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# Classification of Downy Mildew, Powdery Mildew and Black Rot diseases of Grape Leaf using Back Propagation Algorithm

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**ABSTRACT:** Nowadays, recognition of leaf diseases is challenging yet important topic in Agricultural field. Worldwide research is going on to recognize the leaf disease with the help of single image. An efficient leaf disease detection system will help farmers to gain optimum yield. The proposed approach aims to build system to identify disease of the grape leaf from leaf image. For disease recognition , system uses color co-occurrence methodology for extracting disease relevant features and neural network as a classifier that can discriminate between diseases such as Downy mildew, powdery mildew & black rot.

**KEYWORDS**:RGB, HSV, Mask, Back Propagation Algorithm

## I. INTRODUCTION

India is an agricultural country; wherein about seventy percentage of the population depends on agriculture. Grape fruit enjoys a pre-eminent status among all cash crops present in the country and is the principal raw material for flourishing wine industry. It provides livelihood to about sixty million people and is an important agricultural commodity providing remunerative income to millions of farmers both in developed and developing countries. 70 per cent of the grape cultivated area in India is present in Maharashtra. But this area is under rain fed conditions Water stressed seed or plant, will have poor growth leading to low yield as well as exposure to diseases.

Leaf Diseases are economically important as they can cause a loss of yield. Plant diseases can turn into dilemma as it can cause significant reduction in both quality and quantity of agricultural products. Rapid, accurate identification of diseases in the vineyard is key to preventing serious outbreaks and losses in yield and quality. However, the presence of a pathogen or disease does not necessarily mean that a treatment is required. The severity of diseases varies from year to year, depending primarily on weather conditions, the presence of inoculum (history of the disease) and the susceptibility of the vines. This means that a disease can be devastating one year and insignificant the next. The measures to be taken to prevent losses may therefore vary from season to season. Suitable evaluation and diagnosis of crop disease in the field is very critical for the increased production.

## II. 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. Zulkifli Bin Husin and Abdul Hallis Bin Abdul Aziz developed fast and accurate method in which the chilli leaf diseases are detected using color clustering method. Here graphical user interface is used[1]. Yinmao Song, ZhihuaDiao, Yunpeng Wang, Huan Wang developed feature extraction methods of crop disease based on computer image processing technology. Based on color, texture and shape feature extraction method in three aspects features and their respective problems were introduced start from the perspective of lesion leaves [2]. Keru Wang and Shaokun Li [3] created a model of cotton leaf chlorophyll determination based on using the

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machine vision technology for the color features of cotton leaf. The research showed that the BIR values of ROB color system, the b and b\r values of chromaticity coordinate and the S values of HIS color system were all significantly correlated with chlorophyll content of cotton leaf. These values could be used to determine the concentration of chlorophyll.

Libo Liu and Ouomin Zhou [4] studied the identification method of rice leaf disease according to the color characteristics of leaf lesion area. Vane Zhang [5] used cucumber as object and studied the diagnostic method of nutritional status of greenhouse crop with the application of computer vision technology. The result showed that the green component and the color component H of the leaves were linear correlation with the nitrogen which could be used rapid diagnosis of crop indicators under the same conditions. Chunhua Hu and Pingping Li [6] used the O/B and OIR statistics features of the ROB system to distinguish the deficiency cucumber blades, they used the features of the Ohta system to identity the color of different cucumber leaves and extracted the H relative percentage histogram of HSV color system to determine the pathological interval of deficiency leaves, the research achieved good results.

P. Revathi, M. Hemalatha [7] used Image Edge detection Segmentation techniques for Cotton Leaf Spot Disease Detection. Image Edge detection Segmentation techniques in which, the captured images are processed for enrichment first. Then R, G, B color Feature image segmentation is carried out to get target regions (disease spots). Later, image features such as boundary, shape, color and texture are extracted for the disease spots to recognize diseases and control the pest recommendation.

Kim et.al, have classified the grape fruit peel diseases using colour texture features analysis. The texture features are calculated from the SGDM and the classification is done using squared distance technique. Grape fruit peel might be infected by several diseases like canker, copper burn, greasy spot, melanose and wind scar [8]. The classification accuracy achieved is 96.7Helly et.al developed a new method in which HSI transformation is applied to the input image, and then it is segmented using Fuzzy C-mean algorithm. Feature extraction stage deals with the colour, size and shape of the spot and finally classification is done using neural networks [9]. Real time specific weed discrimination technique using multilevel wavelet decomposition was proposed by Siddiqil et.al. In this histogram equalization is used for pre-processing, features are extracted from wavelet decomposition and finally classified by Euclidean distance method [10]. The classification accuracy obtained is 97%.

