Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 4, Issue. 4, April 2015, pg.900 – 905

RESEARCH ARTICLE

Artificial Neural Network Based Plant Leaf Disease Detection

Shivkumar Bagde, Swaranjali Patil, Snehal Patil, Poonam Patil
Department of Computer Engineering, SVIT Nasik, India
shivkumar.b@hotmail.com; swarapatil94@gmail.com; patilsnehal83@rediffmail.com

Abstract— The studies of plant disease refer to the studies of visually observable patterns of a particular plant. Nowadays crops are damaged due to many types of diseases. Damage of the insect is one of the major diseases. Insecticides are not always proved efficient because insecticides may be harmful for some bird species. It also affect on the animal food chains. A common practice for biologist is to estimate the damage on plant (leaf, stem) because of disease by calculating the affected area in plants especially on leaf and stem. In most of the cases pests or diseases are seen on the leaves or stems of the plant. Therefore in identification of plants diseases, leaves and stems of plant will play a vital role in finding out the pest or type of diseases, percentage of the disease incidence or pest, symptoms of the disease or pest attack, will lead to successful cultivation of crops. According to various surveys on crops diseases the estimated crop losses amounting to several billion dollars every year.

Now using image processing technology, the accuracy to predict these diseases will increases considerably. In particular, this article will lead to described and analyzed research work on two major aspects: detecting, classifying the disease according to the diseased images and comparative study of classification algorithm used.

Keywords— "Plant Disease", "Artificial Neural Network", "Backpropagation", "K-mean clustering", "Image processing"

I. INTRODUCTION

The studies of plant disease refer to the studies of visually observable patterns of a particular plant. Nowadays crops are damaged due to many types of diseases. Damage due to insect is one of the major diseases. Insecticides are not always proved efficient because insecticides may be toxic to some kind of bird species. It also affect on natural animal food chains. A common practice for biologist is to estimate the damage of plant (especially leaf, stem) because of disease by an eye on a scale based on percentage of damaged area of plant. As we know, India is an agricultural country; wherein about 70% of the population depends on agriculture. Indian farming had a wide range of diversity to select a suitable Fruits and Vegetable crops according to season. However, the cultivation of these types of crops for optimum yield and quality production is highly technical. It will be improved by the aid of technological support and guidance. The management of perennial fruit crops requires close monitoring especially for the management of diseases that can affect production significantly and subsequently the post-harvest life of the crop. In case of this technique, i.e. image processing plays an important role.[3] In case of plant the disease is defined as any impairment of normal physiological functioning of plants, producing characteristic symptoms. A symptom is a phenomenon accompanying something and is regarded as

evidence of its existence. Disease is caused by pathogen which is any agent causing disease. In most of the cases pests or diseases are seen on the leaves or stems of the plant. Therefore identification of plants , leaves, stems and finding out the pest or diseases, percentage of the pest or disease incidence ,symptoms of the pest or disease attack, plays a key role in successful cultivation of crops. It is found that diseases cause heavy crop losses amounting to several billion dollars annually. The scope in doing research in this field is: First there are two main characteristics of plant disease detection using machine-learning methods that must be achieved, they are: speed and accuracy. Hence there is a scope for working on development of innovative, efficient & fast interpreting algorithms which will help plant scientist in detecting disease. Second, work can be done for automatically estimating the severity of the detected disease.

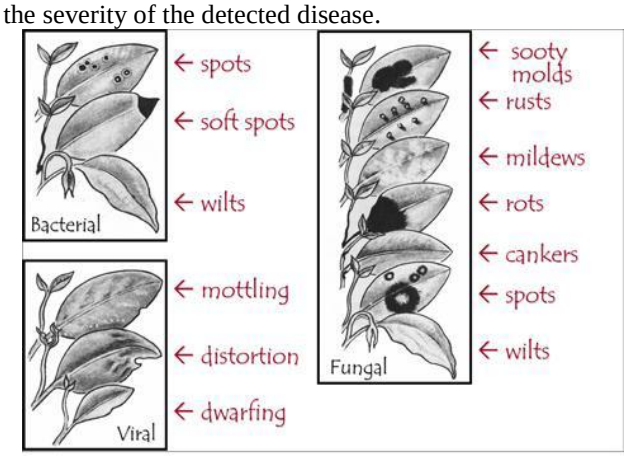

Fig. 1. Various types of plant diseases

Image Samples of Plant diseases is shown below:

