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BACTERIAL BLIGHT AND MOSAIC DISEASE DETECTION ON CASSAVA LEAF USING SUPPORT VECTOR MACHINE

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Abstract*: Cassava has been used as a staple food of many nations. It is also known as manioc, and tapioca. In Malaysia, cassava is eaten as supplementary food either steamed, boiled or fried and small cottage industries produce traditional snacks. Its tuber is the most popular form of consumption, although the leaves are also consumed at times for medicinal purposes. Even though cassava is a popular form of consumption, it is vulnerable to disease. The type of disease that can be found on cassava is bacterial blight and mosaic disease. Problems arise when farmers must detect the disease using the expert's naked eyes which takes a lot of time and is a difficult process to be carried out on a large farm and it may lead to inaccurate results. Hence, we proposed work that includes applying techniques of image processing to automatically classify cassava leaf into mosaic and bacterial blight disease. Features such as color and texture are obtained from the leaf image and Support Vector Machine (SVM) are used to classify the cassava leaf. It is found that SVM gives of 87.5% accuracy. Therefore, SVM is found effective in detecting cassava leaf diseases.*

Keywords*: SVM, Image processing, Bacterial blight disease, Mosaic disease, Cassava leaf*

Introduction

Cassava, one of the important food sources also known as tapioca is one of the crops that made into industry consistently growing because of its benefits and versatility. In Malaysia, it is widely grown in the orchard or local houses. Despite being the third-largest human carbohydrates and nutrients supplier (Lansche et al., 2020) in the world, it is still easy to get exposed to some diseases. This top staple food cassava can also easily get an infection, such as viruses, bacteria and fungus.

Currently, many farmers lack of knowledge to recognize and classify the types of cassava diseases. Farmers are unable to describe disease on call to examine the picture of the disease region affected (Mitkal et al., 2016). This is happened because many of them do not know how to detect the disease (Mwebaze et al., 2019). It has become a huge challenge for farmers to

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study and diagnose cassava diseases. Nevertheless, many farmers are still unaware of the importance of this knowledge to their farming.

Fungus and bacteria cause cassava disease such as cassava brown streak disease (CBSD), cassava mosaic disease (CMD), cassava bacterial blight (CBB) and cassava green mite (CGM) (Owomugisha & Mwebaze, 2016). For this study, we have selected two classes for detection - CMD and CBB.

CMD is the most serious and common infection of the virus affecting cassava. It is considered to be a significant constraint for the cultivation of cassava is transmitted by white flies, CMD's common symptoms include mosaic, mottling, misshapen and twisted leaflets, and an overall reduction in size of leaves and plants. Leaves affected by this disease have patches of normal green color mixed with different proportions of yellow and white depending on the severity. CBB is caused by the bacteria and is spread around the world. The disease is representing in black leaf spots and blights, angular leaf spots, premature drying and shedding of leaves due to wilting of young leaves and severe attack (Owomugisha & Mwebaze, 2016).

In this study, classification is used to interpret the extracted region in the image that helps to recognize the type of disease infection in the leaves. Classification of plant leaves diseases has been studied for a long time in much of the literature.

Literature Review

Cassava

Cassava (Manihot esculenta), also known as tapioca is the world's most commonly cultivated root crop. In tropical countries, cassava, other than rice and maize, is the third major calorie source (Luar et al., 2018). Though cassava is the world's largest carbohydrates for human food, it is vulnerable to viruses. Among are cassava, CMD, CBB, CBSD and CGM (Owomugisha & Mwebaze, 2016).

Type of diseases

a) CMD: The most dangerous and popular infection. Transmitted by white flies, the common symptoms are yellow or pale green and the leaves look wrinkled and smaller leaves and plants.
b) CBB: Caused by the fungus and is spread around the world. The disease is represented in brown circular leaf spots with several varieties around the spots displaying a chlorotic halo. Severe infections can turn yellow or brown at the leaves.
c) CBSD: Carried by white flies which caused yellow of the vein which sometimes enlarges and forms visually large yellow patching (Hillocks et al., 1996). CBSD also shows symptoms of dark-brown affecting areas on the tuber root with a reduction in root size.
d) CGM: It causes white spots on the leaves. Severe CGM also causes mottling symptoms that can be easily confused with cassava mosaic, the leaves affected dry out, shrink and break away from the plant.

