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Lemon Leaf Disease Detection and its Solution

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Abstract — Citrus trees are very needful that the people consume the citrus fruits daily and are affected by various diseases like Citrus canker, citrus black-spot and the citrus leaf-miner which are to be handled by the farmers within some time to increase their production. Disease recognition on citrus leaves is a difficult work. Many diseases commonly recognized on leaves of lemon tree. By taking the proper remedy for the disease, so that crop losses should also reduces. This system is helpful for the owners of the crop to recognize the kind of the disease and helps them to control within least amount of time. Our system recognizes the kind of disease as such as they occur on leaf of the lemon tree. The main aim of this project is to detect the disease of the lemon leaves and providing appropriate solution to that disease. Initially the images of the lemon leaves are captured through the high resolution digital camera for good quality. Then the captured images are converted from RGB to gray scale level for enhancement. These converted images are segmented by the method called K-Means cluster to extract the diseased part on the leave and the Multi class SVM is used for classification. Therefore our proposed system increases the crop yield and improves the farming economically.

Keywords-Lemon leaf, Citrus canker, Citrus Black-spot, Citrus Leaf-miner, K-Means, Multiclass SVM, Classification.

I. INTRODUCTION

India is an Agriculture country wherever huge number of folk's life is based on agriculture. Farmer has large vary of diversity to pick out appropriate crops. The farming of various crops for minimum yields and good product is very necessary. It can be improved with assistance of technical support. The lemon may be a little evergreen tree native to Asia. Lemon was the first industrial supply of acid before the event of fermentation primarily based processes. Lemon is sedative and antispasmodic agent used for medical functions. The most cause for the disease is that the leaf of the citrus tree. Most of the disease on citrus is based on leaf. The previous system is an automatic system for recognizing plant species supported leaf image equivalent to three plant sorts. they're analyzed using two totally different shape modeling techniques, Moments-Invariant(M-I) model and the Centroid-Radii(C-R) model .The system has used a technique for the extraction of shape, color associated texture options from leaf images and training an neural network classifier to spot the precise leaf class. So that the farmers couldn't determine the disease at initial stage.

In this paper we tend to develop the advanced computing setting to recognize the diseases mistreatment affected pictures of lemon leaves. Images of leaves area unit taken from photographic camera, smart phones and processed mistreatment image growing. The software system will precisely differentiate the distinction of color on these leaves .Depending upon that distinction, more comparison is formed with the information keep image features. Then the part of the leaf sport is used for the classifying and testing the leaves for detective work malady. This method would classify the disease supported threshold price and intimate the farmer regarding the disease and its remedies.

Most common symptoms includes in the tree are abnormal leaf growth, colour distortion, scrawny growth, shriveled and broken pods though diseases and bug pests will cause appreciable yield losses or cause death for plants and it's conjointly directly have an effect on to human health. These needs careful designation and timely handling to guard the crops from significant losses. In citrus tree diseases will be occur in varied components like fruit, stem and leaves. Tree gives many flowers and fruits in the least seasons around the world.

In the first stage we select the query image from dialog box and resize the image into standard pixels, those should be same for training set. In the second stage, divide image into different clusters and select cluster containing disease to detect the type of disease and extract the features of selected cluster of image form the feature vector. In the third stage compare the query feature vector with training set features and finally in the fourth stage declare the type of disease by considering most similar features from training and the extracted elements are go through a trained neural network.

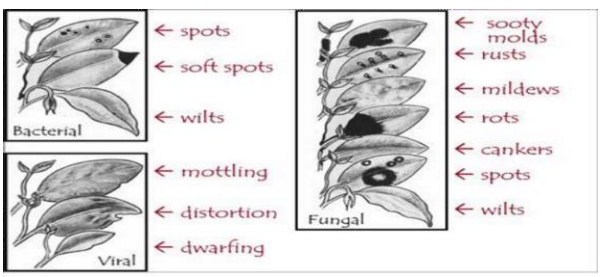

Figure1. Types of Diseases

1.1 Lemon Diseases

Citrus trees can exhibit variety of symptoms reflective varied disorders which will adversely influence their health, vigor and productivity to varied degrees. Characteristic disease symptoms is very important as inappropriate actions might typically persuade be pricy and harmful to the yield.

