Plants Identification by Leaf Shape Recognition: A Review

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Abstract: *Plants are essentials for life on Earth. Different species of plants can be distinguished with the help of leaf shapes, petals barks, and fruits. A digital recognition of plant species is a now a days in demand for various purposes. Generally flower and fruits are at specific times and leaves are throughout the year hence for leaf shape recognition.*

Keywords— *Plants, flower, leaf shape, digital image processing, Principal component, neural network, Gabor filters, wavelet transform.*

I. INTRODUCTION

Plants are essentials for life on Earth [1].Plant recognition is most useful in agriculture, forestry, and medicine. Due to rapid deforestation it is very urgent to set up digital databases of plants. Some of digital image processing techniques are used for this task. This paper reviews work that has been utilized digital image processing techniques to automate identification/recognition of plant species by their leaf shapes. Different steps involving for leaf classification[2]:

- Image acquisition.
- Image pre processing (noise removal, resize)
- Feature extractions
- Use of different types of classifiers
- Identification/recognition

This paper represents survey of different plant species identification techniques. Section II is about Materials and Methods, In section III Discussion is regarding problems and instructions, section IV concludes.

II. MATERIALS AND METHODS

Leaf shape has most discriminative power leaf shape analysis technique can be carried out in the frequency domain as well as spatial domain [1].Elliptic Fourier Descriptors used by[3],and a set number of Fourier harmonics are calculated with Fourier coefficients. This technique is useful for shape reconstruction from its descriptor. Ten Fourier harmonics are necessary followed by Principal Component Analysis (PCA) for dimensionality reduction; suggested by [4].Du et al. [5] utilized Radial Basis Function Neural Network (RBFNN) Fourier analysis methods to recognize plants from their leaf images. Andrade et al [6] uses EFD technique to analyse leaf shape. By using EFD Furuta et al [7] and [8] identified leaf shapes of plant species.

The papers [9] and [10] described the method of EFD for leaf shape analysis. Aimen et al [11] proposed morphological features, Fourier Descriptors and newly developed shape defining features. These features given to ANN as input vector. Data set utilized are FLAVIA and ICL, accuracy reported for both the dataset is 96%. Zalikha Zulkifli et al [12] proposed Generalised Regression Neural Network for classification. They also compared Zernike Moment Invariant (ZMI), Legendre Moment Invariant (LMI) and Tchebichef Moment Invariant (TMI) characteristics features from leaf images. Zernike Moment Invariant (ZMI) are better when combined with other classifiers as shown by Abdul[13]. ZMI combined with Gray Level Co- occurrence Matrices, geometric features, color moments accuracy obtained is 94.96%. Caner Uluturk et al [14] developed method based on half leaf features. FLAVIA dataset was used. With the help of PNN, recognition accuracy reported is 92.5%.

In the paper [15] GLCM and PCA techniques were utilized on 390 leaves to classify 13 types of plants. Results for GLCM was 78% accuracy and for PCA was 98%. Computation time for GLCM is less than PCA. Stephen Gang Wu [16] experimented on FLAVIA dataset by comparing three classifiers. i) SVM-BDT reports accuracy of 96% ii)PNN 91% iii) Fourier Moment 62%.PCA technique was performed by A kadir et al[17] on two datasets e.g. FLAVIA and FOLIAGE dataset by showing improvement in recognition accuracy. Zheru chi et al[18] proposed a novel method of Gabor filter bank classifiers. In the pre-processing phase Gabor filters are employed by Yusof et al[19] with GLCM to extract features, a multilayer neural network is used for classification. Sandeep et al[20] extracted leaf color, edge and area as features for identification of Indian Medicinal plants.L2 norm was utilized for classification and obtained promising results for plant classification except Tulsi menthe species and mint ocium.

Thai Herb Leaf image recognition system developed by Chomtip Supolgaj[21] using K-NN classifier. Dataset was divided into training and testing with value of k =6 in the K-NN classifier and classification accuracy was 93.29% Xiao-Feng Wang et al[22] proposed a digital morphological features based system. The 20species of plant leaves are classifieds by using fifteen features with promising results.Gaussian interpolation and Wavelet Transformation (WT) was proposed with k-NN and Radial Basis Probabilistic Neural Network (RBPNN) for leaf recognition by Xiao [23], accuracy found was 95%.Multiresolution and multidirectional Curvelet transform is applied on leaf images to obtain leaf information. Obtained coefficients are given as input to trained SVM classifier the results. This technique was used by Prasad et

al[24] and hence found improvement in accuracy. Meade and Parenell [25] experimented to increase accuracy by applying Centroid-Contour-Distance (CCD) to leaf images. In their research paper Lee and Chen [26] proved that compactness and aspect ratio are more useful than outline contour features. They used nearest neighbour classifier.

Table 1:- Summary of some techniques for leaf recognition/identification

Authors	Techniques	Datasets	Recognition accuracy%
Aimen Aakif et al	Morphological features, Fourier Descriptor	FLAVIA and ICL	96% for both dataset
Abdul	ZMI combined with GLCM	-----	94.96
Caner Uluturk et al	Half leaf features	FLAVIA	92.5
A. Ehsanirad et al	GLCM and PCA	----	GLCM-78,PCA-98
Stephen Gang Wu	SVN-BDT,PNN Fourier Moment	FLAVIA	SVN-BDT-96 PNN-91 Fourier Moment-62
Chomtip supolgaj	k-NN	----	93.29
Xiao	k-NN and RBPNN	----	95

III. PROBLEMS AND INSTRUCTIONS

There are several varieties of plants and different types of leaves such as simple leaves compound leaves, Broad leaves and narrower leaves, leaves may be lobed or not lobed. In order to overcome these difficulties number of Digital Image Processing Techniques should be applied individually or in combined manner. Similarly plants physical features like texture weight, color and hardness should be taken into account for better recognition. It is necessary to develop plant species recognition system for particular species.

IV. CONCLUSION

In this survey paper different digital image processing methods for recognition of leaves are studied and explained. Digital images of leaves provided by world's Herberia can be used by researchers to develop new algorithms for recognition of plant species by leaf shape, employing image processing techniques. Mobile Apps can be developed by using these techniques.

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