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Classification and Detection of Plant Disease using Feature Extraction Methods

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Abstract

Today scientific knowledge relentlessly bringing change and comfort in day to day life. With this goal in mind plant disease identification and management is projected in carried work to prevent the plants from many diseases. Every country has prominent place for agricultural productivity and hence it is required to take care of plants for the sustainable growth of the country. To detect plant diseases Image processing steps are used to extract features from the images of plant leaves. The images are classified to define the disease detected through Graphical user interface (GUI) and it also calculates the affected region and it is shown as percentage of disease detection. The algorithms used are K-means clustering and Support vector machine for comparison and percentage of disease detection. The analysis of the work is carried through objective values such as mean, Entropy, variance, kurtosis, skewness, contrast and homogeneity. However contrast enhancement is also done for low intensity images. The resultant values are future enhanced with a hardware placed to monitor the status and update the information in Internet of things (IOT) for effective management of the plant disease detection.

Keywords: clustering; Detection; Hardware; Feature; extraction;

INTRODUCTION

The word disease is classified as Dis means reverse, negative or opposite and ease means is to relieve pain or provide comfort. A plant disease is an indication of harmful deviation of abnormal functioning of physiological process. Usually it can be clarified as malfunctioning in the process cycle. When there is abnormality in the functioning the reproductive structures of plant leaves is changed. There are many tragic events related to the plant diseases happened in the history of human life. The science of plant pathology defines the diseases in plants cause damage in the leaves and yield into fungi by taking the energy from the plants. There are many common diseases from plants like blights, phytophthora blight, cankers, rots, rusts, wilts these diseases provides symptoms to become alert of malfunctioning. But if the problem persists then it yields into Anthracnose, club root, Damping-off, downy mildew, leaf blisters, molds, black spots, scabs and viruses. One of the technique used in management of plant diseases is integrated pest management techniques. The methods used to control and manage the diseases is through identifying the plant condition through visual manner. The pests and damage can be monitored to describe the information through knowing the defect from leaves and nutritional deficiency. The disease cycle and pathogens are identified through the images captured. These images are processed with clustering techniques to define the affected region of the plants. Graphical user interface (GUI) is designed through visually by obtaining the result of affected region in the plant leaves. The disease occurs over the time and instantly it results in injury of plant. The process affects the plant functions through physiological process and results in abnormal condition. The symptoms are visible by detecting the changes in shape and color. The signs of plant disease should be identified early for avoiding various consequences later. The plant pathology was identified by a scientist named Speerschneider in 1857 who originated the disease on plant leaves.

LITERATURE SURVEY

There are four types of plant diseases which are classified as Anthracnose, Alternaria Alternata, Bacterial Blight and Cercospora leaf spot

A. Bacterial blight

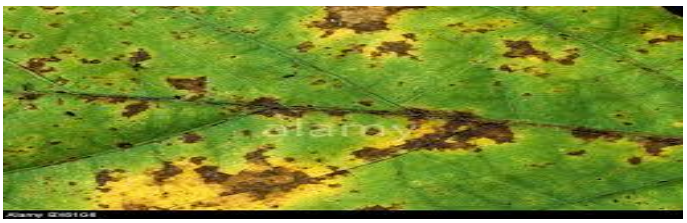

Figure 1: Bacterial blight

The basic symptoms of the disease can be observed as leaves become pale green and lesions in the leaves expand and appear as dead spots. The elongation of lesions extent into the full leaf and in between they can be seen as linear streaks. The infections of the disease are severe and exudate as milky gray at end of the leaf. The life cycle of Bacteria blight first spread through soil and water and then through driven rains. These bacteria occurs usually in winters and subsequently the infections spread through the rain drops and also with contact of insects. The wet weather and bacteria occurs at the temperatures of 15-25 C. The emerging leaves are avoided by infection bacteria due to warm and dry weather. The agriculture productivity losses damage the yield to 10-15% by this disease. The disease can be managed by using free seed

and rotating non grain crops. These management incidents will somehow reduce the effect of this disease[6].