The disease symptoms which can be addressed throughout this thesis are a vital part of business citrus production programs. Correct disease management or remedial measures should be undertaken only when symptoms recognized early.

- ***Citrus canker:*** This disease is caused by a microorganism pathogen, could be a serious disease of most citrus verities. Citrus canker is very contagious and might be unfold speedily by wind-driven rain, lawnmowers, and human movement and Citrus canker is controlled by copper fungicides and spraying copper fungicides on the leaves of the lemon tree. This disease is the commonly affected to the area which the citrus leaf and it can be occurred.

Figure2. Citrus Canker

- ***Citrus leaf-miner:*** This is caused by the citrus leaf mineworker larvae enter the leaf tissue and start feeding to a lower place the epidemic (surface layer) cells. The Citrus leaf mineworker usually will not-noticeably have an effect on growth and yield of mature trees. Biological management through natural enemies and the introduced parasitoid wasp makes a major contribution in suppressing the matter. However, young trees are prone to severe leaf-miner injury thanks to frequent leaf flushes.

Figure3. Leaf-miner

- ***Citrus Black Spot:*** This disease is caused by Guignardia citricarpa. and this fungus affects citrus plants throughout subtropic climates, inflicting a discount in each fruit amount and quality.

Figure4. Black spot

- ***Normal Leaf*:** This leaf has no disease and it is healthy.

Figure5. Normal Leaf

1.2 Plant diseases analysis and its symptoms

The RGB image feature pixel count technique is always applied to agriculture science. Image analysis will be applied for the below purposes:

1. Identify diseased lemon leaf.
2. Measure the infected area by disease.
3. Search out the boundaries and color of the affected area.
4. Determine the size & shape of the leaf.
5. Identify the object properly.

II. LITERATURE SURVEY

In this literature survey, the various Image processing techniques to detect the Citrus leaf diseases are discussed. Furthermore, India is a country dominated by agriculture and allied fields. Horticulture is one in every of the allied fields. Bagalkot district has several places wherever the farmers accept farming. Pomegranate, lime, chikku and different fruits. Unfortunately, the leaf diseases, worms, insects etc. cause the reduction in yield. Hence, the motivation for taking on this downside.

