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CLASSIFICATION OF DISEASES ON THE LEAVES OF COTTON USING GENERALIZED FEED FORWARD (GFF) NEURAL NETWORK

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Abstract- In this paper a new classification algorithm is proposed for the Identification of cotton leaf diseases Using Generalized Feed Forward Neural Network. In order to develop algorithm 40 captured 5 type of cotton diseases images of cotton have been considered, With a view to extract features from the cotton captured images after image processing, an algorithm proposes WHT transformed 128 coefficients. The Efficient classifiers based on Generalized feed forward (GFF) Neural Network. A separate Cross-Validation dataset is used for proper evaluation of the proposed classification algorithm with respect to important performance measures, such as MSE and classification accuracy. The Average Classification Accuracy of GFF Neural Network comprising of one hidden layers with 43 PE's organized in a typical topology is found to be superior for Training. Finally, optimal algorithm has been developed on the basis of the best classifier performance. The algorithm will provide an effective alternative to traditional method of cotton leaf images analysis for Classify the five type cotton leaf diseases .

Keywords—Signal & Image processing, GFF neural network, Transformed domain techniques, MATLAB, Microsoft Office Excel etc.

1.INTRODUCTION:

India is an agricultural country where about 70% of the population depends on agriculture. Farmers can select suitable fruits and vegetable crops from a wide range. The cultivation of these crops for superlative yield and quality produce is highly specialized. The management should keep a close supervision of crops so that diseases do not affect the production. Diseases are impairment to the normal state of the plant that modifies or interrupts its vital functions such as photosynthesis, transpiration, pollination, fertilization, germination etc. These diseases are caused by pathogens viz., fungi, bacteria and viruses, and due to adverse environmental conditions. Therefore, the early stage diagnosis of plant disease is an important task.

Farmers require continuous monitoring of experts which might be prohibitively expensive and time consuming. Therefore looking for fast less expensive and accurate method to automatically detect the diseases from the symptoms that appear on the plant leaf is of great realistic significance. This enables machine vision that is to provide image based automatic inspection, process control and robot guidance.

Through our project we are going to make a system which will detect and classify cotton leaves diseases. India was recognized as cradle of cotton industry. In Vidarbha (Maharashtra) region, Cotton is the most important cash crop grown on an area of 13.00 lacks hectors with production of 27 lack bales of cotton (2008-09). Disease on the cotton is the main problem that decreases the productivity of the cotton. The main source for the disease is the leaf of the cotton plant. About 80 to 90 % of disease on the cotton plant is on its leaves. So for that our study of interest is the leaf of the cotton tree rather than whole cotton plant.

In this paper their five type of cotton diseases are classified are

1) Bacterial disease: e.g. Bacterial Blight

2) Fungal diseases: e.g. Anthracnose, Leaf Spot

3) Viral disease: e.g. Leaf Curl, Leaf Crumple, Leaf Roll.

4) Diseases Due To insects: Whiteflies,

5) Diseases Due To insects :Leaf insects

Out of the above types of disease these diseases dramatically affect the leaf of cotton plant and its leaves. So that we proposed a system which helps in detecting the diseases of cotton leaves which will help the farmers to detect disease and take proper prevention to enhance the production of cotton. We took the pictures of diseased cotton leaves and performed various preprocessing techniques on them for removing the boundary of the leaf. The main target is to identify the disease in the leaf spot of the cotton crops. In this regard, It is discussed that about 80 to 90percentage disease on the Cotton crops are on its leaf spot. Consequently an area of interest is that identifying the leaf of the cotton rather than whole cotton. We used ANN as the classifier for testing the input test image with the database image so that proper disease can be detected. The main objective of the proposed work is to detect diseases in cotton leaves. It is very necessary to detect the diseases in cotton leaves. Detection of cotton leaf diseases can be done early and accurately using Artificial neural network.

