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SOIL AND LEAF RECOGNITION USING BTAL ALGORITHM

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ABSTRACT:

Agriculture is the backbone of human sustenance on this world. Now a days with growing population we need the productivity of the agriculture to be increased a lot to meet the demands.The main purpose of this application is to recognize soil and leaf images using proposed BTAL (Back propagation, Thinning and LPP) algorithm. The soil image is recognized by comparing the actual pixel situation with specific patterns using LPP algorithm. After recognizing, the specifications (like name, description etc.,) of that soil image are displayed. If we are taking for 30 soils for the training set. In Leaf recognition, to show that the outer frame of a leaf and a Back propagation Network is enough to give a reasonable statement about the species it belongs to. Leaves Recognition is a neuronal network based java application/applet to recognize images of leaves using Back propagation Network. The intention is to give the user the ability to administrate a hierarchical list of images, where he can perform some sort of edge detection to identify the individual tokens of every image. The Thinning algorithm here is used to process 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. Efficacy of the proposed methods is studied by using two neural classifiers. These are neuro-fuzzy controller and a feed-forward back-propagation multi-layered perceptron to discriminate between 31 classes of leaves. The features have been applied individually as well as in combination to investigate how recognition accuracies can be improved.

Keywords: Image Processing, Edge detection, Neuronal network, thinning, LPP algorithm.

1. INTRODUCTION:

Plants and soil are plays a most important part in the cycle of nature .Soil is the mixture of minerals ,organic matters ,gases, liquids and countless organisms that together support life on human beings. It gives the most complex and dynamic natural systems.Soil Structure refers to the way of the soil aggregates, particles and pore space are arranged with respect to each other.Soil scientists use shape,size and strength to defined it .Platy,block,granular,subangular blocky are some terms associated with soil structure. Organic matters and clay minerals are the primary agents for binding soil particles together to form aggregates.Sandy,low organic matter soils often lack structure. They are the primary producers that sustain all other life forms including people. This is because plants are the only organisms that can convert light energy from the sun into food. Animals, incapable of making their own food, depend directly or indirectly on plants for their supply of food. Leaves of same species also have variation in there shapes and moreover leaves of different species may have a same size because of the complex nature of leaves. So we need some hierarchy in this process. A leaf from an unknown species of plant will be the input to the proposed system.

the current work proposes an innovative scheme of a plant recognition system based on digital images of plant leaves. In nature, plant leaves are two dimensional containing important features that can be useful for classification of various plant species, such as shapes, colours, textures and structures of their leaf, bark, flower, seedling and morph[1,4]. A leaf from an unknown species of plant will be the input to the proposed system. The system then segments the leaf image from its background, computes the morphological feature representation used for matching, and then displays the similarity percentage as computed[5]. The leaf image will be captured on a plain contrast background to reduce the complexity of the segmentation algorithm and give better performance.

The present paper proposes a scheme for automated recognition of three types of plant species by analyzing shape features from digital images of their leaves. It follows: Section 2 provides an overview of related work, Section 3 outlines the proposed approach with discussions on overview, feature computation and classification schemes,Section 4 provides details of the dataset and experimental results obtained and Section 5 provides the overall conclusion and the scope for future research.

2.RELATED WORK:

Soil image Recognisation based on digital image processing technique in Remote Sensing and Geographical Information System domain where digital photographs of the soil samples were used for soil pH determination[10]. Digital photographs were collected during sunlight while photographs of the soil sample were taken in dark room for the purity of digital value of the spectra. soil pH range varies from 6.80-7.04 and 5.58-6.58 in light yellowish and greenish colour respectively while their corresponding pH index values were 0.0071-0.0451 and 0.0084- 0.0239[11]. Thus soil pH range varies from 7.30-7.50, 6.80 -7.04 and 5.58-6.58 in deep brown colour, light yellowish colour and greenish colour respectively.

Leaf image recognisation development started in July 2001 based on a study project of Jens Langner at the University of Applied Sciences Dresden (HTW) and was completed in late August.To realize the above mentioned purpose and to make it possible to use this application on nearly every operating system, the choosen programming language for the implementation is Java. Beside the fact of writing a java based application to realize this purpose, one addtional feature is that it could also be used as a java applet to directly give the user the ability to start it via a java enabled internet browser. The main tasks of this application is used to detect the tokens using prewitt edge detection algorithm[2].A plant leaf identification,most of them used neuronal network algorithm.Image processing is most important preliminary phase and it taking image as a tokens.. This tokens will then be the basis of the neuronal network calculations to make it possible to recognize a unknown leaf image and specify the species it belongs to.This paper implements a leaf recognition algorithm using easy-to-extract features and high efficient recognition algorithm. Our main improvements are on feature extraction and the classifier. All features are extracted from digital leaf image.Except one feature, all features can be extracted automatically[7].

