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An Efficient Identification Technique for Detecting Leaves

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***Abstract*—**A Leaf Detection System for plant classification based on the leaf vein and shape. we can decide leaf direction using leaf vein, and then use frequency domain data by using Probabilistic Neural Network(PNN) on distance between contour and centroid in the given leaf image. After the evaluation of PNN, the kind of leaf result will be displayed by checking the leaf from database.

***Keywords*—** *Probabilistic Neural Network (PNN); Principle Component Analysis (PCA); extract leaf feature; leaf contour; leaf extraction.*

I. INTRODUCTION

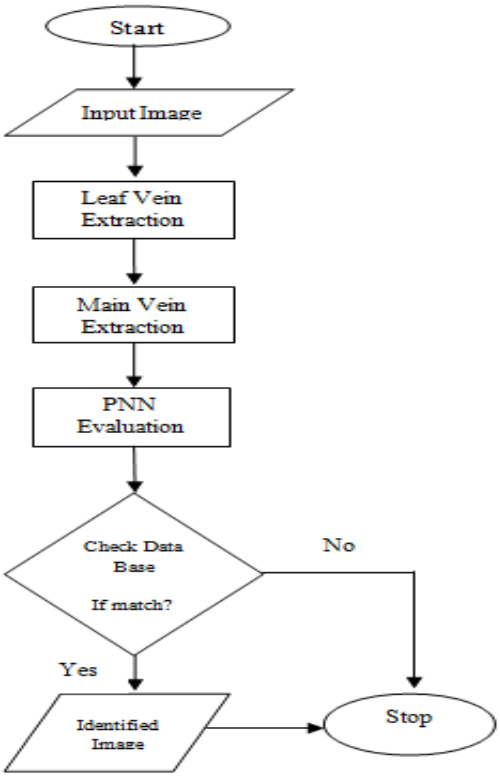
Plants exist everywhere we do not live, as well as we live. The significant information was carried by so many for the development of human society [8]. The emergency situation is that many plants are destructing by humans. So it is very important for plant safety to set up a database. When compared to other methods, like cell and molecule biology methods, classification depends on leaf image; it is the first choice for classification of leaf plant [7].

This paper focuses on leaf detection, which is used to classify different kinds of leaves. Sampling leaves and photonic them are low-cost and convenient. Now-a-days, everyone can easily transfer the GUI leaf image to a computer and by using image processing approach it automatically extracts features of a computer. This paper implements a leaf detection algorithm using easy-to-extract features and high efficient identification algorithm. Our main improvements are on feature extraction and the classifier. All features are extracted from digital leaf image. As to the classifier, we use Probabilistic Neural Network for its fastest speed and simple structure [1].

In the color-based conventional study [4] [8], a simple color coincidence between two images can be calculated by comparing their color histogram. Also in the shape based-conventional study, they have used contour-based simple features and region and features could be accepted as time domain data. However, the identification performance was finite due to leaf color was damaged by the seasons and when they are classify those leaves, there is a problem that user to directly specify both ends of the leaves.

We propose a leaf detection system for plant classification depends on the leaf vein and shape. One point to remember is that we can decide direction of a leaf using vein of a leaf, and then use frequency domain data by using Probabilistic Neural Network on distance between contour and centroid in the given leaf image [1].

A. Flow Chart



II. PROPOSED METHODOLOGY

In this paper , we propose and implement a leaf detection system using the leaf vein and shape that can be used for plant classification. The approach that was proposed by us is that it uses major main vein and the proposed approach uses major main vein and frequency domain (mathematical functions) data by using Probabilistic Neural Network methods by calculating the distance between contour and centroid on the detected leaf image. Total 21 leaf features were extracted for the leaf identification, which they include:

1. The distance feature between centroid and all points on the leaf contour.
2. Mathematical functions by PNN that was performed using the distances.

In summary, for 21 leaf features 10 features were extracted using distance, PNN magnitude, and phase, the other 10 features were extracted using the digital morphological features using four basic graphic features and five vein features, and by using convex hull last 1 feature was extracted. To verify the validity of the approach, so many leaf images apply to classify 32 kinds of plants. In the probationary results, the proposed leaf detection system showed an average identification rate of 97.19%, and we can confirm that the identification rate of the proposed leaf detection system shows better performance than the existed leaf detection method.

