platform.
iii) The operating systems perform differently, especially in the case of disk- or graphics-intensive operations.

4.4.2 Processors

Minimum: Any Intel or AMD x86-64 processor

Recommended: Any Intel or AMD x86-64 processor with four logical cores and AVX2 instruction set support

4.4.3 Disk

Minimum: 2.9 GB of HDD space for MATLAB only, 5-8 GB for a typical installation

Recommended: An SSD is recommended

A full installation of all Math Works products may take up to 29 GB of disk space

4.4.4 RAM

Minimum: 4 GB

Recommended: 8 GB

For Polyspace, 4 GB per core is recommended

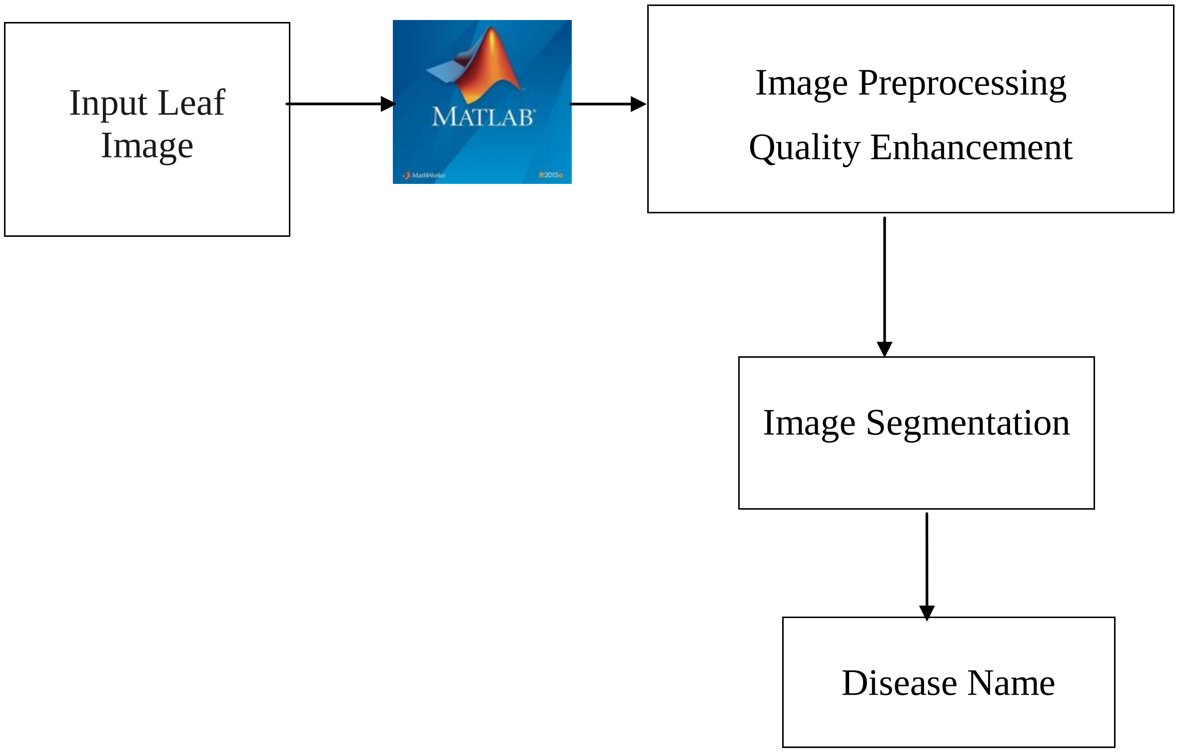
4.4.5 Graphics

No specific graphics card is required.

Hardware accelerated graphics card supporting OpenGL 3.3 with 1GB GPU memory is recommended.

GPU acceleration using the Parallel Computing Toolbox requires a CUDA GPU. See GPU Computing Support for details.

4.5 SYSTEM DESIGN



CHAPTER 5
IMPLEMENTATION

5.1 TOOLS USED

MATLAB includes development tools that help you implement your algorithm efficiently. These include the following:

5.1.1 MATLAB Editor

Provides standard editing and debugging features, such as setting breakpoints and single stepping.

5.1.2 Code Analyzer

Checks your code for problems and recommends modifications to maximize performance and maintainability.

5.1.3 MATLAB Profiler

Records the time spent executing each line of code.

5.1.4 Directory Reports

Scan all the files in a directory and report on code efficiency, file differences, file dependencies, and code coverage.

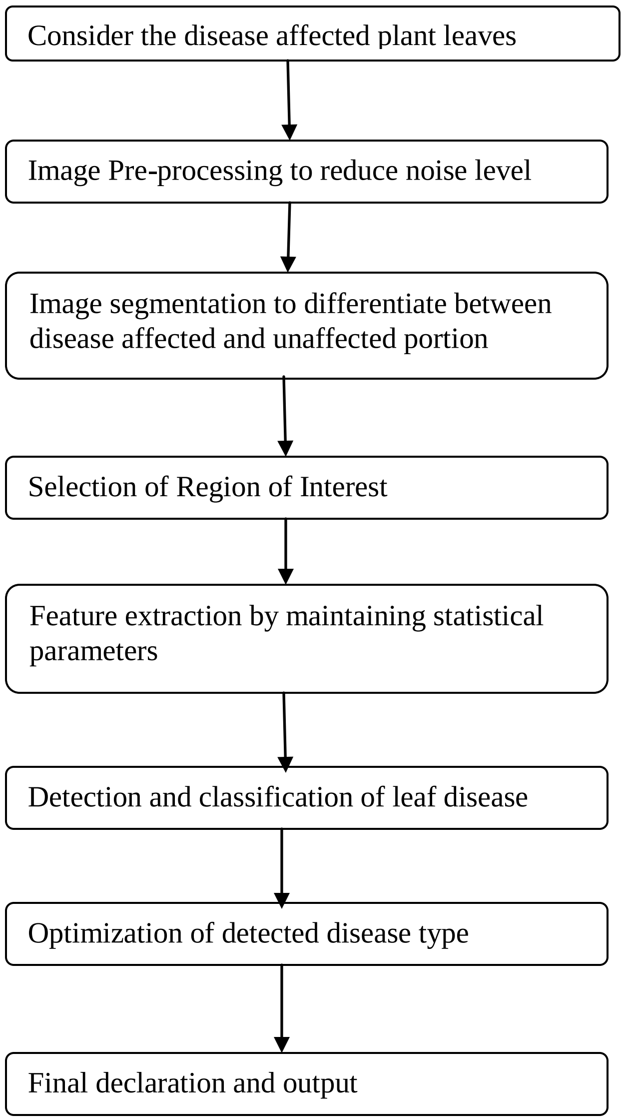
5.1.5 Designing Graphical User Interfaces

By using the interactive tool GUIDE (Graphical User Interface Development Environment) to layout, design, and edit user interfaces. GUIDE lets you include list boxes, pull-down menus, push buttons, radio buttons, and sliders, as well as MATLAB plots and Microsoft ActiveX® controls. Alternatively, you can create GUIs programmatically using MATLAB functions.

5.1.6 Performing numeric computation

MATLAB contains mathematical, statistical, and engineering functions to support all common engineering and science operations. These functions, developed by experts in mathematics, are the foundation of the MATLAB language. The core math functions use the LAPACK and BLAS linear algebra subroutine libraries and the FFTW Discrete Fourier Transform library. Because these processor-dependent libraries are optimized to the different platforms that MATLAB supports, they execute faster than the equivalent C or C++ code.

5.2 FLOW CHART



5.3 PSEUDO CODE

Step 1: Consider the Disease Affected Plant Leaves.

Step 2: Pre-process the Image to reduce noise value in considered leaf image.

Step 3: Perform Image Segmentation using K-means Clustering to cluster the image into leaf affected portion and unaffected one.

Step 4: Select the disease affected Region of Interest from the Segmented Image.

Step 5: Perform Feature Extraction by maintaining statistical Parameters of Skewness, Standard Deviation, Homogeneity, Contrast, Smoothness, Correlation, Kurtosis, Energy, Entropy, Mean Variance, RMS, and IDM.