Identifying the diseases

According to (Raut & Fulsunge, 2017), manual disease monitoring does not produce satisfactory results because naked eye monitoring is an old process that takes longer time to classify diseases and expertise knowledge is needed. In addition, visual or naked-eye detection

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of plant diseases is very expensive, unreliable, inaccurate and difficult (Ghatol & Dhok, 2019). Therefore, the identification of different plant diseases is needed to prevent damage.

Classification

Classification is the process used to interpret the extracted region in an image that helps to recognize the type of disease infection in the leaves.

K-Nearest Neighbor (KNN)

KNN is one of the nearest neighbor (NN) techniques structures. K-nearest neighbors (KNN) is simple and suitable for various classification problems (Hossain et al., 2019). No prior knowledge of training or any other learning algorithm is needed. It aims to determine how much one data point belongs to one class or another, on the bases of the nearest data points. It gets a set of space points and then considers the distance between two similar points in the right metrics of that space. The algorithm then works to determine which of these points should be considered when selecting the class, by selecting k of the nearest data points for that observation to predict new observations and by giving the most common class of the classes (Agha et al., 2018).

Support Vector Machine (SVM)

The most used classifier is found to be SVM. Though every classifier has its advantages and disadvantages, SVM is simple to use and robust technique (Gavhale & Gawande, 2014). SVM is one supervised learning machine algorithm that categorize vectors in a space of feature into one of two sets. SVM is based on the concept of a line of decision identifying the boundaries of the decisions, which is the line of decisions used to separate between an input group of different class members (Agha et al., 2018). SVM can be built using different kernel features such as a linear kernel, RBF and polynomial kernel. Since the effectiveness of SVM depends on the kernel selection, it will optimize the performance, minimize errors and overfit (Vamsidhar et al., 2019). By that it was found that in many cases the SVM has shown better performance in identifying and classifying. The classification of images using SVM is obtained by comparing the training feature vector with the test feature vector to determine the target class.

Convolution Neural Network (CNN)

CNN is the deep learning model most commonly used for the large scale identification and detection of images (Zhang et al., 2018). Over recent years, apart from language and speech recognition, CNN has benefited from network training with the use of more complex networks where deeper networks have provided great success in many fields of computer vision, including classification and restoration (Kobler et al., 2017).

Related Works

(Kothawale et al., 2018) studied the identification of grape leaf disease using SVM technique to classify the leaf image into the correct classes. Pre-processing is used to remove noise and enhance contrast. The input RGB image is transformed to grayscale intensity image and grayscale values by creating a weighted sum of the components R, G and B to remove the background noise. The histogram based approach is used to measure all pixels in the image for segmentation part. Determine the most commonly used color for the position of pixels. To extract the features of the leaf images, color and texture features are chosen to achieve good results and accuracy. Using gray level co- occurrence matrix (GLCM) method feature

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extraction is done. Then support vector machine is used to identify leaf disease based on the matching features. The output and the accuracy 89.90% is obtained.

(Narmadha & Arulvadivu, 2017) identified paddy leaf disease which are brown and narrow brown spots. Leaf can be affected by environmental, chemical and nutritional problems and it has infected plant growth. Classification and detection of diseases were defined through support vector machine (SVM), artificial neural network (ANN), and fuzzy classification. According to this report, SVM is only categorized into two classes as the leaf is damaged or not damaged while the paddy plant disease can be identified by ANN and Fuzzy. The leaf disease can be identified automatically by using this system.

(Islam et al., 2017) proposed a method using image processing and machine learning to diagnose and classify the diseases from leaf images. Support vector machine (SVM) was used for classification to classify the diseases into the right classes. Finally, in display components, the results of classification showed. 100 healthy leaves and 200 diseased leaves were used. The database has been divided into two categories which is for training with 180 images (60%) and set of testing are 120 images (40%). The results of this system with an accuracy is 95%. The system also provides a feasible, efficient and time-saving way to classify diseases.

Methods

Total 200 images of cassava leaf disease which consists of CBB and CMD are used in this study, which 100 CBB images and 100 CMD images. The dataset is taken from Kaggle dataset. The images have been divided into 80% for training and 20% for testing. To classify, the dataset is trained using the Support Vector Machine classifier before the accuracy test is carried out. The processes to train and classify the images is shown in Figure 1.

