Indonesian Journal of Electrical Engineering and Computer Science
Vol. 10, No. 1, April 2018, pp. 191~200
ISSN: 2502-4752, DOI: 10.11591/ijeecs.v10.i1.pp191-200

Classification of Leaf Disease from Image Processing Technique

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Article Info

Article history:

Received Jan 1, 2018
Revised Mar 15, 2018
Accepted Mar 29, 2018

Keywords:

Leaf Disease
Image Processing
Classification
Support Vector Mahine

ABSTRACT

Disease in palm oil sector is one of the major concerns because it affects the production and economy losses to Malaysia. Diseases appear as spots on the leaf and if not treated on time, cause the growth of the palm oil tree. This work presents the use of digital image processing technique for classification oil palm leaf disease sympthoms. Chimaera and Anthracnose is the most common symtoms infected the oil palm leaf in nursery stage. Here, support vector machine (SVM) acts as a classifier where there are four stages involved. The stages are image acquisition, image enhancement, clustering and classification. The classification shows that SVM achieves accuracy of 97% for Chimaera and 95% for Anthracnose.

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1. INTRODUCTION

Palm oil or its scientific name Eleais guineensis is an important and useful economic crop which used as for the food industry as well as for the non-food industry. The monocotyledons crop oil palm is a member of the Palmae family and the Cocoidae subfamily. There are three species of the palm oil tree that can be found around the world which are Elaeis: E. guineensis originally from Africa, E. olifera originally from South America and the last one is E. odora also originate from South America. The African oil palm was named by Jacquin in 1763. The specific name guineensis directs it origin at the Guinea Coast while genus name Elaeis originated from "elaion" the Greek word which means oil [1]. The second largest known oil palm plantation in the world is Malaysia. It is recorded in 2012 that Malaysia has a total planted oil palm tree area of 5.07 million hectares in.

However, disease infection can disrupt the production of palm oil and that is why to obtain maximum production, the health of the palm oil tree is crucial. All growing stages of oil palm plants can be infected by a disease. Usually, the diseases can be found and detected in older crop but a younger palm oil tree in the nursery stage also can be infected by the diseases. The palm oil tree that was infected by the disease normally shows a symptom in the early stage of infestation usually on its leaves. Before the symptoms can be spotted visually, the fungus or virus maybe internally grow inside the palm oil tree [2]. The production of oil palm in Malaysia also has increased from year to year. However it can be maximize by taking care of the palm oil trees health. This is because palm oil trees are exposed to several diseases. Generally, the disease microorganisms are fungi, bacteria and virus [3]. To reduce the incidence in replanting the palm oil tree in the plantation area, different approaches was used to control the disease infections on existing plantation area. However, in advanced disease infections, it has no satisfactory methods that can be used in reducing the effect of the infections on the yield. Because the disease infections on palm oil tree

usually has specific symptoms, the most basic method to detect the infected palm oil tree is by visual inspection which is known to use intensive labour and consume more time [4]. Many solution to the problem regarding the disease infection have been proposed such as fungicide injection into stem and soil mounding. These actions was taken to slow down the infestation process on the palm oil tree and to prolong the palm oil tree life. Thus detection of the palm oil tree disease from early stage is crucial so that accurate preventive action can be taken in order to tackle the problem arise [5]. Disease management is a challenging task. Mostly diseases are seen on the leaves or stems of the plant. Precise quantification of these visually observed diseases, pests, traits have not studied yet because of the omplexity of visual patterns. Hence tere has been increasing demand for more specific and sophisticated image pattern understanding [6].

The application of image processing and support vector machine (SVM) classifier algorithm can be done by using MATLAB software as the platform. MATLAB is the short form of Matrix Laboratory as its basic data element is the matrix. A simple integer is considered as matrix of one row and one column. Several mathematical operations that work on arrays or matrices are built-in to the MATLAB environment. MATLAB was chosen because it is a computing platform that is capable of developing and testing number of applications in it. The major advantage of using MATLAB software compared to other software is the graphical user interface (GUI) which can contribute positively to understand the concepts with ease. The pictorial illustrations confer better understanding of the concepts with ease [7].