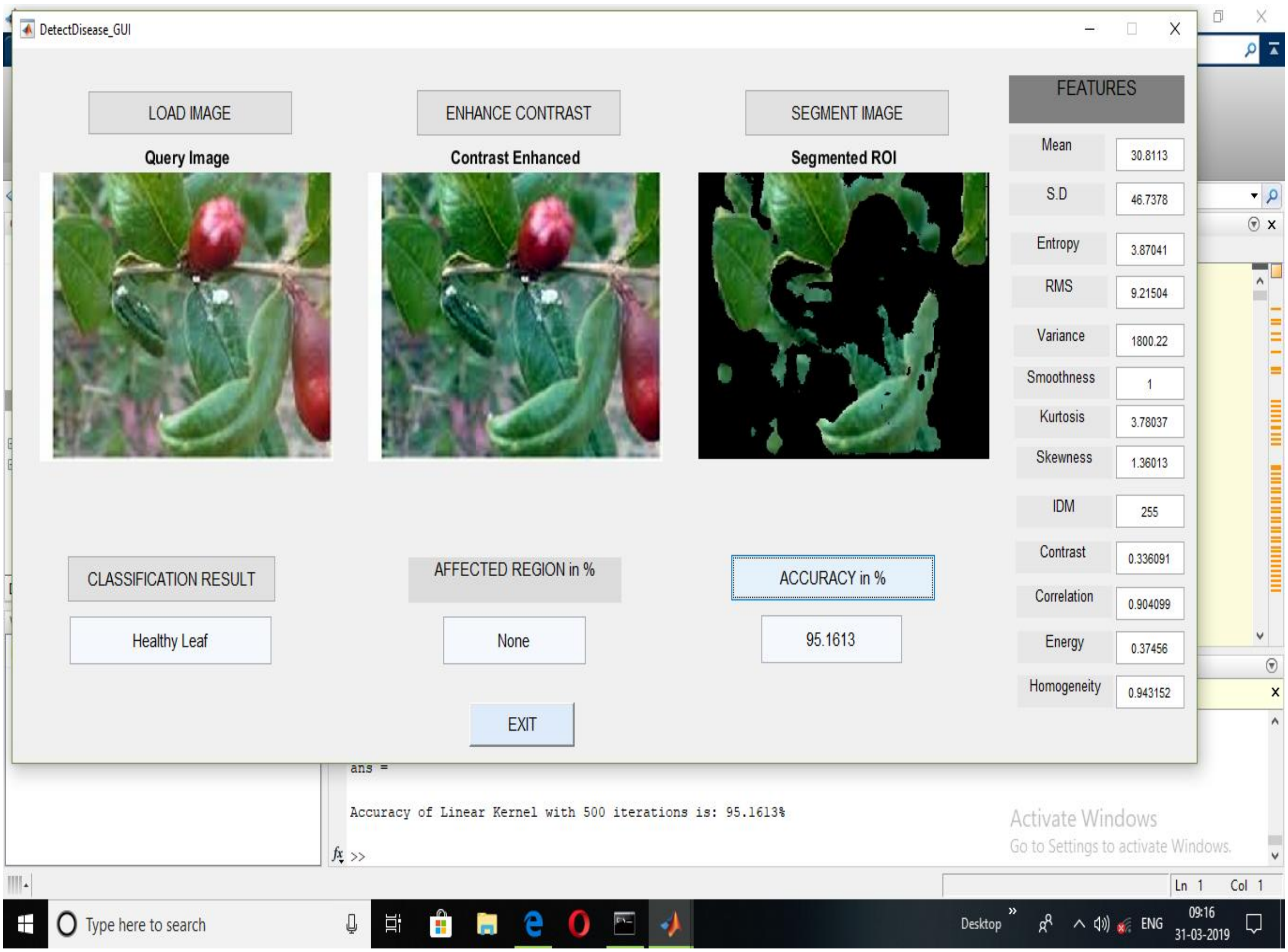
Step 6: Apply Support Vector Machine for the Detection & Classification of disease type.

Step 7: Apply Particle Swarm Optimization for the optimization of results.

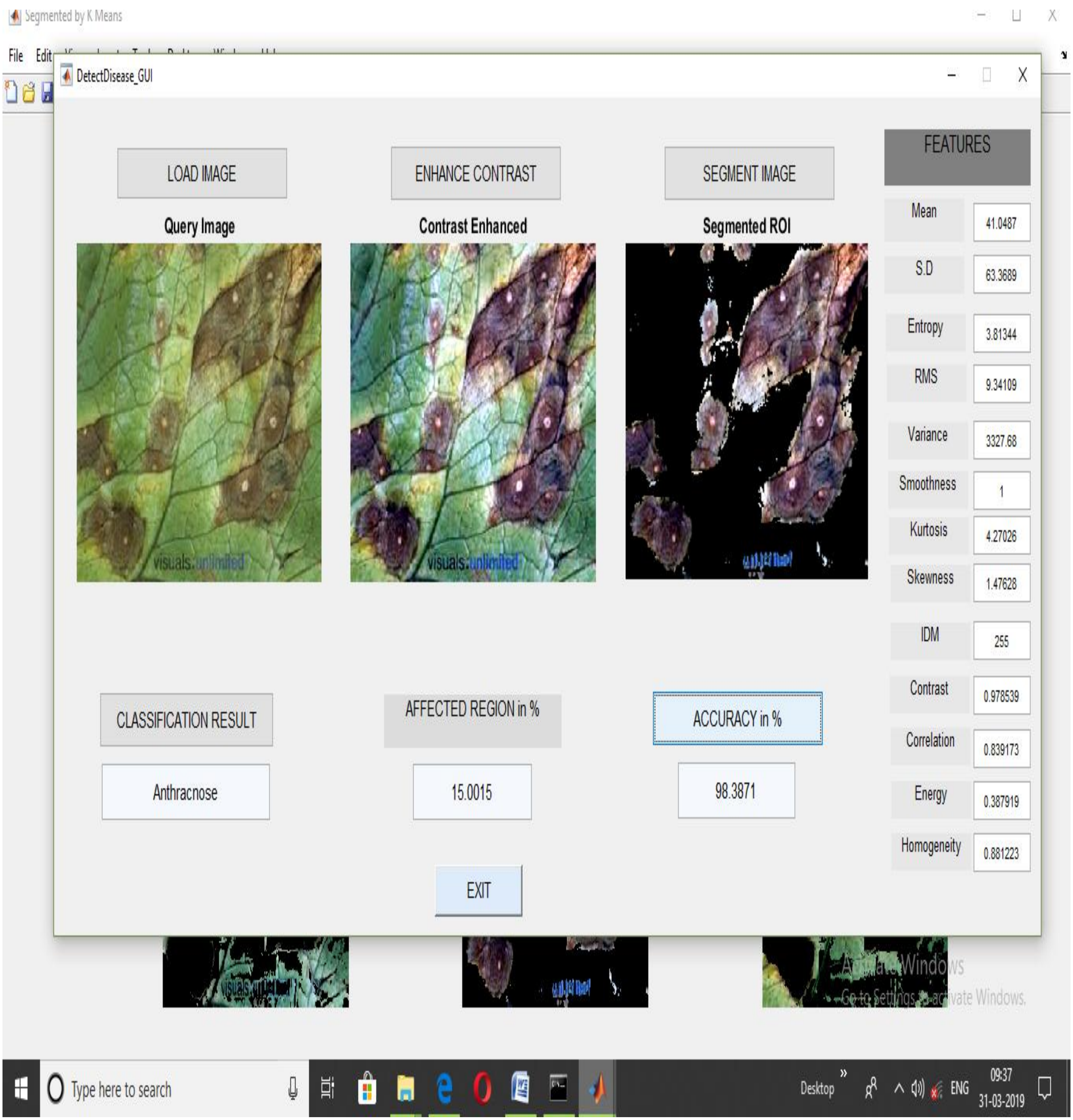
Step 8: Declare the Disease type and evaluate the percentage of disease affected portion.

