POWDERY MILDEW DISEASE IDENTIFICATION IN PACHAIKODI VARIETY OF BETEL VINE PLANTS USING HISTOGRAM AND NEURAL NETWORK BASED DIGITAL IMAGING TECHNIQUES

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Abstract - *The betel vine cultivation is very much affected by diseases and outcome of the farmer is big loss for betel vine cultivation. The aim of this paper is to detection of Powdery mildew disease in the betel vine plants using digital image processing techniques. The digital images of the uninfected or normal betel vine leaves and the digital images of the infected in powdery mildew diseased betel vine leaves at different stages are collected from different betel vine plants using a high resolution digital camera and collected betel vine images are stored with JPEG format. The digital image analyses of the leaves are done using the image processing toolbox in MATLAB. The RGB color betel vine images were converted into gray scale image. Histogram were plotted and stored as a database for uninfected and powdery mildew disease infected in first day to final day for all the pachaikodi variety of betel vine leaves. For the Back propagation neural network algorithm was created to identify the percentage of correct and incorrect classifications were identified. Finally this investigation helps to recognize the powdery mildew disease can be identified before it spreads to entire crop.*

Key Words: Piperaceae, Piper betel, Powdery mildew disease and Oidium Piperis

1.INTRODUCTION

The betel vine leaves were popularly known as Vettilai in Tamil and also commonly known as Paan in Hindi. Biological name of betel vine leaves were known as Piper betel. It belongs to the family of Piperaceae. The Vitamins B and C is highly available in the betel vine leaves and they were mainly used in a tonic to the brain, liver and heart for human [5]. The fresh juice of betel vine leaves are used to many ayurvedic preparations. The betel vine plants were cultivated throughout India except the dry northwestern parts. The six betel vine leaves with a little bit of slaked lime are equal to 300 ml of cow milk particularly for the vitamin and mineral nutrition. The group of research work was going on in the field of betel vine disease analysis for various centers within the country under the name "All India Coordinated Research Project on Betel vine". 70 varieties of betel vine leaves are Cultivated in the world. Among these 70 varieties, 40 varieties of betel vine leaves are Cultivated in India. 30 varieties of betel vine leaves are Cultivated in West Bengal. Tamil Nadu, Uttar Pradesh, Bihar, Maharashtra, Karnataka, West Bengal, Andhra Pradesh and Kerala states are widely cultivated in the betel vine. In Tamilnadu, based on the color, size and taste, there are many varieties of betel vine leaves available and some of the most popular varieties are vellaikodi, Karpoori, pachaikodi and Sirugamani. Pachaikodi variety of betel vine leaves was considered in this research work paper. During the cultivation of betel vine, diseases were one of the most important causes that reduce quantity of the betel vine leaves. The most important betel vine plants diseases were powdery mildew disease, leaf rot disease, foot rot disease and leaf spot disease. Powdery mildew disease is caused by Oidium piperis. The disease appears on the undersurface of the leaves as white to brown powdery patches. These patches gradually increase in size and often coalesce with each other. They vary in size from a few to 40mm in diameter and are covered by dusty growth which is fairly thick in cases of severe attack [8][5]. Areas on the upper surface corresponding to patches on the under surface appear yellowish, raised and irregular in outline. Young leaves when infected fail to grow and become deformed the surface being cracked and the margin turned inwards. The disease has been reported to be in the leaves

Fig -1: Powdery mildew disease affected betel vine leaves

only and it has been found to disappear during the hot season. Figure 1 shows the images of front and back view of powdery mildew infected betel vine leaves. In this research paper Powdery mildew disease were considered for pachaikodi variety of betel vine plants.