B. Anthracnose

Figure 2. Anthracnose

This disease is caused due to fungi in the genus collectotrichum and happen in many species of plant. It develops dark and soaked lesions on stems and fruits. Harvesting with cleanliness and avoiding the rotted waste will somehow will avoid this disease for few days. The disease with fungus appears more in winters and continues the growth of spores in the leaves for a temperature of 75-85 F. Usually this disease spreads from plant to other in the form of insects, rain and wind. The dead tissue in diseases appear more in cankers and anthracnose. So the importance of horticulture is important to avoid such causes. The organisms are fungi, mycoplasms and virus reflects to various causes and affect to major species [1]. Canker disease also affect unique species of plants and cause endangered bactericides for a plant. Hence there is a need to find the diseases in earlier stage to avoid hazards in agricultural productivity.

C. Alternaria alternate

It is a fungus that is observed on the leaf spot and over 380 host species of plants. This disease appears in major parts of the plants such as blights, rots and leaf spots. The infections are so immune that it cause health effects on human life [4]. Hence there should be appropriate monitoring to the disease for avoiding future consequences. The spores on the leaves are due to asexual situations known as conidia. The lesions or drying and they appear from 10 to 50 days if proper care is not taken and it is also known as alternate.

Figure 3: Alternaria alternata

The disease cycle is triggered majorly due to rainfall and humidity. But as the condition deteriorates the germination is in night time and also penetrates from the top of the leaf. The affected region in the leaf can be observed within 12 hours.

D. Conidiophore

Conidiophore is a disease that appears in the form of pale brown to olive brown. This disease spread from 25-60 or 3-3-5 µm. These conditions are varied from straight or flexuous and appear in the form of bushy heads arising from substrate. These are very short and I ceiled for plant disease[3].

E. Cercospora leaf spot

Figure 4. Cercospora leaf spot

This disease is also a genus of fungi and these species do not have a sexual stage and the genus is mycospharella. The diseases leave spots on the plants and this appears in well-known species and information is the best known of it. These well-known diseases studied can be easily monitored and verified through image processing. The images of plant leaves are acquired and they are being processed to known the disease for early prediction and treatment of diseases. Hence it has been required now to give attention to the plant diseases for better agriculture yield and productivity. Regular inspection and monitoring of the crop avoids losses in the field and better productivity [2].

Hence the productivity of the fruits from plants gives a good income to the crop and also avoids any health hazards to human life. It has been seen that there is a need to bridge the gap between productivity of plant and diseases through technological barriers. The details of plant diseases should be known for pathology plants. The science today has been increase to a stage where every details of diseases can be found by doing a small search so hence this work gives a good hand to help the society and human life for better yield in future.

PROPOSED WORK

The Basic steps involved in for plant disease detection are shown in the below process of detection and classification using image processing is shown in Figure 5.

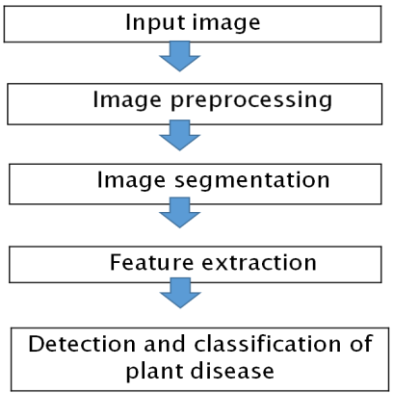

Figure 5. Basic steps for plant disease detection and classification

A. Image Acquisition

The plant leaves are captured by using a camera and the form of images are color images. The basic image colors are Red, Green and Blue. The image transformation of RGB image is device independent structure and can be converted in to any domain for clarity of the image.

B. Image Pre-processing

Preprocessing techniques are used to remove noise and crop the region selected. The region of interest in image is applied with smoothening filter and thereby it is enhanced in to stretch contrast. The enhancement in the image is carried out by the conversion of RGB in to gray scale which is carried out by the below equation.