B. The Decision of Leaf direction using Main Vein:

Leaf vein extraction we convert the input GUI leaf image to a gray scale image and then implement opening operations. In alternative words, firstly erosion operations are performed and after dilation operations are performed on eroded image. We obtained variance image of gray scale image and variance image of performed opening operation. Then, we are obtained leaf vein image by convert the variance image to binary image. Figure shows an example of leaf vein extraction.

The opening operation is a process of applying erosion operation of a leaf image and applies dilation operation for an eroded image, and then the leaf image extracts its veins . By those veins we can decide direction of a leaf.

C. Leaf vein extraction:

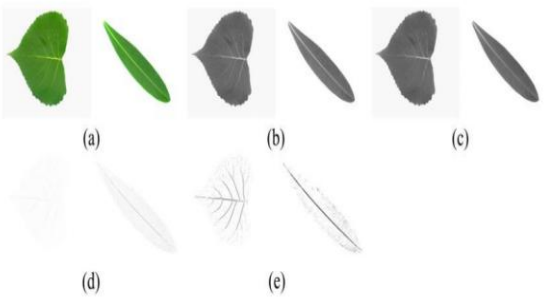


Figure 1: Sample figure of leaf vein extraction:

(a) Input image (b) processed gray scale image (c) accomplish opening operations (d) difference between image b and c, (e) leaf vein image.

D. Main vein extraction:

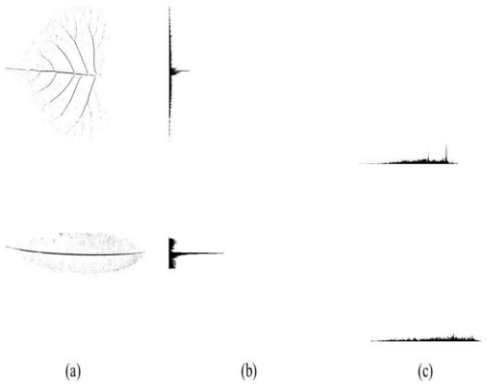


Figure 2: Sample figure of main vein extraction and decision of leaf direction: (a) leaf vein image (b) projections (points) in the horizontal direction (c) projection (points) in the vertical direction.

From the above figures we clearly know that when we have completed morphological operations on a leaf and it will shows its features by implementing vertical and horizontal projections .

E. Algorithm

Step-1: Take the GUI image of a leaf, Extract main vein of leaf using projections in the horizontal.

Step-2: After extracting the main vein, we decided the direction of the leaf through the projections in the vertical direction.

Step-3: The calculated distance is measured by the centroid of the region of leaf to all points on the leaf contour as follows:

$$D(i) = \sqrt{|Cx - P(i)x|^2 + |Cy - P(i)y|^2}$$

Where, D(i) is the distance between the centroid of the leaf region and the i^{th} leaf contour pixel. Cx, Cy are the coordinates of the centroid of the leaf region, and, P(i)x , P(i)y are the coordinates of i^{th} leaf contour pixel.

Step-4: Then, PNN is performed using calculated distance values.

Step-5: The distance is captured by measuring the longest distance point from the centroid in a clockwise direction.

Step-6: After the PNN evaluation it compares the database and gives the matching leaf.

By using horizontal projections we extract main vein of leaf. We conclude the main vein to the maximum point of the histogram, at the same time of leaf vein image rotated 180 degrees. After extracting the main vein, we determined the direction of the leaf through the projections in the vertical direction. The distance is estimated by measuring the centroid of the leaf.

PNN is performed by using calculated distance values. The distance is obtained by calculating the longest distance point from the centroid in a clockwise direction. 10 features were extracted based on the distance, PNN magnitude, and phase.

The 10 features are as follows: distance for average, distance for standard deviation, Zero Crossing Rate (ZCR) of the distance from the average distance, PNN magnitude for average, PNN magnitude for standard deviation, number of peaks higher than the average of the PNN magnitude, the priority of the top ten peaks of the PNN magnitude, PNN phase for average, PNN phase for standard deviation, and ZCR of the PNN phase from the average of the PNN phase.

By this evaluation we get PNN value of a leaf and after that we use that value to check the similar features of a leaf from the data base what we have defined. If the given leaf is similar with any leaf from the data base then we get the result as what kind leaf it is.