The process of processing digital images with various techniques is known as such as digital image processing. The process includes image restoration, image de-noising, image segmentation, and also edge detection of the image. In this modern era, the digital image processing plays an important part in a technology development including all sectors [8]. As the classifier, the SVM was chosen to be used because support vector learning is based on simple ideas which have its origin in statistical learning theory. The simplicity comes from the fact that SVM apply a simple linear method to the data but in a high-dimensional feature space non-linearly related to the input space. Moreover, even though we can think of SVMs as a linear algorithm in a high-dimensional space, in practice, it does not involve any computations in that high dimensional space. This simplicity combined with state of the art performance on many learning problems such as classification, regression, and novelty detection has contributed to the popularity of the SVM [9], [10]. Leaf disease detection image processing that can recognize problems in crops from images, based on colour, texture and shape to automatically detect diseases and give the fast and accurate solutions to the farmer was studied by [11] which concentrated on the affected area of diseases and classification.

The current method now was said to consume more time is because human can cause error, and this can lead to consuming more time to classify the right diseases. Besides that, different diseases have different ways to handle it. New disease that can be visually spot it symptoms may require the leaves to be test in the laboratory and require a week or maybe a month to detect it. So, it is necessary to develop a system that is able to assist the worker in the oil palm plantation area in determining the specific disease symptoms on the oil palm tree. This system will help the worker to determine the symptoms accurately in a short time period. Therefore, in this work SVM has been used as a classifier to identify and classify the disease infection based on spot that reflect the diseases of Chimaera and Anthracnose.

2. RESEARCH METHOD

There are five main steps used for classification of palm oil leaf diseases as shown in Figure 1. The overall classification consists of image acquisition through digital camera, image enhancement, clustering and classification.By going through this processes, the presence of diseases on the palm oil leaf can be identified.

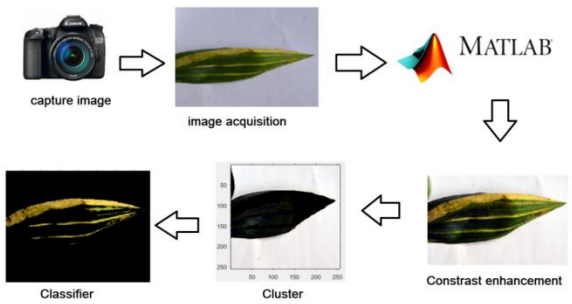

Figure 1. The overall process of disease classification

2.1. Image acquisition

The images used in this work were taken from palm oil leaf. There are two types of diseases are identified as the most common diseases found on the leaf of palm oil tree. The images were taken from with a NIKON digital camera. The images were all color images. No flash was used while taking the picure and the image scenes were taken with white background paper. Figure 2 shows the sample images desases spotted on a palm oil leaf.

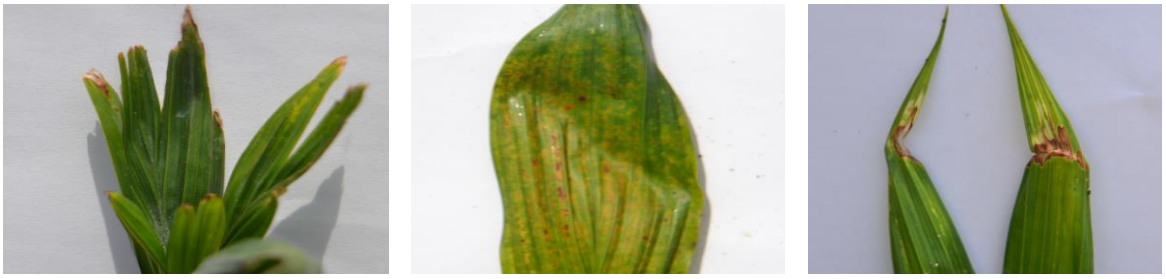

Figure 2. Sample images of different palm oil leaf

2.2. Image Enhancement

There are various technique in image enhancement such as constrast adjustment, image filtering, morphological operations, deblurring, ROI-based processing and image arithmetic. However, in this project the image enhancement technique that was used was only contrast enhancement. The contrast enhancement was done to reduce the noises in the image which make the region of interest of the image not clear that can lead to the quality of the image dropped so that the quality of the image will be improve [12]. This technique will adjust the image intensity values or colour map.

2.3. Clustering Technique

Segmentation is done through clustering [13]. A basic clustering k-means algorithm is used for segmentation in textured images [14]. It clusters the related pixels to segment the image. Segmentation is done through feature clustering and there it will be changed according to the colour components. Segmentation is purely depending on the characteristics of the image.

