REAL TIME GRAPE LEAF DISEASE DETECTION

Nivedita.R.Kakade[1], Dnyaneswar.D.Ahire [2]

[1] *Lecturer in Department of Electronics & Telecommunication, MCOERC, Maharashtra, India Maharashtra, India.*

[2] *Assistant Professor, Department of Electronics & Telecommunication, MCOERC, Maharashtra, India*

ABSTRACT

India being an agro-based economy, farmers experience a lot of problem in detecting and preventing diseases in fauna. So there is a necessity in detecting diseases in fauna which proves to be effective and convenient for researchers Major economic and production losses occur because of diseases on the plant .Now a days there are several diseases seen on the plants. For increasing production and quality it is important to control such a harmful diseases .For controlling such a diseases it is necessary to detect a specific disease. In our country many farmers are not so educated to get correct information about all diseases, they require expert advice. But it is impossible for expert to reach at each farmer. Even if they got expert, expert uses naked eye observation. But naked eye observation has very less accuracy. We introduce here new approach based on image processing for detecting plants leaf diseases .The goal is to detect, identify, and to accurately quantify the first symptoms of disease. Plant disease are caused by bacteria, fungi, virus etc. of which fungi is main disease causing organism. The proposed system is very sensitive and accurate method in the detection of plant diseases, which will minimize the losses and increases the economical profit. It includes following steps in that, image acquisition, image pre-processing, features extraction and neural network based classification. The developed algorithm's efficiency can successfully detect and classify the examined disease with accuracy of 92.94%

Keyword: - *Classification technique, Disease Detection, Feature Extraction, Image Processing*.

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1. INTRODUCTION

India is an agricultural country.70% of population depends on agriculture. Farmer has wide range of diversity to select suitable fruit and vegetable crop. Plant disease has gaining importance as it can cause significant reduction in both quality & gaining quality of agricultural product. So, research on detection of plant disease is gaining importance now a days, which may prove useful in monitoring large fields and thus automatically detection symptoms as they appear on plant [1].Grapes (Vitis vinifera)are an important fruit crop in India. Grapes are the third most widely cultivated fruit after citrus and banana. Grape is one of the most delicious and nutritious fruit. Grapes are widely consumed as fresh fruit in India. It is also used for producing raisins, wine, juice, juice concentrate, squash, beverages, jams and marmalades.

Grape fruit enjoys a pre-eminent status among all cash crop in a country and is principal raw material for flourishing wine industry. It also provide live hood to about 65 million people and is an important agricultural commodity providing remunerative income to millions of farmer in developed as well as in developing country.[2] About 60% of grape are cultivated in India is under rain feed condition. Water stressed seed or plant will cause poor growth leading to low yield as well as expose to disease Due to disease on plant there is loss of 10-30 % of crop. Farmers do the naked eye observation and judge the diseases by their experience. But this is not accurate and proper way. Sometimes farmers need to call the experts for detecting the diseases but this also time consuming way. Most of the disease on plant is on their leaves and on stem of plant. The diseases are classified into viral, bacterial, fungal, diseases due to insects, rust, nematodes etc. on plant. Early detection of diseases is a major challenge in horticulture/agriculture science. Many disease produce symptoms which are the main tools for field diagnosis of diseases showing external symptoms out of a series of reactions that take place between host and pathogen. As such, several important decisions regarding safe practices, the production and processing of plant have been made in the recent past. One of the main concerns of scientists is the automatic disease diagnosis and control [15,16].

Computer vision systems will help to tackle the problem. Computer vision systems developed for agricultural applications, namely detection of weeds, sorting of fruits in fruit processing, classification of grains, recognition of food products in food processing, medicinal plant recognition, etc. In all these techniques, digital images are acquired in a given domain using digital camera and image processing techniques are applied, on these images to extract useful features that are necessary for further analysis.