In the neuronal network is used for sigmoid function[12].Plant species identification requiresrecognizing the plant by various characteristics,such as size, form, leaf shape, flower color, odor, etc., and linking it with a common or so-called scientific name[8]. The classification algorithm implemented for accurate identification of the plants based on Leaf image. Different data modeling techniques used include curvature scale space , fuzzy logic , fractal dimensions[9], Fourier analysis ,wavelets [9], curvelets and Zernike moments . A

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variety of classifiers have also been used viz. neural networks [3], support vector machines , nearest neighbors [6], and K-means for identifying unknown leaves.

3. PROPOSED SYSTEM:

Our system is based on image processing which finds an unknown soil and leaf without any previous knowledge, which is useful for any layman. The basic factors for identification of species are, image edge detection , back propagation and Neural Network shown in Fig 1.It is used to retriveval of leaf images based on the shape of the leaf image given as input by the user.For example, If the input is a unknown soil and leaf ‘s image,then the output will be given that determine the which soil and leaf is present here.

In this approach we follows several steps,

1. user uploads an image of soil and leaf of his /her choice.
2.we find out the feature extraction using image preprocessing.
3. recognize the given soil and leaf image.
4.comparing the training data set with test data set.
5.Then determine the information about the particular image.

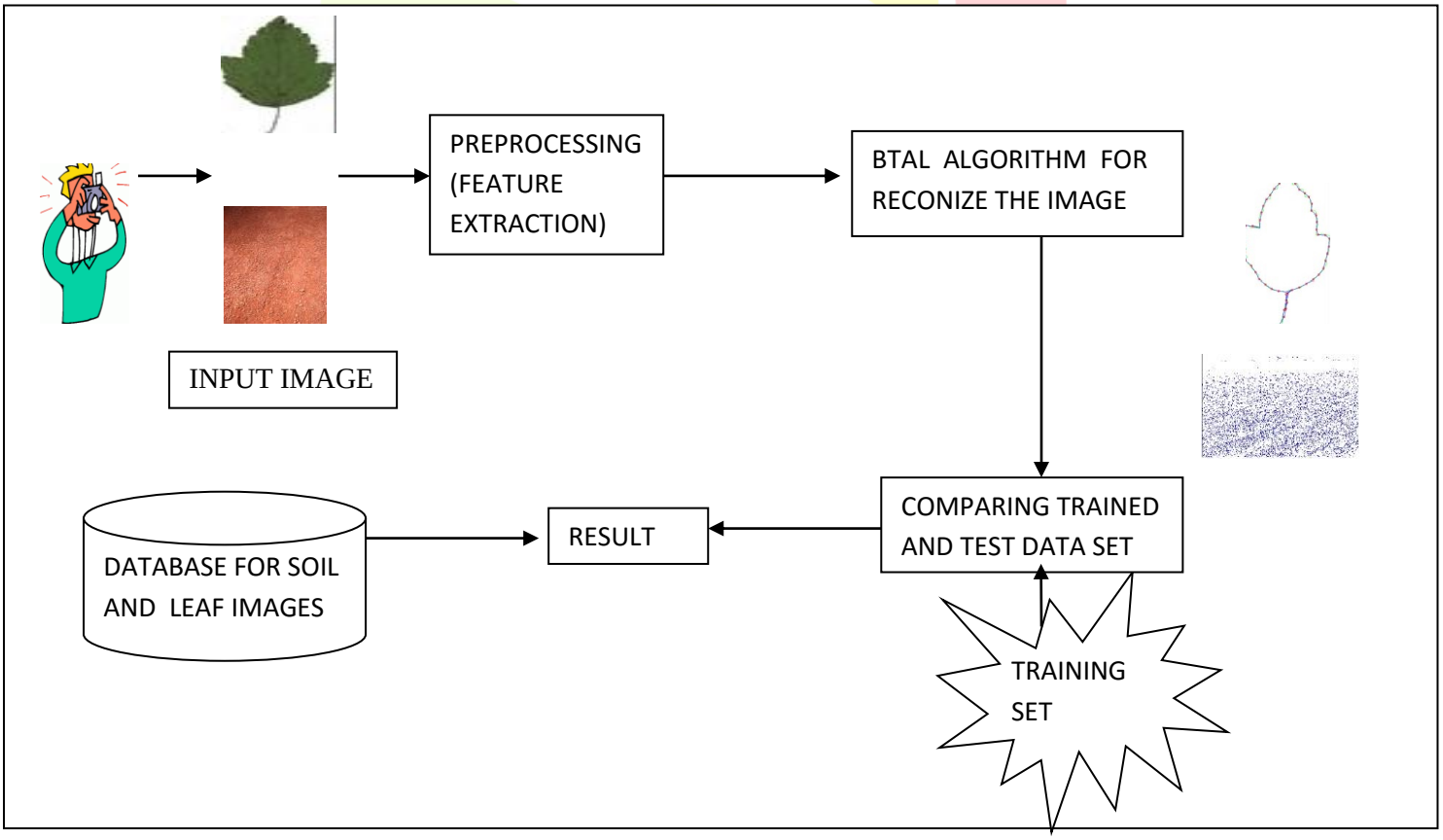

Fig 1.Architecture Diagram

STEP 1: Image Upload

User can upload any image of a soil and leaf in jpeg or png format of his or her choice.We have ready dataset for comparing with that unknown image.

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STEP 2: Image Preprocessing

Image processing is the enhancement of image i.e., processing an image so that the results are suitable for particular application. Processing image involves operations for making the background white for removing unwanted noise.One of the most important parts of the whole application is the image processing. Without finding any usefull tokens in the leaf images, the neuronal network calculation. So we spent lots of our efforts in the pixel comparison using Locality Preserving Projection(LPP) algorithm and edge detection using thinning algorithms.

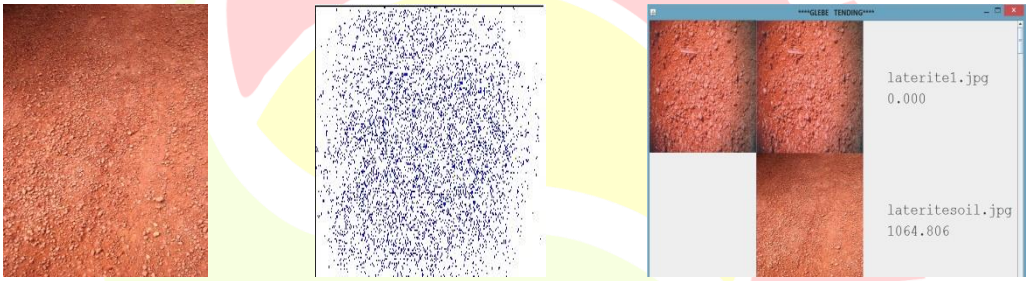

Fig 2 Soil image recognition

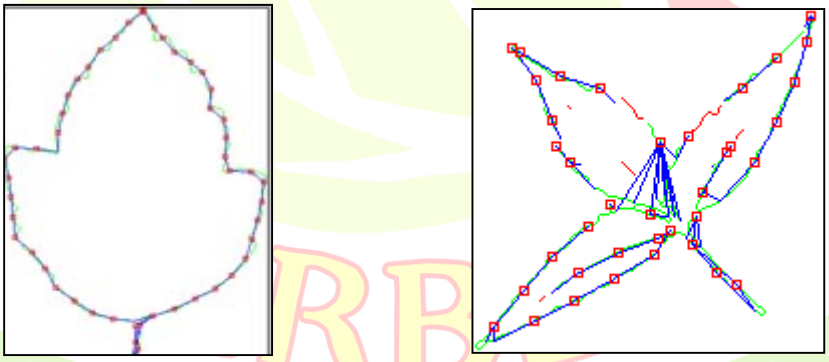

Fig 3 Image edge detection for leaf

In edge detection, the distance of the tokens (red square) and a minimum amount of pixels a line have to be to be recognized as a part of the shape. For a good quality result you should normally add at least 5 images of a species to give the neuronal network enough tokens to find the specific shape of this leaf species.