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

Histogram equalization technique is used to equalize the intensities and distribute the values in the function. The enhancement of the images is carried out cumulatively over the distributed intensity values.

C. Image Segmentation

The image is portioned in to various parts based on the similarity. The segmentation methods used are otsu and k-means clustering for each clusters of the similar image. Later the image can be converted in to HIS model for signifying each portion of the image

D. Boundary and spot detection algorithm

The HIS model of the image is used in segmenting the portion of the image and spot is detected for the infected part. The 8-connectivity of pixels are clustered for defined features with number of classes of K. These features are classified by minimizing the distance between corresponding cluster and object.

- Heuristic approach is done by defining the K cluster and pick the value from the center or randomly.
- The pixels in the image are calculated to find the distance between cluster center and pixel.
- The averaging of cluster center is computed from all pixel values
- Hence the steps are repeated again and again to obtain the selected feature

E. Otsu Threshold Algorithm:

The gray level images and binary images are created using thresholding. The threshold value starts with zero and reaches one for binary images but for threshold it starts form zero to two fifty five. The otsu's algorithm used for thresholding is defined in the following steps

- Pixels are classified into two based on the threshold.
- Mean of the cluster and means of square difference is calculated
- The obtained pixels are multiplied to one another to define the cluster times.

The symptoms of the diseases are observed for changing color of the leaf. The infected portion of the leaves are classified based on the RGB imges. The otsu's threshold is observed and calculated based on the intensities and threshold values.

F. Feature Extraction

The process of feature selection and extraction is very important in this application as it relates with texture, color and morphology. The disease can be detected and better result can be observed with respect to the features. The detection of disease is shown with color distribution in the image like hardness and roughness in the texture of the image. This shows the infected plant areas of the leaves.

G. Color co-occurrence Method

The texture and color are the unique features in this method which can be classified for translation of RGB to HIS

$$H = 0 \quad Theta \ \ if \ B < G \qquad \ldots\ldots\ldots\ldots (1)$$

$$H = 360 - Theta \ \ if \ B > G$$

$$S = 1 - \frac{3}{(R+G+B)}[\min(R,G,B)] \qquad \ldots\ldots (2)$$

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

The computation statistics are evaluated using SGDM matrix and GLCM function and later can be used in objective analysis of image processing.

H. Leaf color extraction using H and B components:

The images are enhanced with anistropic diffusion and defines the effected region by separating the color from the background. The B and H components of color space can also use anisotropic diffusion for recognizing the colors in the leaf. The methods are diffused in every region for representing each cluster and identifying the disease pathology.

IMPLEMENTATION

A. GUI Development Environment

The GUI-Graphical user interface involves two basic tasks such as

- GUI components layout
- GUI components programming

The layout tools are primarily set with preferences. These files are called as M-files and initialization of this tasks are launched back in to a framework to execute users and activate the components of GUI.

Hence this GUI helps in easy interaction to the user and changes can be easily reflected in implementing the tools.

B. GUI Implementation

The M-file works with the commands and layout can be actively defined with files to save and launch in GUI in interactive manner.

C. A FIG-file and M-File

The M-file an FIG- file is used with Ui control and axes and the object properties are used to launch and control GUI. The call backs are the functions used to work with M-file. The M-file has a documentation and procedure to follow with steps. The blocks of M-file has user controls and axes for visualization of the results. The below figure shows the GUI is implemented in the Matlab software with two illustrative tasks.

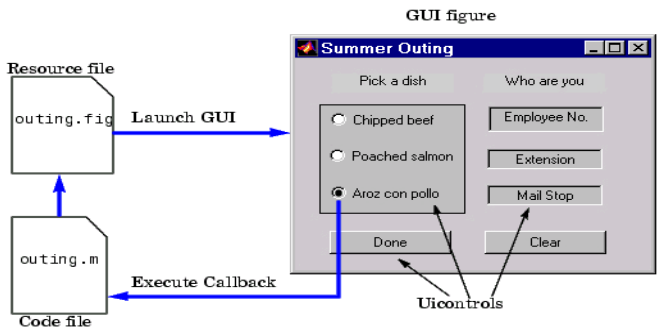

Figure 6. Graphical user blocks

EXPERIMENTAL RESULTS

The results for the project is as follows

In a GUI there are 6 virtual buttons appeared on the screen for Loading an image, Enhancing, Segmenting, Classification result, Affected region, Accuracy.

