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# Plant classification based on leaf Shape features using Neural Network

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**ABSTRACT**

*Plant classification becomes very much demanding research area for the use of taxonomist and botanist as well as in agricultural requirement. Using computerized techniques for performing these task is more effective. This research paper presents the classification of plants by using Feed forward Back Propagation Neural Network designed.This method performed in three steps first is leaf image processing to find the leaf shape patterns, leaf shape features extraction that follows classification. Leaf images of 220 different plant species are processed to find the leaf shape patterns. Leaf shape features are computed automatically from the leaf shape patterns of the leaf image samples. Neural network designed based on the leaf shape features for plant classification. This paper is organized in the sections, Introduction,Methods, Methodology and Conclusion*

***Keywords—Leaf Image Processing,Leaf Shape,Plant Classification, Feed Forward Neural Network.***

## I . INTRODUCTION

Plants are very important part of our ecosystem. It maintains the balance of environment. The imbalance in environment is because of deforesting. Due to this imbalance we face the problem of natural disaster like draught. Plants are important source of development of human being and living of them. Plants are useful for various industries. They are useful in production of medicines they are also useful as foodstuff. Plant classification is process by which we can group together the plant species based on some physiological characteristics which are common by some criterion [4]. For plant classification trained taxonomist and botanist follows various tasks. They follow many methods such as morphological anatomy, cell biology and molecular biological approach [10]. These methods are required to follow many critical tasks. Performing these tasks is time consuming process and it requires more efforts. These processes are less efficient as it is difficult to remember one all the species in the world[3]. There are many features which classify the plant species with physiological characteristics leaf component of almost all species can be used for classifying the plant species as they are more readily available.

This paper presents the performance of the neural network for classification of the plant species. Plant classification process is presented here based on the leaf shape features which are automatically extracted from the leaf image samples. This method is not required efforts to perform the critical task for classification.

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**IIMETHODS**

## 2.1 Leaf image processing

The leaf image processing is required to eliminate the unwanted part from the leaf image that reduces the leaf features for studying the leaf shape which may make the classification complex and affect the efficiency of the classification model. In leaf image processing techniques the image segmentation task performs major role for finding the leaf shape. This image segmentation method find the leaf shape starts with examining the local discontinuity at each pixel level element in an image. This process examines the location of part of the feature that is of interest, it also examine the boundary pixel to define it as a part of leaf shape. Boundary pixels has the property of having gradual change in intensity operators required supposed to determine such gradual change for determining the boundary pixel.Canny method by double thresholding perform the task of leaf image segmentation to extract leaf shape[4].

## 2.2 Classification

In classification method the Feed Forward Back propagation Neural network model is designed with the function Levenberg-Marquardt backpropagation. Thismodel performs sigmoidal function in the hidden layer. The Jacobian matrix is computed by using first derivative of error with respect to weight and bias of the input. This is used for finding the gradient for approximation.For overall performance of the network, mu is adjustedto minimize error and used with the approximation. Performance of the classification model is evaluated based on mean squared error.

Training stops when either the maximum number of epochsis reached or performance is minimized to the goal or the performance gradient falls below minimum gradient or mu exceeds the maximum value.

**III METHODOLOGY**

This set of experiment is performed on the leaf images from the ICL database [5] This database contain the leaf shape images of 220 different species. For finding the leaf shape patterns the steps are followed as given in Fig.1.

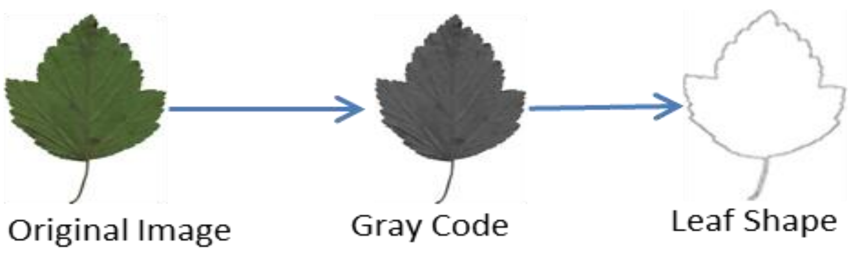


**Fig.1: Leaf image processing**

## 3.1. Leaf image pre-processing

The leaf image sample is transformed into gray code level format.For shape feature extraction, leaf image processed to remove unwanted features from the image sample. Every leaf image is processed to get the uniform

