LEAVES RECOGNITION USING BACK PROPAGATION NEURAL NETWORK-ADVICE FOR PEST & DISEASE CONTROL ON CROPS.

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KEYWORDS

AGRICULTURE – CROPS—PLANTS –LEAVES – PEST IMAGES RECOGNITION BACK PROPAGATION NEURAL NETWORKS—CONTROL MEASURES.

ABSTRACT

The main goal of this paper is to develop a software model, to suggest remedial measures for pest or disease management in agricultural crops. Using this software, the user can scan an infected leaf to identify the species of leaf, pest or disease incidence on it and can obtain solutions for its control. The software system is divided into modules namely: Leaves Processing, Network Training, Leaf Recognition, and Expert advice. In the first module edge of the leaf and token values found. The Second module deals with the training of the leaf to the neural network and finding the error graph. The third and fourth modules are to recognize the species of the leaf and identify the pest or disease incidence. The last module is aimed at matching the recognized pest or disease sample on to the database where in pest-disease image samples and correcting remedial measures for their management are stored.

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1. ## INTRODUCTION

India is an Agriculture based country. Wherein seventy percent of the population depends on Agriculture. When pests and diseases affect the crops, there will be a tremendous decrease in production. In most of the cases pests or diseases are seen on the leaves or stems of the plant. Therefore identification of plants , leaves, stems and finding out the pest or diseases, percentage of the pest or disease incidence , symptoms of the pest or disease attack, plays a key role in successful cultivation of crops.

In order to increase the crop productivity, farmers approach experts to seek their advice regarding the treatment of incidence of pest and diseases to their crops and suggestions for control. Some times they have to go long distances to contact experts. Even though they go such distances expert may not be available at that time. Some times, the expert whom a farmer contacts, may not be in a position to advise the farmer with the available information and knowledge. In these cases seeking the expert advise is very expensive and time consuming.

The proposed system "Leaves Recognition using Back Propagation Neural Networks" is aimed to develop a java program to recognize the images of leaves by using previously trained Neural Network. The outer frame (edge) of the leaf and a back propagation neural network is enough to give a reasonable statement about the species it belongs to. The system is user friendly. The user can scan the leaf and click the recognition button to get the solution.

2. **PROBLEM SPECIFICATION**

The proposed system "Leaves Recognition using Back Propagation Neural Networks—Advise for Pest and Disease Control on crops" is consisting of five modules. They are: Leaves Processing module, Network Training module, Leaf Recognition module, pest recognition module and Expert advice module. The first module 'Image processing' module is finding an edge of the given leaf and also finding the token values. The second module 'network training module' is training the entire network and drawing the error graph. The third module 'recognition module' is recognizing the given leaf at what percentage it matches to the already trained leaf. The fourth module 'Pest Recognition module' is finding out the pest percentage on the given leaf. The Last module is matching the pest details in the database and retrieving the stored information regarding the remedial measures for the concerned pest.

3.REQUIREMENT SPECIFICATION

Input and Output Requirements: The system needs a scanner or Digital camera to capture the input images. It also needs the symptoms of pest or disease attack.

The system needs to generate the following outputs.

- A frame displaying a graphical view of the tokens of the input leaf scanned and also to present information like name of the leaf and token count.
- A frame displaying the damaged area of the leaf and highlighting the damaged area of the leaf, displaying the information like percentage of matching to already trained leaves and also pest percentage.

Computational Requirement Specification:

- To study about Prewitt edge detection algorithm.
- Applying Thinning algorithm for reducing more than one pixel edge to one pixel edge.
- Study about feed forward back propagation neural networks.
- Implementing all techniques and recognizing leaves and finding the percentage of best fit with the existing leaf.
- Implementing all techniques and recognizing pest percentage.

4 TOOLS, TECHNIQUES AND METHODS USED

Image edge detection:

On of the main tasks of this application is the detection of specific tokens in a leaf image. These tokens will then be the basis of the neuronal network calculations. Assuming that the image is a full 2D scan of a single leaf

Prewitt edge detection produces an image where higher grey-level values indicate the presence of an edge between two objects. The Prewitt Edge Detection filter computes the root mean square of two 3x3 templates. It is one of the most popular 3x3 edge detection filters.