5.4 SCREENSHOTS

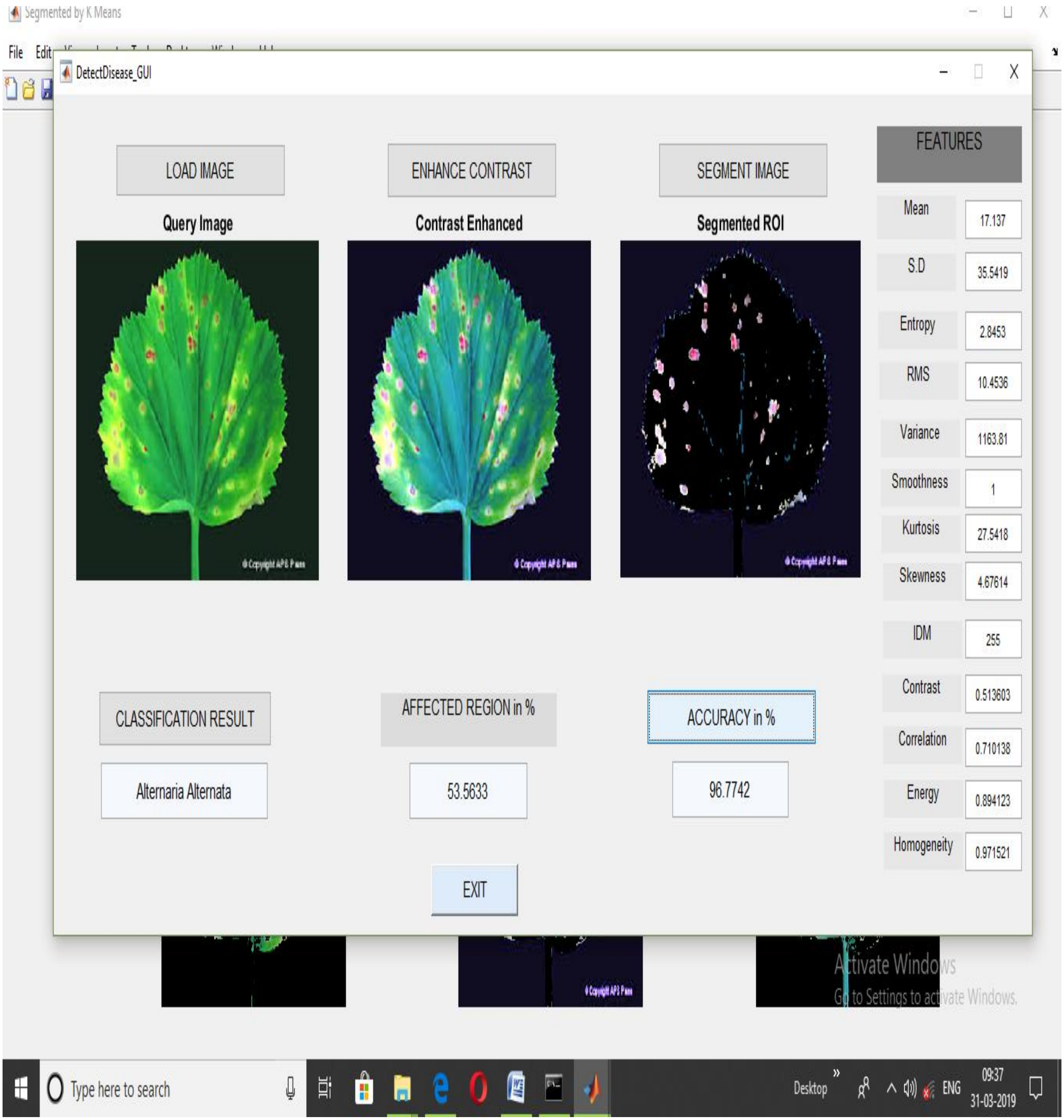
Test image for the disease Healthy Leaf



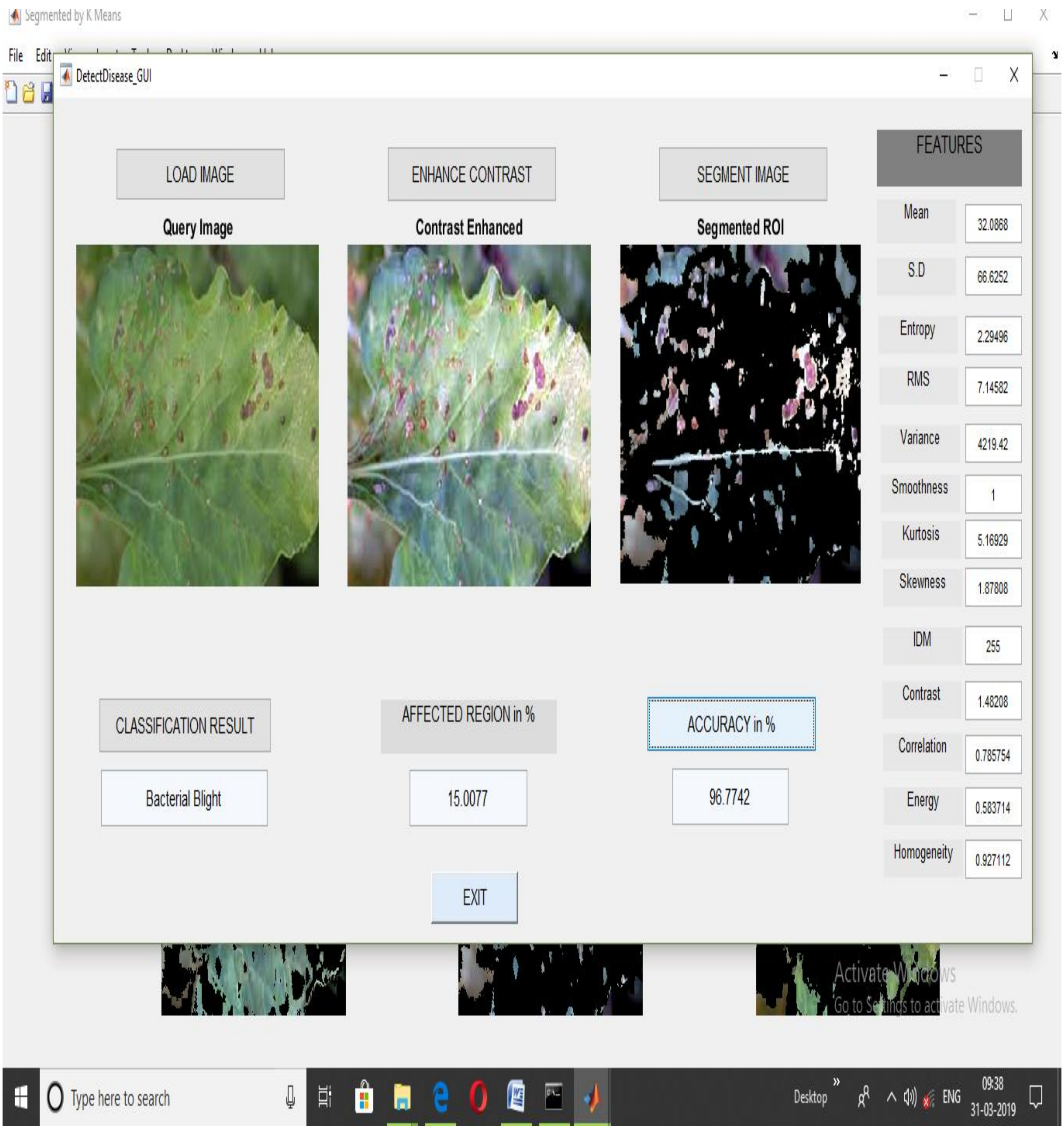
Test image for the disease Anthracnose



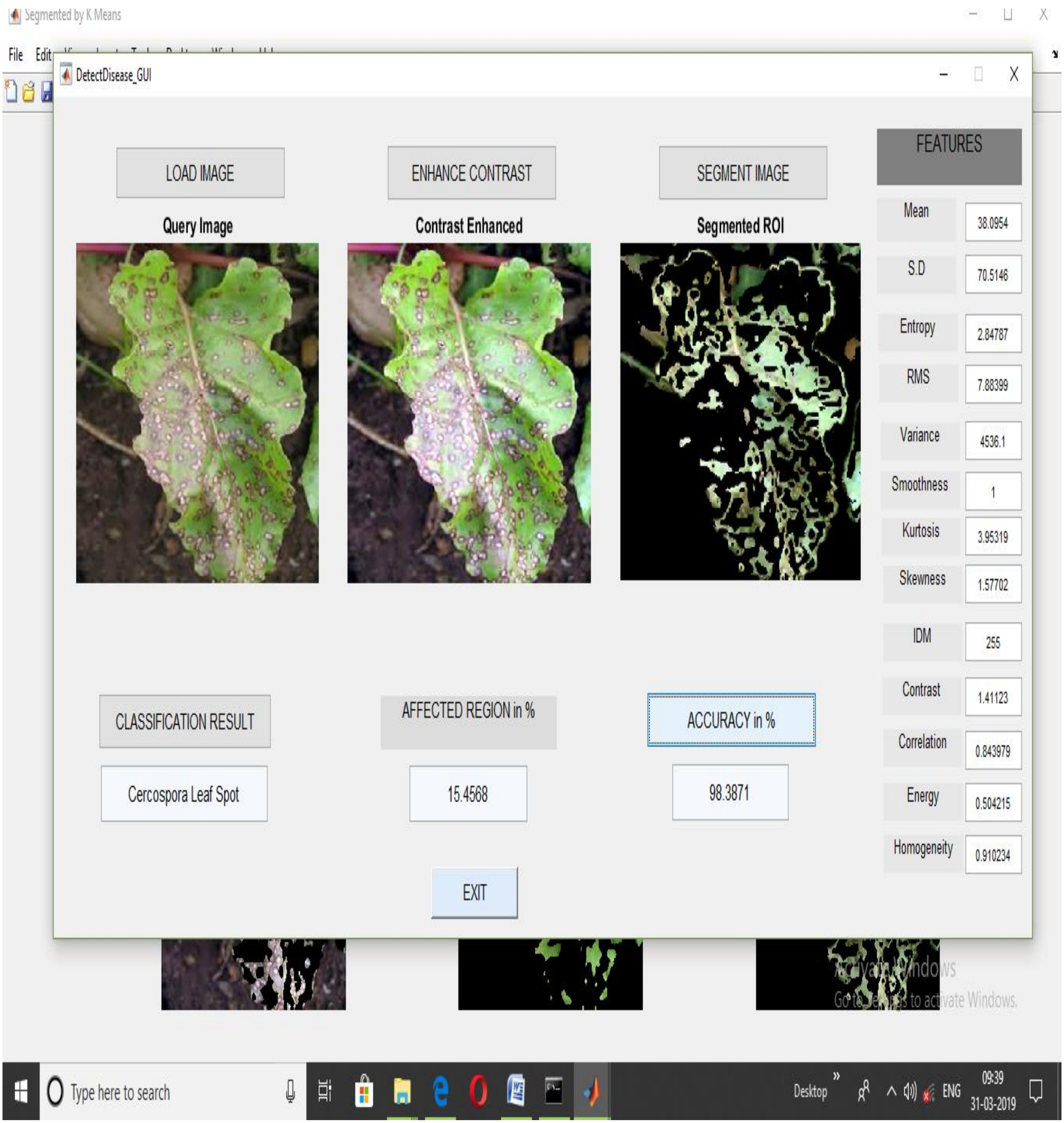
Test image for the disease Alternaria Alternata