Plant diseases are caused by bacteria, fungi, virus, etc., of which fungi are responsible for a large number of diseases in plants. In the proposed work, we have focused on recognition of fungal disease from the visual symptoms and classify them using image processing. Fig.1 shows image samples affected by fungal disease symptoms. The paper is organized into four sections. Section 2 gives b brief idea of previous work and techniques adopted for disease detection .Section 3 materials and methods used. Section 4 describes results and discussion. Section 5 gives conclusion of the work.

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2. RELATED WORK

Digital image processing and image analysis technology based on the advances in microelectronics and computers has many applications in biology and it circumvents the problems that are associated with traditional photography. This new tool helps to improve the images from microscopic to telescopic range and also offers a scope for their analysis. It, therefore, has many applications in biology. Many literatures is available for different plant disease detection using different techniques. Some of them are highlighted as below. Various papers are suggesting to diagnosis the cotton leaves using various approach suggesting the various implementation ways as illustrated and discussed below.

In 2008 Meunkaewjinda. A, et.al., proposed the work on cotton leaf disease .Researcher in his work proposed modified self-organizing feature map that uses genetic algorithms for optimization segmentation is performed and support vector machines is used for classification. The segmented image is filtered with Gabor wavelet that allows the system to detect and analyze leaf disease color features more efficiently classification of the cotton diseases [1]

In 2011 Hui Li et al., proposed the work based on the Web-Based Intelligent Diagnosis System for Cotton Disease Control system. In their research they used the proposed method in a BP neural network which is based on decision-making system. A research scheme includes system test, in which different 80 samples, including number of main species of diseases, and samples is of 10 in each sort were included. The final result shows that the rate of correctness. The system identifies the symptom was 89.5% in average, and the average running time for a diagnosis was 900ms [3].

In 2011 Ajay A. Gurjar, Viraj A. Gulhane proposed Detection of Diseases on Cotton Leaves and Its Possible Diagnosis. The features could be extracted using self-organizing feature map together. Back-propagation neural network is used to recognize color of image. Information is used to segment cotton leaf pixels within the image, now image is well analyzed and depending upon software perform further analysis based on the nature of this image. They concluded that system provides 85 to 91% of exact disease detection depending upon the quality of image [2].

In 2012 P. Revathi and M. Hemalatha proposed Homogeneous Segmentation using Edge Detection Techniques for Proficient Identification of the Cotton Leaf Spot Diseases. They proposed a system that uses mobile to capture symptoms of cotton leaf spot images and Neural classifier was used in their technique to diagnose disease in cotton plant. The main objective of their Research work is to use Homogeneity-base edge detector segmentation. It takes the result of any edge detector and divides it by the average value of the area. The division removes the effect of uneven lighting in image and then area is tested by using classifier. [4]

In 2013 Qinghai He et al. proposed the work based on cotton leaf in which three different color models for extracting the injured image. Images were developed, then converted into the RGB, HIS, and YcbCr color model. The ratio of damage (γ) was chosen as feature to measure the degree of damage which is caused by diseases or pests. By implementing different color model comparative results are obtained. The comparison of result shows good accuracy in both color models as well as in YCbCr color space. Out of there two models is considered as the better color model for extracting the infected leaf images [6]

In 2014 Shruti and Nidhi Seth proposed a method of Fungus/Disease Analysis in Tomato Crop using Image Processing Technique. In this paper the image of the crop leaves are taken by a camera and processed for getting a gray colored and segmented image depending upon the nature and size of the fungus. A reference is set for acceptable and rejects crop quality based on the growth of fungus level. [10].

3. PROPOSED SYSTEM

After study various literature review, there is a need to develop real time system which will effectively use to detect diseases on grape plant. The task of plant disease identification and classification is of greater importance in the field of agriculture. Therefore, developing automated techniques for plant disease classification has gained much interest in the field of research now a days. To diagnosis the disease, an image processing system has been developed to automate the identification and classification of various disorders.