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STEP 3: Operation on images

Soil image :

The proposed system finds the specific pixels and color which represents that portion of the image**.** The new linear dimensionality reduction algorithm, called Locality Preserving Projections(LPP). This leads one to consider methods of dimensionality reduction that allow one to represent the data in a lower dimensional space(Fig2).

In general

Given a set **x**1; **x**2; _ _ _ ; **x**m in Rn, find a transformation matrix A that maps these m points to a set of points **y**1; **y**2; _ _ _ ; **y**m in Rl (l _ n), such that **y**i ”represents” **x**i, where **y**i = AT **x**i. Our method is of particular applicability in the special case where **x**1, **x**2; _ _ _ ; **x**m 2 M andMis a nonlinear manifold embedded in Rn.

1. **Constructing the adjacency graph**:
   neighborhoods. [parameter _ 2 R] Nodes i and j are connected by an edge if k**x**i □ **x**jk2 < _ where the norm is the usual Euclidean norm in Rn.
   k nearest neighbor [parameter k 2 N] Nodes i and j are connected by an edge if i is among k nearest neighbors of j or j is among k nearest neighbors of i.
2. **Choosing the weights**
   Wij = 1 if and only if vertices i and j are connected by an edge.
3. **Eigenmaps**:
   XLXT **a** = _XDXT **a** (1)
   where D is a diagonal matrix whose entries are column (or row, since W is symmetric) sums of W, Dii = _jWji. L = D □W is the Laplacian matrix.
   xi ! **y**i = AT **x**i;A = (**a**0; **a**1; _ _ _ ; **a**l□1)
   where **y**i is a l-dimensional vector, and A is a n _ l matrix.

Leaf image:

The proposed system finds the specific tokens which represents that portion of the image where transfer of lower to higher pixel intensity occurs. These tokens are used for neural network calculations. Edges are recognized by abrupt intensity variations in an image. The first gradient is typically calculated to locate the edges. The 3 * 3 masks are used to extract the edges from image and convolved them through it. Prewitt edge detection technique is selected due to efficiency and simplicity in single template.

Prewitt edge detection produces an image (Fig3) 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
-1 0 1	-1 -1 -1
X	Y

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Now consider the following 3x3 image window:

```
+------------+
| a1  a2  a3 |
| a4  a5  a6 |
| a7  a8  a9 |
+------------+
```

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.The idea behind the transfer of the leaf image shape into a neuronal network usable form is, that the cosinus and sinus angles of the shape represents the criterias of a recognition pattern.

The right hand image shows a part of a leaf image that was already processed through the above mentioned edge detection and thinning algorithms.

To give you an idea of what you see in this image,

- Green line: The shape of the leaf image after a successfull 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.

Mainly this configuration are the properties of the neuronal network. It based on the amount of images and network properties you normally need to specify around 500-1000 training steps to get a good result in the recognition later. If the error rate drops below 0.01 you normally should encounter no problem in recognizing different leaf images.

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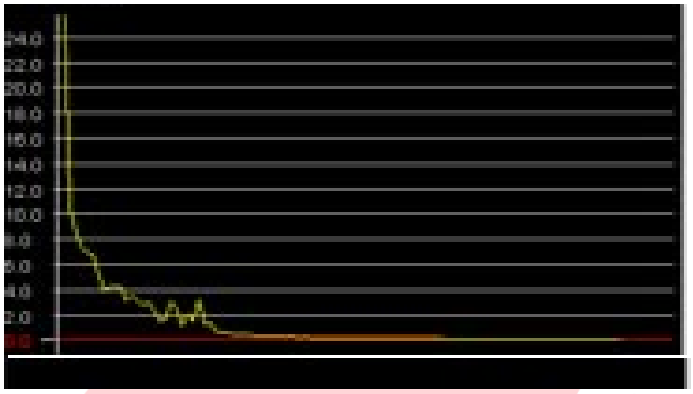

Fig 4 Detection graph

STEP 4: Locality Preserving Projection algorithm

Suppose we have a collection of data points of n-dimensional real vectors drawn from an unknown probability distribution. In increasingly many cases of interest in machine learning and data mining, one is confronted with the situation where n is very large. However, there might be reason to suspect that the "intrinsic dimensionality" of the data is much lower. This leads one to consider methods of dimensionality reduction that allow one to represent the data in a lower dimensional space.It builds a graph incorporating neighborhood information of the data set. Using the notion of the Laplacian of the graph, we then compute a transformation matrix which maps the data points to a subspace. This linear transformation optimally preserves local neighborhood information in a certain sense. The locality preserving quality of LPP is likely to be of particular use in information retrieval applications. If one wishes to retrieve audio, video, text documents under a vector space model, then one will ultimately need to do a nearest neighbor search in the low dimensional space. Since LPP is designed for preserving local structure. LPP is linear. This makes it fast and suitable for practical application.