1. The first step is loading an image as shown in figure 7 below

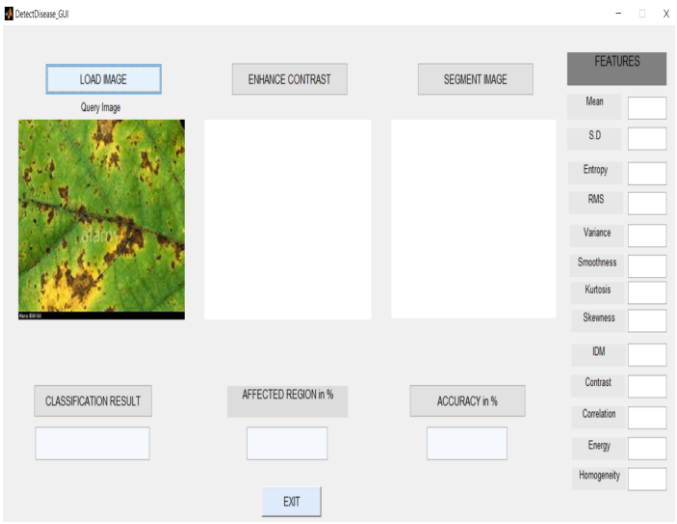

Figure 7. Load input image

The next step is enhancing an image, the image is enhanced by pressing enhance button on the screen and the image is shown in below figure 5.2

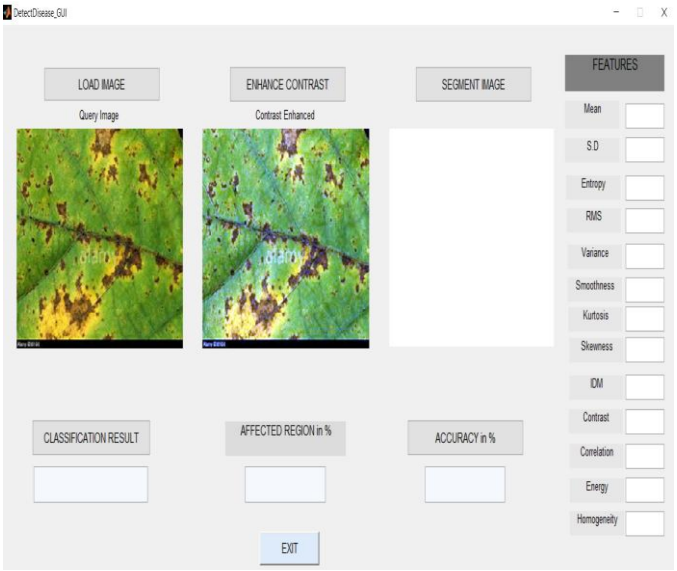

Figure 8. Enhance image

The next step is to segment an image, the segmentation is done by using k-means clustering method. By pressing the segment image button three clusters appear on the screen. We need to select a cluster which is closely related to the original image. The clusters formed are shown 9 below

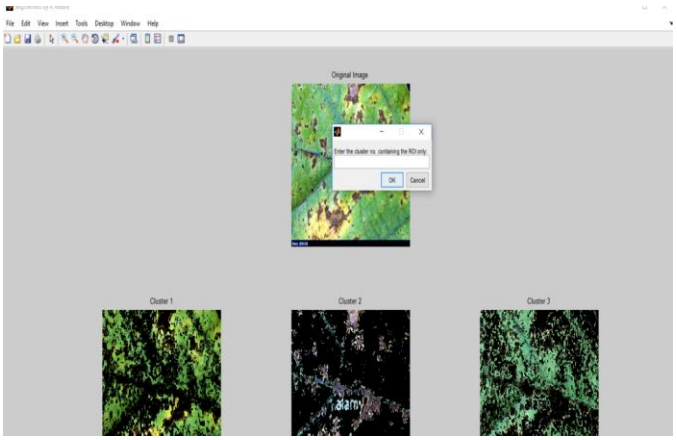

Figure 9. Clusters

After selecting the cluster, the segmented image is shown 10 in below figure with the classification result and affected region of the leaf.