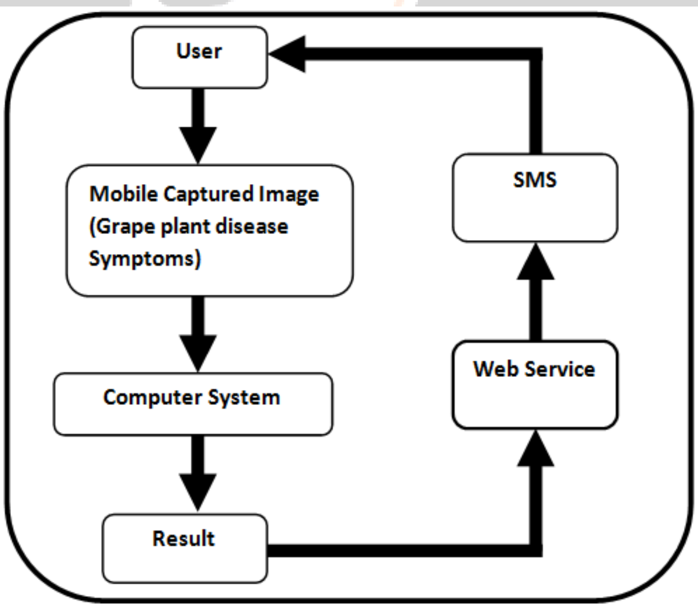


Fig-2: Overall structure of system

We propose an image-processing-based solution for the automatic leaf diseases detection and classification. We test our solution on five diseases which effect on the plants; they are: Black rot, Downy mildew, powdery mildew, Normal and Leafroll First, the digital images are acquired from the environment using a digital camera. Then image-processing techniques are applied to the acquired images to extract useful features that are necessary for further analysis. After that, several analytical discriminating techniques are used to classify the images according to the specific problem at hand fig.3 depicts the basic procedure of the proposed vision-based detection algorithm in this research

3.1 Description of overall system

1) User: Users who want to know the type of disease on grape leaf will capture the image and sent to computer system.

2) Computer System: The actual database of the project is stored in the PC. The disease affected leaf to be tested is compared with database in the PC which gives more accurate result and displays result. The software processing is done using MATLAB tool.

3) Web Service: Through internet service farmer will send image and system will send the result to the farmer.

3.2 System Algorithm

Basic steps for describing the proposed system are as follows:

1. Acquire image from farmer.
2. Give image input to the system.
3. Image Pre-processing
4. Segmentation
5. Extract the features.
6. Apply classifier.
7. Get result.
8. Send SMS to farmer.

3.3 Software architecture

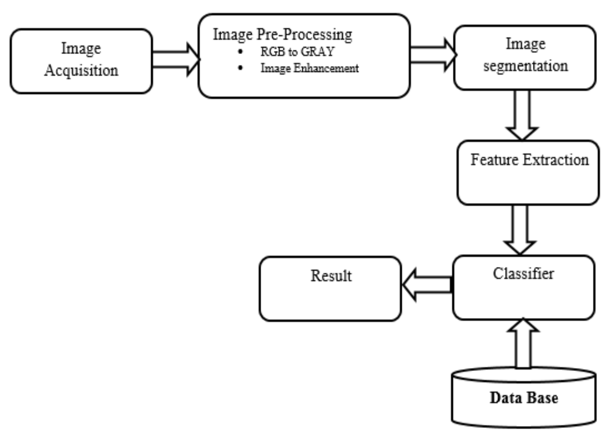


Fig -3: Basic procedure for the Leaf Disease Detection

1) Image acquisition:

Firstly, the images of various leaves acquired using a digital camera with required resolution for better quality. The construction of an image database is clearly dependent on the application. The image database itself is responsible for the better efficiency of the classifier which decides the robustness of the algorithm.