In [1], the author presents variety of image process techniques to extract unhealthy part of leaf. Here SF-CES gives better improvement of the colour image, science lab and Ycbcr colour space supports K-means clustering for malady half extraction and suggests that of clusters. Then Gray Level Co-occurrence Matrix (GLCM) texture feature and colour textures options are extracted for further classification. Finally, Support Vector Machine is used for classification. In [2], this paper presents the various methods of image processing like SGDM Feature extraction and helps us to observe and classify all the major diseases of lemon leaf. The benefits of the system are economical, quick and correct in police investigation the illness by scaling the threshold values. The threshold values differ for each illness per their options and vary of affected areas. Therefore the developed system is incredibly helpful for verifying the illness mechanically and informing the farmer regarding the kind of illness .It conjointly provides the actions to be taken as remedy so as to avoid wasting their crops. In [3], this paper presents Image process algorithms and was used for feature extraction and classification. Pictures of the leaf surface were extracted from the first RGB pictures, then regenerate into Hue, Saturation, and Intensity (HSI) colour area illustration victimization CCM (Colour Co-occurrence Methodology), that uses each the colour and texture of a picture to attain distinctive options that represent the image. Every HSI image was accustomed generate abstraction Gray-level Dependence Matrices (SGDM). Once SGDMs were generated, a complete of thirty-nine image texture options were obtained from every citrus leaf sample. Classification tests were conducted on four alternate classification algorithms. In [4], this paper presents the k-nearest neighbor technique is probably the foremost easy of all calculations for anticipating the category of a check illustration. Also, neural systems are tolerant to clamant inputs. Be that because it could, in neural system it's laborious to know structure of calculation. SVM was discovered cantered with the simplest accessible machine learning calculations in transcription high-dimensional info sets. In SVM machine unpredictability is diminished to quadratic sweetening issue and it's simple to manage quality of call rule and frequency of error. In [5], this papers presents the principle methodology of this system is to acknowledge the diseases. Speed and preciseness are the first attributes of sickness recognition. Consequently, the augmentation of this work can consider developing the advanced algorithms for fast and that we precise recognition of leaves with diseases. This paper clarifies associate degree utilization of composition examination in recognizing the plant diseases. The results of this system will acknowledge the leaf diseases with very little machine effort. In [6], this paper presents an image process based methodology is proposed and utilized for leaf and stem disease detection. Here author has a tendency to check our project on 5 infections that impact on the plants; they are: Early burn, soft mould, gray mold, late singer, minor achromatic color. The projected methodology is image process based and within the initial step of the projected approach, these images are segmented utilizing the K-means system, within the second step the portioned pictures are responded to a pre-prepared neural system. Our trial results demonstrate that the projected methodology will basically support and programmed discovery of plant disease. supported our examinations, the created Neural System classifier that depends on measurable arrangement perform well and may effectively establish associate degreed order the tried disease with an truth of around 93. In [7], this paper presents associate form of plant diseases together with Grape and wheat diseases. The symptoms, classification and detection of these diseases are delineated in peculiarity. Image segmentation is principally performed on the leaves so as to examine the malady gift in it. The pathogens square measure primarily chargeable for the disease that destroys the leaf and stem of the plants. Back propagation networks, radial basis function neural networks (RBFNN), Generalized Regression Networks (GRNNs) and Probabilistic Neural Networks (PNNs), image sweetening, image segmentation, feature extraction, symbolic logic, Multi-class Support Vector Machine and native Binary Pattern. square measure used because the techniques that helps within the detection of the plant diseases. The combination of two or additional techniques may also be utilized for recognition of diseases of the trees. In [8], this paper presents the projected framework assists us with detective work and arranges all the diseases. The advantages of the framework area unit practiced, fast and precise in scaling therefore on acknowledge the sickness the limit values. The sting price contrasts for each sickness as indicated by their parts and scope of influenced areas. Thence this paper reason that the framework is extraordinarily valuable for distinctive the sickness consequently and advising the farmer concerning the type of

sickness and offers the moves to be created as cure with a selected finish goal to spare their harvest land. In [9], this paper summarizes image process techniques for many plant species that are used for recognizing plant diseases. The foremost techniques for detection of plant diseases are: back propagation neural network, support vector machine, K-means clustering, and SGDM. These techniques are required to analyses the healthy and patho-logical plants leave. A number of the challenges in these techniques. Impact of background knowledge within the ensuing image, optimization of the technique for a selected plant leaf diseases, and automation of the technique for continuous machine-driven observation of plant leaf diseases below universe field conditions. The review suggests that this sickness finding technique shows a decent potential with a capability to detect plant leaf diseases and a few limitations. In [10], this paper presents the method of texture analysis for detection and classification of the diseases of the plant leaves is explained. So the projected algorithmic rule is tested on 10 species of plants specifically beans, banana, lemon, jackfruit, mango, sputa, tomato, and potato. The diseases particular to those trees are taken for our methodology. The experimental results indicate that the projected system will acknowledge and classify the leaf diseases with slightly machine effort.

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III. MOTIVATION & PROBLEM DEFENITION

3.1 MOTIVATION

The main motivation of this project is to observe the disease of the citrus leaves using some image process techniques and providing the solution to that disease. By detecting the disease of the lemon tree and tell the farmer about that disease.