2. MATERIALS AND METHODS

For the Histogram based analysis, the front and back view normal or healthy betel vine leaves and powdery mildew disease infected in early stage to final stage betel vine leaves were individually collected at different plants using a high-resolution digital camera for all pachaikodi betel vine plants from erode, karur and trichy district of Tamil nadu, India. The collected betel vine leaves back grounds were eliminated using photo shop and these digital images were stored in the system [13]. These stored betel vine images were resized. Digital imaging techniques were divided into two phases. Normal or uninfected betel vine leaves phase and Powdery mildew disease infected in early stage to final stage of betel vine leaves phase. The uninfected betel vine leaves phase consists of without any disease infected in the betel vine leaves. The same variety of front and back view betel vine leaves were collected at different betel vine plants and place. The RGB color betel vine images were converted into gray scale image. Histogram were plotted and stored as a database for all pachaikodi variety of betel vine leaves. Infected betel vine leaves phase consists of Powdery mildew disease infected in early stage to final stage of betel vine leaves. The same varieties of betel vine sample leaves were selected from uninfected betel vine plant, which is nearest to the betel vine plant infected by Powdery mildew disease. The serial numbers were given to all selected betel vine sample leaves. The front and back view betel vine sample leaves was collected serial number wise at different plants and place [10]. The RGB color betel vine images were converted into gray scale image. Histogram was plotted for all pachaikodi variety of betel vine leaves and plotted histogram was compared with the stored data base values. If the calculated Histogram plot and stored Histogram plot were same range for all gray scale values, the selected betel vine leaves were included in samples otherwise samples were removed to the selected list. The accepted same variety of betel vine sample leaves were collected serial number wise for next two three days. The RGB color betel vine images were converted into gray scale image. Histogram was plotted for all pachaikodi variety of betel vine leaves and plotted histogram was compared with the stored data base values. If any difference were identified between calculated and stored database values on any particular day for the particular betel vine leaf, that particular day were counted as Powdery mildew disease infected in first day for the particular betel vine sample leaf. These Powdery mildew disease infected betel vine leaves were collected serial number wise for infected in first day to final day. The RGB color betel vine images were converted into gray scale image. Histogram was plotted for all pachaikodi variety of betel vine leaves and stored as a data base. The back propagation neural network based techniques were used to input and output data set of betel vine leaves. Confusion matrices and mean square error values were used to trained the back propagation neural network and evaluate its performance. Trained neural network, validation performance and testing the neural network were involved in this research paper. For back propagation neural network confusion matrix were consist of training confusion matrix, testing confusion matrix, the validation confusion matrix and all training, testing and validation confusion matrixes were combined. The training outputs were almost perfect, as we can see by the high numbers of correct responses in the green squares and the low numbers of incorrect responses in the red squares. The lower right blue squares demonstrate the overall accuracies. For the neural network based foot rot disease identification analysis, The RGB color betel vine images were converted into gray scale image. The mean, median and mean square error values were calculated and back propagation neural network algorithm was created. Uninfected betel vine gray scale image and foot rot disease infected first day to last day betel vine gray scale image were loaded and trained. Finally accuracies of foot rot disease infected in first day to last day were calculated for pachaikodi variety of betel vine leaves.

3. MATERIALS AND METHODS

3.1 Histogram Based Powdery Mildew Disease Identification

The histogram for front and back view normal betel vine leaves was shown in Chart 1.The histogram for front and back view powdery mildew disease infected in first day betel vine leaves were shown in Chart 2.The histogram for front and back view powdery mildew disease infected in second day betel vine leaves were shown in Chart 3.The histogram for front and back view powdery mildew disease infected in third day betel vine leaves were shown in Chart 4.The histogram for front and back view powdery mildew disease infected in fourth day betel vine leaves were shown in Chart 5.The histogram for front and back view powdery mildew disease infected in fifth day betel vine leaves were shown in Chart 6. The gray scale value of the histogram for front view of uninfected betel vine leaf was between 50 and 150. However the initial gray scale value was near to 100 and final gray scale value was near to 150.

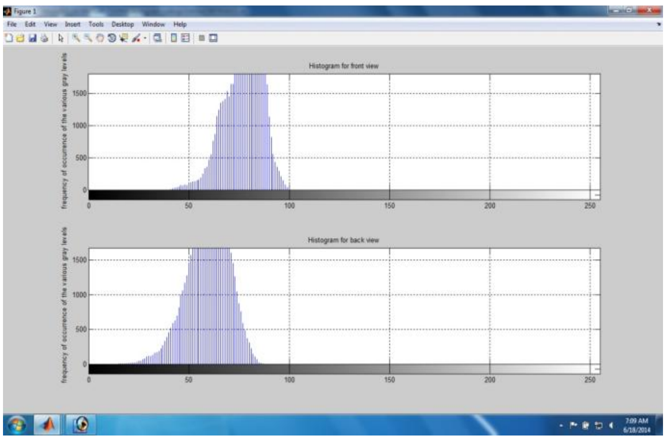

Chart -1: Histogram for front and back view normal betel vine leaves

Maximum frequency of occurrence of the gray scale value was between 50 and 150.The gray scale value of the histogram for back view of uninfected betel vine leaf was between 50 and 150. However the initial gray scale value was near to 50 and final gray scale value was near to 100. Maximum frequency of occurrence of the gray scale value