The Prewitt edge detection filter uses these two 3x3 templates to calculate the gradient

value:

```
      -1  0  1     1  1  1                +------------+
      -1  0  1     0  0  0                | a1  a2  a3 |
      -1  0  1    -1 -1 -1                | a4  a5  a6 |
          X           Y                   | a7  a8  a9 |
                                          +------------+
```

consider the following 3x3 image window:

where:

- § a1 .. a9 - are the grey levels of each pixel in the filter window
- § X = -1*a1 + 1*a3 - 1*a4 + 1*a6 - 1*a7 + 1*a9
- § Y = 1*a1 + 1*a2 + 1*a3 - 1*a7 - 1*a8 - 1*a9
- § Prewitt gradient = SQRT(X*X + Y*Y)

All pixels are filtered. In order to filter pixels located near the edge of an image, edge pixels values are replicated to give sufficient data

Thinning:

Thinning algorithm to minimize this threshold-based edge to a one-line frame where we then can apply a sort of token recognition.

The used thinning algorithm here processed the image recursively and minimizes the found lines to a one-pixel wide one by comparing the actual pixel situation with specific patterns and then minimizes it.

Back propagation Neural Network:

Another main part of this work is the integration of a feed-forward back propagation neuronal network. The inputs for this neuronal network are the individual tokens of a leaf image, and as a token normally consists of a cosines and sinus angle, the amount of input layers for this network are the amount of tokens multiplied by two. The image on the below should give you an idea of the neuronal network that takes place in the Leaves Recognition application.
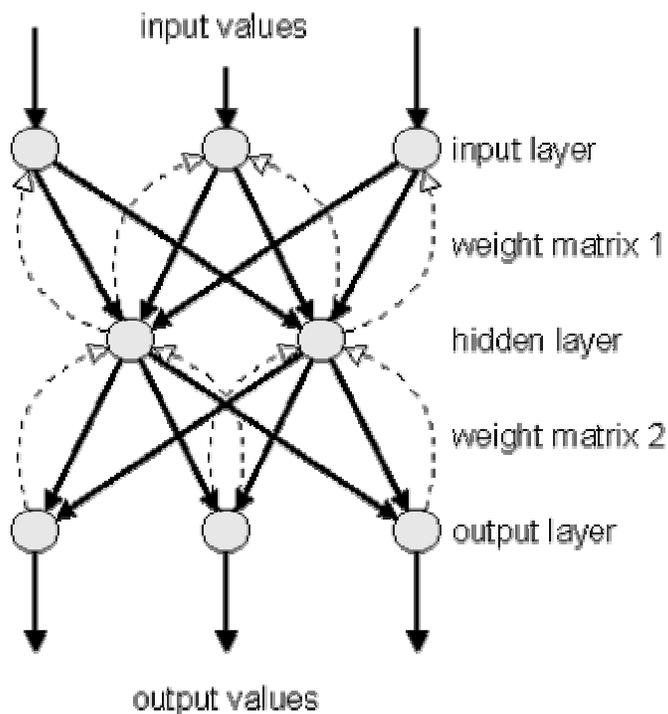
I have chosen a feed-forward back propagation network because it was part of the task to show that just a back propagation network and the shape of a leaf image is enough to specify the species of a leaf. The implemented networks also just have one input, hidden and output layer to simplify and speed-up the calculations on that java implementation. To fill the input neurons of the network, I used the calculated leaf tokens. The number of output neurons is normally specified by the amount of different species because we use a encoded form to specify the outputs. The normal mathematical principals of a back propagation network specify all other behavior of the network.

5. METHODOLOGY

Image processing ():

     This procedure takes the various leaves as input and finds the number of tokens using edge detection algorithm and thinning algorithm. Calculates the sine and cosine values for each token and stores as XML file, these values are used as input in the back propagation.

Leaf image token:

     The central part of this application is the tokens of each leaf image that are found after the image processing is through with it.

     The idea behind the transfer of the leaf image shapes into a neuronal network usable form is, that the cosines and a sinus angle of the shape represents the criteria of a recognition pattern.