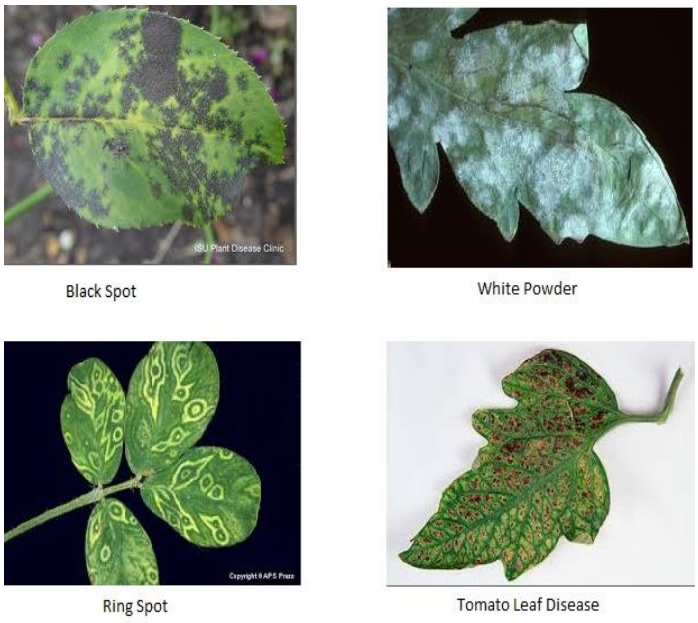

Fig 2. Image samples of plant disease

The image processing can be used in agricultural applications for following purposes:
1. To detect diseased leaf, stem, fruit.
2. To quantify affected area by disease.
3. To find shape of affected area.
4. To determine size & shape of fruits

II. TECHNICAL OVERVIEW

Following gives description of the algorithms which we are using in our project.

K-means Clustering Algorithm:

The K-means clustering algorithm tries to classify objects (pixels in our case) based on a set of features into K number of classes. The classification is done by minimizing the sum of squares of distances between the objects and the corresponding cluster or class centroid.

Colour Co-occurrence Method:

GLCM texture considers the relation between two pixels at a time, called the reference and the neighbour pixel. The neighbour pixel is chosen to be the one to the east (right) of each reference pixel. How many times within the image area a pixel with some grey level (neighbour pixel) falls to the right of another pixel with some grey level (reference pixel).A different co-occurrence matrix exists for each spatial relationship.

Otsu method:

In computer vision and image processing, Otsu's method is used to automatically perform clustering-based image thresholding, or, the reduction of a gray level image to a binary image. The algorithm assumes that the image contains two classes of pixels following bi-modal histogram (foreground pixels and background pixels), it then calculates the optimum threshold separating the two classes so that their combined spread (intra-class variance) is minimal.[6]

Classifier:

Texture Feature Classification Methods are as follows.

K-nearest neighbour:

K-nearest neighbour classifier is used to calculate the minimum distance between the given point and other points to determine the given point belongs to which class. Goal is to computes the distance from the query sample to every training sample and selects the neighbour that is having minimum distance.

Radial basis function:

A radial basis function (RBF) is a real-valued function whose value depends only on the distance from the origin. The normally used measuring norm is Euclidean distance. RBF's are the networks where the activation of hidden units is based on the distance between the input vector and a prototype vector.

Artificial neural networks:

ANNs are popular machine learning algorithms that are in a wide use in recent years. Multilayer Perception (MLP) is the basic form of ANN that updates the weights through back propagation during the training. There are other variations in neural networks, which are recently, became popular in texture classification Back propagation network: A typical BP network consists of three parts: input layer, hidden layer and output layer. Three parts in turn connect through the collection weight value between nodes. The largest characteristic of BP network is that network weight value reach expectations through the sum of error squares between the network output and the sample output, and then it continuously adjusted network structure's weight value. It is popular and extensively used for training feed forward networks. Also it has no inherent novelty detection, so it must be trained on known outcomes for training feed forward networks.

III. PROBLEM STATEMENT

Plant diseases have turned into a dilemma as it can cause significant reduction in both quality and quantity of agricultural products. It is estimated that 2007 plant disease losses in Georgia (USA) is approximately $539.74 million. Of this amount, around 185 million USD was spent on controlling the diseases, and the rest is the value of damage Caused by the diseases.

The naked eye observation of experts is the main approach adopted in practice for detection and identification of plant diseases. However, 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. Automatic detection of plant diseases is an essential research topic as it may prove benefits in monitoring large fields of crops, and thus automatically detect the symptoms of diseases as soon as they appear on plant leaves. Therefore; looking for fast, automatic, less expensive and accurate method to detect plant disease cases is of great realistic significance.