The feature extraction values are displayed after segmentation process.

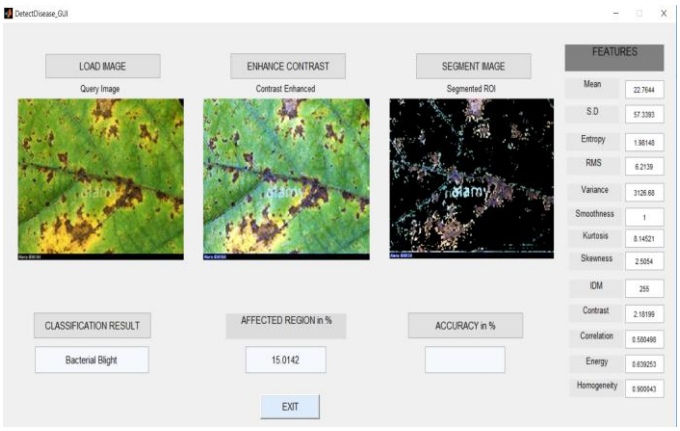

Figure 10. Classification and Affected region

The accuracy of the result is obtained by pressing the accuracy in % button which is shown in figure 11 below

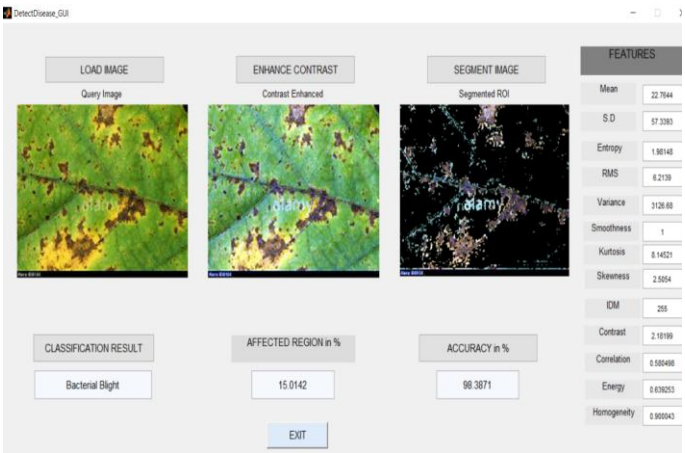

Figure 11. Accuracy

It is one of the types of classification in plant disease.in order to check if the plant is affected with this type first, we need to load an image as shown in the figure 12 below

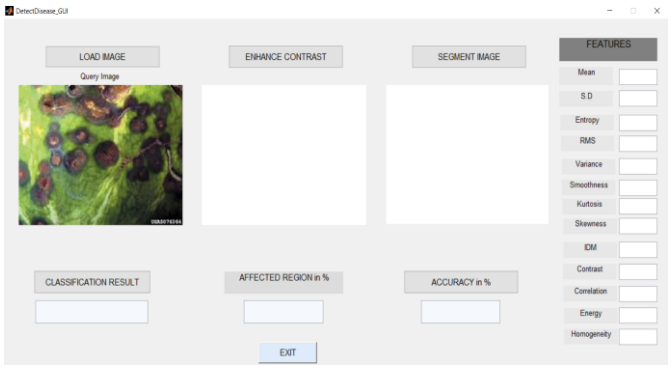

Figure 12. Load input image

Load the input image into the GUI. After that, the process is same as we done in above case i.e enhancing contrast, segmentation, classification result, affected the region, and accuracy.