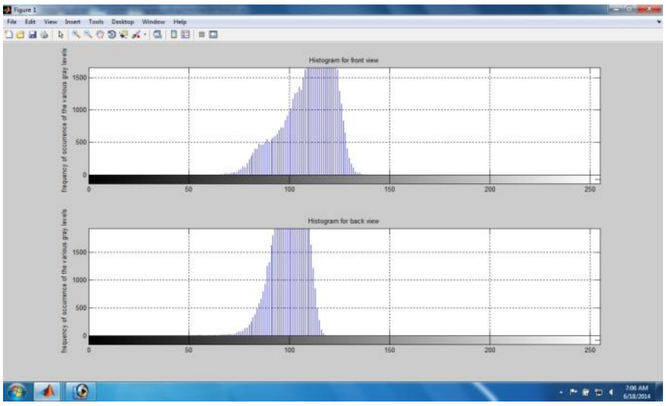

Chart -2: Histogram for front and back view powdery mildew disease infected in first day betel vine leaves

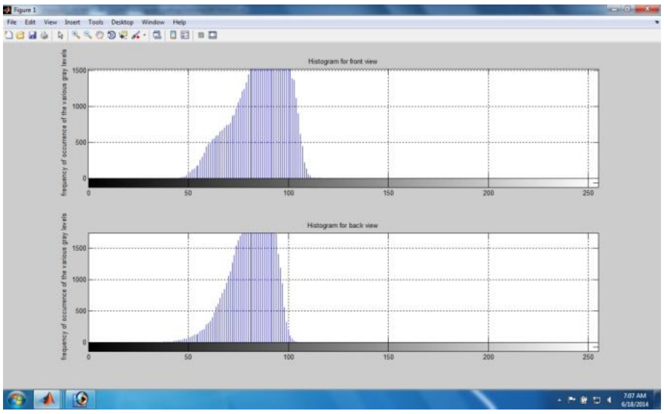

Chart -3: Histogram for front and back view powdery mildew disease infected in second day betel vine leaves

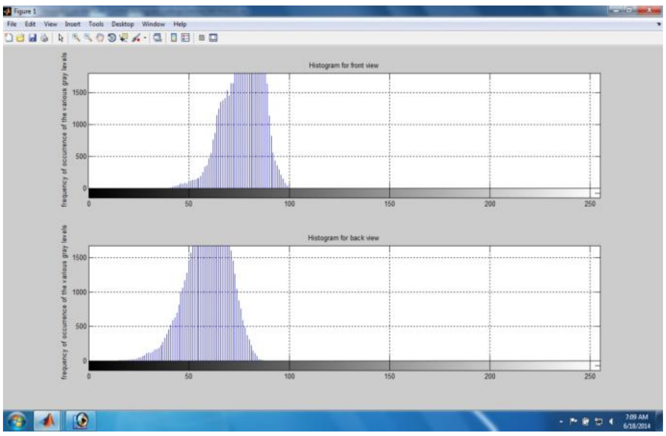

Chart -4: Histogram for front and back view foot rot disease infected in third day betel vine leaves

was between 100 and 150.The gray scale value of the histogram for front view of betel vine leaf with powdery mildew disease at first day of infection was between 50 and 150. However the initial gray scale value was near to 50 and final gray scale value was near to 150. Maximum frequency of occurrence of the gray scale value was between 100 and 150.The gray scale value of the histogram for back view of betel vine leaf with powdery mildew disease at first day of infection was between 50 and 150.

