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LEAF DISEASE CLASSIFICATION USING ARTIFICIAL NEURAL NETWORK

Syafiqah Ishak[a], Mohd Hafiz Fazalul Rahiman[a*], Siti Nurul Aqmariah Mohd Kanafiah[b], Hashim Saad[c]

[a]Tomography Imaging and Instrumentation Research Group, School of Mechatronic Engineering, Universiti Malaysia Perlis, Pauh Putra Campus, 02600 Arau, Perlis, Malaysia
[b]School of Mechatronic Engineering, Universiti Malaysia Perlis, Pauh Putra Campus, 02600 Arau, Perlis, Malaysia
[c]Rimba Herba Perlis, Sungai Batu Pahat, 01000 Kangar, Perlis, Malaysia

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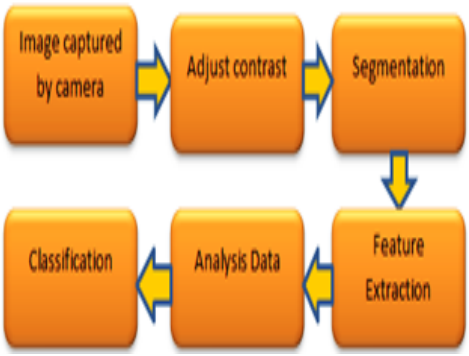
*Corresponding author
hafiz@unimap.edu.my

Graphical abstract



Abstract

Nowadays, herb plants are importance to medical field and can give benefit to human. In this research, Phyllanthus Elegans Wall (Asin-Asin Gajah) is used to analyse and to classify whether it is healthy or unhealthy leaf. This plant was chosen because its function can cure breast cancer. Therefore, there is a need for alternative cure for patient of breast cancer rather than use the technology such as Chemotherapy, surgery or use of medicine from hospital. The purpose of this research to identify the quality of leaf and using technology in agriculture field. The process to analysis the leaf quality start from image acquisition, image processing, and classification. For image processing method, the most important for this part is the segmentation using HSV to input RGB image for the color transformation structure. The analysis of leaf disease image is applied based on colour and shape. Finally, the classification method use feed-forward Neural Network, which uses Back-propagation algorithm. The result shows comparison between Multi-layer Perceptron (MLP) and Radial Basis Function (RBF) and comparison between MLP and RBF shown in percentage of accuracy. MLP and RBF is algorithm for Neural Network. Conclusively, classifier of Neural Network shows better performance and more accuracy.

Keywords: Leaf disease, phyllanthus elegans wall, image prosessing

1.0 INTRODUCTION

In this research, the aim is to develop a technology in agriculture field, based on engineering technique. Nowadays, crops face many traits/diseases. Damage caused by the insect is one of the major trait/disease. Insecticides are not always proven to be efficient because insecticides may be toxic to some kind of birds. It also damages natural animal food chains. A common practice for plant scientists is to estimate the damage of plant (i.e. leaf, stem) based on percentage of the affected area of disease detected by naked eye on a big scale. It results in subjectivity and low throughput. This paper provides an advance technique in several methods used to study plant diseases/traits using image processing. The methods studied are for increasing throughput and reducing error arising from human experts in detecting the plant diseases. Detection of leaf disease using engineering technology and mathematically theory in Artificial Neural Network (ANN) use for analyzes the result. Recently, ANN is widely used in agriculture image processing and it is one of the popular methods for classification problems as compared to most

traditional classification approaches. At the end of this study, Neural Network will classify the sample data of leaf image based on healthy or unhealthy category.

Method used for this project is to get leaf image from herb plant. Method of extraction the image acquisition uses suitable image processing algorithms and then makes recognition and classification of healthy or unhealthy leaves using Artificial Neural Network. Image pattern of classification for this project is based on color and area of leaf.

This project relates to the agriculture field based on engineering approaches. The title of this project is leaf disease classification using Artificial Neural Network. Method for this project is get leaf image from herb plant. Extract the image acquisition using suitable image processing algorithm. Then make recognition and classification of healthy or unhealthy leaves using Artificial Neural Network. Image pattern of classification for this project is based on color and area of leaf.