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format for processing further. Original true colored leaf image is processed pixel by pixel to map in gray level format by combining weighted red, green and blue color code of every pixel as given in equation (1).

$$0.2989 * R + 0.5870 * G + 0.1140 * B \quad (1)$$

### 3.2.Leaf image segmentation

This step preprocesses all the leaf images to uniform gray level code. Preprocessed images then segmented to extract the leaf shape patterns.Canny method is applied for segmenting leaf image for shape extraction.In this experiment the grey level code component of threshold of leaf image is used as the high threshold and 0.4 multiple of this high threshold value is used as low threshold. Thus we found the leaf shape of the all the leaf image samples for various species in the dataset. Fig.1 shows the result of the leaf image segmentation i.e. leaf shape for the sample image.

### 3.3.Extracting the shape Features

After finding the leaf shape from the leaf images, the leaf features are extracted. These eighteen features includes geometrical features of the leaf shape these shape features are variant to the leaf images.

**Table1: Shape Features**

| Sr.No Features | Description |
|---|---|
| Area | It is the total number of pixels in the leaf image that is area of leaf |
| Eccentry | This the ratio between DistBetFoci and MajorLength |
| Perimeter | Distance around the boundary of the region of leaf shape |
| MajorLength | Length of minor axis of the elliptical shape of leaf |
| MinorLength | Length of major axis of the elliptical shape of leaf |
| ConvexArea | Number of pixels in the convex image of leaf |
| Solidity | This is the proportion of the pixels in the convex hull i.e the ratio of Area of leaf and its ConvexArea |
| DistBetFoci | The ratio between Eccentricity and MajorLength |
| Orientation | Angle between MajorLength and X-axis for leaf image |
| Circularity | It is the ratio between the Area and square of Perimeter that determines the circular shape of leaf |
| Eqdiam | Regional Diameter of leaf calculated as Sqrt(4*Area/ $\pi$) |
| Elongation | Ratio of Length of the leaf to the width |
| AspectRatio | It is the ratio from width to length of leaf |
| Rectangularity | This is computed by finding multiplication of MajorLength and MinorLength/Area |
| Narrowness | Ratio of regional diamenter of leaf to its MajorLength |
| Roundness | Determine the rounding shape |

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| | |
|---|---|
| Cx | Centroid x-axis |
| Cy | Centroid y-axis |

### 3.4. Performing Classification

With eighteen features classification of the 220 plants are performed. This uses artificial neural network classification method. Feed forward neural network classification model is designed to perform the plant classification based on leaf shape 18 features with classical architecture of 70-30% of the data set input. About 70 % of the dataset is used for training the neural network and 30 % of dataset is used for testing the classification model.

**Table 2: Classification Result**

| Dataset | Correct Classification | Incorrect Classification |
|---|---|---|
| ICL | 93.82% | 6.18% |

To study the performance of the model first it is designed with the one hidden layer and five species row vector. This model takes input, as leaf shape features of samples of five species of the plants at iteration. This way total 220 species of the plants are classified by the model. This neural network model has given the average of 93.82% accuracy for classification all 220 plant species. 6.18% species are incorrectly classified.

**Table 3: Classification Accuracy**

| Methods | Accuracy |
|---|---|
| MLNN [11] | 94% |
| 1-NN [6] | 93% |
| BPNN [8] | 92% |
| k-NN (k=4) | 92% |
| RBPNN[6] | 91% |
| PNN[9] | 90% |
| k-NN (k=5) [6] | 86% |
| Proposed Method | 93.82% |

## IV. CONCLUSION

This experiment is performed for plant classification of leaf image samples of 220 different species. These species are classified by using the artificial neural network classifier this method has designed a feed forward neural network with back propagating the result to the input of the neural network. With this model, for plant species data input resultant accuracy is average of 93.82 %

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