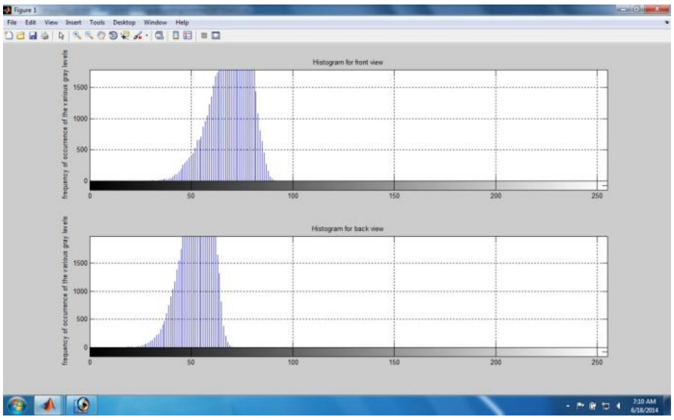

Chart -5: Histogram for front and back view powdery mildew disease infected in fourth day betel vine leaves

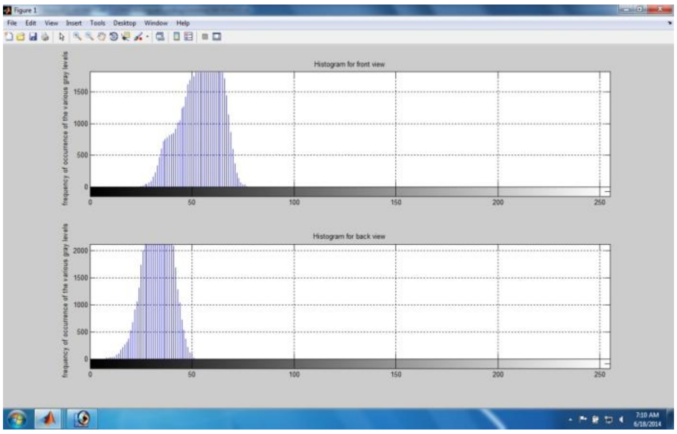

Chart -6: Histogram for front and back view powdery mildew disease infected in fifth day betel vine leaves

However the initial gray scale value was near to 50 and final gray scale value was near to 100. Maximum frequency of occurrence of the gray scale value was near to 100.The gray scale value of the histogram for front view of betel vine leaf with powdery mildew disease at second day of infection was between 0 and 150. However the initial gray scale value was near to 50 and final gray scale value was near to 100. Maximum frequency of occurrence of the gray scale value was near to 100. The gray scale value of the histogram for back view of betel vine leaf with powdery mildew disease at second day of infection was between 0 and 150. However the initial gray scale value was near to 50 and final gray scale value was near to 100. Maximum frequency of occurrence of the gray scale value was near to 100.The gray scale value of the histogram for front view of betel vine leaf with Powdery mildew disease at third day of infection was between 0 and 100. However the initial gray scale value was near to 50 and final gray scale value was 100. Maximum frequency of occurrence of the gray scale value was between 50 and 100. The gray scale value of the histogram for back view of betel vine leaf with powdery mildew disease at third day of infection was between 0 and 100. However the initial gray scale value was near to 0 and final gray scale value was near to 100. Maximum frequency of occurrence of the gray scale value was near to 50.The gray scale value of the histogram for front view of betel vine leaf with powdery mildew disease at fourth day of infection was between 0 and 100. However the initial gray scale value was near to 50 and final gray scale value was near to 100. Maximum frequency of occurrence of the gray scale value was between 50 and 100. The gray scale value of the histogram for back view of betel vine leaf with powdery mildew disease at fourth day of infection was between 0 and 100. However the initial gray scale value was between 0 and 50 and final gray scale value was between 50 and 100. Maximum frequency of occurrence of the gray scale value was near to 50.The gray scale value of the histogram for front view of betel vine leaf with powdery mildew disease at fifth day of infection was between 0 and 100. However the initial gray scale value was between 0 and 50 and final gray scale value was between 50 and 100. Maximum frequency of occurrence of the gray scale value was near to 50. The gray scale value of the histogram for back view of betel vine leaf with powdery mildew disease at fifth day of infection was between 0 and 100. However the initial gray scale value was near to 0 and final gray scale value was near to 50. Maximum frequency of occurrence of the gray scale value was near to 50. Finally, the result for histogram analysis of gray scale values has shown the variations of infected leaves on the day basis. The gray scale values were decreased as the disease infected day increases. This analysis helps to identify disease infected in early stage.