2.Research Methodology:

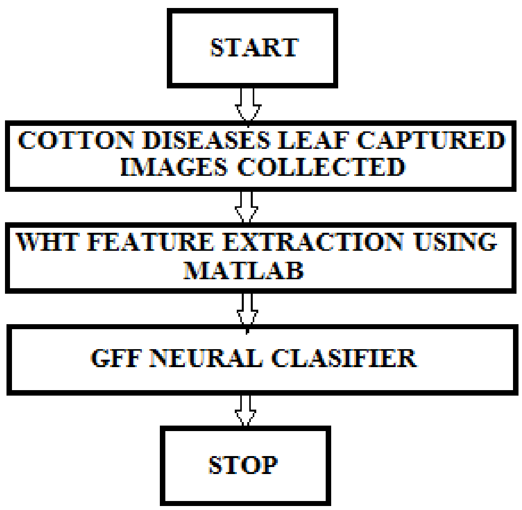

Figure2 Methodology of work

It this paper to study Cotton diseases classification Using Generalized Feed Forward Neural Network. Data acquisition for the proposed classifier designed for the classification of Cotton diseases shall be in the form of cotton leaf captured images..The most important un correlated features as well as coefficient from the images will be extracted .In order to extract features, statistical techniques, image processing techniques, WHT transformed domain will be used.

3.NEURAL NETWORKS

Following Neural Networks are tested: Feed-Forward Neural Networks

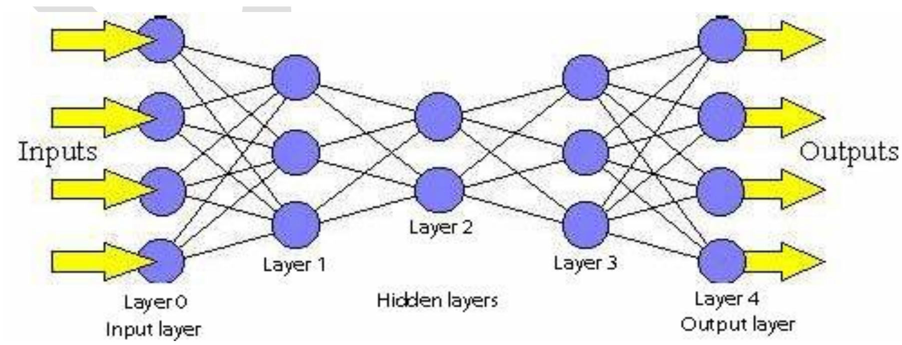

Figure 3 feed-forward network.

Feed-forward networks have the following characteristics:

1. Perceptrons are arranged in layers, with the first layer taking in inputs and the last layer producing outputs. The middle layers have no connection with the external world, and hence are called hidden layers.

2. Each perceptron in one layer is connected to every perceptron on the next layer. Hence information is constantly "fed forward" from one layer to the next., and this explains why these networks are called feed-forward networks.

3. There is no connection among perceptrons in the same layer.

A single perceptron can classify points into two regions that are linearly separable. Now let us extend the discussion into the separation of points into two regions that are not linearly separable. Consider the following network:

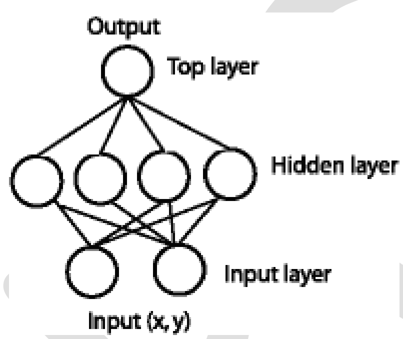

Figure. 3.2 A feed-forward network with one hidden layer.

The same (x, y) is fed into the network through the perceptrons in the input layer. With four perceptrons that are independent of each other in the hidden layer, the point is classified into 4 pairs of linearly separable regions, each of which has a unique line separating the region.

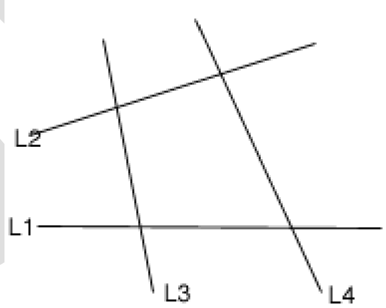

Figure 3.3 lines each dividing the plane into 2 linearly separable regions.

The top perceptron performs logical operations on the outputs of the hidden layers so that the whole network classifies input points in 2 regions that might not be linearly separable. For instance, using the AND operator on these four outputs, one gets the intersection of the 4 regions that forms the center region.

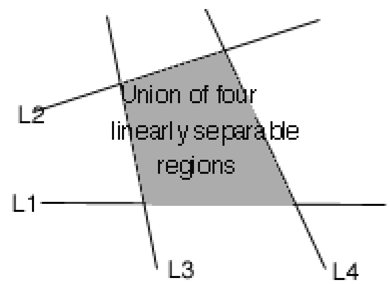

Figure3.4 Intersection of 4 linearly separable regions forms the center region.