Test image for the disease Bacterial Blight



Test image for the disease Cercospora Leaf Spot



CHAPTER 6

TESTING

Testing: In this phase, the test set for prediction of leaf as healthy/Unhealthy (diseased) with its disease name will be used to evaluate the performance of the classifier.

6.1 FINE-TUNING

Fine-tuning helps to increase the accuracy of prediction by making small modifications to improve or optimize the outcome. The best suited model for plant disease detection will be achieved through the process of experimental adjustment of the parameters.

6.2 EVALUATION MEASURES

Measures such as accuracy, mean, standard deviation, entropy, RMS, variance, smoothness, kurtosis, skewness, IDM, contrast, correlation, energy, homogeneity will be computed to evaluate the performance of the classifier.

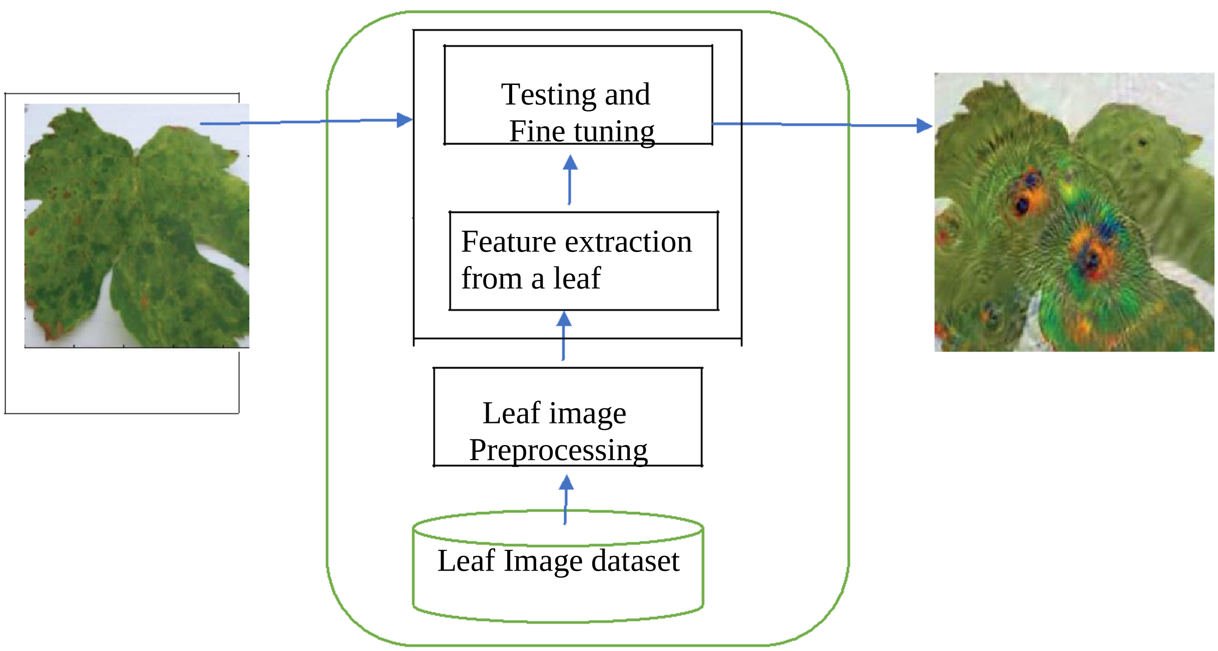


Fig 6.1: Architecture of Leaf Disease Detection System

Software testing **is** an investigation conducted to provide stakeholders with information about the quality of the product or service under test. Software testing can also provide an objective, independent view of the software to allow the business to appreciate and understand the risks of software implementation. Test techniques include the process of executing a program or application with the intent of finding software bugs (errors or other defects).
Software testing involves the execution of a software component or system component to evaluate one or more properties of interest. In general, these properties indicate the extent to which the component or system under test:

- meets the requirements that guided its design and development,
- responds correctly to all kinds of inputs,
- performs its functions within an acceptable time,
- is sufficiently usable,
- can be installed and run in its intended environments, and
- Achieves the general result its stakeholder's desire.

As the number of possible tests for even simple software components is practically infinite, all software testing uses some strategy to select tests that are feasible for the available time and resources. As a result, software testing typically (but not exclusively) attempts to execute a program or application with the intent of finding software bugs (errors or other defects). The job of testing is an iterative process as when one bug is fixed; it can illuminate other, deeper bugs, or can even create new ones.

Software testing can provide objective, independent information about the quality of software and risk of its failure to users and/or sponsors.

Software testing can be conducted as soon as executable software (even if partially complete) exists. The overall approach to software development often determines when and how testing is conducted.

CHAPTER 7

CONCLUSION

The detection and classification of leaf diseases accurately is the key to prevent the agriculture loss. There are a list of methods and classifiers to detect plant diseases. But in this research work, we are using image processing technique for the detection of plant leaf diseases. A framework for the design of plant leaf disease detection is presented here with its work flow. Dataset for the proposed concept is prepared with the plant leaf suffered with diseases Cercospora Leaf Spot, Bacterial Blight, Anthracnose and Alternaria Alternata. We have also analyzed the disease affected portion of leaf. As per the designed framework, we can say that proposed concept of image processing is efficient enough to detect the plant leaf diseases. The experimental results indicate that the proposed approach is a valuable approach, which can significantly support an accurate detection of leaf diseases in a little computational effort with the help of support vector machine classifier in order to increase the recognition rate of final classification process. Also by computing severity and amount of disease present on the crop, only necessary and sufficient amount of pesticides can be used making agriculture production system economically efficient.

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USER MANUAL

A Matlab code is written to classify the leaves into one of the following types: 'Alternaria Alternata', 'Anthracnose', 'Bacterial Blight', 'Cercospora Leaf Spot' and 'Healthy Leaves'.