2) Image pre-processing:

In the second step, this image is pre-processed to improve the image Pre-processing includes color conversion, histogram, and histogram equalization. Color conversion and histogram equalization is used to improve the quality and clarity images. Grayscale images are easy to process in any application because they have only intensity values. The histogram equalization enhances the contrast of images by transforming the intensity values.

The conversion is obtained using the function:

$$y = f(x) \tag{1}$$

Here, x is the original input data and y is the converted output data. The function f(x) converts RGB values to grayscale values using weighted sum of the R, G, and components:

$$f(x) = 0.2989 * R + 0.5870 * G + 0.1140 * B \tag{2}$$

3) Histogram Equalization:

Histogram equalization is one of the image enhancement techniques. This method distributes the intensities of the images. Through this distribution, increases contrast of the areas from local contrast to higher contrast. Histogram equalization is used to improve the interpretability, visibility and quality of the image. Histogram equalization creates an output image with a uniform histogram.

4) Filtering

Filtering is a technique for modifying or enhancing an image. Filtering is a neighborhood operation, in which the value of any given pixel in the output image is determined by applying some algorithm to the values of the pixels in the neighborhood of the corresponding input pixel.

Gaussian filtering is used to blur images and remove noise and detail. In one dimension, the Gaussian function is:

$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{\frac{x^2+y^2}{2\sigma^2}} \tag{3}$$

Where σ is the standard deviation of the distribution.

5) Segmentation:

Image segmentation refers to the process of partitioning the digital image into its constituent regions or objects so as to change the representation of the image into something that is more meaningful and easier to analyze.

Canny edge detection:

It is an optimal edge detection technique as provide good detection, clear response and good localization. It is widely used in current image processing techniques with further improvements.

Advantages of canny edge detection algorithm.

1) Less sensitive to noise
2) It removes streaking problem
3) Adaptive in nature: Canny algorithm depends on variable or adjustable parameter. like σ which is the standard deviation of Gaussian filter and threshold values.
4) Good localization: Canny operator provides edge gradient orientation which results in good localization.

6. Feature Selection

In statistical texture analysis, texture features are computed from the statistical distribution of observed combinations of intensities at specified positions relative to each other in the image. According to the number of intensity points (pixels) in each combination, statistics are classified into first-order, second-order and higher-order statistics. The Gray Level Co-occurrence Matrix (GLCM) method is a way of extracting second order statistical texture features. GLCM introduced by Haralick contains information about the positions of pixels having similar gray level values.

A GLCM is a matrix where the number of rows and columns is equal to the number of gray levels, G, in the image. The matrix element $P(i, j \mid d, \theta)$ is the relative frequency with which two pixels, separated by distance d, and in direction specified by the particular angle (θ) , one with intensity i and the other with intensity j.

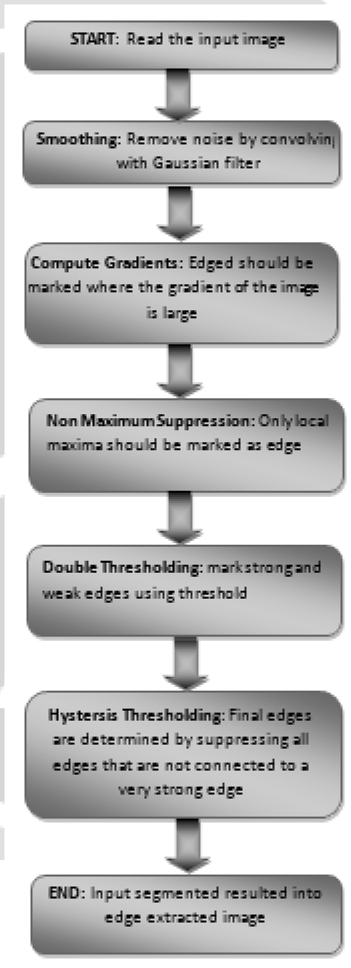


Fig-4: Algorithm of Canny Edge Detection

GLCM algorithm

1. Count all pairs of pixels in which the first pixel has a value i, and its matching pair displaced from the first pixel by d has a value of j.
2. This count is entered in the ith row and jth column of the matrix Pd[i,j]
3. Note that Pd[i,j] is not symmetric, since the number of pairs of pixels having gray levels[i,j]does not necessarily equal the number of pixel pairs having gray levels [j,i].
4. The elements of Pd[i,j]can be normalized by dividing each entry by the total number of pixel pairs.
5. Normalized GLCM N[i,j], defined by:

$$N[i,j] = \frac{P[i,j]}{\sum_1 \sum_j P[i,j]} \quad (4)$$

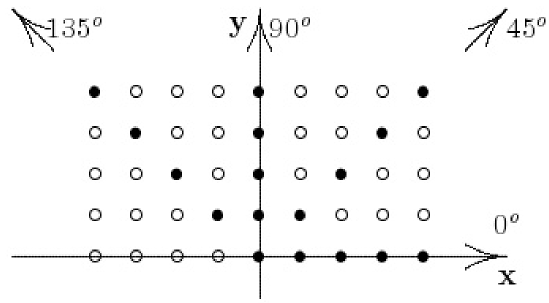


Fig-5: Geometry for measurement of gray level co-occurrence matrix for 4 distances d and 4 angles

We have found that only 4 features contribute as discriminating features as this is essential for better classification. Measurements that are possible to estimate via the co-occurrence matrix are: energy, entropy, , cluster shade ,cluster prominence and correlation. The Equations (5), (6), (7), (8) are used to evaluate the textural features.

$$\text{Energy} = \sum_i \sum_j p(i,j)\, 2 \quad (5)$$

$$\text{Entropy} = \sum_i \sum_j P(i,j) \log P(i,j) \quad (6)$$

$$\text{Correlation} = \frac{\sum_i \sum_j (ij) P(i,j) - \mu_x \mu_y}{\sigma_x \sigma_y} \quad (7)$$

$$\text{Cluster Prominence} = \sum_{i=0}^{G-1} \sum_{j=0}^{G-1} \{i + j - \mu x - \mu y\} 4\ X\ P(i,j) \quad (8)$$

$$\text{Cluster Shade} = \sum_{i=0}^{G-1} \sum_{j=0}^{G-1} \{i + j - \mu x - \mu y\} 3\ X\ P(i,j) \quad (9)$$

7. Artificial Neural Network

Artificial Neural Network has been a motivating methodology for training and classification purposes. In this work Neural Network Pattern recognition toolbox has been used and implemented in MATLAB for classification of leaf disease. Network function is known by large connections between the elements. The architecture of the neural network is shown in Figure 5 which consists of three layers namely input, hidden and output layer.