2.0 LITERATURE REVIEW

2.1 Phyllanthus Elegans Wall (Asin-Asin Gajah)

India is an agricultural country wherein most of the population depends on agriculture [1]. And agriculture is one of the major domains which covered economy of the nation. The quality and quantity of the agricultural production is affected by environmental parameters like rain, temperature and other weather parameters which are beyond control of human beings. Another major parameter which affects productivity of the crop is the disease where human beings can have control to improve the productivity for quality as well as for quantity. Farmers in rural country have minimal access to agricultural experts, who can inspect crop images and render advice and farmers have wide range of diversity to select suitable crops for their farm [3]. However, the cultivation of these crops for optimum yield and quality produce is highly technical. It can be improved by the aid of technology support. Generally the naked eye method is used to identify the diseases [4]. In this method experts are involved who have the ability to detect the changes in leaf color. This method involves lots of efforts, takes long time and also not practical for the large fields. Many times different experts identify the same disease as the same disease. This method is expensive as it requires continuous monitoring of experts. The Figure 1 has shown the leaf of Phyllanthus Elegans Wall.

Figure 1 Plant of Phyllanthus Elegans Wall

The expert person for analysis leaf disease can increase cost for agriculture. So, with using technology in agriculture, this method can use for long time and reduce the cost.

Plant diseases have turned into a dilemma as it can cause significant reduction in both quality and quantity of agricultural products.

2.2 Image Processing Method

Based on S. Arivazhagan *et al.* [2] detection and classification of leaf diseases has been proposed. Method for segmentation is based on masking and removing of green pixels, applying a specific threshold to extract the infected region and computing the texture statistics to evaluate the disease. Before segmentation method, S. Arivazhagan *et al.* [2] using HIS (hue, saturation, intensity) for color transformation structure. HIS color model is a popular color model because it is based on human perception. For texture feature they are using Color-Co-Occurrence. This method used to develop through the SGDM. From their research, co-occurrence is a statistical way to describe shape by statistically sampling the way certain gray-levels occur in relation to other levels. From the investigation that they have made is classify plant disease into various type [2].

N.J. Janwe and Vinita Tajane [12] suggested for their medical plants disease identification using Canny Edge detection algorithm, Histogram Analysis and CBIR. The identification of medical plants based on its edge features. The leaf image converts to gray scale and calculate the edge histogram. The algorithm that purposed is canny edge detection. The area and color of the image is extracted in the form of the histogram for the overall image. Based on their research, they find up the color histogram separate the layers of the RGB image into red, green and blue color histogram to check the intensity of each color pixels in that testing which is helpful for identification of healthy and infected sample [12].

2.3 Classification

Many papers have been presented in International Journals and conferences; researchers have worked on hierarchical, neural networks and machine learning methods. The work on classification of leaves started in the early 20th century [13]. Some of the classifier techniques that are always been used by pass researchers are Support Vector Machine (SVM), Neural

Network, conventional multiple regression, k-Nearest Neighbor and Genetic Algorithm. Prasad Babu *et al*. proposed Back propagation neural network for recognition of leaves in [14]. It was proved that just a back propagation network and shape of leaf image is enough to specify the species of a leaf. Tzionas *et al*. in implemented an artificial vision system that extracted specific geometrical and morphological features [13]. Using a novel feature selection approach, a subset a significant image features was identified. A feed forward neural network was employed to perform the main classification task and that was invariant to size and orientation. It could successfully operate even with the deformed leaves. It achieved a considerable high classification ratio of 99% [13]. Further, Lin and Peng in attempted to realize a computer automatic classification for 30 broad leaved plants in a more convenient, rapid and efficient manner using PNN achieving 98.3% of accuracy [13]. Kumar *et al*., conducted a survey on different classification techniques; k-Nearest Neighbor classifier, Neural Network, Genetic Algorithm, SVM and Principal Component Analysis and listed their advantages and disadvantages. The drawbacks of SVM are that it is a binary classifier, training is slow, and it is difficult to understand structure of algorithm. It also has limitation with speed and size, both in training and testing [13].

2.4 Method of Back Propagation

Back-propagation algorithm is a systematic method for training a multi-layer perceptron (MLP). The Back-propagation algorithm can be used to solve problems in many areas. The back-propagation training algorithm involves 3 stages:

i. Feed-forward of the input training pattern
ii. Back-propagation of the associated error
iii. Weight adjustment

A multilayer net can learn the input patterns only to an arbitrary accuracy. A MLP is a multilayer, feed forward neural with an input layer, an output layer and hidden layer. The neurons in the hidden and the output layers have biases which are similar to weights on connection from units whose output is always 1 [15]. Back-propagation algorithm is derived from generalized delta rule. It is a gradient descendent method which minimizes the total squared error of the output of the network [15].