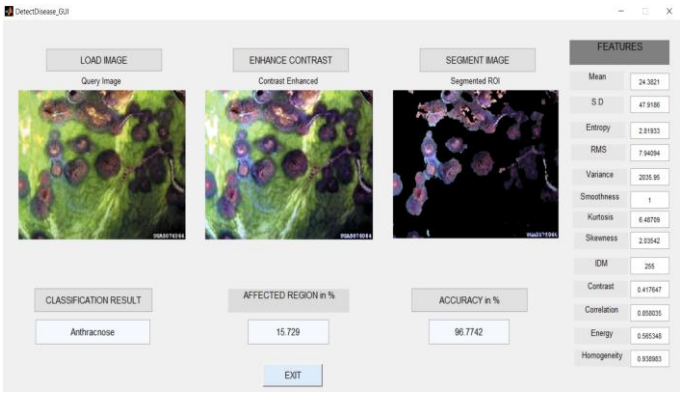

Figure 13. Overall output

The overall output involve segmentation, enhancement, finding classification result, affected region and accuracy as shown in figure 13.

It is another type of classification, in order to check if the plant is affected with this type first we need to load an image as shown in figure below.

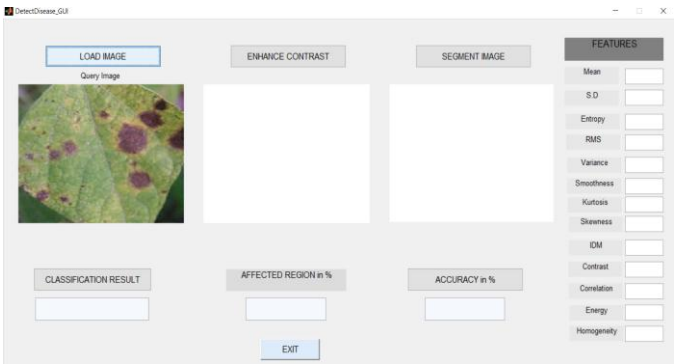

Figure 14. Load input image

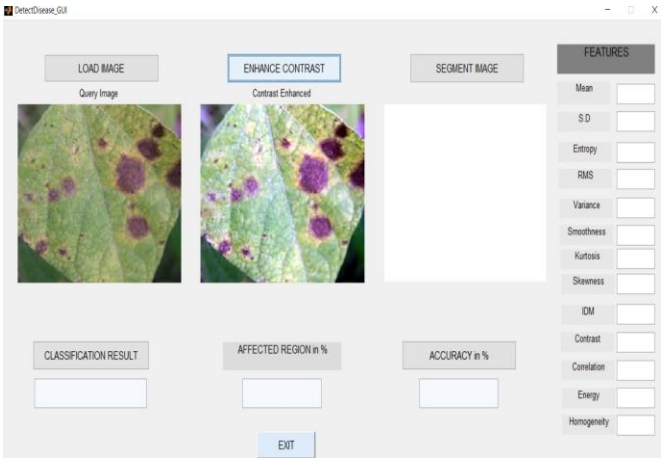

Figure 15. Enhance contrast

For proper segmentation of an image, we need to select an approximated cluster related to the original image and the clusters for the image is shown as follows