3.2 PROBLEM DEFINITION

Diseases of the plants have become a big headache because it will cause important dicrease in each quality and amount of horticultural product. The most important techniques for detection of plant diseases are: SVM, K-means clustering, and SGDM. These techniques area unit used to analyses the healthy and unhealthy plants leaves. Atomic discovery of plant diseases could be a very important because it could demonstrate benefits in perceptive expansive fields of harvests, and therefore consequently establish the ailments from the manifestations that show up on tree soars. It will empower machine vision that's to offer image primarily based programmed investigation, procedure management and mechanism direction. Nearly, visual ID is figure serious, less actual and will be potential simply in very little areas. After detection of the plant disease we've got to classify the diseases for plant disease classification the neural network rule is projected. Neural network methods like Feed Forward Neural Network (FFNN), Learning Vector Quantization (LVQ) and radial basis function (RBF) square measure most often used classifiers.

The problem definition concluded after the literature survey is **"Lemon Leaf Disease Detection and its Solution".** The main aim of this project is to design and develop an Disease detection system that will differ from the existing system.

3.3 OBJECTIVES

The major objectives of this Methodology are as follows:

1. Preparing a database of images of a lemon leaf disease.
2. Detect the affected area among the lemon images.
3. Evaluation of the co-occurrence methodology for recognition..
4. Develop NNs strategies classification of a lemon leaves based on the features obtain from co-occurrence methodology.

IV. PROPOSED SYSTEM

Initially, the images of many lemon leaves are captured utilizing high resolution camera so as to get the good results & efficiency and image processing techniques are used to these images to extract required features which will be required for other analysis. After that, several analytical techniques are applied to classify the images according to the specific problem.

In the primary step, the captured (RGB) images of all the lemon leaf samples are chosen.

4.1 The one-by-one procedure step of proposed approach:

I. RGB leaf image acquisition;
II. Converting the lemon leaf image from RGB to Grey scale level;
III. Masking the green-pixels in the leaf;
IV. Remove the masked green pixels from the leaf;
V. Segment the components of leaf and obtain the useful segments;
VI. Compute the texture features using Colour Co-Occurrence method;
VII. Use the Neural Network for classification.

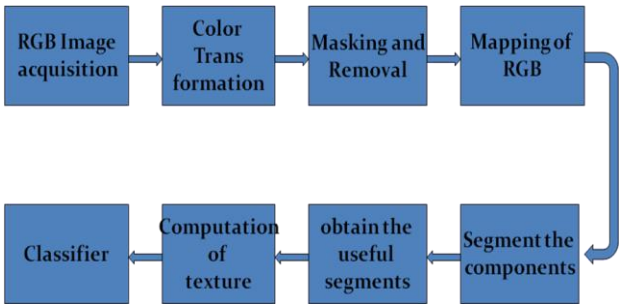

Figure6. Block Diagram of Proposed System

I. RGB Leaf image acquisition

- Image acquisition is a process of storage and digitization of various leaf images.
- Basically, images of lemon leaves are captured by utilizing a camera with needed resolution for higher quality.
- The building of a database of an image is almost dependent on the system.
- The database of an image is totally responsible for the high efficiency of the classifier and it decides the strength of the algorithm.

II. Converting the lemon leaf image from RGB to Grey scale level

- Secondly, the RGB images of lemon leaves are converted into grey scale level.
- Grey scale images consist of brightness information and grey scale image consists 8 bits information.
- The pixel value range in grey scale is from 0-255.

III. Masking the green-pixels in the leaf

- In this stage we tend to determine largely green colored pixels based on such threshold value.
- The green pixel elements are masked as follows: if the green component of the pixel intensity is lower than the computed threshold value, the red, green and blue components of this pixel element are assigned to a value zero.

IV. Removal of masked green pixels from the leaf

- In this step, the pixels values with zeros red, green, blue values are fully removed. This provides a lot of exact input for classification and reduces the time of processing.

V. Segment the components of leaf and obtain the useful segments

- From the above steps, the affected part of the leaf is extracted.
- The affected region is divided into variety of patches of equal size.
- The size of the patch is selected in order to the data isn't lost.
- After segmenting the infected region into patches acquire the helpful segments that aren't infected.