3.2 Back Propagation Neural Network Based Identification Of Accuracies

The neural network training performance plot and confusion matrix of uninfected betel vine leaf from its front view were shown in Chart 7. In the neural network training performance plot, neural network training was completed at 28th iteration. The best validation performance was 0.007 at 22th iteration. For the training confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For the validation confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For the test confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For all training, validation and test confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 100%. The neural network training performance plot and confusion matrix of uninfected betel vine leaf from its back view were shown in Chart 8. In the neural network training performance plot, neural network training was completed at 36th iteration. The best validation performance was 0.019 at 30th iteration. For the training confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%.

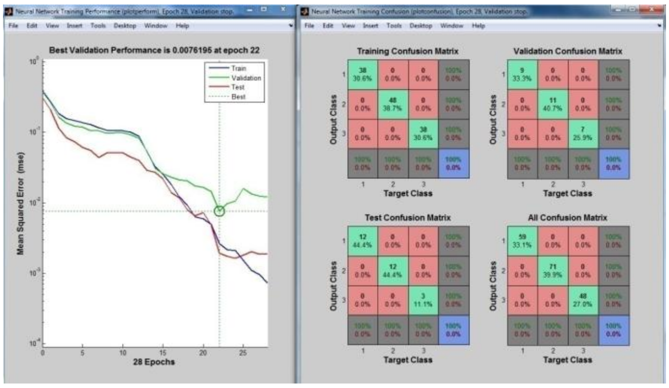

Chart -7: Neural network training Performance graph and confusion matrixes for front view uninfected betel vine leaf

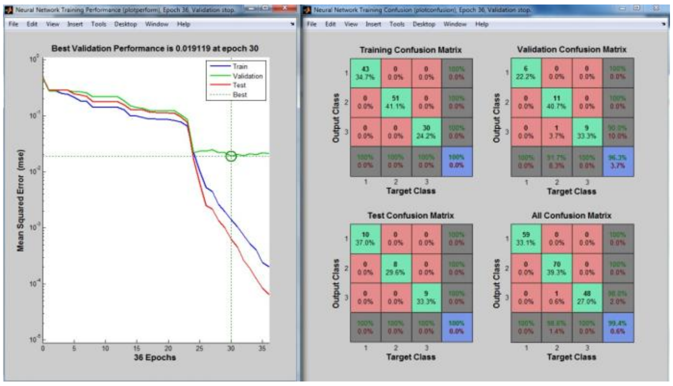

Chart -8: Neural network training Performance graph and confusion matrixes for back view uninfected betel vine leaf

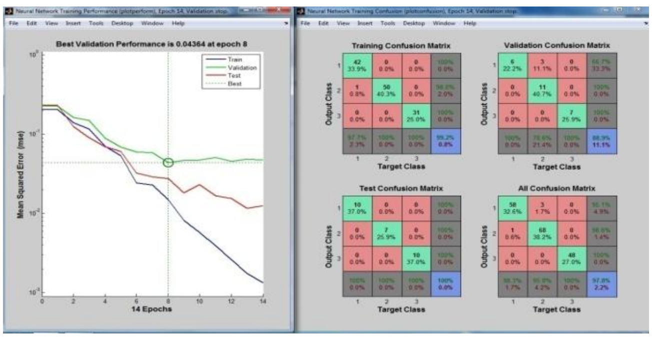

Chart -9: Neural network training Performance graph and confusion matrixes for front view powdery mildew disease infected in first day betel vine leaf

For the validation confusion matrix, percentage of correct classification was 96.3% and percentage of incorrect classification was 3.7%. For the test confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For all training, validation and test confusion matrix, percentage of correct classification was 99.4% and percentage of incorrect classification was 0.6%. The neural network training performance plot and confusion matrix of powdery mildew disease infected in first day betel vine leaf from its front view were shown in chart 9. In the neural network training performance plot, neural network training was completed at 14th iteration. The best validation performance was 0.043 at 8th iteration. For the training confusion matrix, percentage of correct classification was 99.2% and percentage of incorrect classification was 0.8%. For the validation confusion matrix, percentage of correct classification was 88.9% and percentage of incorrect classification was 11.1%. For the test confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For all training, validation and test confusion matrix, percentage of correct classification was 97.8% and percentage of incorrect classification was 2.2%. The neural network training performance plot and confusion matrix of powdery mildew disease infected in first day betel vine leaf from its back view were shown in chart 10. In the neural network training performance plot, neural network training was completed at 25th iteration.