IV. LITERATURE SURVEY

Literature survey is the most important step in software development process. Before developing the tool it is necessary to determine the time factor, economy n company strength. Once these things are satisfied, ten next steps are to determine which operating system and language can be used for developing the tool. Once the programmers start building the tool the programmers need lot of external support. This support can be obtained from senior programmers, from book or from websites. Before building the system the above consideration are taken into account for developing the proposed system.[5]

In this paper detection of leaf diseases has been used method is threefold: 1) identifying the infected object based upon k-means clustering; 2) extracting the features set of the infected objects using color co-occurrence methodology for texture analysis; 3) detecting and classifying the type of disease using NNs, moreover, the presented scheme classifies the plant leaves into infected and not-infected classes. From above literature survey it is found that the following methods are used by different researchers for plant disease detection &analysis:

1. Back propagation neural network.
2. Airborne hyper spectral imagery & red edge techniques.
3. Image analysis integrated with Central Lab Of Agricultural Expert System (CLASE) diagnostic model.
4. Combination of morphological features of leaves, image processing ,feed forward neural network based classifier & fuzzy surface selection technique for feature selection.
5. Support vector machines for developing weather based prediction models of plant diseases.
6. Wavelet based image processing technique and neural network.
7. Image Processing with PCA & Probabilistic Neural Network (PNN).

V. OBJECTIVES

The major objectives of this research is as follows:
1. Make the collection of images of a various leaves diseases.
2. Using clustering algorithm, detect the infected area among that images.
3. To detect the disease in a leaves, evaluate colour co-occurrence method.
4. To develop ANNs strategies classification of a leaves based on the features obtain from colour co-occurrence method.

To increase the performance of disease detection technique is the main objective of the research work. Collection of images of a various leaves diseases are used for study. Artificial Neural Network are used for further processing.

VI. ALGORITHM

Basic steps for describing the proposed algorithm are as follows:
1. RGB image acquisition
2. Create the colour transformation structure
3. Convert the colour values in RGB to the space specified in the colour transformation structure
4. Apply K-means clustering
5. Masking green-pixels
6. Remove the masked cells inside the boundaries of the infected clusters
7. Convert the infected (cluster / clusters) form RGB to HSI Translation
8. SGDM Matrix Generation for H and S
9. Calling the GLCM function to calculate the features
10. Texture Statistics Computation
11. Configuring Neural Networks for Recognition
12. Comparing two algorithms used for recognition.

Data Flow Chart:

In details, in step 2 a colour transformation structure for the RGB leaf image is created, and then, a device-independent colour space transformation for the colour transformation structure is applied in step 3. Steps 2 and 3 are inevitable for carrying out step 4. In this step the images at hand are segmented using the K-

Means clustering technique. These four steps constitute phase 1 whereas, the infected object (s) is/are determined. In step 5, we identify the mostly-green coloured pixels. After that, based on specified and varying threshold value that is computed for these pixels using Otsu's method , these mostly green pixels are masked as follows: if the green component of pixel intensities is less than the pre-computed threshold value, the red, green and blue components of the this pixel is assigned to a value of zero. This is done in sense that these pixels have no valuable weight to the disease identification and classification steps, and most probably those pixels represent healthy areas in the leave. Furthermore, the image processing time should become significantly reduced.