VI. Computing the texture features using Color Co-Occurrence method

- The Co-occurrence texture analysis methodology is developed by the spatial Gray-Level Dependence Matrices (SGDM).
- The Gray level Co-occurrence matrix (GLCM) could be a mathematical way to describe shape by statistically sampling the method certain grey-levels occurs in respect to various gray levels.
- These matrices measure the possibility that a pixel element at one specific grey level will occur at a unique distance and orientation from any pixel element on condition that pixel element incorporates a second specific gray level.

VII. Configuring the Neural Networks for Recognition

- Finally, when detecting the disease of the lemon leaf. The Neural Network is employed for classification based on the texture features.

4.2 Neural network based classification: The extracted features area unit given as inputs to pre-trained neural network for automatic classification of diseases. BPNN, SVM, Radial basis functions, K-nearest neighbors area unit some well-known neural networks. Neural network is chosen as a classification tool because of its well-known technique as a prosperous classifier for several real applications. The training associate degreed validation processes area unit among the necessary steps in developing an correct process model using NNs. The data-set for training and validation processes consists of two components

4.3 Classification

In our proposed approach the lemon diseases belongs to identical category. This can be carried out by Support Vector Machine (SVM) classifier. Support Vector Machine is machine learning technique used for classification and regression analysis. In a group of training examples, each one is marked to one of the two classes. An SVM model could be a illustration of the examples as points in area, mapped in order that the samples of the separate classes area unit divided

by a transparent gap that's as wide as attainable. New examples area unit then mapped into that very same area and belong to a class supported that aspect of the gap they fall on. The SVM is shown in below fig.

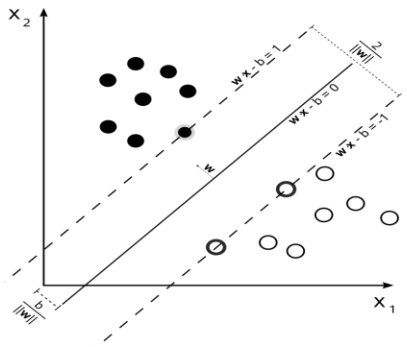

Figure7. Support Vector Machine

4.3.1 Non-linear SVM

Bernhard E. Boser, Isabelle M. Guyon and Vladimir N. Vapnik suggested to build non-linear classifiers by using the kernel trick to maximum margin hyper-planes in 1992. The algorithm is quite similar, except that every dot product is replacing by a non-linear kernel function. This algorithm to fits to the maximum margin hyper-plane in to the transformed feature space is shown below.

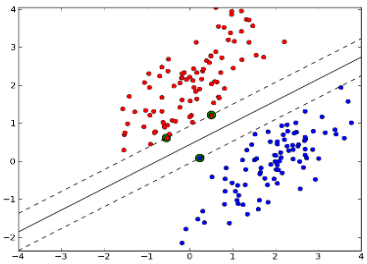

Figure8. Non-linear SVM

4.3.2 Multi-Class SVM

Multi-Class SVM assigns labels to instances by utilizing support vector machines, In which the labels are drawn from the finite set of part elements. This main method is therefore to convert back the single multi-class problem into multiple binary category issues.

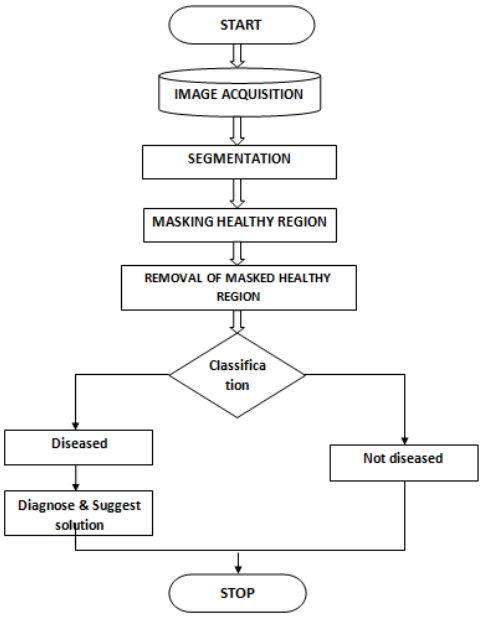

Figure9. Flow Chart of Proposed System

V. IMPLEMENTATION

5.1 Implementation

In the proposed project work the Lemon leaf disease detection and its solution is developed and in order to simply determine the diseases so farmers needn't check manually and at random and this method reduces their effort and the leaf disease detection works by the following steps

