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Classification of Diseases on the Leaves of Cotton

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ABSTRACT: In this paper a new classification algorithm is proposed for the Classification of five type of diseases on the cotton leaves. In order to develop algorithm 40 captured cotton leaves images have been considered, With a view to extract features from the cotton leaves captured images after image processing, an algorithm proposes WHT transformed coefficients. The Efficient classifiers based on Multilayer Perceptron (MLP) 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 MLP Neural Network comprising of one hidden layers with 10 PE's organized in a typical topology is found to be superior (100 %) for Training and cross-validation. 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 leaves captured images analysis for Classify the five type of diseases on the cotton leaves.

KEYWORDS: Neural solution, MatLab, Excel, all six type of cotton diseases images.

I. 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.

We will take an input image of defected plant leaves and extract the features of leaves. In our project we will consider colour as feature. With the help of this feature we will compare our defected plant leaves with the database present there. We will use Artificial Neural Network as our classifier for comparison of cotton leaves. An artificial neural network (ANN), usually called neural network (NN), is a mathematical model or computational model that is inspired by the structure and/or functional aspects of biological neural networks. Depending on the applications, many systems have been proposed to solve or at least to reduce the problems, by making use of image processing, pattern

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recognition and some automatic classification tools. Another method is to regularly observe the plants. Disease images are acquired using cameras or scanners.
Then the acquired image has to be processed to interpret the image contents by image processing methods. The diseases on the cotton leaves are classified as

A) Bacterial disease: e.g. Bacterial Blight

Figure 1:Cotton leaf with Bacterial blight disease

The disease appears on different parts of cotton plant, both at seedling and mature plant stages. The disease first appears on the leaves in form of water soaked region, then turns into black and gets dried up. In some cotton plants, water soaked region gets enlarged into angular reddish spots of about 1 mm in diameter. [9][10][11].

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

Figure 1.2:Cotton leaf with fungal disease

The fungus may attack cotton seedlings, but the disease usually appears when the plants are more mature. Affected plants are first darker green and stunted, followed by yellowing of the leaves and loss of foliage. First, symptoms appear on lower leaves around the time of first flower. The leaf margins wilt, turn yellow, then brown, moving inward. Infected plants fruit earlier than normal with smaller bolls that open prematurely.

Two or more leaf spots may occur at the same time. Symptoms are varied, but generally these organisms cause circular concentric lesions similar to a target spot . These foliar diseases tend to be more prevalent at crop maturity and during periods of high humidity.

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

Figure 1.3: Cotton leaf with Viral disease

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Two types of symptoms are associated with *Cotton leaf curl virus-infected* cotton. A typical, severe upward or downward leaf curl symptom accompanied by foliar discoloration and mosaic is commonly reported in most African countries and in India and Pakistan. There are also reports of a less severe symptom phenotype referred to as small vein thickening which is characterized by foliar enations, a slight mosaic and leaf curling.

D) Diseases Due To insects: Whiteflies, Leaf insects.

Figure 1.4:Cotton leaf with whiteflies disease, and Leaf insects

Because the whitefly larvae feed on the plants' sap, plant vigor is severely impacted. The honeydew (a sugary liquid) excreted by the larvae encourages growth of sooty mold, is unsightly and reduces the light available to the plant for photosynthesis, thus further weakening it. Ants are also attracted to this honeydew and will farm whitefly in much the same manner as they farm aphids And leaf insect disease is occur by eating the leaf by insect like white flies and gross hoper etc insect.

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

II **PROPOSED ALGORITHM**

A. ***Research methodology :***

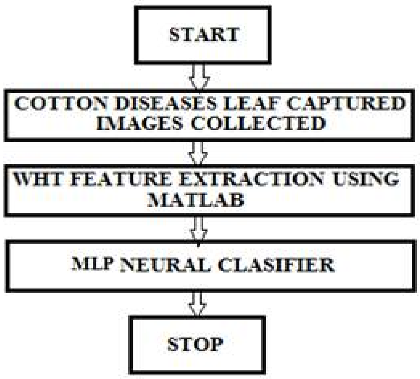

Figure2.1 Methodology of work

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It is classification of diseases on the leaves of cotton Using Neural Network Approaches.. Data acquisition for the proposed classifier designed for the classification of diseases on the leaves of cotton shall be in the form of cotton leaves 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, transformed domain will be used.