STEP 5: Neuronal network

Another main part of this work is the integration of a feed-forward backpropagation neuronal network. As described earlier the inputs for this neuronal network are the individual tokens of a leaf image, and as a token normally consists of a cosinus and sinus angle, the amount of input layers for this network are the amount of tokens multiplied by two. The number of output neurons is normally specified by the amount of different species because we use a encoded form to specify the outputs.All other behaviour of the network is specified by the normal mathematical principals of a backpropagation network. This neuronal network adopts with three tier network structure including the input layer,hidden layer,output layer.

In our system we are using neural network with one hidden layer. Each hidden layer is associated with the sigmoid function. In other words neurons in a same layer have same activation function. Sigmoid function is an exponential function which is used for calculation and transfer of knowledge from input neurons to output neurons. The graph for sigmoid function can be shown as in Fig 5.

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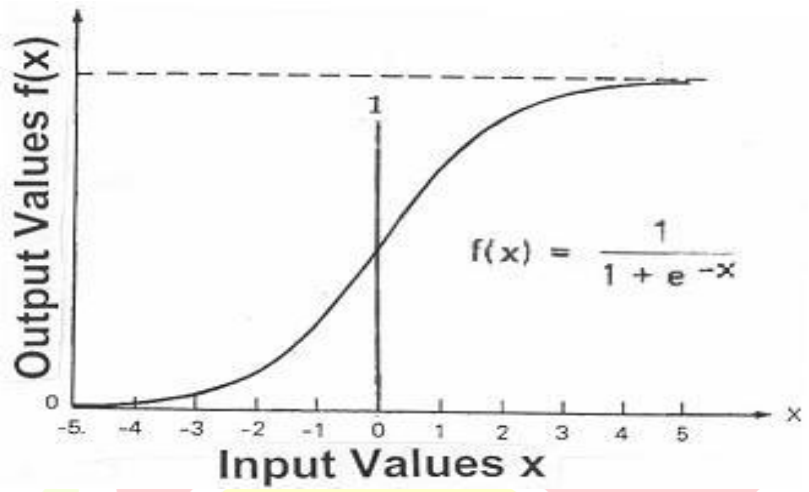

Fig 5 Sigmoid function

Sigmoid Function: f (x) = 1/(1+e^-x)

Sigmoid Derivative: f'(x) = f (x) * [1 - f (x)]

STEP 6: Thinning

To identifying a specific leaf image`s species here is that the outer frame of a leaf is enough to specify the species it belongs to. To accomplish that, it is necessary to identify this outer frame exactly. The previously applied Prewitt Edge detection normally just identify the edges with a preconfigured threshold and after this edge detection we have to perform a thinning algorithm to minimize this threshold-based edge to a one-line frame .

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

4.EXPERIMENTAL RESULT:

We have used the dataset for various soils like alluvial,laterite,red,desert,black,mountain soils and sand etc . Here, Firstly we add new soil image and find the color and pixels for each soil image after that we proceed by training set using LPP algorithm. In recognition panel we add the unknown leaf to be recognized.

After recognise the soil image, The system display the information about the particular recognised image and then shows information about the crop growth in that soil(Fig 6).

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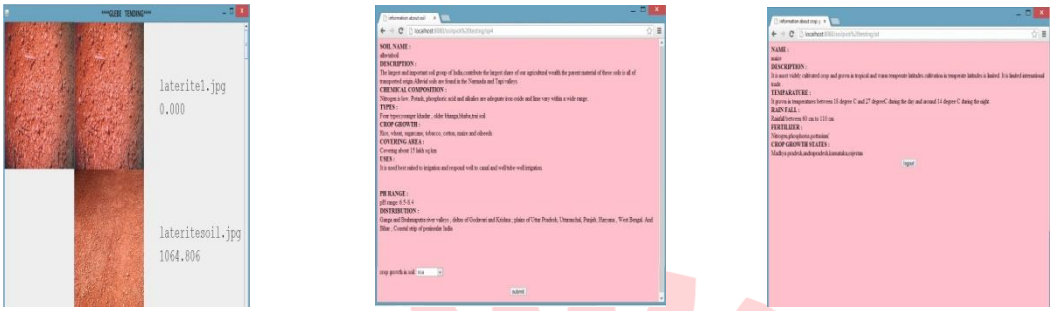