2.4. Classification

Classifier is used for classifying images based on their fatures. Support vector mahine (SVM) was proposed for only two class problems but also for decision making. The software was written in MATLAB. In which training and testing performed via several classifier such as k-means neighbor, radial basis function, artificial neural networks and support vector machine. SVM has been also found to be very promising to achieve efficient classification of leaf disease [15], [16].

3. RESULTS AND ANALYSIS

In this work, the data set used is collected from Tapak Semaian Felcra in Sendayan Negeri Sembilan focused on the most common diseases infection spotted on the palm oil leaf which are Chimaera and Anthracnose disease.

The Chimaera disease is caused by the genetic problem of the oil palm tree seeds. The symptoms of the disease are the leaves have white stripe or yellowish-white, and the lack of chlorophyll. The leaves will not recover as normal tree leaves so the growing palm oil trees in the nursery stage that was infected with Chimaera disease will not be used for further stage in palm oil plantation. Figure 4 shows the symptoms of the Chimaera disease.

Figure 3. Tapak semaian benih Sendayan, Negeri Sembilan

Figure 4. Chimaera disease symptoms spotted on the leaf

Basically, Anthracnose disease can affect all palm oil trees at any growth stages. The symptom is most visible on leaves and also ripe fruit. It first appears on leaves as small brown spots, dark brown spots or also black spots between the veins and these spots will expand to elongated streaks. Typically, these are brown or black in color and are bordered by a pale yellow colour. The colour of the infected part darkens as it ages. The disease can also produce cankers on petioles and on stems that causes severe defoliation and rotting of fruits and roots. Acervuli are produced on the dead tissues and when mature they emit gelatinous pink spore masses. The symptoms of the Anthracnose diseases are as shown in the example as in Figure 5.

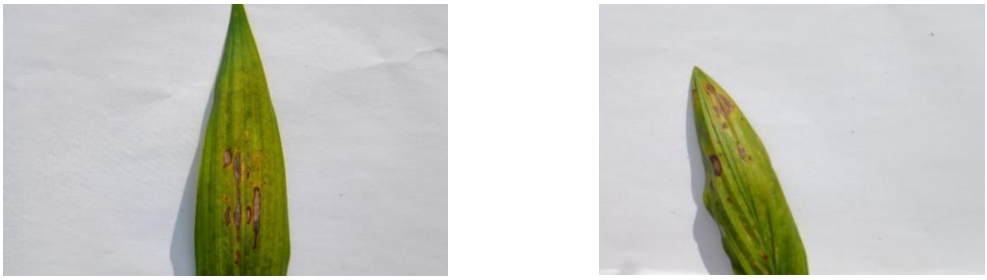

Figure 5. Anthracnose disease symptoms spotted on the leaf

3.1. Image acquisition

This sample images was uploaded into the MATLAB software to be analyse for the detection and classification of the palm oil tree diseases. After the selected sample image uploaded into the MATLAB software, the first process that the image will then through is image pre-processing technique. The image will be resized to 300x400. The new image size will be used for the whole process so that the image will be process in the same size through the whole process to avoid in difference result produce. The main purpose of resizing the image was to display the image in the GUI. Based on the figure shown below, Figure 6 represents Chimaera disease sample image and Figure 7 represents Anthracnose disease sample image that was used in this classification.