Step 1: Open the command prompt and run the command as below

>matlab -softwareopengl

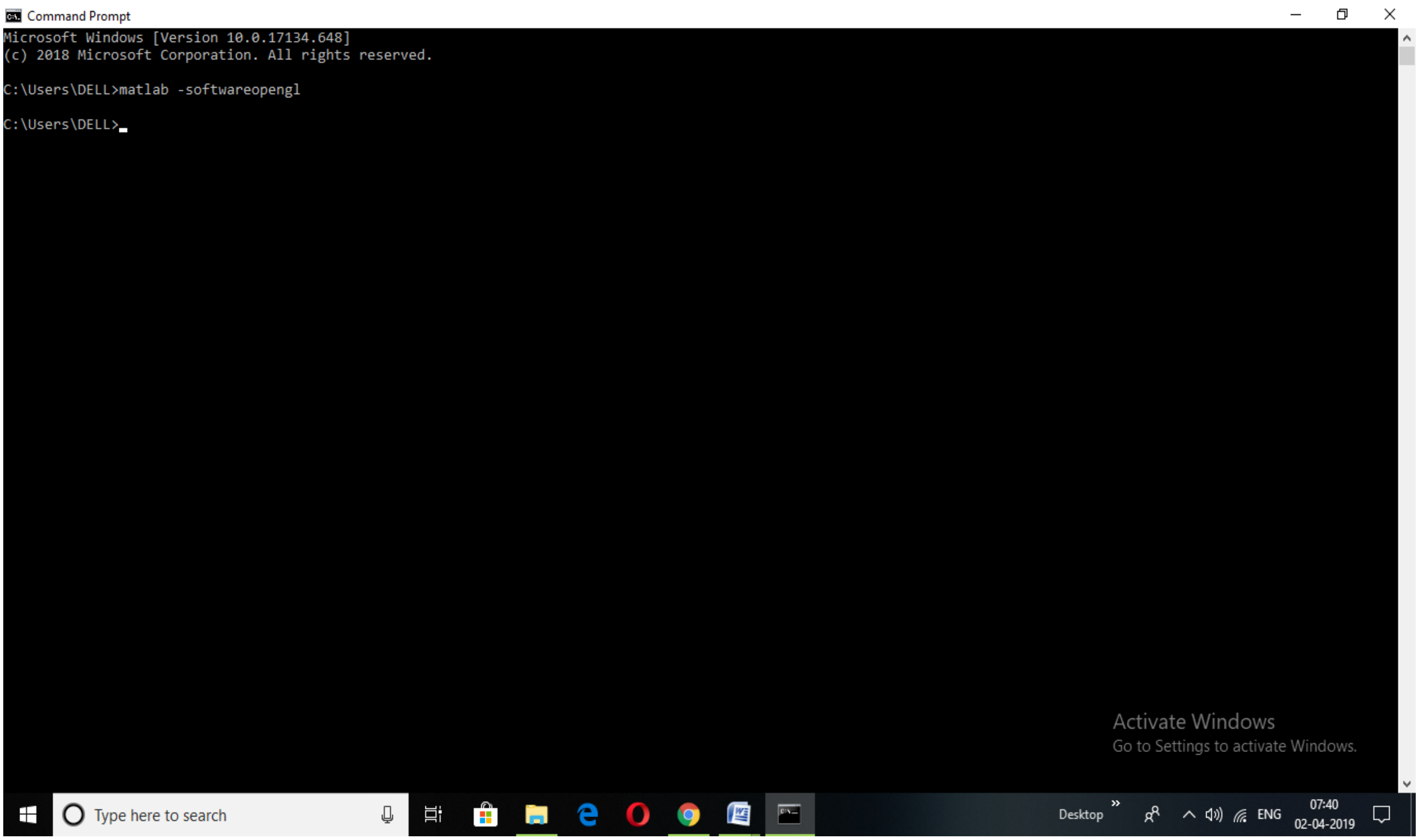

Fig 9.1: Command Prompt

Run the above command as shown in the command prompt in order to open the Matlab. By opening the matlab in command prompt we can quickly access the Matlab tool efficiently.

Step 2: After executing the above command the Matlab tool opens as shown below

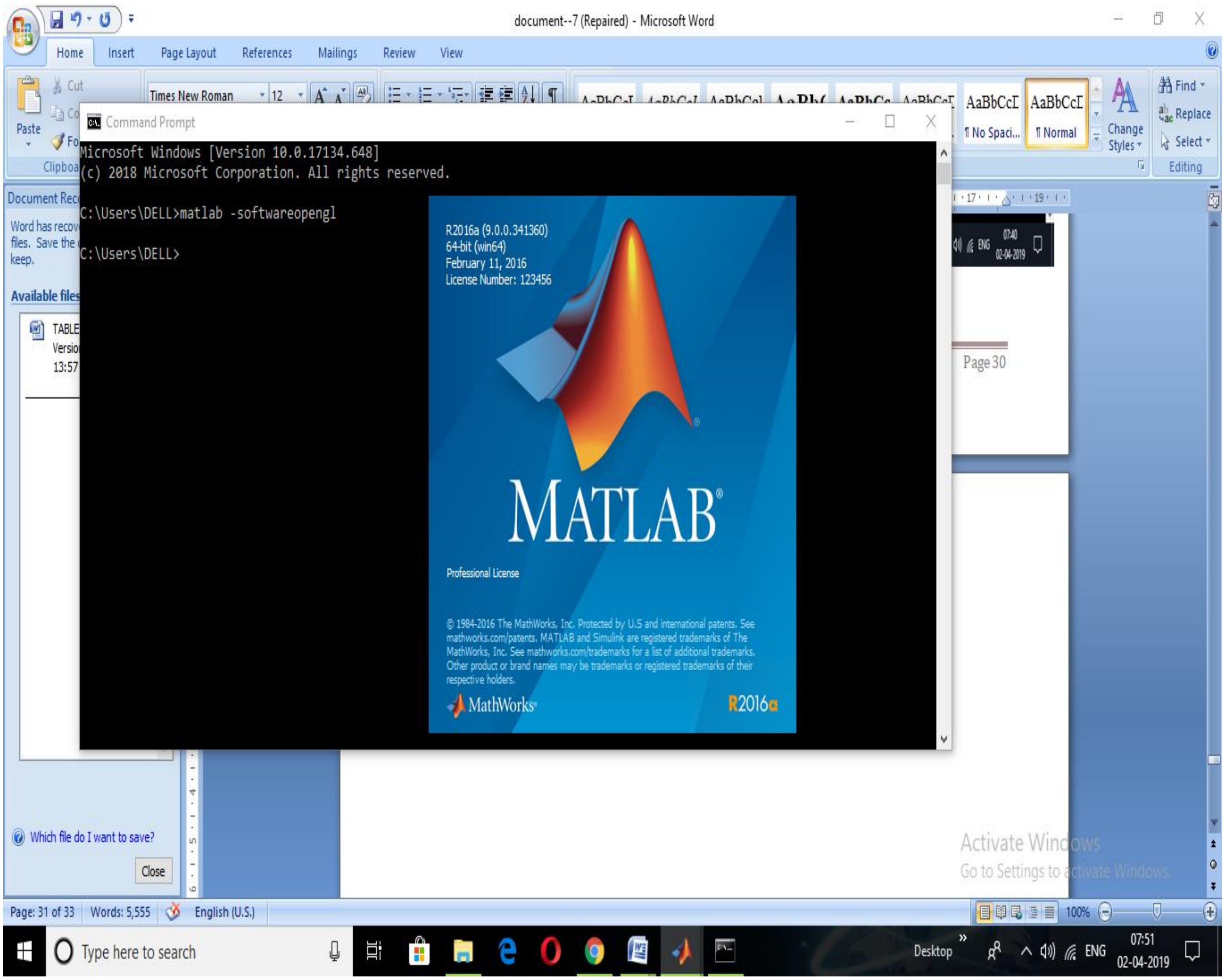

Fig 9.2: Opening Matlab

The Matlab tool starts opening as soon as the command executed. Please wait till the matlab is opened, it may take time. Please check the system requirements if any problem or troubleshoot occurs.

Step 3: Open the Leaf _Disease_Detection project from the desired Matlab path and select the folder DetectDisease_GUI.m