Chart -10: Neural network training Performance graph and confusion matrixes for back view powdery mildew disease infected in first day betel vine leaf

The best validation performance was 0.018 at 19th iteration. For the training confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For the validation confusion matrix, percentage of correct classification was 96.3% and percentage of incorrect classification was 3.7%. For the test confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For all training, validation and test confusion matrix, percentage of correct classification was 99.4% and percentage of incorrect classification was 0.6%. The neural network training performance plot and confusion matrix of powdery mildew disease infected in second day betel vine leaf from its front view were shown in chart 11. In the neural network training performance plot, neural network training was completed at 25th iteration.

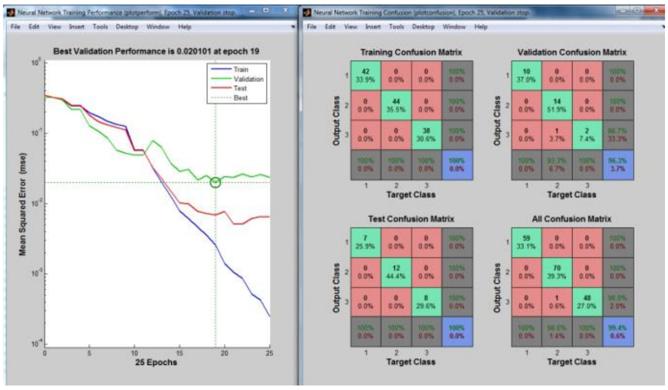

Chart -11: Neural network training Performance graph and confusion matrixes for front view powdery mildew disease infected in second day betel vine leaf

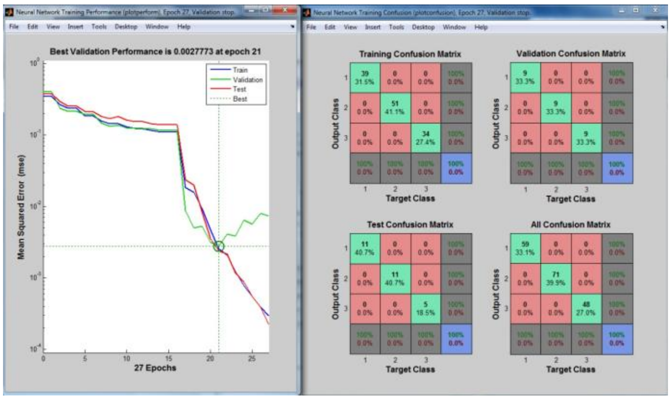

Chart -12: Neural network training Performance graph and confusion matrixes for back view powdery mildew disease infected in second day betel vine leaf

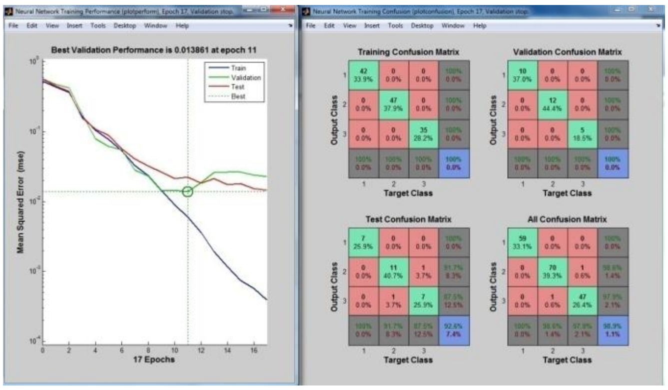

Chart -13: Neural network training Performance graph and confusion matrixes for front view powdery mildew disease infected in third day betel vine leaf

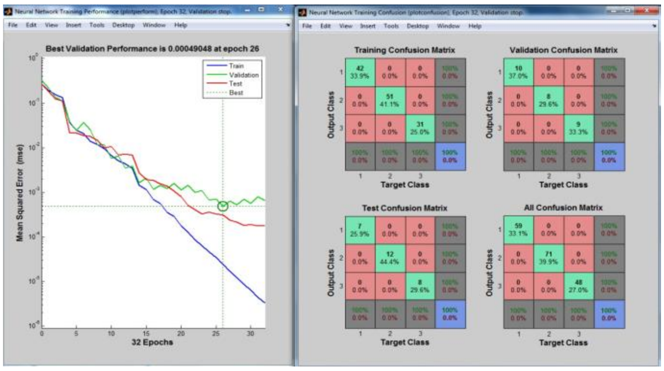

Chart -14: Neural network training Performance graph and confusion matrixes for back view powdery mildew disease infected in third day betel vine leaf