By varying the number of nodes in the hidden layer, the number of layers, and the number of input and output nodes, one can classification of points in arbitrary dimension into an arbitrary number of groups. Hence feed-forward networks are commonly used for classification.

4. Learning Rules used:

- ***Momentum***

Momentum simply adds a fraction m of the previous weight update to the current one. The momentum parameter is used to prevent the system from converging to a local minimum or saddle point. A high momentum parameter can also help to increase the speed of convergence of the system. However, setting the momentum parameter too high can create a risk of overshooting the minimum, which can cause the system to become unstable. A momentum coefficient that is too low cannot reliably avoid local minima, and can also slow down the training of the system.

- Conjugate Gradient

CG is the most popular iterative method for solving large systems of linear equations. CG is effective for systems of the form A=xb-A (1) where x _is an unknown vector, b is a known vector, and A _is a known, square, symmetric, positive-definite (or positive-indefinite) matrix. (Don't worry if you've forgotten what "positive-definite" means; we shall review it.) These systems arise in many important settings, such as finite difference and finite element methods for solving partial differential equations, structural analysis, circuit analysis, and math homework.

Developed by Widrow and Hoff, the delta rule, also called the Least Mean Square (LMS) method, is one of the most commonly used learning rules. For a given input vector, the output vector is compared to the correct answer. If the difference is zero, no learning takes place; otherwise, the weights are adjusted to reduce this difference. The change in weight from ui to uj is given by: dwij = r* ai * ej, where r is the learning rate, ai represents the activation of ui and ej is the difference between the expected output and the actual output of uj. If the set of input patterns form a linearly independent set then arbitrary associations can be learned using the delta rule.

It has been shown that for networks with linear activation functions and with no hidden units (hidden units are found in networks with more than two layers), the error squared vs. the weight graph is a paraboloid in n-space. Since the proportionality constant is negative, the graph of such a function is concave upward and has a minimum value. The vertex of this paraboloid represents the point where the error is minimized. The weight vector corresponding to this point is then the ideal weight vector.

- Quick propagation

Quick propagation (Quickprop) [1] is one of the most effective and widely used adaptive learning rules. There is only one global parameter making a significant contribution to the result, the e-parameter. Quick-propagation uses a set of heuristics to optimise Back-propagation, the condition where e is used is when the sign for the current slope and previous slope for the weight is the same.

- Delta by Delta

Developed by Widrow and Hoff, the delta rule, also called the Least Mean Square (LMS) method, is one of the most commonly used learning rules. For a given input vector, the output vector is compared to the correct answer. If the difference is zero, no learning takes place; otherwise, the weights are adjusted to reduce this difference. The change in weight from ui to uj is given by: dwij = r* ai * ej, where r is the learning rate, ai represents the activation of ui and ej is the difference between the expected output and the actual output of uj. If the set of input patterns form a linearly independent set then arbitrary associations can be learned using the delta rule.

It has been shown that for networks with linear activation functions and with no hidden units (hidden units are found in networks with more than two layers), the error squared vs. the weight graph is a paraboloid in n-space. Since the proportionality constant is negative, the graph of such a function is concave upward and has a minimum value. The vertex of this paraboloid represents the point where the error is minimized. The weight vector corresponding to this point is then the ideal weight vector. [10]

5. RESULT

The GFF neural network has been simulated for 40 different images of cotton leaf out of which 33 were used for training purpose and 7 were used for cross validation.

The simulation of best classifier along with the confusion matrix is shown below :