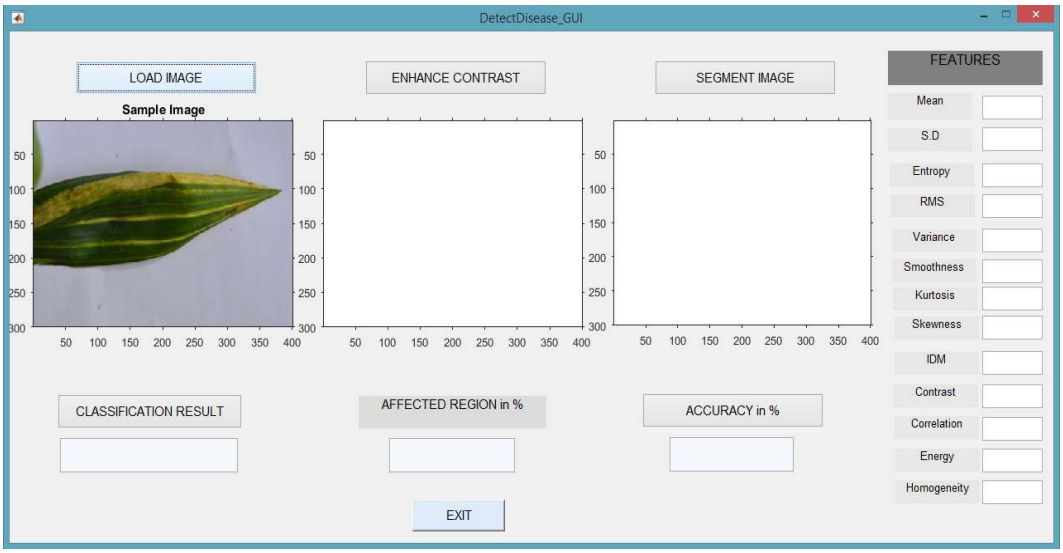

Figure 6. Sample image of Chimaera disease

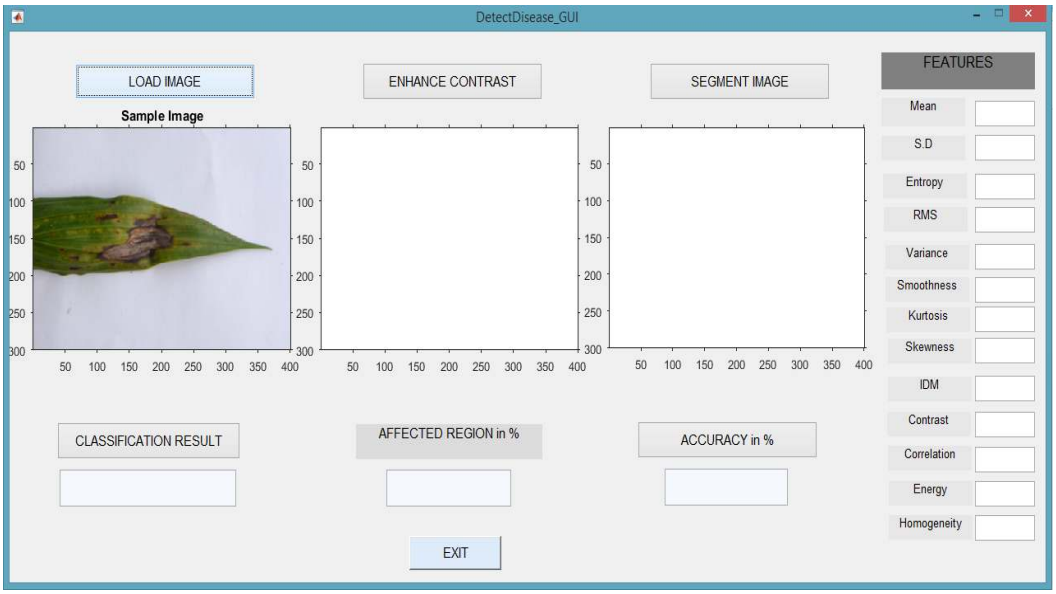

Figure 7. Sample image of Anthracnose disease

3.2. Image Enhancement

Figure 8 and Figure 9 below shows the selected sample image for Chimaera disease and Anthracnose disease that has been uploaded going through the image enhancement process. The selected image processing technique that was used was contrast enhancement. Contrast enhancement is known to be a process to make the features of the image to stand out more clearly by making optimal use of the colours available on the display. The main objective of the sample image to go through this process was to reduce the noises in the image. This is because the noises in the image will reduce the quality of the image. By reducing the noise in the image, the quality of the image can be taken to a higher so that the region of interest of the image which is the disease pixel can be easily detected without any error. Contrast enhancement technique will modify the colour intensity values or colour map of the image. The function in image enhancement used to maps the intensity values in grayscale image to a new values such that 1% of data is saturated at low and high intensities of the grayscale image. Figure 8 shows the Chimaera disease while Figure 9 shows Anthracnose disease sample image after the contrast has been enhanced.