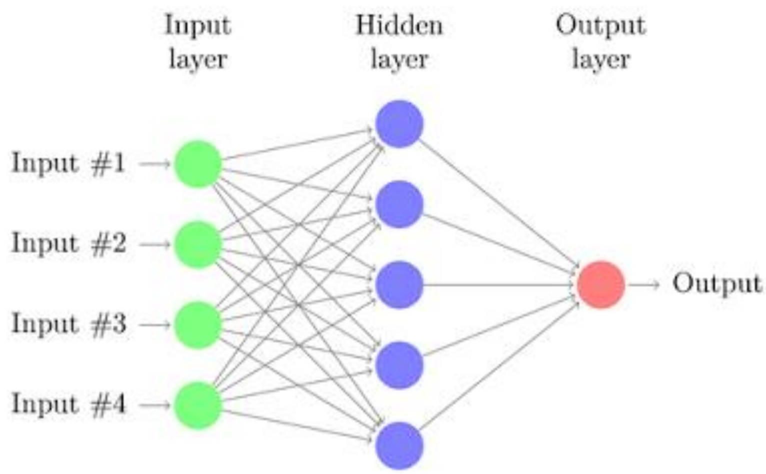


Fig-6: Architecture of neural network

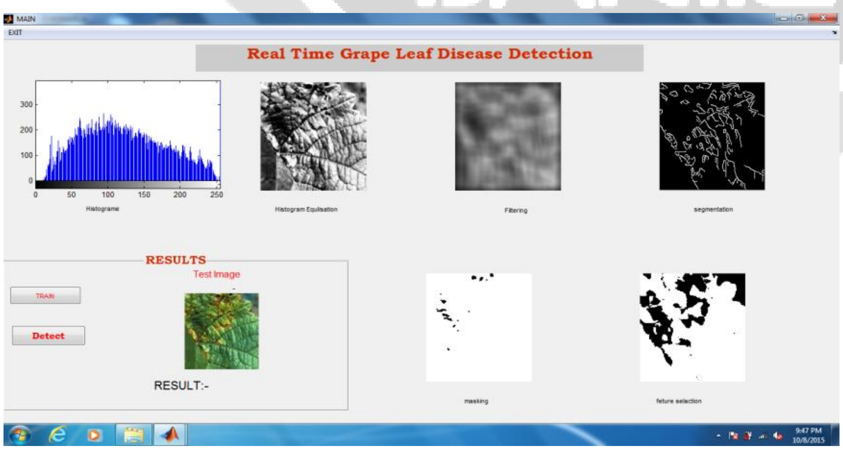
Back propagation neural network (BPNN) is the most important algorithm for the supervised training of multilayer feed-forward ANN. The BPNN are simple and effective to implement and found suitable for a wide range of machine learning applications. The number of neurons in the input layer corresponds to the number of input features and the number of neurons in the output layer corresponds to the number of classes. The number of nodes in the hidden layer is calculated using the Equation 10.

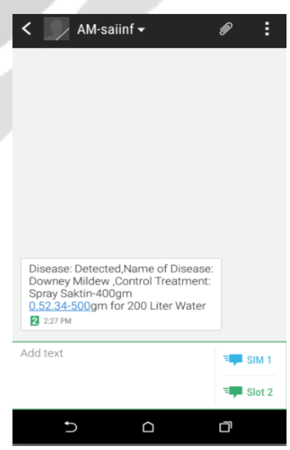
$$n = \frac{(I+O)}{2} + y^{0.5} \qquad (10)$$

Where n= number of nodes in hidden layer,
I= number of inputs feature,
O= number of outputs, and
y= number of inputs pattern in the training set.
Once the weight of learning database has been calculated then ANN is able to test for any query image which is not already in learning database.

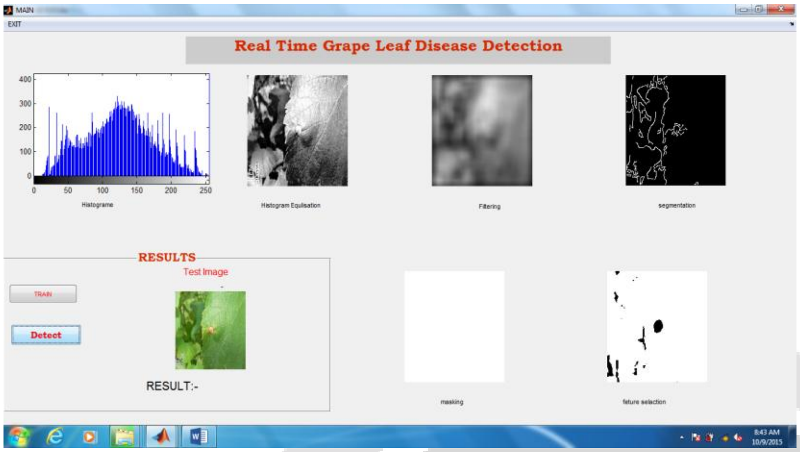
4. Simulation Results:

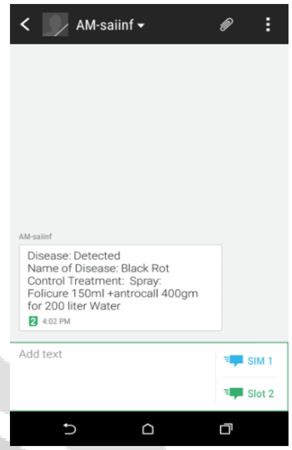
1) Downey Mildew



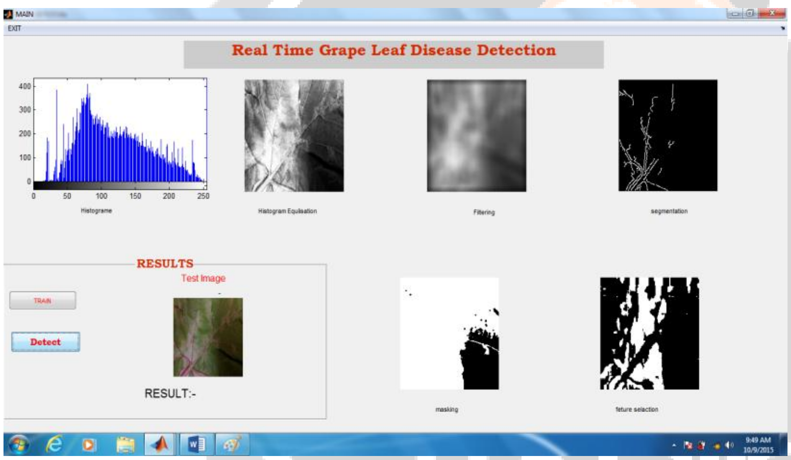


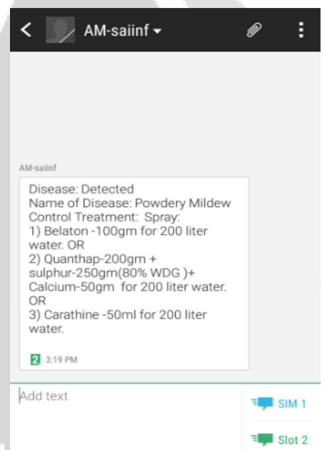
2) Black Rot



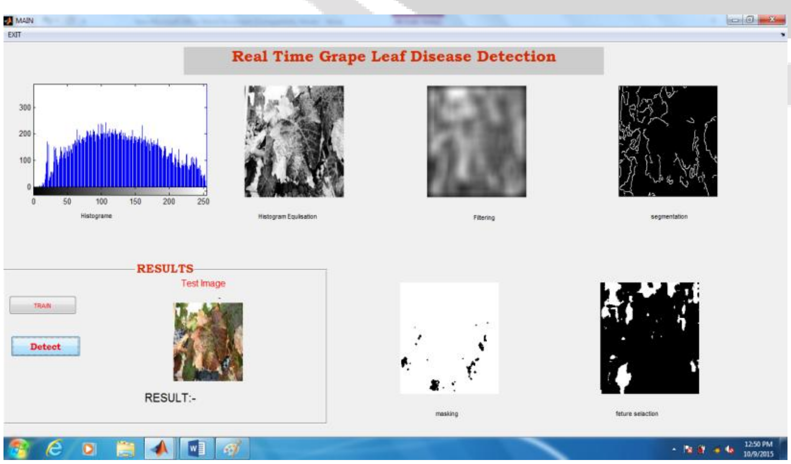


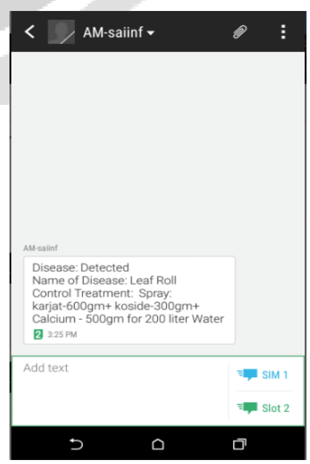
3)Powdery Mildew



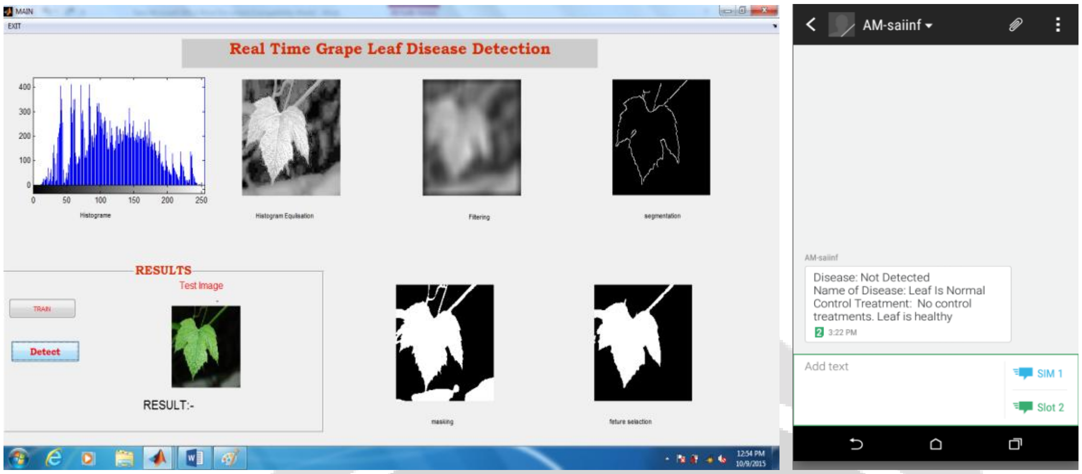


4)Leaf Roll





5) Normal Leaf



4. Results and Discussion

For classification using Neural Networks, the Neural Network Toolbox available in MATLAB 7.0 was used. The ANN is trained with 115 images of different disease type. The remaining 40 images are used for testing. Around 15% image samples are used for validation of the designed classifier model.

The percentage accuracy is defined as the ratio of correctly recognized image samples to the total number of test image samples. The Percentage accuracy is given by Equation 12.

$$\text{Percentage Accuracy } (\%) = \frac{\text{Correctly Recognized Image Samples}}{\text{Total Number of Test Images Samples}} * 100 \quad (12)$$

Table 1: Results of proposed system

	Normal Leaf	Downey Mildew	Powdery Mildew	Black rot	Leaf Roll	Accuracy %
Normal Leaf	18	0	0	0	2	**90.00**
Downey Mildew	0	48	0	1	0	**97.91**
Powdery Mildew	0	1	38	1	0	**95.00**
Black rot	0	0	1	10	0	**90.90**
Leaf Roll	1	0	0	0	11	**90.90**
			Over all Accuracy			**92.94**

5. Conclusions

We have developed leaf disease detection and diagnosis system with the help of image processing which is capable of diagnosing disorders. A set of features was selected to be extracted using feature extraction phase, and those features were stored in the feature database, which is designed for this purpose. The captured leaf image parameters were compared with the parameters of healthy leaf and disease was detected. According to disease pesticide control was done. From Table 1, the experimental results show that the proposed method is effective. The classification rate is above 92.94%

In the experiments, the reasons for misclassification of the plant disease are concluded as follows: the symptoms of the texture of diseased plant leaves vary at the beginning. To improve the plant disease identification rate at various stages, we need to increase the training samples and extract the effective features from leaf texture.

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BIOGRAPHIES

	Nivedita.R.Kakade. Lecturer in Matoshri College of Engineering & Research Center, Nashik. ME in VLSI & Embedded System.
	Prof.D.D.Ahire Assistant Professor in Matoshri College of Engineering & Research Center, Nashik. He has done his Masters in communication & perusing P.hD from Pune University