1) Neural Networks

Following Neural Networks are tested:

Multilayer perceptron (MLP)

The most common neural network model is the multi layer perceptron (MLP). This type of neural network is known as a supervised network because it requires a desired output in order to learn. The goal of this type of network is to create a model that correctly maps the input to the output using historical data so that the model can then be used to produce the output when the desired output is unknown. A graphical representation of an MLP is shown below:

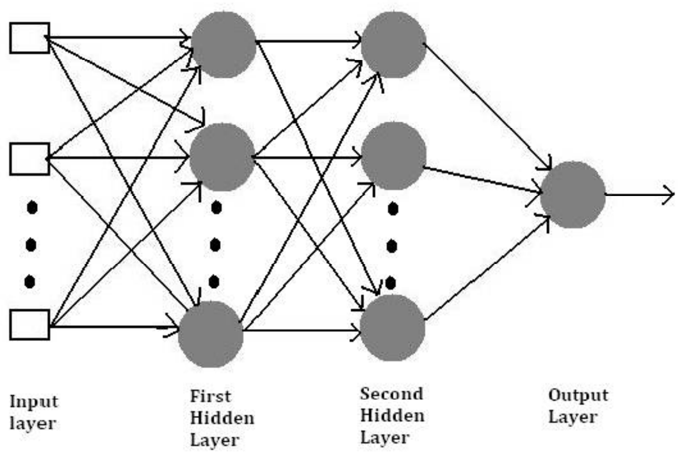

Figure 2.2: The Structure Of Neural Network Model MLP.

The MLP and many other neural networks learn using an algorithm called back- propagation. With back-propagation, the input data is repeatedly presented to the neural network. With each presentation the output of the neural network is compared to the desired output and an error is computed. This error is then fed back (back-propagated) to the neural network and used to adjust the weights such that the error decreases with each iteration and the neural model gets closer and closer to producing the desired output. This process is known as "training".

- ***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

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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.
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III. SIMULATION RESULTS

1) Computer Simulation

The MLP 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 :

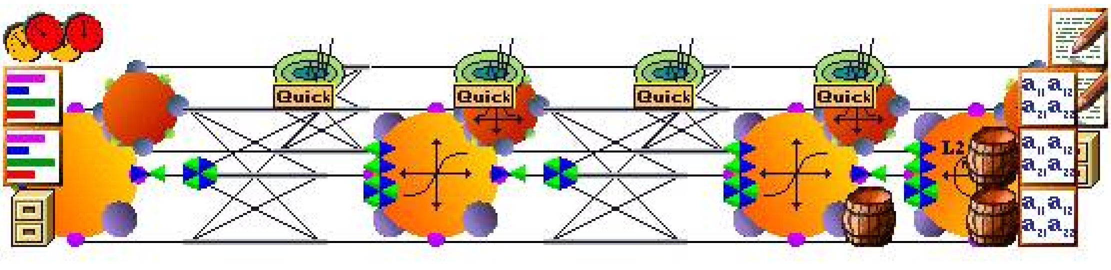

Fig.3.1 MLP neural network trained with QP learning rule

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2) Results

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)	4	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)	0	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	0.033049062	0.000945515	0.049695912	0.057904959	0.008507046
NMSE	0.269900671	0.007721702	0.405849949	0.2837343	0.041684526
MAE	0.110687681	0.027555927	0.195016127	0.158909676	0.073738329
Min Abs Error	0.013350937	0.012140171	0.077316284	0.022372827	0.027652169
Max Abs Error	0.453960758	0.050697133	0.374441487	0.57325509	0.163501536
R	0.960387213	0.996505408	0.878966238	0.919031367	0.98878722
Percent Correct	100	100	100	100	100

TABLE III. Accuracy of the network on CV data set

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Performance	NAME(VIRAL DISEASES)	NAME(INSECT DISEASE(W))	NAME(INSECT DISEASE(L))	NAME(FUNGAL DISEASE)	NAME(BACTERIAL DISEASE)
MSE	0.006870269	0.001795275	0.008517465	0.008986	0.004388822
NMSE	0.064497616	0.016853916	0.057256292	0.045304418	0.02078012
MAE	0.062521174	0.03376003	0.076623967	0.07276298	0.048564338
Min Abs Error	0.007040218	0.00215818	0.010604551	0.00565146	0.0014124
Max Abs Error	0.244616962	0.143820214	0.208169825	0.196314092	0.240597687
r	0.977408129	0.992013924	0.988473023	0.986434694	0.993700387
Percent Correct	100	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 and show the 100% percent accuracy.

IV. CONCLUSION AND FUTURE WORK

The MLP classifier with QP learning rule gives best performance of 100% in Training as well as in Cross validation.

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