## III. PROPOSED ALGORITHM

Current challenges, on which multiple research groups worldwide are actively working, include the following areas:

1) Plant disease detection using fruit inspection :
   - To determine size & shape of fruits
   - To determine color of affected area
2) Plant disease detection using leaf inspection
   - To quantify affected area by disease
   - To find shape of affected area
   - To determine color of affected area
3) Plant disease detection using stem inspection:
   - To quantify affected area by disease.
   - To find shape of affected area.
   - To determine color of affected area

The algorithm for which can be explained as follows:

1) Acquire images of Black Rot, Downy Mildew and Powdery Mildew diseases in .jpg format. Different diseases are acquired into two phase i.e. in testing phase and training phase.
2) Perform preprocessing operation on input image.
3) Features of disease image are extracted using SGDM matrix method.
4) Neural network classifier is used for recognizing different diseases.
5) Find out the weights which minimize the error between the target and actual output with the help of Back propagation algorithm.
6) Display recognized disease.

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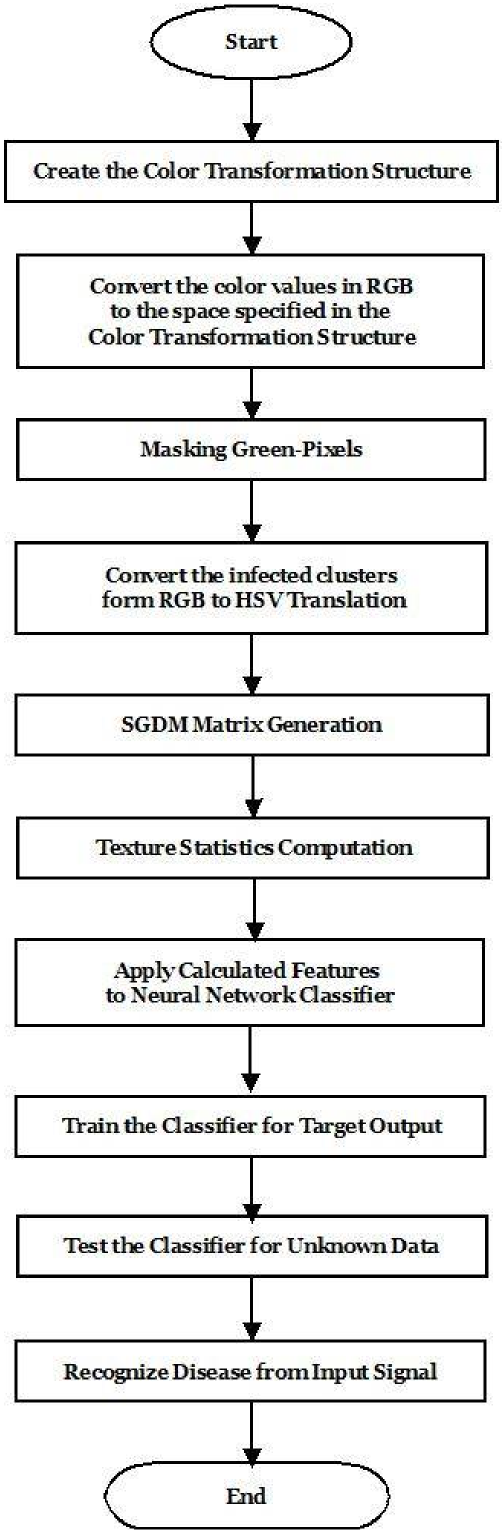


Flowchart of Grape Leaf Disease recognition system.

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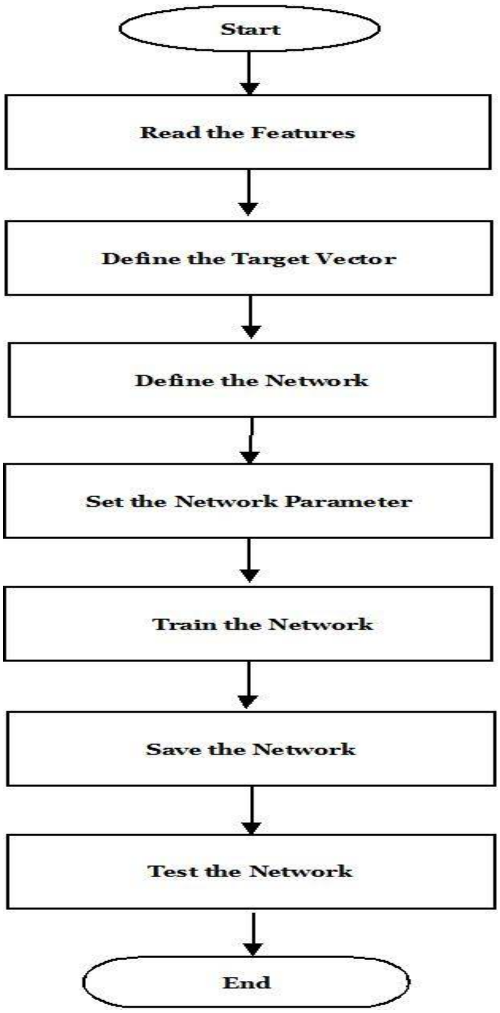


Flowchart of Designing of Neural Network in MATLAB.