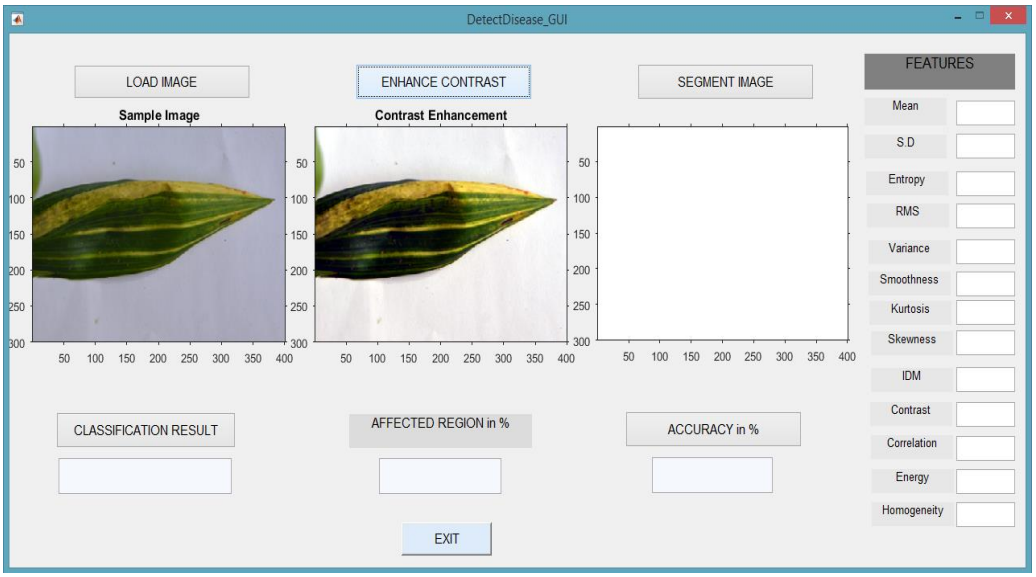

Figure 8. Chimaera disease image after contrast enhancement

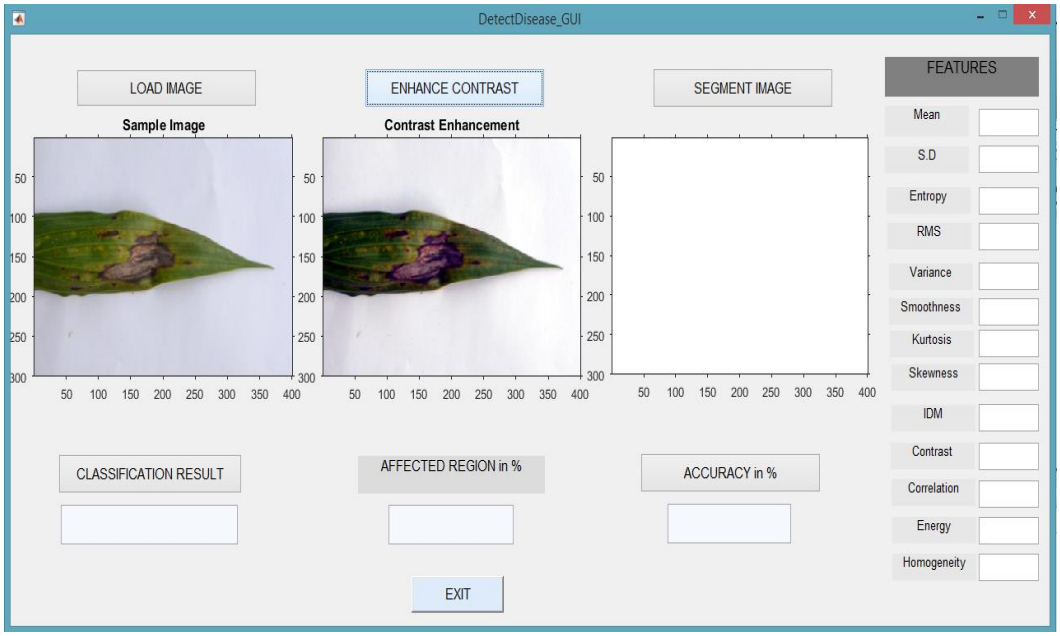

Figure 9. Anthracnose disease image after contrast enhancement

3.3. Clustering

Figure below shows the sample image undergoing image segmentation using K-means clustering technique. K-means clustering technique is known as a method to differentiate things or object in the image in image processing algorithm. It aims to partitions the remarks of the image into k clusters in which each remark have a rightful place to the cluster with the nearest mean, referring as a prototype of the cluster. In this work, the k-means clustering differentiate the sample image into three clusters with respect to the colour pixel of every image by using Euclidean Distance Metric. Referring to Figure 10, the sample image of Chimaera disease was clustered into three clusters. The selected cluster for this disease with respect to the disease symptom shown on the palm oil leaves was selected as shown in cluster 2 as shown in Figure 11. Meanwhile, for Figure 12 it is shown the Anthracnose disease also separated into three clusters. The selected cluster for this disease with respect to the disease symptom show on the palm oil leaves was selected as shown in cluster 3 as shown in Figure 13.