     The image shows a part of a leaf image that was already processed through the Prewitt edge detection and thinning algorithms.
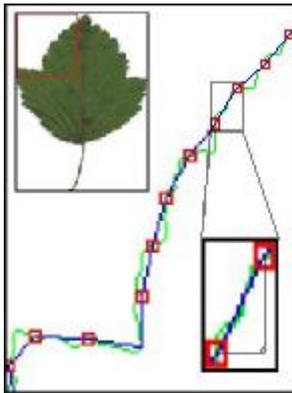

In order to understand the algorithm consider the figure and details shown below.

- Green line: The shape of the leaf image after successful edge detection & thinning.
- Red Square: This Square represents a point on the shape of the leaf image from which we are going to draw a line to the next square.

Blue line: The compound of the center of two squares from which we are going to calculate the cosines and sinus angle. Such a blue line is a representation of a leaf token.If you now take a deeper view on the small triangle zoom on this image you should recognize that it shows a right-angled triangle. This and the summary of all triangles of a leaf image are the representation of the tokens of a leaf from which we can start the neuronal network calculations.

Consider a small image of the right-angled triangle, which represents a token of a single leaf image. Here it should be clear now that the angles A and B are the two necessary parts which will be fit into the neuronal network layers.
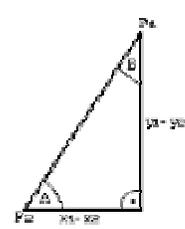
With these two angles we can exactly represent the direction of the hypotenuse from point P1 to P2 which is absolutely necessary for the representation of a leaf image.

Training ()

This trains the full training set by calling the back propagation algorithm., EPOCH number of times. Initially it assigns array wt1 and wt2 with random weights and initializes inp(0) and out(0) to 1.After opening appropriate file it calls procedure on this file. This is continued for EPOCH number of times. These final adjusted weights are stored in the output file for use during recognition phase.

Recognition ():

This reads the input leaf to be recognized by calling image processing unit. For each value of matrix (I, J) the corresponding weights are read from that file.

With the help of weights out1 and out2 are calculated.

Back propagation ():

This procedure is used to train the training set.

This takes the training patterns from the data input, calculates the corresponding node output values. It measures the error between actual value and desired value, and then used those values for adjusting the weights. So that the network is trained.

6.RESULTS AND DISCUSSIONS
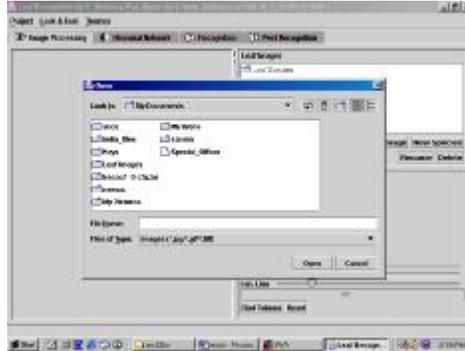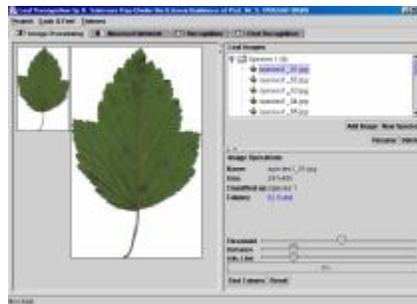
Image Processing Module
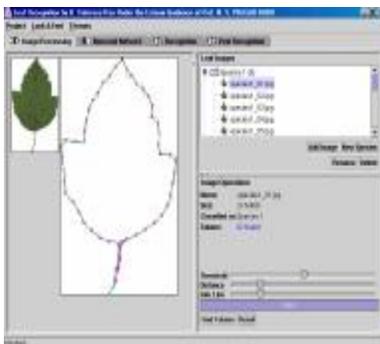
Screen to select Leaf
Images
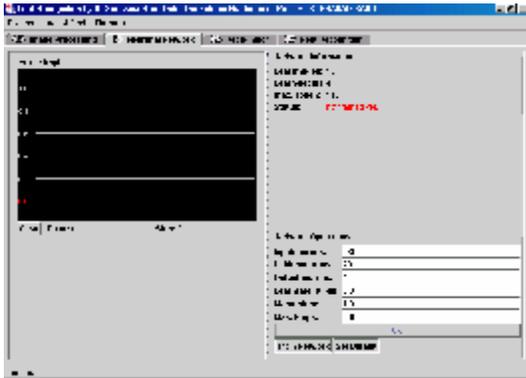