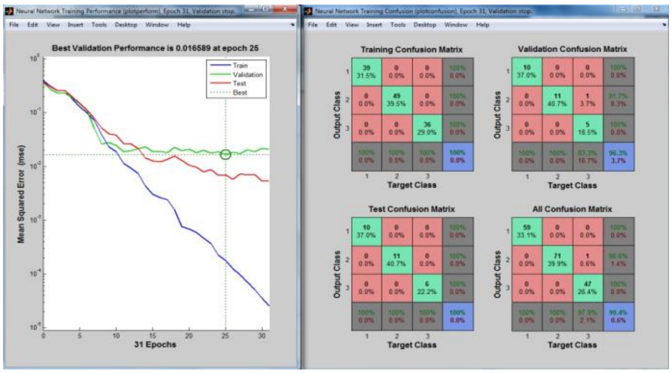

Chart -15: Neural network training Performance graph and confusion matrixes for front view powdery mildew disease infected in fourth day betel vine leaf

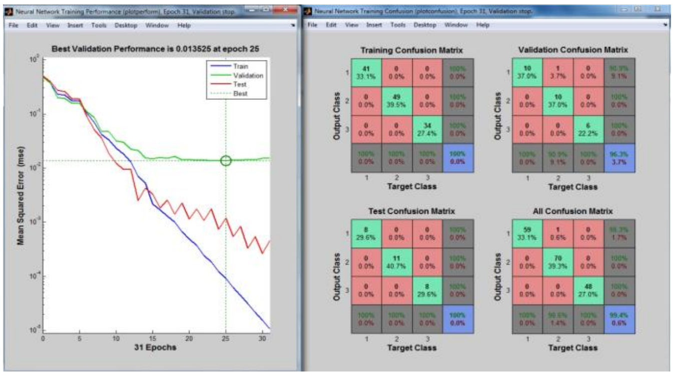

Chart -16: Neural network training Performance graph and confusion matrixes for back view powdery mildew disease infected in fourth day betel vine leaf

The best validation performance was 0.020 at 19th iteration. For the training confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For the validation confusion matrix, percentage of correct classification was 96.3% and percentage of incorrect classification was 3.7%. For the test confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For all training, validation and test confusion matrix, percentage of correct classification was 99.4% and percentage of incorrect classification was 0.6%. The neural network training performance plot and confusion matrix of powdery mildew disease infected in second day betel vine leaf from its back view were shown in chart 12. In the neural network training performance plot, neural network training was completed at 27th iteration. The best validation performance was 0.002 at 21th iteration. For the training confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For the validation confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For the test confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For all training, validation and test confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. The neural network training performance plot and confusion matrix of powdery mildew disease infected in third day betel vine leaf from its front view were shown in chart 13. In the neural network training performance plot, neural network training was completed at 17th iteration. The best validation performance was 0.013 at 11th iteration. For the training confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For the validation confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For the test confusion matrix, percentage of correct classification was 92.6% and percentage of incorrect classification was 7.4%. For all training, validation and test confusion matrix, percentage of correct classification was 98.9% and percentage of incorrect classification was 1.1%. The neural network training performance plot and confusion matrix of powdery mildew disease infected in third day betel vine leaf from its back view were shown in chart 14. In the neural network training performance plot, neural network training was completed at 32th iteration. The best validation performance was 0.0004 at 26th iteration. For the training confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For the validation confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For the test confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For all training, validation and test confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. The neural network training performance plot and confusion matrix of powdery mildew disease infected in fourth day betel vine leaf from its front view were shown in chart 15. In the neural network training performance plot, neural network training was completed at 31th iteration. The best validation performance was 0.016 at 25th iteration. For the training confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For the validation confusion matrix, percentage of correct classification was 96.3% and percentage of incorrect classification was 3.7%. For the test confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For all training, validation and test confusion matrix, percentage of correct classification was 99.4% and percentage of incorrect classification was 0.6%. The neural network training performance plot and confusion matrix of powdery mildew disease infected in fourth day betel vine leaf from its back view were shown in chart 16. In the neural network training performance plot, neural network training was completed at 31th iteration. The best validation performance was 0.013 at 25th iteration. For the training confusion matrix, percentage correct classification was 100% and percentage of incorrect classification was 0%. For the validation confusion matrix, percentage of correct classification was 96.3% and percentage of incorrect classification was 3.7%. For the test confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For all training, validation and test confusion matrix, percentage of correct classification was 99.4% and percentage of incorrect classification was 0.6%.