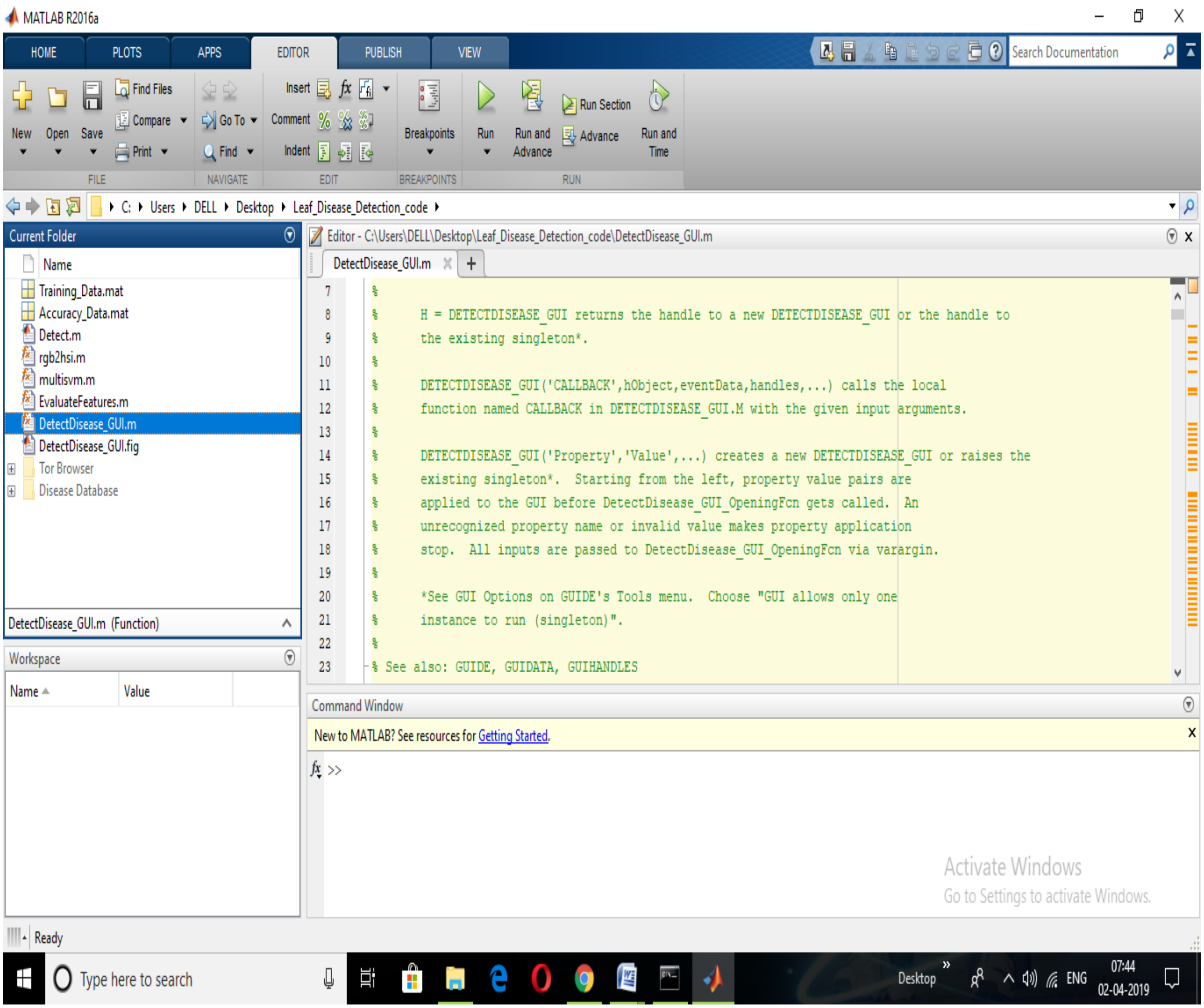

Fig 9.3: Leaf Disease Detection Code

Open the project folder from the desired path in the system and select DetectDisease_GUI.m in order to execute the program.

Step 4: Click on the Run button to execute DetectDisease_GUI.m

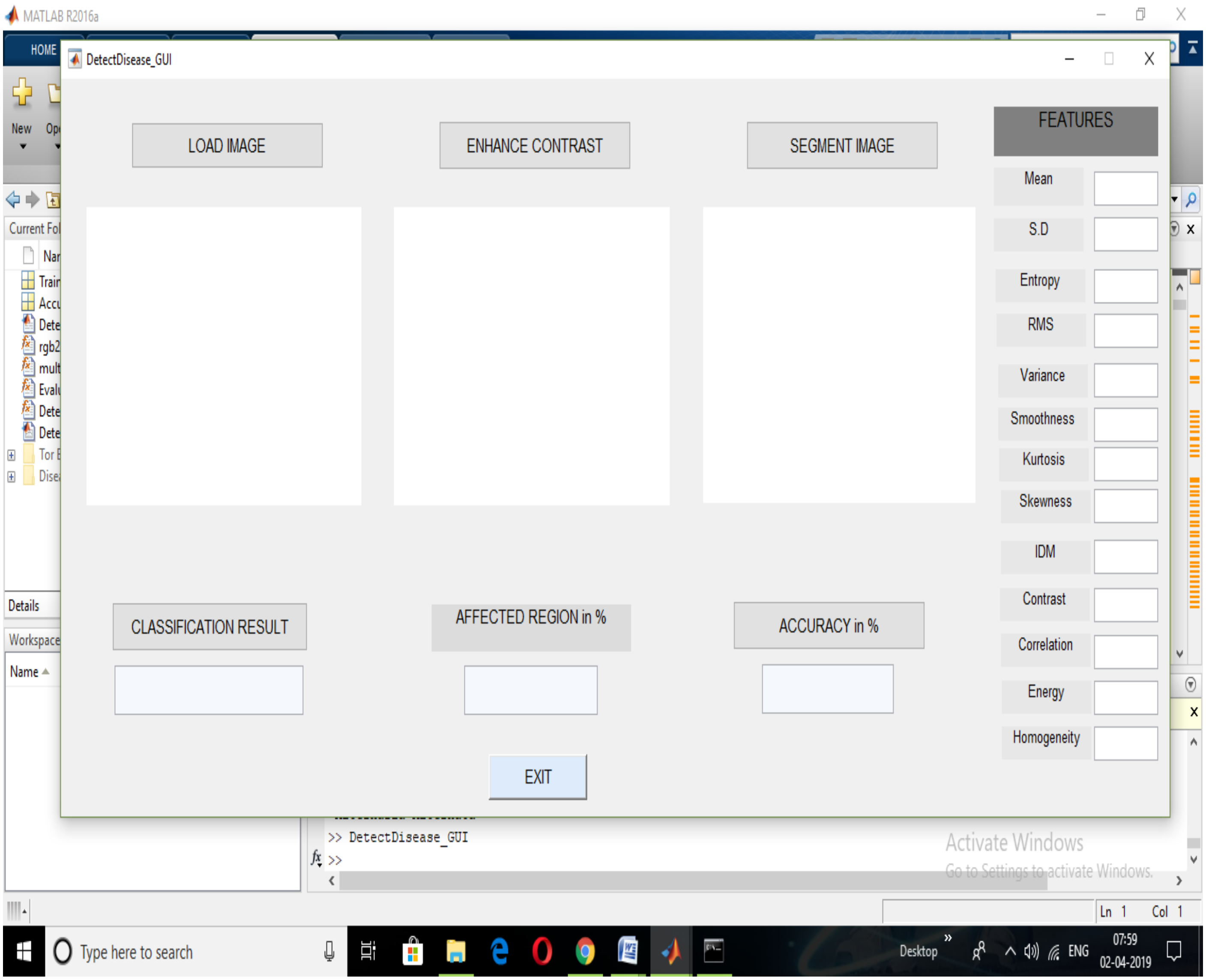

Fig 9.4: Executing the code

To execute the code, select the editor from menu bar. In the editor click the play button. After executing the above screen displays with three segments i.e., Load image, enhance contrast and Segment Image. And the output is displayed with classification result, affected region and accuracy in percentage.

Step 5: Select the leaf image from the disease data set

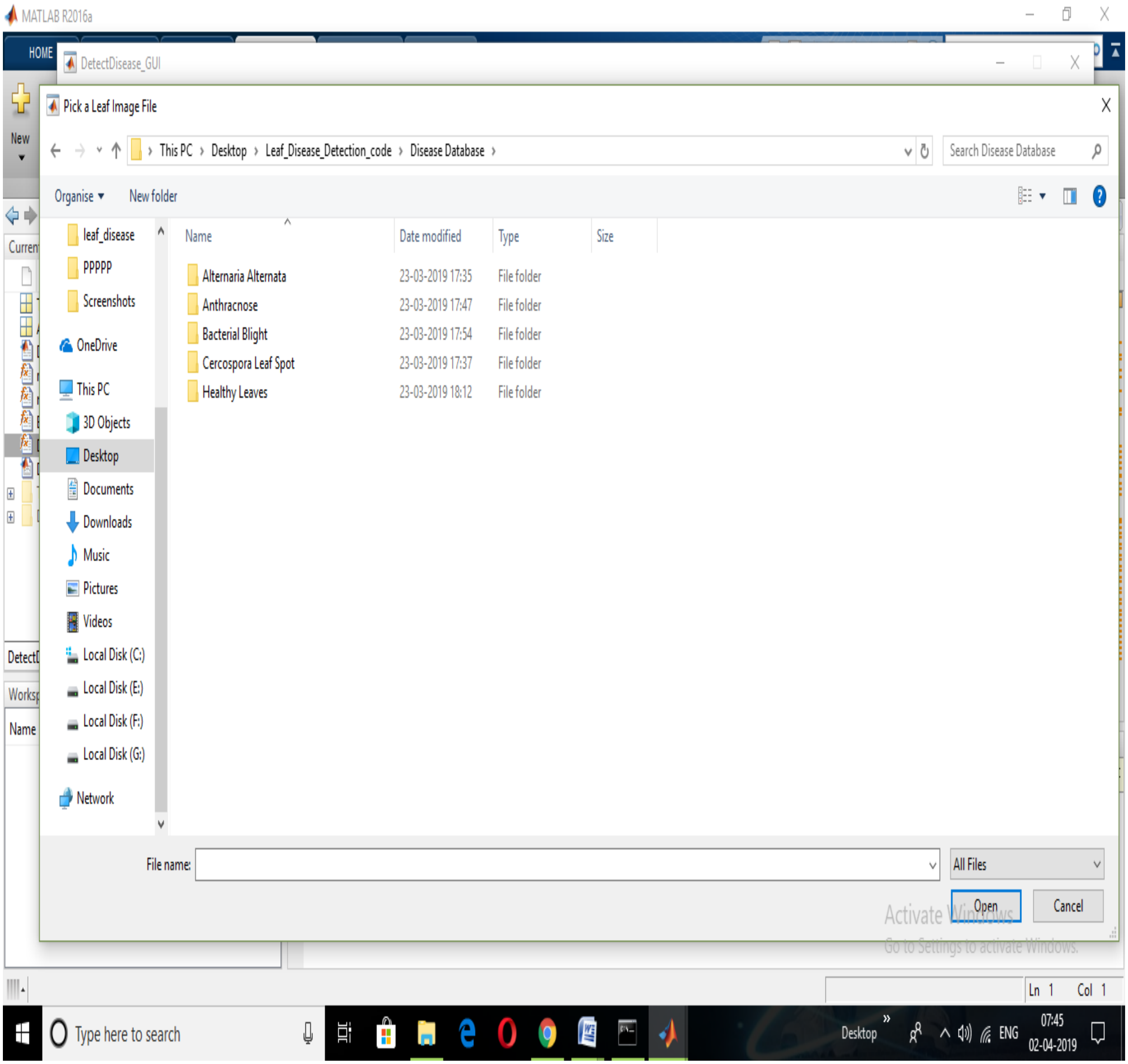

Fig 9.5: Selection of disease

The diseases are classified as shown above. Click load image and select any one of the leaf image from disease database.