1. choose the query image from dialog box
2. resize the image into standard pixels, those should be same for training set
3. Divide image into completely different clusters
4. choose cluster containing disease to detect the kind of disease
5. Extract the features of selected cluster of image form the feature vector
6. Compare the query feature vector with training set features
7. Declare the type of disease by considering most similar features from training set.

Many diseases cannot be found in manual detection and by utilizing some techniques. If we have a tendency to keep an automatic efficient data based mostly system, all diseases is simply found by capturing image of the picture incessantly and examination it with the info that is understood as classifiers used to notice the defect altogether parts of the leaf. The captured images in RGB format is converted to grey scale utilizing MATLAB.

The grey scale images area unit divided into binary images by using grey level threshold segmentation. Feature extractions of segmented lemon leaves area unit done by utilizing canny edge detection. The threshold value of the leaf is often computed by using histogram algorithm. The threshold value is compared with normal threshold values of the lemon leaf stored in classifiers. By utilizing the value we are able to simply say that the leaf is infected or not. The threshold value of normal leaf ranges from 30-32, differs from this value. Currently classification happens; information is formed that is termed as classifiers in MATLAB. Within the classifiers we are going to store the disease name with its solution.

VI. EXPERIMENTAL RESULT

Initially, we have created the GUI for the system using MATLAB in which the GUI loads the Query image of the lemon leaf as shown in Figure10.

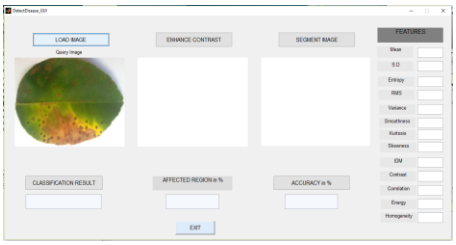

Figure10. Query image

In second step we are converting the RGB level lemon leaf into Gray scale level as shown in Figure11.

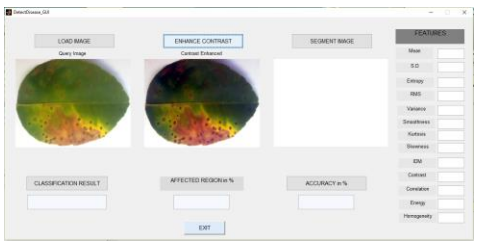

Figure11. Gray scale Image

After converting the gray scale level image the image is segmented using K-Means clustering. In which the image is segmented in three clusters among the three clusters we have to select the cluster containing the Region of Interest (ROI) as shown in Figure12.

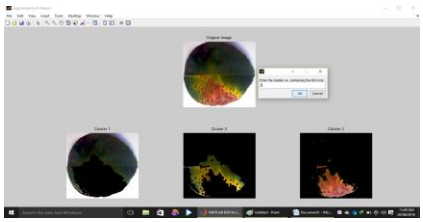

Figure12. Clustered Image

Selected ROI is loaded in to the GUI to verify which ROI is selected and it calculates some features as shown in Figure13.

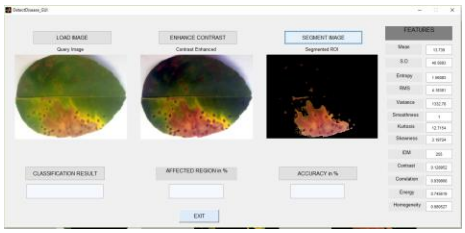

Figure13. Segmented image

Once we select the particular diseased portion containing the cluster it will show the disease name along with the solution for that disease in help dialog box and it will also display the affected region of the disease in percentage as shown in Figure14.