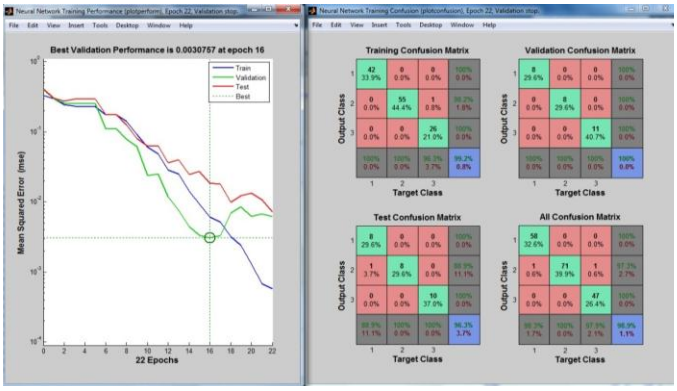

Chart -17: Neural network training Performance graph and confusion matrixes for front view powdery mildew disease infected in fifth day betel vine leaf

neural network training performance plot and confusion matrix of powdery mildew disease infected in fifth day betel vine leaf from its front view were shown in chart 17. In the neural network training performance plot, neural network training was completed at 22th iteration. The best validation performance was 0.030 at 16th iteration. For the training confusion matrix, percentage of correct classification was 99.2% and percentage of incorrect classification was 0.8%. For the validation confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For the test confusion matrix, percentage of correct classification was 96.3% and percentage of incorrect classification was 3.7%. For all training, validation and test confusion matrix, percentage of correct classification was 98.9% and percentage incorrect classification was 1.1%.

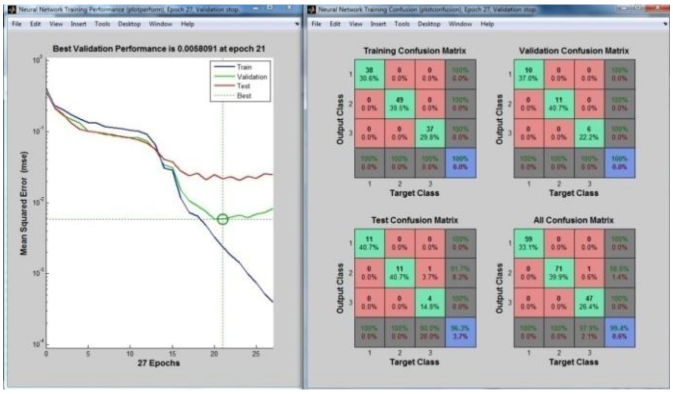

Chart -18: Neural network training Performance graph and confusion matrixes for back view powdery mildew disease infected in fifth day betel vine leaf

The neural network training performance plot and confusion matrix of powdery mildew disease infected in fifth day betel vine leaf from its back view were shown in chart 18. In the neural network training performance plot, neural network training was completed at 27th iteration. The best validation performance was 0.005 at 21th iteration. For the training confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For the validation confusion matrix, percentage of correct classification was 100% and percentage of incorrect classification was 0%. For the test confusion matrix, percentage of correct classification was 96.3% and percentage of incorrect classification was 3.7%. For all training, validation and test confusion matrix, percentage of correct classification was 99.4% and percentage of incorrect classification was 0.6%.

4. CONCLUSIONS

The above research techniques express that the pachaikodi variety of betel vine plants Oidium piperis fungus can be recognized in starting stage of betel vine plantation and saved before the Oidium piperis fungus starts to reach complete pachaikodi variety of betel vine crop. The accuracies of the correct and incorrect classifications of normal or uninfected betel vine leaves, powdery mildew disease infected in first day to final day were calculated for pachaikodi variety of betel vine leaves using back propagation neural network. This technique can also be extended to detect fungus or diseases of all kind plants to recognize starting stage preventive action.

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