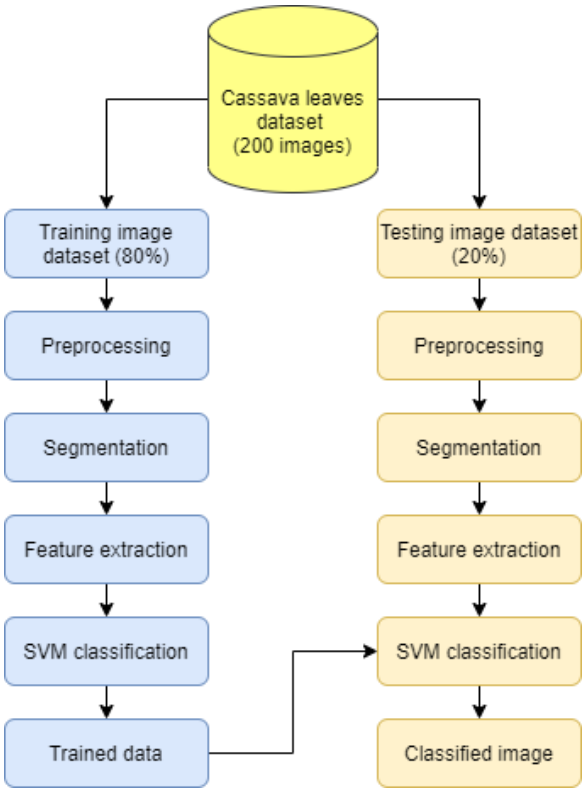

Figure 1: Training and classifying images from the dataset.

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Dataset

Images of infected cassava leaf with CBB and CMD are taken from Kaggle online dataset. A total of 200 images were taken including 100 images of each CBB and CMD. 80 images of bacterial blight and 80 images of mosaic disease are used to train the support vector machine. To test the accuracy, the remaining images are used.

Preprocessing

Aims to make the image data input size compatible before the image is processed using SVM. The activities include resize and enhance the brightness of the leaf image. This technique function would help to make computation in SVM faster.

Segmentation

The images divide into multiple segments to make processing easier and simpler. The results only extract leaf regions from a real image. For segment cassava leaf, ROI is used to separate the image from the background and unnecessary parts of the image. In this prototype, the roipoly function is used to allow the user to manually select the affected parts, so that no necessary elements of the image are removed. The extracted ROI will be displayed to the user after the process is completed.

Feature extraction

After the segmentation process is done, the feature is extracted using color moment and Gray Level Co-occurrence Matrix (GLCM) to obtain color and texture features of the image.

Classification

SVM classification consists of two phases, which are phases of training and testing. It will train all data classes in the training phase. Then, the data will be tested using the model obtained on the trained dataset during the testing phase. The classification of the disease on cassava leaf using the SVM.

Accuracy test

In training phase, SVM train all data classes. Then, the data will be tested using the model obtained on the trained dataset during the testing phase. The formula to get the accuracy is in (1).

$$Accuracy = \frac{True\ positive + True\ negative}{Total\ number\ of\ samples}\ X\ 100 \tag{1}$$

Result and Discussion

The plant disease detection has three major phases which are segmentation, features extraction and classification. SVM technique is applied for the classification. The result of the testing is shown in Table 1.

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Table 1: Results

No.	Input Image	Expected Output	Prototype's Output	Result
1.		Bacterial Blight	Mosaic	False
2.		Bacterial Blight	Bacterial Blight	True
3.		Bacterial Blight	Bacterial Blight	True
4.		Bacterial Blight	Bacterial Blight	True
5.		Bacterial Blight	Bacterial Blight	True
6.		Mosaic	Mosaic	True

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7.		Mosaic	Bacterial Blight	False
8.		Mosaic	Mosaic	True
9.		Mosaic	Mosaic	True
10.		Mosaic	Mosaic	True

The total of 200 images has been divided into 160 and 40 images for training and testing. By using trained model of SVM, the prototype produced the accuracy of 87.5% for testing compared to the training result is 88.1%.

Conclusion

From this study, the accuracy that we get is 87.5%. With the help of this system, users can automatically detect the type of disease on cassava leaf either it is bacterial blight or mosaic disease. The manual disease monitoring does not produce satisfactory results because naked eye monitoring is an old process that takes longer time to classify the diseases. In the future, other classification techniques in machine learning like decision trees, Naïve Bayes classifier or KNN may be used for disease detection in plants and therefore it is hoped that it may help farmers by having an automatic detection of all types of diseases.

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