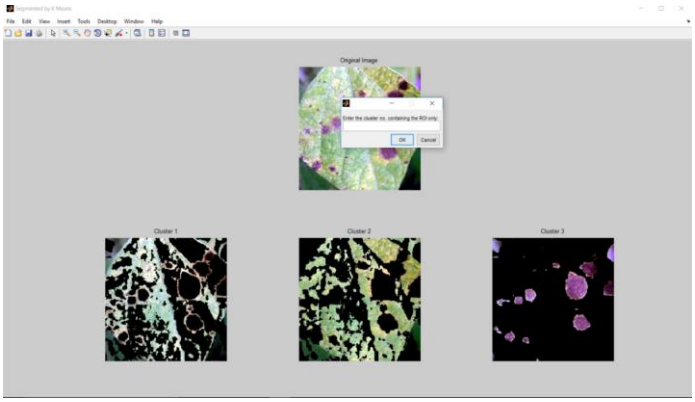

Figure 16. Clusters

After cluster selection for an image, the segmented Image is appeared as below

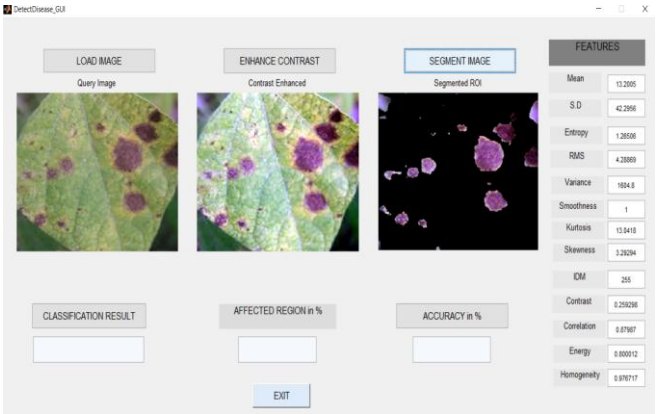

Figure 17. Segment image

For classification result, we need to click on classification result virtual button then it shows about the classification of the plant disease which is shown below.

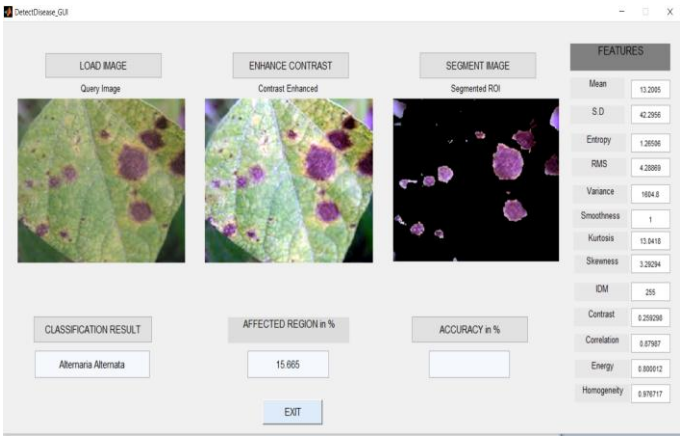

Figure 18. Classification result and affected region

After that for accuracy calculation click on virtual button accuracy in % then it shows how much accuracy the result obtained.

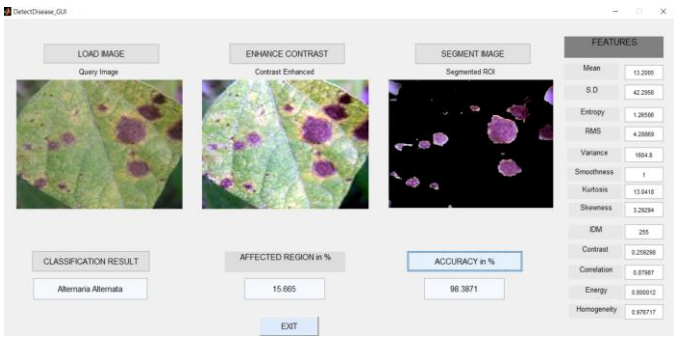

Figure 19. Accuracy

It is another type of classification, in order to check if the plant is affected with this type first we need to load an image as shown in figure below