Image Processing
Module

Screen to display the selected leaf1.
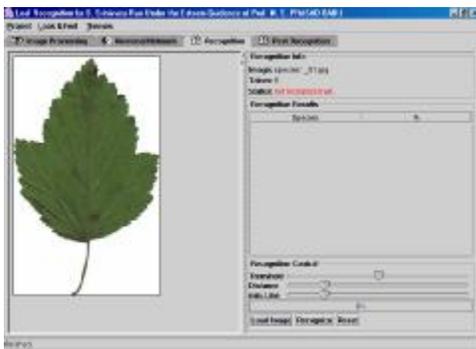
Image Processing Module

Screen to display the edge and tokens of the selected Leaf1
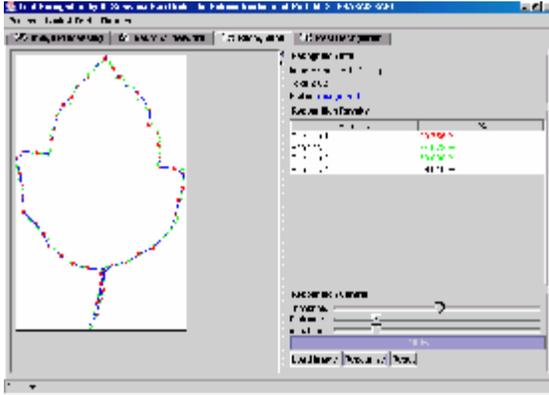
Network Training Module

Starting Screen of Network Training Module.
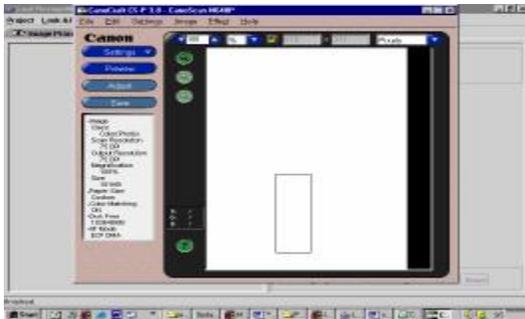
Leaf Recognition Module

Screen to display the Leaf Image1.

Leaf Recognition Module

Screen to display the results of the Recognition module.

Pest Recognition Module

Screen to display the Scanner.
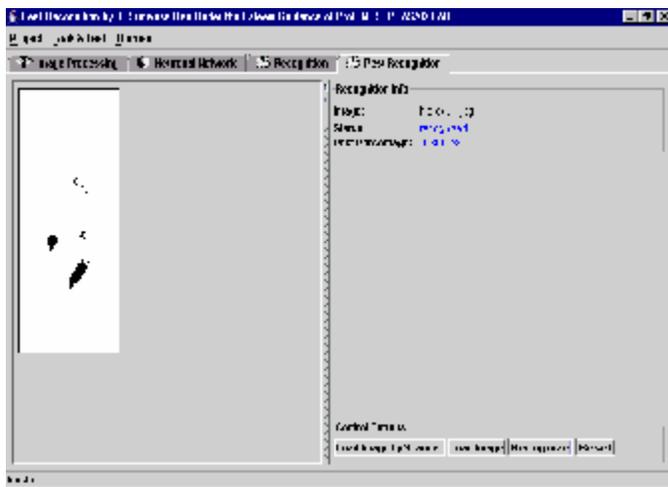
Pest Recognition Module

Screen to display the scanning leaf.

Pest Recognition Module

Screen to display the leaf image for finding pest recognition.

Pest Recognition Module

Screen to display the Pest Percentage of the given leaf and also the damage part.

7. CONCLUSION AND FUTURE SCOPE

A Back propagation neural network for recognition of leaves is implemented in this project. The training set contains minimum five spices for each type of leaf in each data file. Using more number of species in training set and no: of output nodes can enhance the recognition ability. Using quick training algorithms with out losing recognition performance can enhance the scope of this paper.

Further enhancement of this work involves more experimentation's with large training sets to recognize various leaves with pest or damaged leaves due to insects or diseases and develop an expert system. The pest images and insect images are to be collected in large number and are to be send to experts in agricultural research stations to estimate the effect of the pests and diseases on the crops and to propose the remedial measures for it. The present system is developed using java swings. Using the concepts of the Java Beans are may be modified to add network features to the system.

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