Step 6: In the GUI click on Load Image and load the image from Disease Dataset and then click Enhance Contrast.

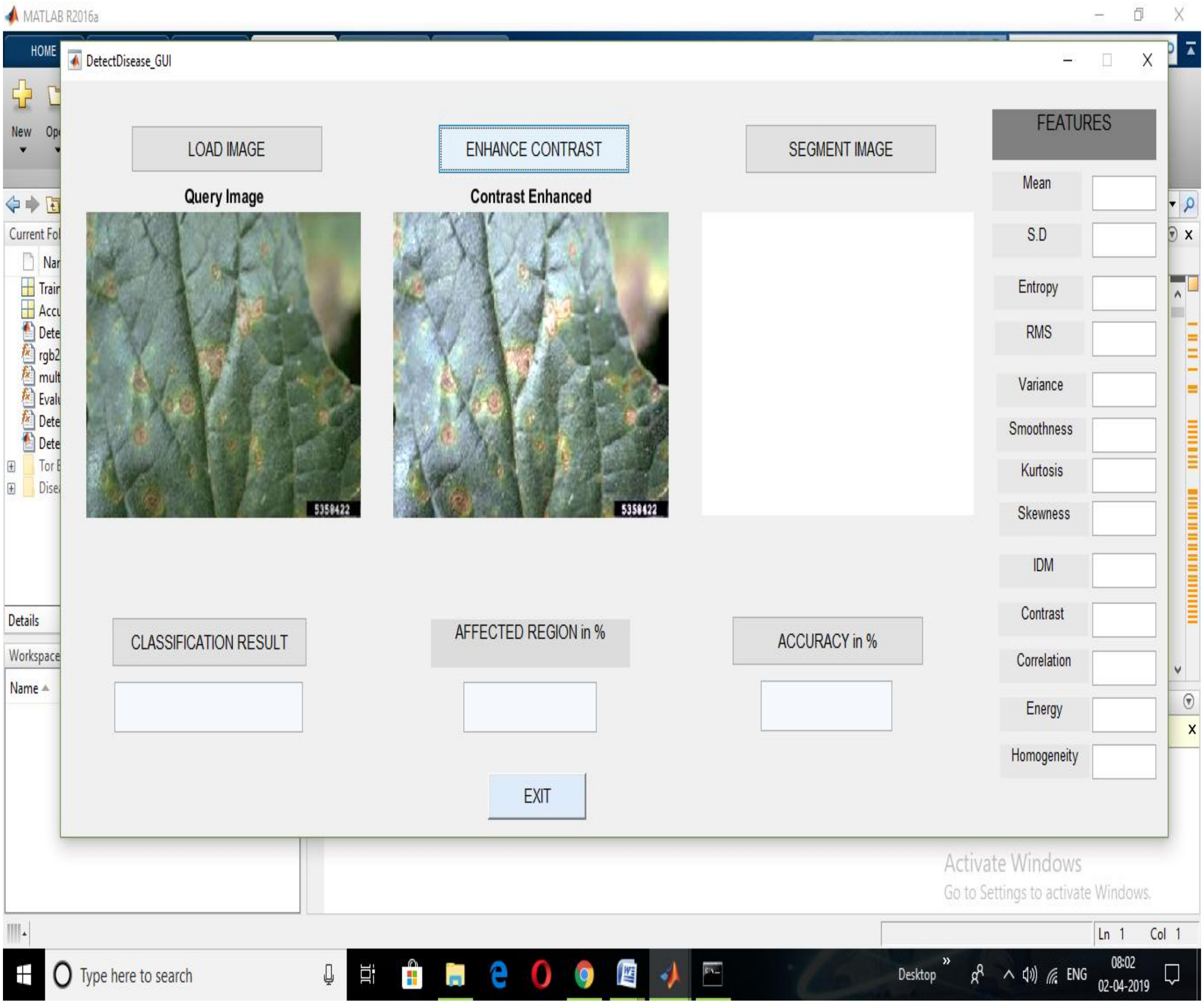

Fig 9.6: Loading Image

After selecting the load image and selecting the image from the disease database. Click Enhance contrast to get affected region percentage.

Step 7: Next click on Segment Image, then enter the cluster no containing the ROI, i.e. only the disease affected part or the healthy part.

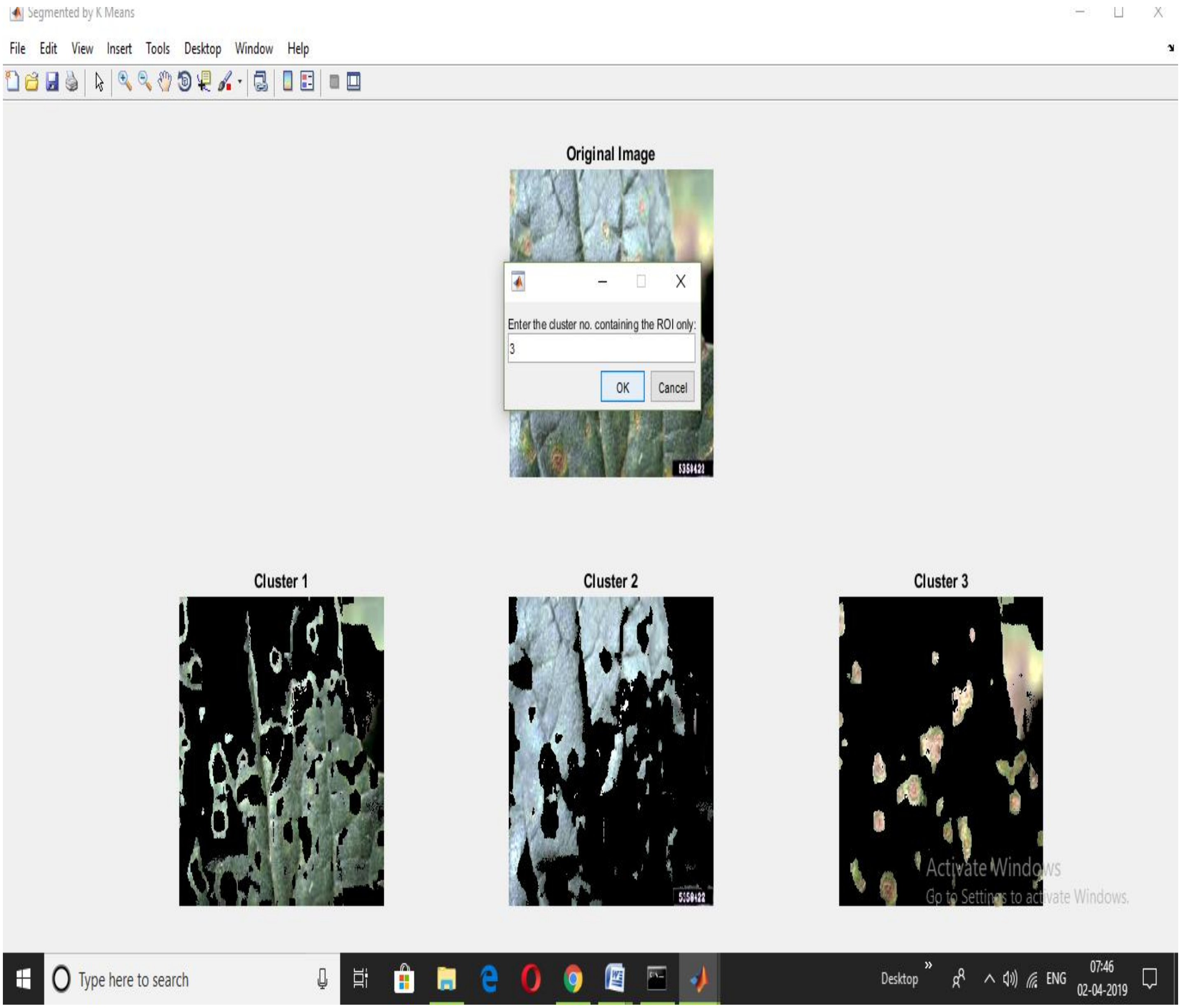

Fig 9.7: Selecting the Cluster

After selecting the enhance contrast, then click segment image so that the above three cluster opens. Select the cluster according to the healthy or unhealthy leaf.