Firstly, the RGB images of leaves are acquired. Then RGB images are converted into Hue Saturation Value (HSV) color space representation. RGB is an ideal for color generation. But HSV model is an ideal tool for color perception. Hue is a color attribute that describes pure color as perceived by an observer. Saturation refers to the relative purity or the amount of white light added to hue and Value means amplitude of light. After the transformation process, the Hue component is taken for further analysis. Saturation and Value are dropped since it does not give extra information.

Downy mildew

Powdery Mildew

Black Rot

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A. ***MASKING***

Masking means setting the pixel value in an image to zero. In this step, we identify the mostly green color pixels. After that, based on specified threshold value that is computed for these pixels. The green components of the pixel intensities are set to zero if it is less than the pre-computed threshold value. Then a binary image is formed called masked image. This masked image is multiplied to red, green and blue components of an original image and cocanitate then another RGB image is formed called removing of green pixels .The green colored pixels mostly represent the healthy areas of the leaf and they do not add any valuable weight to disease identification. Here we are interested in the unhealthy region because it provides valuable weight to us. Here first we take Binary image and then covert that image into mask image. But we are interested in the original colour of the disease area so again it converted into original RGB image. Then this RGB image is again converted into HSV image and extracted only hue plane for the further process.

Segmentation subdivides an image into its constituent regions or objects. The level to which the subdivision is carried depends on the problem being solved. That is segmentation should stop when the objects of interest in an application have been isolated.

Image segmentation algorithms generally are based on one of two basic properties of intensity values: discontinuity and similarity based approach. In the first category, the approach is to partition an image based on abrupt changes in intensity such as edges in an image .The principle approach in the secondary category are based on partitioning an image into regions that are similar according to a set of predefined criteria. Thresholding, region growing and region splitting and merging are examples of methods in this category.

The discontinuity based approach is classified as point detection, line detection, edge detection. The detection of isolated points in an image is straightforward in principle. Using mask of 3 x 3. We say that a point has been detected at the location on which the mask is centered if $|R| \geqslant T$. suppose that four masks that is horizontal,vertical,+450,-450 are run over the image $|Ri|>|Rj|$, for all $j \neq i$ that point is said to be more likely associated with a line in the direction of mask i .For example, if at a point in the image $|R1|>|Rj|$ for j=2,3,4, that particular point is said to be more likely associated with a horizontal line. The edge detection has been obtained by first and second order digital derivatives of an image.

The similarity based approach is divided into Thresholding, region growing and region splitting and merging. Thresholding is obtained by selecting a threshold T, the threshold that separate foreground and background of an image. Then any point (x, y) for which $f(x, y)>T$ is called an object and other is called background point. In the region growing technique, region growing is a procedure that group's pixels or subregions into larger regions based on predefined criteria. The basic approach is to start with a set of seed points and from these grow regions by appending to each seed those neighboring pixels that have properties similar to the seed. In region splitting and merging approach is to subdivide an image initially into a set of arbitrary, disjoint regions and then merge and/or split in an attempt to satisfy the conditions.

From the above steps, the infected portion of the leaf is extracted. The infected region is then segmented into a number of patches of equal size. The size of the patch ischosen in such a way that the significant information is not lost. In this approach patch size of 32X32 is taken. The next step is to extract the useful segments. Not all segments contain significant amount of information. So the patches which are having more than fifty precent of the information are taken into account for the further analysis. After this we apply colour co-occurrence methodology to extract the texture features. Here we calculate five texture features like Contrast, Energy, Local homogeneity, Cluster Shade & Cluster Prominence. These extracted features are used as an input to the neural network in the next block for classification. Finally Based on extracted features training can be given to a classifier. Once all these details are given correctly, the classifier identifies the most likely match for the given input, and it returns the recognized diseased at the output.

B. ***DISEASE CLASSIFICATION***

For classification of emotions through speech signals, extracted features from the feature extraction stage are given to the NN classifier. In this neural networks are used for recognition, due to its superior ability to Recognize Overlapping Patterns. A Back propagation neural network consists of a collection of inputs and processing units known as neurons. Our network consists of an input layer, one hidden layer and an output layer. A general architecture of an artificial neural network is shown in Fig. 4. The main idea behind the Back propagation algorithm is to minimize error, until the Artificial Neural Network learns the training data. In the beginning weights are initialized with random values. In the training process we try to adjust these weights so as to minimize error between desired and target classes.