III. RESULT

A. Display images of leaves:

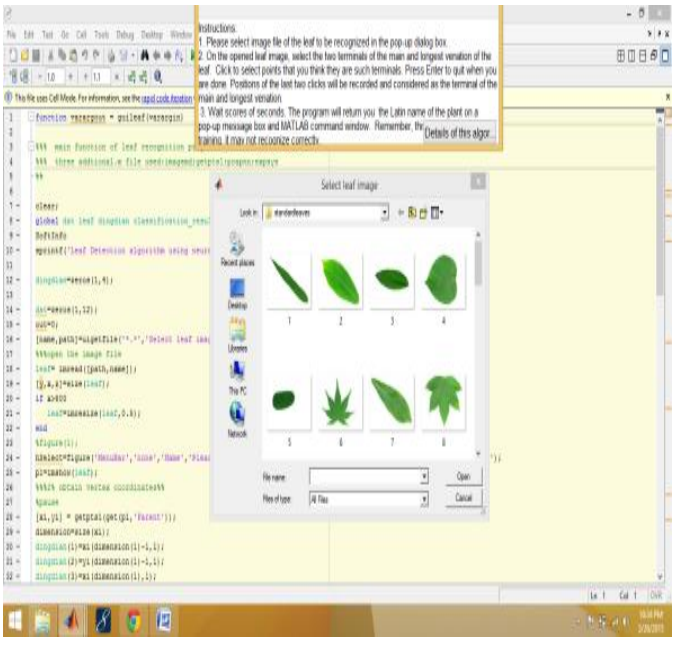


Figure 3: Data Base of Leaves

B. Give an image:

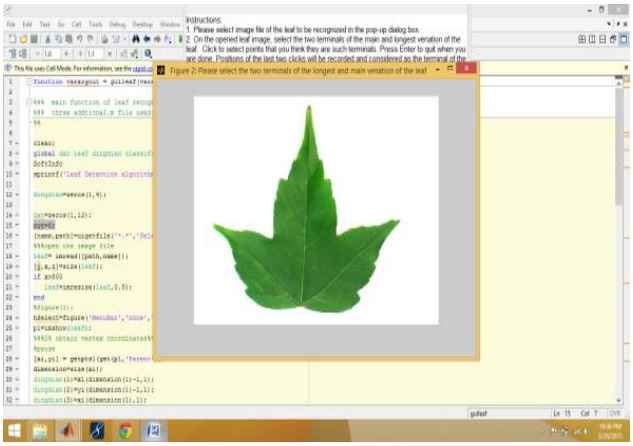


Figure 4: Sample Input Leaf

C. Output:

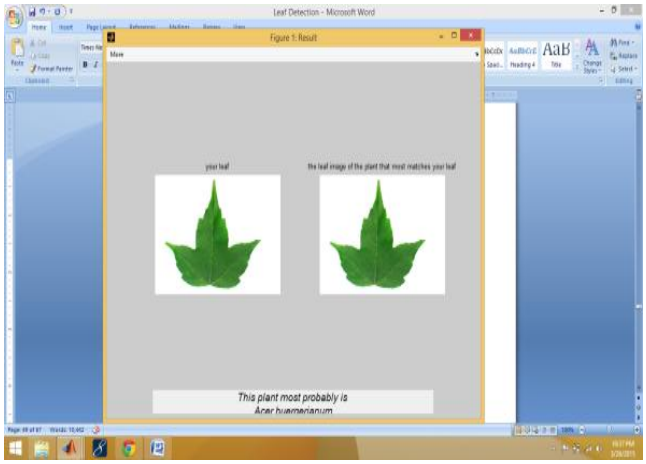


Figure 5: Matches and Identified Leaf

CONCLUSION

This paper introduces a Leaf Detection System using Probabilistic Neural Network. From the digital cameras or scanners the computer can automatically classify many kinds of leaves by leaf images. PNN is used for fast execution and simple structure. To form the input vector of PNN, features are extracted and processed by Principle Component Analysis. Experimental result indicates that our algorithm is workable with accuracy greater than 88% on 32 kinds of plants. When compared to other methods, this algorithm is fast in execution, efficient in recognition and easy in implementation.

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