Step 8: Click on classification results. Then measure accuracy (In this case Healthy vs All diseases).

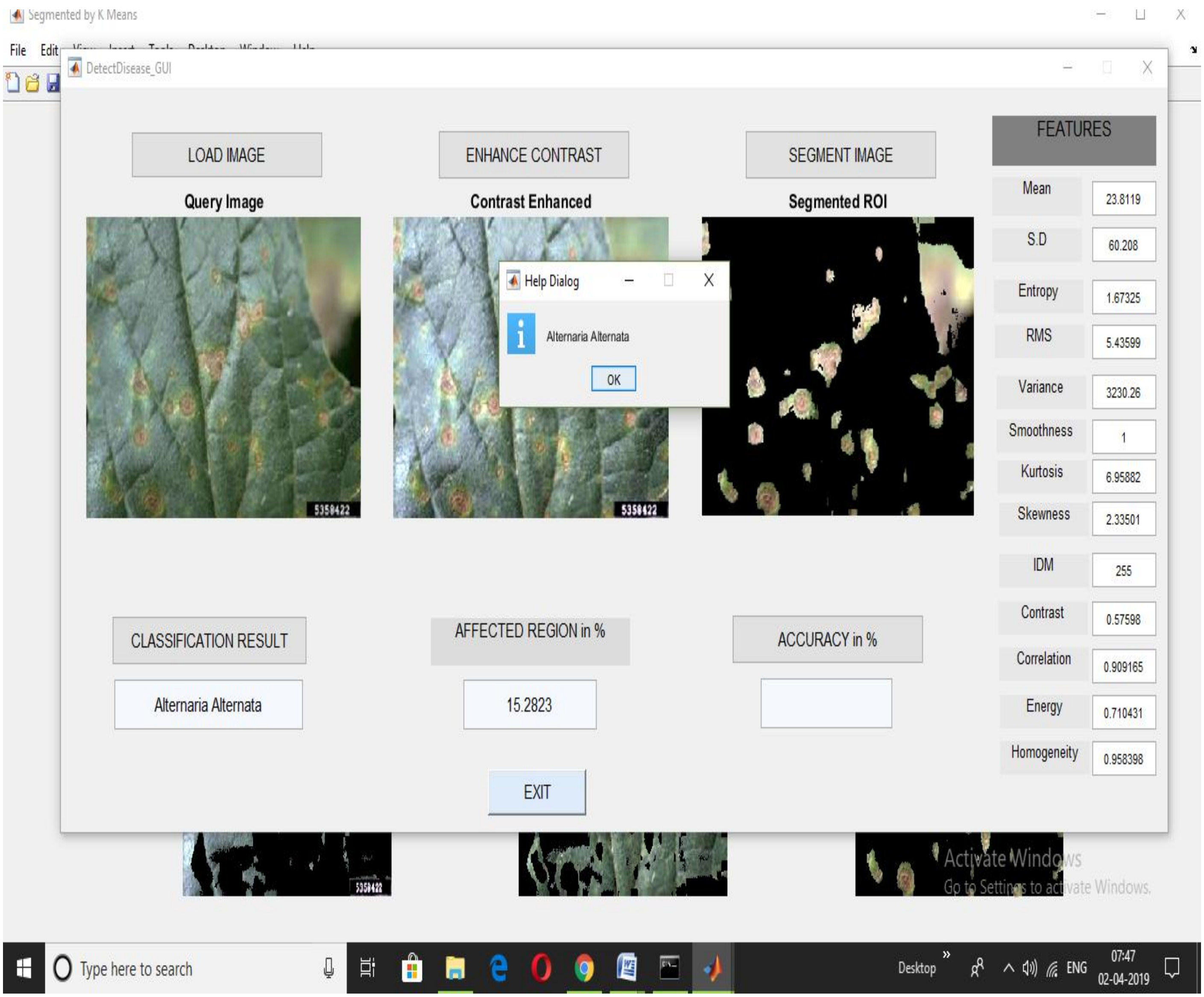

Fig 9.8: Disease detection

After selecting one of the cluster, the classification result shows one of the disease name leaf get affected or healthy leaf if it is healthy.

Step 9: The final output showing the disease name or healthy leaf with accuracy and affected region percentage.

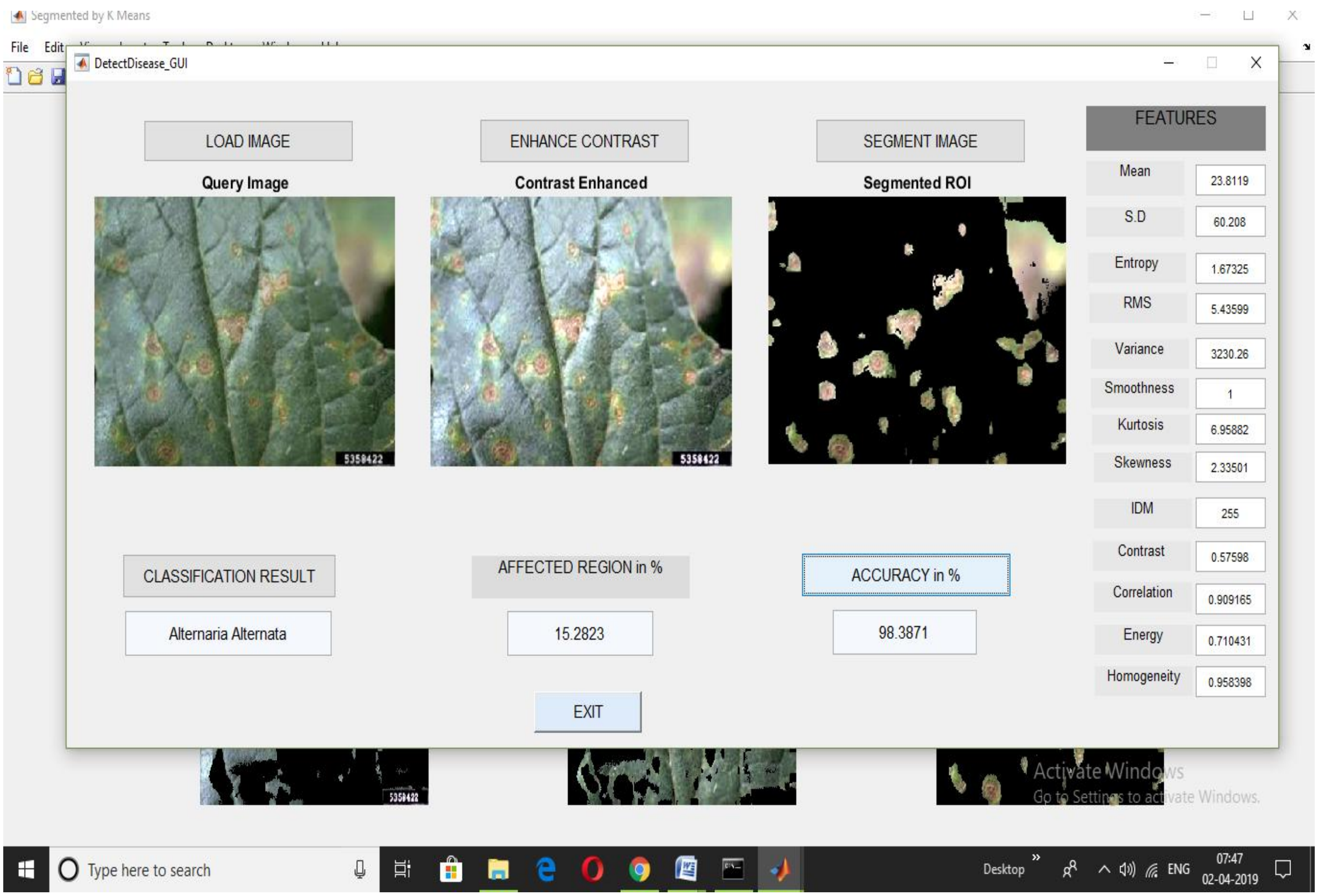

Fig 9.9: Accuracy Percentage

Finally we will get the accuracy in percentage after performing the 500 iterations and affected region in percentage.