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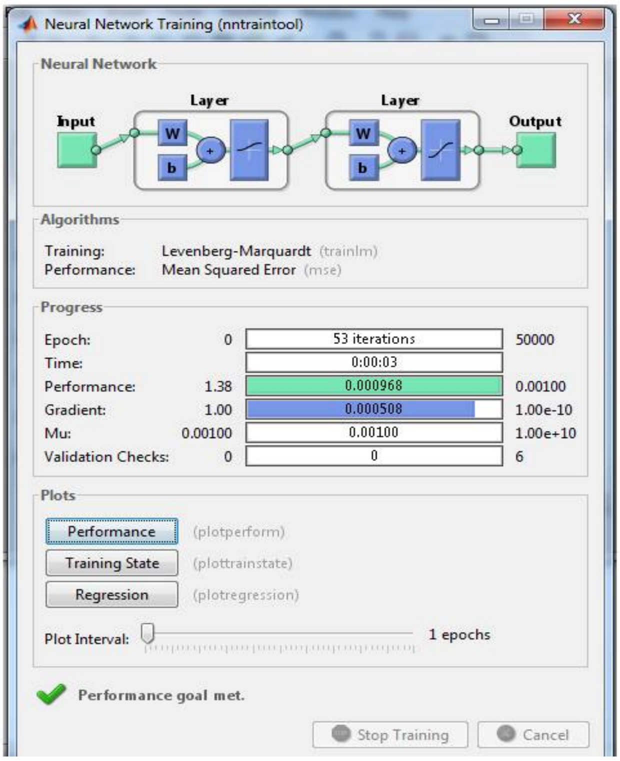
Input layer consist of input nodes to which extracted features are applied. In each layer neurons are interconnected by connection strengths called as weights. To successfully classify the patterns into different disease classes, the coefficients from feature extraction stage are applied to the input layer nodes. The outputs from input layer nodes are connected to the hidden layer; each hidden layer is connected to the output layer. Many constraints are taken into account while designing neural network for disease recognition such as required number of no of hidden layers, number of neurons in each layer.

## IV. Neural Network Training

After creation of the network, it can be trained for recognizing diseases by presenting training inputs and their corresponding targets. Type of training used is supervised training in which user has provided desired output for each input pattern. The mode used for training a network is batch mode. Batch mode means that the weights and biases of the network are updated only after the entire training set has been applied to the network. The objective of the neural network training is to find the weights and biases between the neurons which will find out global minimum of the error function. For recognition of diseases, Levenberg-Marquardt algorithm is used to train the classifier. The network performance is analysed in terms of its mean-squared error (MSE). In the training phase the network error reaches required goal, as shown in fig. below



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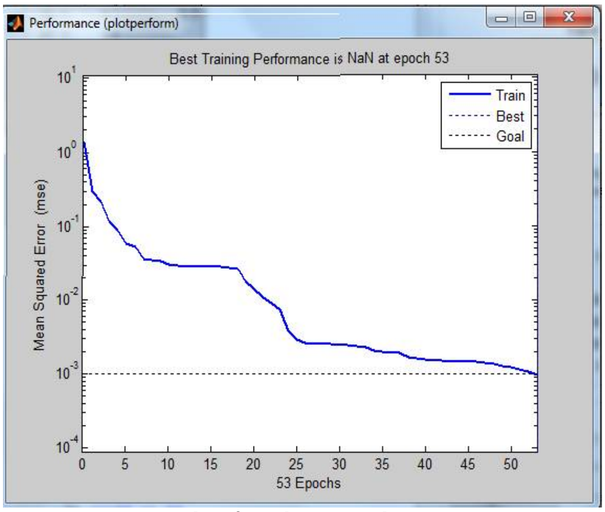


Fig. 1: Plot of epoch vs. error during training.

## V. NEURAL NETWORK TESTING

The trained neural network can now be tested with the testing samples. By performing testing on unknown data, we can analyse the network in terms of how well the network will do when applied to data from the real world. For testing purpose we used 40 samples of each emotion from each case and evaluated the result. The result analysis can be done from confusion matrix. The overall accuracy calculated from Table I is 94%.

TABLE I

| **Confusion Matrix for Accuracy calculation.** | | **Predicted Grape leaf disease** | | |
|---|---|---|---|---|
| | | **BR** | **PM** | **DM** |
| **Actual Grape leaf disease** | **BR** | 38 | 2 | 0 |
| | **PM** | 3 | 36 | 1 |
| | **DM** | 0 | 2 | 38 |

**Confusion Matrix.**

## VI. CONCLUSION

In this paper we classify Downy mildew, powdery mildew & Black rot diseases of grape leaf. For feature extraction we use color co-occurrence methodology color co-occurrence methodology gives excellent result when used with neural network classifier. With the help of this classifier early detection of diseases is possible. This classifier is very useful for farmers.

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