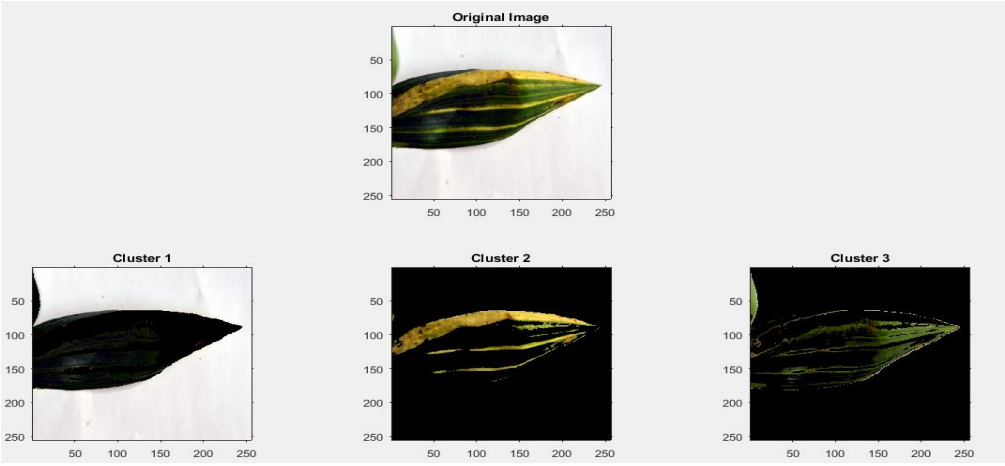

Figure 10. Chimaera disease image cluster 1, cluster 2 and cluster 3

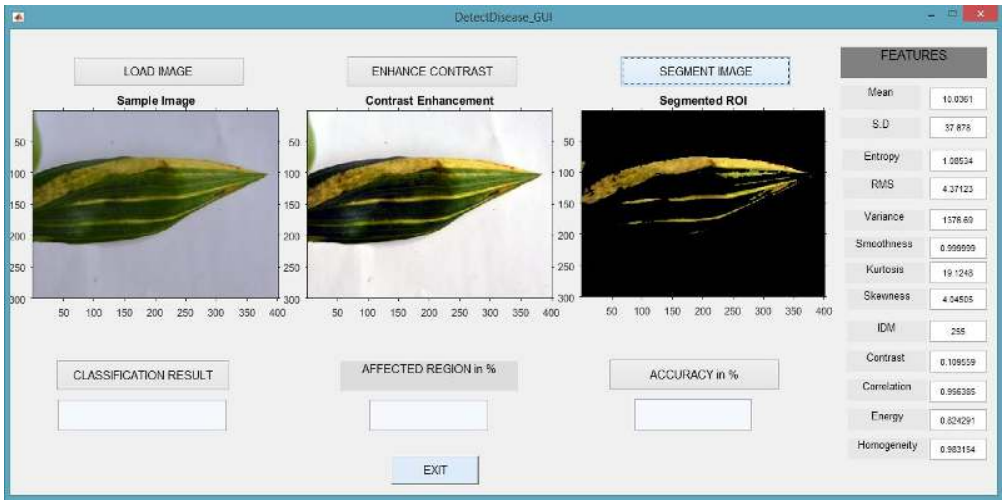

Figure 11. Chimaera disease selected cluster

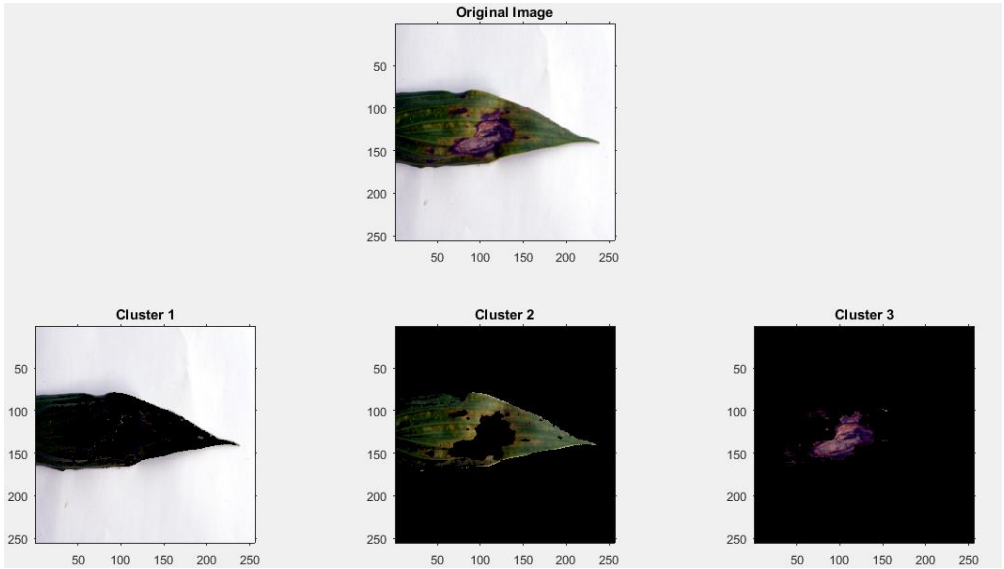

Figure 12. Anthracnose disease image cluster 1, cluster 2 and cluster 3

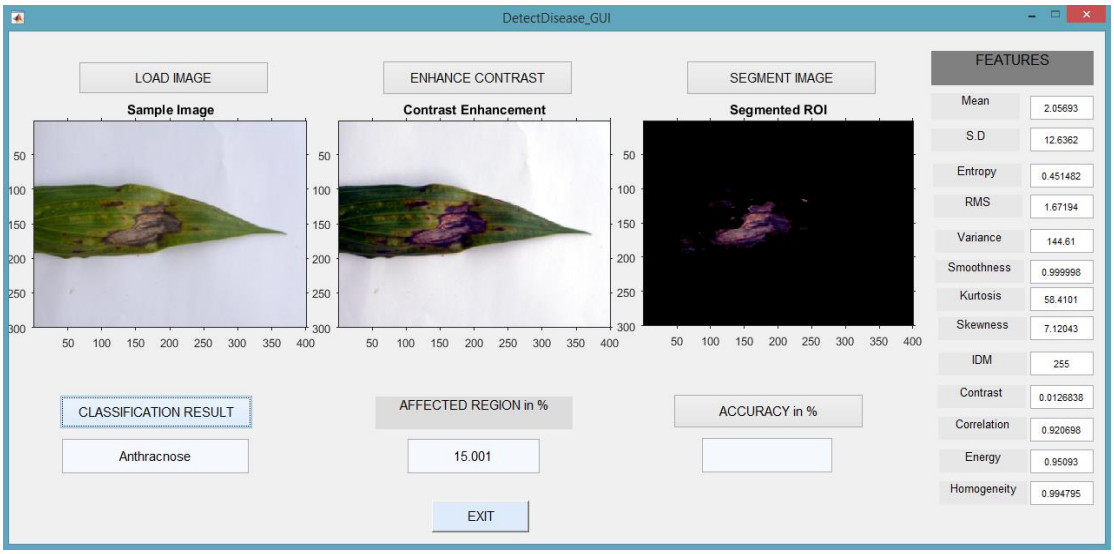

Figure 13. Anthracnose disease selected cluster

3.4. SVM Classifier

The accuracy result for the multiclass SVM classifier for both Chimaera and Anthracnose disease for the sample image used was shown in the figure and table below. The classification of the sample images was done by comparing the feature that has been extracted earlier that represents the sample image with the dataset that has been produced. The feature extracted earlier have the same number of columns as the dataset. This is because the number of columns defines the number of features while the row indicates the group to which each row of the sample image has been assigned to. The accuracy was computed with 500 iterations for each sample image. The tested sample image undergoing classification can produce an average accuracy up to more than 90% which is the system can be said as a good system. Figure 14 and Figure 15 shows the result of classification and accuracy based on the automated simulation process.