Fig 6 Results for soil images

We have used the dataset for various leaf species like Azadirachta indica(neem), Pinus(pine tree), Quercus(oak),etc . Here, Firstly we add new species then add images of the same species under it and find the tokens for each leaf image after that we proceed by training these tokens using neural network later in recognition panel we add the unknown leaf to be recognized.

In order to optimize obtained results, we used to combine these features, where we get more efficiency in classification; the following table and figure prove this idea.

Algorithms	Accuracy	Precision	Recall	Fmeasure
naive bays	85.21	85.45	83.87	81.67
decision tree	68.88	56.09	87.45	45.78
prewitt edge detection	88.34	78.9	79.23	82.32
back propagation /thinning	90.45	92.78	91.1	92.45

Table 1 Results obtained by classification of edge detection algorithm

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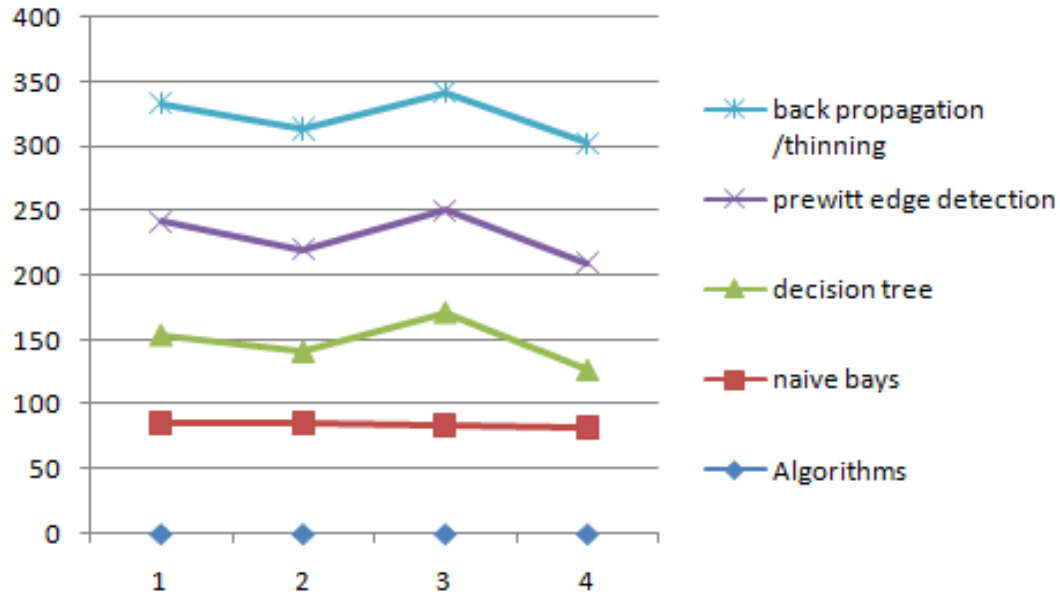

Fig 7 Results obtained by classification of edge detection algorithm

We compared the accuracy of our algorithm with other general purpose (not only applicable to certain species) classification algorithms that only use leaf-shape information.According to Table 1, the accuracy of our algorithm is very similar to other schemes. Considering our advantage respect to other automated/semi-automated general purpose schemes,easy-to-implement framework and fast speed of BTAL algorithm, the performance is very good.

Fig 8 results for leaf image

5. CONCLUSION:

Plants and Soil play an important role in our lives, without soil there will not be any nature, without plants there will not be the existence of the ecology of the earth.we will detect the NPK value of the soil and say how much percentage of npk needed for the soil. The large amount of leaf types now makes the human being in a front of some problems in the specification of the use of plants, the first need to know the use of a plant is the identification

of the plant leaf.The above analysis and graph, and we display various details of unknown species in a specified area. For future scope diseases occurring in the unknown species and solution to overcome the diseases will provided. Back Propagation and Thinning algorithm must be done which gives output in terms of very high accuracy using minimal computational resources.

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