I. Feed-forward the input training pattern

During feed-forward, each input neuron (Xi) receives an input signal and broadcast it to each hidden neuron, which in turn computes the activation and passes it on to each output unit, which again computes the activation to obtain the net output [15].

II. Back-propagation of the associated error

During training, the net output is compared with the target value and the appropriate error is calculated. From the error, the error factor δk is obtained which is used to distribute the error back to the hidden layer.

III. Weight adjustment

Weight adjustment which means the weight must update when error to distribute the error back to the hidden layer has. In a similar manner, the error factor δj is calculated for unit Zj. After the error factors are obtained, the weights are updated simultaneously

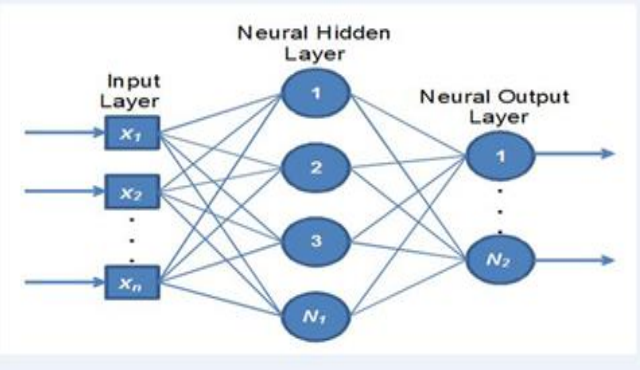


Figure 2 A two layer MLP architecture [16]

3.0 METHODOLOGY

This chapter describe about process to get the result of the classification of leaf disease. Figure 3 shows the flow chart of the proposed approach. First process is getting the image acquisition by using 8-Mega Pixel smart phone. The fifty samples image for healthy leaf image and fifty sample unhealthy leaf images are taken and the image processing method is used. The process for image processing has three components which are contrast enhancement, segmentation and features extraction. Lastly, the collected data will be classified to health or unhealthy of leaves using Artificial Neural Network.

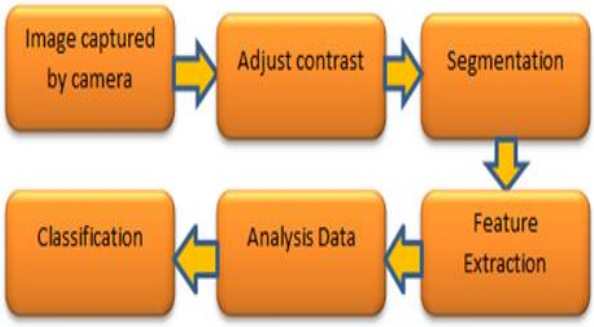
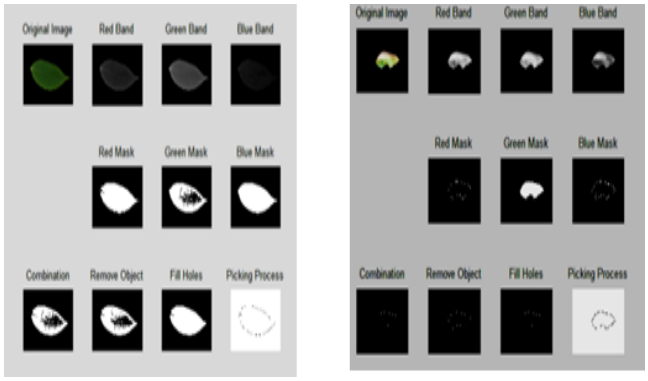