Figure14. Displaying Disease

After displaying the particular disease name it will evaluate the maximum accuracy with 500 iterations as shown in Figure15.

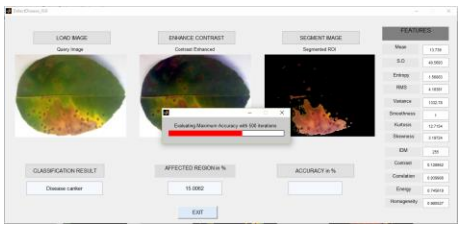

Figure15. Evaluating accuracy

Finally, iterating after 500 iterations the accuracy of the disease is displayed in percentage in which the disease is affected to the leaf as shown in Figure16.

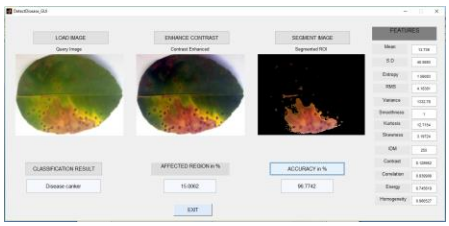

Figure16. Resulting image

Applications of the System

- ✓ Bio-technology labs
- ✓ Horticulture
- ✓ Gardening in cities
- ✓ Forest
- ✓ Nursery in fields

We are taking the various lemon leaves for testing and training for detecting the disease as shown in table 1.

	Number of leaf	disease detected	Disease not detected	Accuracy in %
Citrus canker	5	4	1	80
Leaf miner	5	5	0	100
Black spot	5	4	1	80
Normal leaf	5	5	0	100

Table 1 Accuracy measure

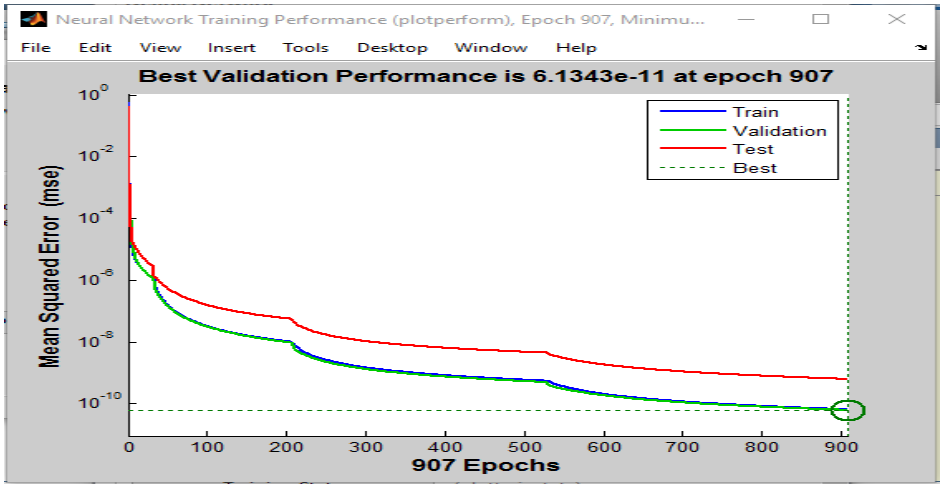

Figure17. Performance Graph

CONCLUSION

The lemon leaf disease detection and its solution help us to detect all possible lemon leaf diseases. The main aim of this project is to detect the disease of the lemon leaves and providing appropriate solution to that disease. Image processing methods are employed to recognize and classify the lemon leaf diseases. By the help of these methods, the lemon diseases can be detected at the initial step itself. The major techniques for detection of lemon diseases are: K-Means cluster, GLCM, and Multiclass SVM. These techniques are used to detect the unhealthy and healthy lemon leaves. This system is more helpful for identifying the lemon leaf disease and this system will inform the farmer regarding the kind of disease.

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