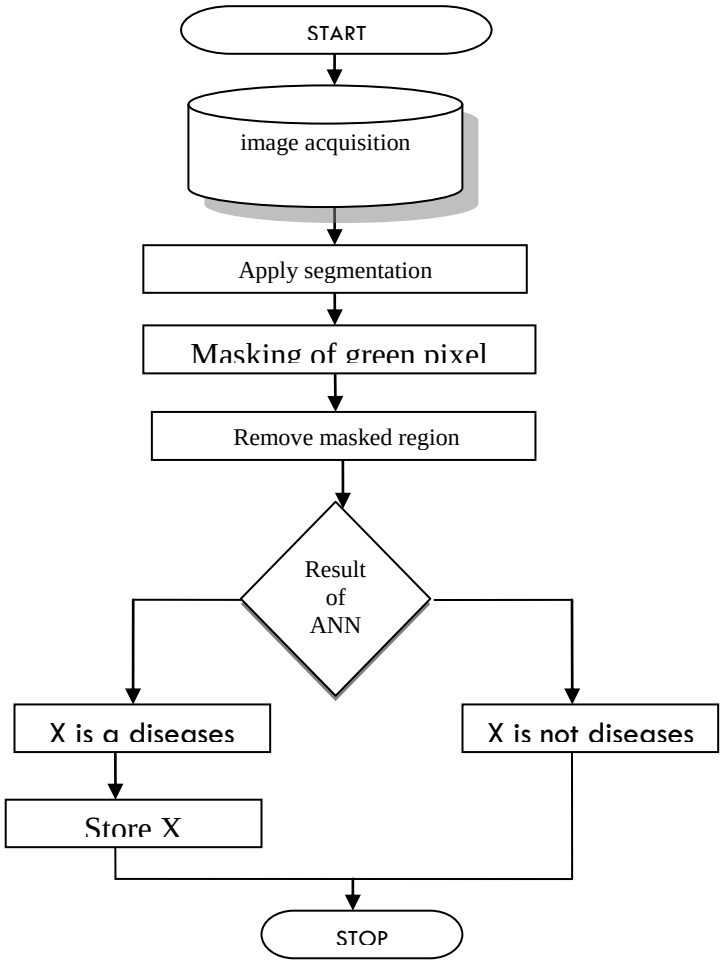

Fig 3: Data Flow Diagram

In step 6 the pixels with zeros red, green and blue values and the pixels on the boundaries of the infected cluster (object) were completely removed. Steps 5 and 6 form phase 2, and this phase is helpful as it gives more accurate disease classification and identification results with satisfied performance and the overall computation time should become significantly less. The observations behind steps 5 and 6 were experimentally validated. Next, in step 7 the infected cluster was then converted from RGB format to HSI format. In the next step, the SGDM matrices were then generated for each pixel map of the image for only H and S images. The SGDM is a measure of the probability that a given pixel at one particular gray-level will occur at a distinct distance and orientation angle from another pixel, given that pixel has a second particular gray-level. From the SGDM matrices, the texture statistics for each image were generated. Concisely, the features set were computed only to pixels inside the boundary of the infected areas of the leaf. In other words, healthy areas inside the infected areas were also removed. Steps 7 – 10 form phase 3 in which the texture features for the segmented infected objects in this phase are calculated. Finally, the recognition process in the fourth phase was performed to the extracted features through a pre-trained neural network. For each image in the data set the subsequent steps in Algorithm 1 were repeated.

VII. SCOPES AND APPLICATION

India is an agricultural country hence there is no less scope as far as utilization is concerned. The applications will range from different fields. Some of them are as follows

- Agriculture
- Nursery
- Bio-technology labs
- Gardening
- Forest Department

VIII. CONCLUSION

The literature survey done in this paper provides a new insight in detection of the diseases of plant .The scope in doing research in this field is as follow:

There are two main characteristics of plant disease detection using machine-learning methods that must be achieved, they are: speed and accuracy. Hence there is a scope for working on development of innovative, efficient & fast interpreting algorithms which will help plant scientist in detecting disease.

The present paper reviews and summarizes image processing techniques for several plant species that have been used for recognizing plant diseases. The major techniques for detection of plant diseases are: BPNN, SVM, K-means clustering, and SGDM. These techniques are used to analyses the healthy and diseased plants leaves. Some of the challenges in these techniques viz. effect of background data in the resulting image, optimization of the technique for a specific plant leaf diseases, and automation of the technique for continuous automated monitoring of plant leaf diseases under real world field conditions. The review suggests that this disease detection technique shows a good potential with an ability to detect plant leaf diseases and some limitations. Therefore, there is scope of improvement in the existing research.

REFERENCES

[1] How Many Clusters? Which Clustering Method? Answers Via Model-Based Cluster Analysis CHRIS FRALEY AND ADRIAN E. RAFTERY Department of Statistics, University of Washington, USA

[2] Applying image processing technique to detect plant diseases Anand.H.Kulkarni1, AshwinPatil R. K.2 Department of Information Science and Engineering1 Department of Computer Science and Engineering2 Gogte Institute Of Technology, Belgaum, Karnataka, India.

[3] Jayamala K. Patil, Raj Kumar, ―Advances In Image Processing For Detection of Plant Diseases‖, JABAR, 2011, 2(2), 135-141.

[4] S. Ananthi, S. Vishnu Varthini, ―Detection and classification of plant leaf diseases‖, IJREAS, 2012, 2(2), 763-773.

[5] H. Al-Hiary, S. Bani-Ahmad, M. Reyalat, M. Braik and Z. ALRahamneh, ―Fast and Accurate Detection and Classification of Plant Diseases‖, IJCA, 2011, 17(1), 31-38, IEEE-2010.

[6] Mrunalini R. Badnakhe, Prashant R. Deshmukh, ―Infected Leaf Analysis and Comparison by Otsu Threshold and k-Means Clustering‖, IJARCSSE, 2012, 2(3), 449-452.