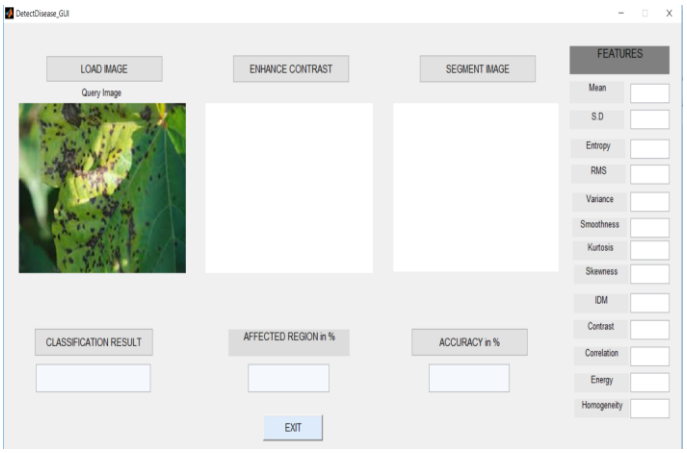

Figure 20 load image

After that the following procedure is followed Enhancing contrast of an image, segmenting an image, finding classification result, affected region of the leaf, the accuracy of the result. The detailed output after performing above operations is shown in below figure

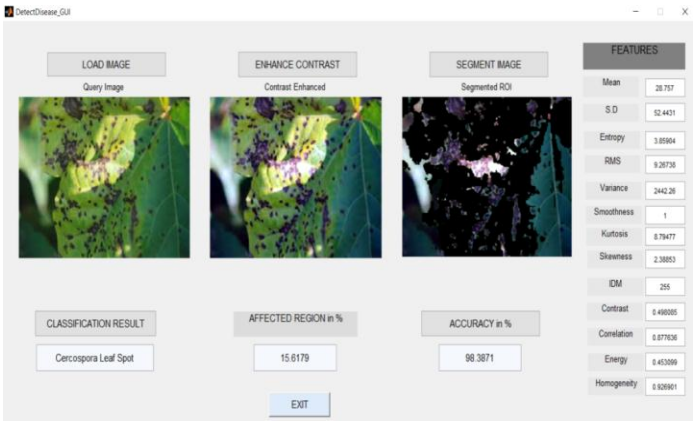

Figure 21. Overall output

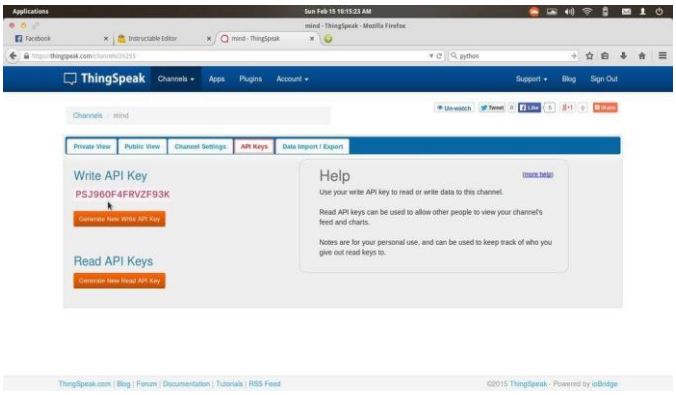

Figure 22. The overall output can also be uploaded into IOT-things speak by using a hardware.

B. Objective Analysis

The summary of the results is shown in a table with some extraction values for different classification of plant diseases.

Table 1. Summary regarding classification of disease

Type of disease	Feature extraction								
	Mean	S.D	entropy	rms	variance	kurtosis	skewness	contrast	homogeneity
Alternaria alternata	128.96	118.69	3.62	12.57	10666.3	1.09	0.015	0.411	0.944
Anthracnose	24.3821	47.91	2.81	7.94	2035.95	6.48	2.03	0.41	0.938
Bacterial Blight	65.84	86.16	4.20	10.10	6494.76	1.78	0.73	6.48	0.74
Cescospora leaf spot	33.801	62.19	3.28	8.39	3440.22	5.09	1.79	1.20	0.89

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. This paper discussed various techniques to segment the disease part of the plant. This paper also discussed some Feature extraction and classification techniques to extract the features of infected leaf and the classification of plant diseases. The use of ANN methods for classification of disease in plants such as self-organizing feature map, back propagation algorithm, SVMs etc. can be efficiently used. From these methods, we can accurately identify and classify various plant diseases using image processing techniques. We can extend this method to use as soil classifier and it can also be extended to medical applications. Further research has to be focused to implement this proposed method to find brain tumour.

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