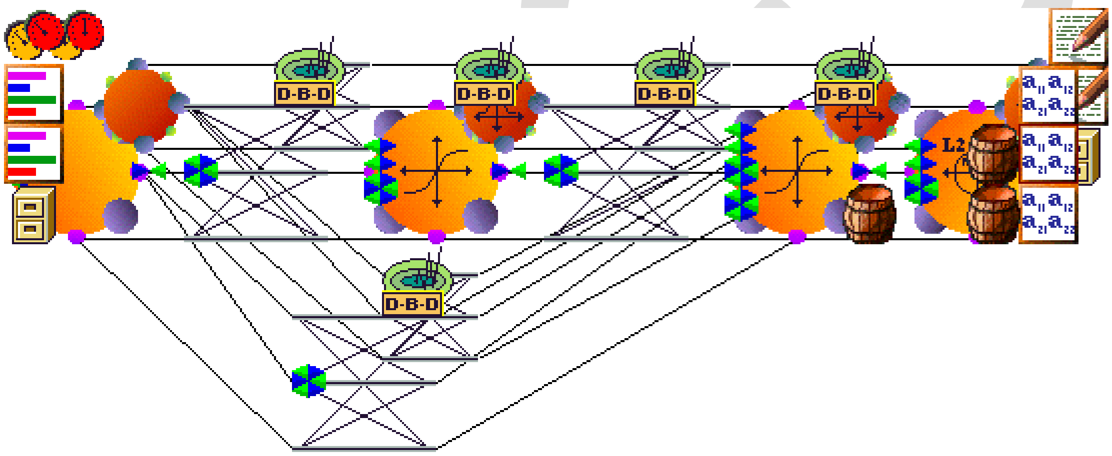

Fig.3.1 GFF neural network trained with DBD learning rule

Output / Desired	*NAME(VIRAL DISEASES)*	*NAME(INSECT DISEASE(W))*	*NAME(INSECT DISEASE(L))*	*NAME(FUNGAL DISEASE)*	*NAME(BACTERIAL DISEASE)*
NAME(VIRAL DISEASES)	1	0	0	0	0
NAME(INSECT DISEASE(W))	0	1	0	0	0
NAME(INSECT DISEASE(L))	0	0	1	0	0
NAME(FUNGAL DISEASE)	0	0	0	2	0
NAME(BACTERIAL DISEASE)	0	0	0	0	2

Table I. Confusion matrix on CV data set

Output / Desired	*NAME(VIRAL DISEASES)*	*NAME(INSECT DISEASE(W))*	*NAME(INSECT DISEASE(L))*	*NAME(FUNGAL DISEASE)*	*NAME(BACTERIAL DISEASE)*
NAME(VIRAL DISEASES)	3	0	0	0	0
NAME(INSECT DISEASE(W))	0	4	0	0	0
NAME(INSECT DISEASE(L))	0	0	6	0	0
NAME(FUNGAL DISEASE)	1	0	0	9	0
NAME(BACTERIAL DISEASE)	0	0	0	0	10

TABLE II. Confusion matrix on Training data set

Here Table I and Table II Contend the C.V as well as Training data set.

Performance	***NAME(VIRAL DISEASES)***	***NAME(INSECT DISEASE(W))***	***NAME(INSECT DISEASE(L))***	***NAME(FUNGAL DISEASE)***	***NAME(BACTERIAL DISEASE)***
MSE	0.003502326	0.005589084	0.079955832	0.17433369	0.108121481
NMSE	0.02860233	0.045644182	0.65297263	0.854235083	0.529795257
MAE	0.050577721	0.06220967	0.1389038	0.29452856	0.148613715
Min Abs Error	0.005251159	0.007578511	0.007714629	0.005173916	0.009514855
Max Abs Error	0.11060234	0.155716946	0.741059901	0.694447492	0.866460327
R	0.988277329	0.980244718	0.936379849	0.488353526	0.787603815
Percent Correct	100	100	100	100	100

TABLE III. Accuracy of the network on CV data set

Performance	***NAME(VIRAL DISEASES)***	***NAME(INSECT DISEASE(W))***	***NAME(INSECT DISEASE(L))***	***NAME(FUNGAL DISEASE)***	***NAME(BACTERIAL DISEASE)***
MSE	0.000420875	0.000707553	0.000136332	0.034983502	0.001004076
NMSE	0.003951148	0.006642462	0.000916452	0.176375154	0.004754083
MAE	0.012495808	0.01780273	0.005755934	0.06070842	0.022096759
Min Abs Error	4.47669E-05	0.000172183	8.2842E-06	0.000141984	0.000481886
Max Abs Error	0.051128465	0.055535121	0.053406065	1.052568774	0.055239122
R	0.998307613	0.997495344	0.999571658	0.920490138	0.998710596
Percent Correct	75	100	100	100	100

TABLE IV. Accuracy of the network on training data set

Here Table III and Table IV Contain the C.V and Training result.

6.CONCLUSION

This paper demonstrated how artificial neural networks(ANN)could be used to build accurate cotton diseases classifier. In order to train the neural network we extract shape features from real cotton leaf images that we captured at earlier time. We use Generalized Feed-Forward Network as classification. The result show that in training four diseases 100% accept viral diseases is 75% accuracy but in cross-validation result 100% accuracy.

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