Figure 3 The flow chart of the proposed system

4.0 RESULTS AND DISCUSSION

4.1 Image Processing

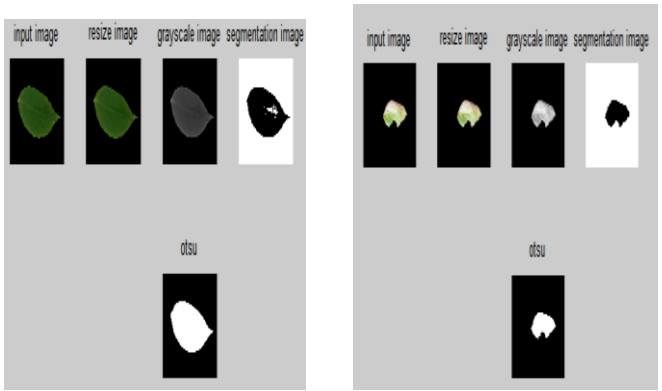
This section will discuss details results based on color pixel and area pixel. Figure 4 shows the process to get pixel for green area for different sample of leaf. The process for (a) produces the highest pixel as compared to (b) because this sample of leaf is healthy if seen by naked eye. The sample of (b) seen unhealthy because has less green pixel. This process repeated for 50 samples of healthy leaves and 50 samples of unhealthy leaves.



(a) Total green pixel = 17840 (b) Total green pixel = 102

Figure 4 Result of green pixel for two different samples

Figure 5 shows the process to get pixel for an area for different type sample of leaf. The process for (a) got the highest pixel compare with (b).This process repeated for 50 samples leaf of healthy and 50 sample of unhealthy.



(a)Total area pixel = 18739 (b) Total area pixel = 5996

Figure 5 Result of area pixel for two different samples

4.2 Analysis Data

This experiment used simple ratio based on area and color pixel. The 50 samples of healthy leaf and 50 samples of unhealthy leaf analyzed and calculated.

$$\text{Ratio based on color} = \frac{green\ pixel}{area} \quad (1)$$

$$\text{Ratio based on area} = \frac{area\ unhealthy}{area} \quad (2)$$

4.3 Classification Technique

In this method, the health of leaf is classified using Back-propagation algorithm. Back-propagation algorithm is systematic method for training a multi-layer perceptron (MLP). (RBF) will compare with (MLP) to get the better result for accuracy of classification. In this method, the health classification of leaf is done using MATLAB. This is example for the classified data of the leaf into two classes. This data taken from data image processing based on color and shape to evaluate the performance of classification.

4.4 Performance of MLP Network

Construction, learning and test are different phases used in classification problems modeled by neural networks. Three layers exist in a network of back propagation, including an input layer with two parameters, a hidden layer containing ten neurons and an output layer containing a single neuron. The weights of the network connection are set randomly in the learning phase. The input parameters are normalized between 0 and 1. Table 1 shows the experimental results of healthy or unhealthy dataset using MLP network. Mean square is a network performance function. It is measure the network's performance according to the mean of squared errors.

Table 1 Experimental results of healthy or unhealthy dataset using MLP

Training Samples	Test Samples	Classification Efficiency Multi-Layer Perceptron MLP
90	10	99.15%
80	20	94.05%
30	70	90.3%

Note that 90.3% of leaves are classified correctly in the case where the test samples are more than the training samples. The percentage of error is 9.7%.

4.5 Performance of RBF Network

The same discussed at performance network to train and test the RBF network. This process same with how to get performance of MLP.The both value for training sample and test sample taken same value.Table 2 shows experimental results of healthy or unhealthy dataset using RBF. Note that 99.2% of leaves are classified correctly in the case where the training samples are more than the test samples. The percentage error is 0.8%.

Table 2 Experimental results of healthy or unhealthy dataset using RBF

Training Samples	Test Samples	Classification Efficiency Radial Basis Function RBF
90	10	98.85%
80	20	99.1%
30	70	99.2%

Note that 99.2% of leaves are classified correctly in the case where the training samples are more than the test samples. The percentage error is 0.8%.

4.0 CONCLUSION

Leaf disease classification using Artificial Neural Network has been successfully analyzed using image processing method and classified using Neural Network to get the performance of the data. The image processing method has been applied to 100 samples of leaf and the data based on color and area of unhealthy analysed. The objective to capture and analysis data from leaf images for classify healthy or unhealthy of the leaves of medicine plants was achieved using image processing method. From image processing method, algorithm of adjusted contrast, segmentation and features extraction is used to extract image and to get data. The three of the method are included in image processing method. The experiment results have been done using Artificial Neural Network. Multi-layer feed forward Neural Network which are multi-layer perceptron and radial basis function RBF are the structures of the network used to class healthy or unhealthy of leaves. In the final experiment, the result shows that the RBF network performs better than MLP network.

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