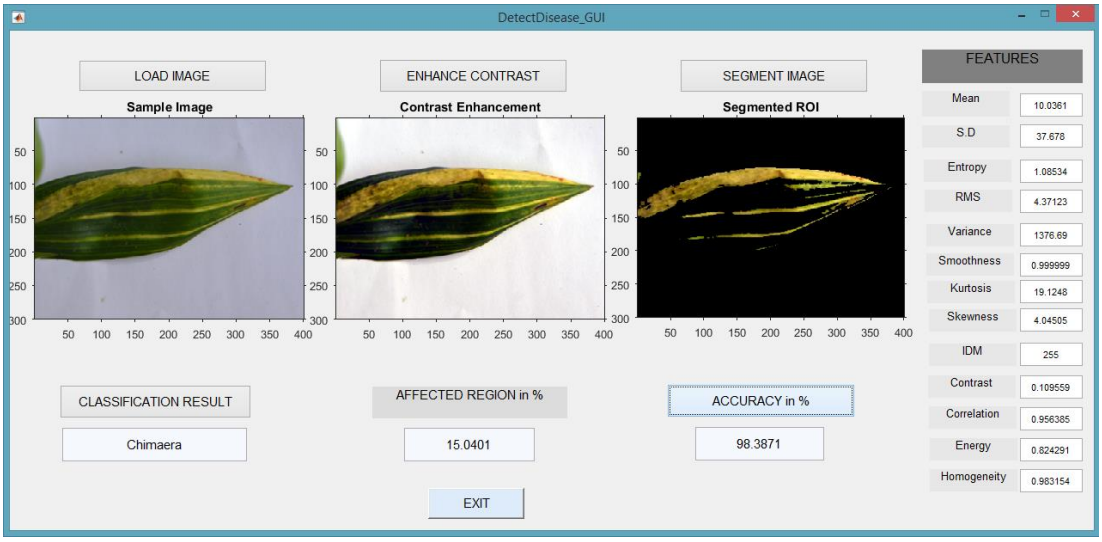

Figure 14. Classification and accuracy result for Chimaera disease

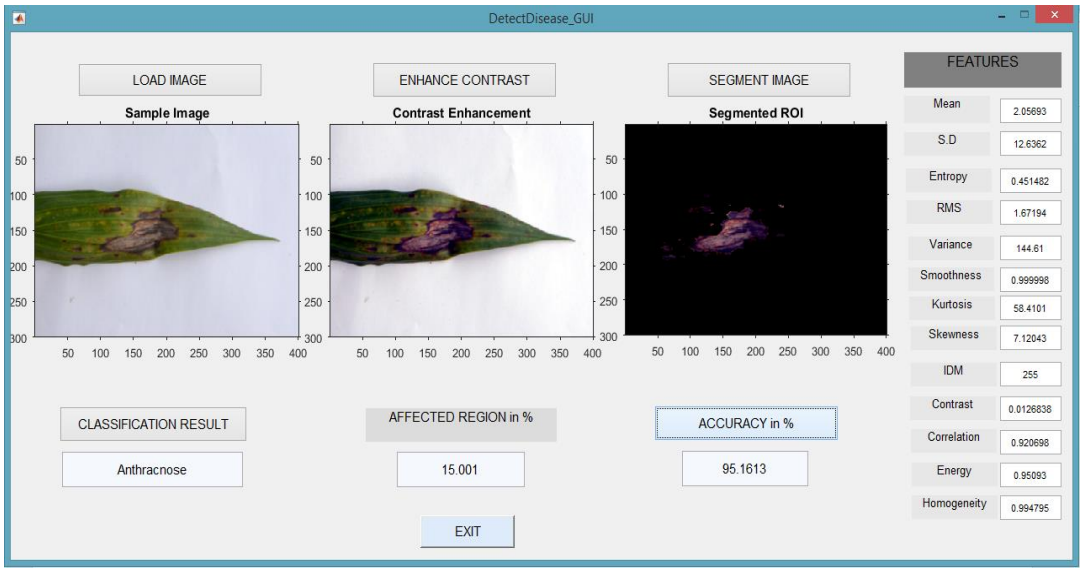

Figure 15. Classification and accuracy result for Anthracnose disease

4. CONCLUSION

The application of image processing and SVM classifier algorithm can be achieved in classify the spotted leaf diseases found on the oil palm tree during the nursery stages. The ability to classifying Chimaera and Anthracnose in digital images could lead to the development of automated vision-guided for site visit. In this work, SVM is proposed and verified the ability to classify diseases effectively using the digital images. From the rexperiment, the result indicates that the proposed technique and approach able to cluster and classify the Chimaera and Anthracnose symptoms. It shows that the accuracy achieved for Chimaera is 97% while the accuracy of Anthracnose is 95%.

ACKNOWLEDGEMENT

The authors would like to express their gratitude to the International Islamic University Malaysia, which has provided funding for the research though RIGS16-087-0251. The authors also would like to express special thanks and gratitude to the Universiti Teknologi MARA for the support.

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