A Survey On Recognition Of Plant Leaves Using Various Classifiers And Various Morphological Features

Ms. Divya T1, Asha C Korwar2, Prof. Virupakshappa3
1, 2 Student, Computer Science, 3 Assistant Professor,
Department of Computer Science, AIEET Kalaburagi, Karnataka
asha.korwar@gmail.com, t.divya.shiva@gmail.com, virupakshi.108@gmail.com

ABSTRACT

In this paper we present survey on several different techniques which can be used for plant leaves classification. Based on various morphological features plant leaf samples can be classified. Several major kinds of classification methods include decision tree induction, k-nearest neighbor classifier, artificial neural network, fuzzy logic probabilistic neural network etc. The main aim of this survey is to provide an overall review of different classification techniques and feature extraction methods in image processing.

I. INTRODUCTION

Plants play a vital role in ecosystem which provides food, medicine, oxygen, fuel and much more. As there are various different species of plants are available on Earth, it is a perplexing job to identify each and every plant and recognize its importance. Plant Identification plays crucial role in various fields like medicine, agriculture, culinary art etc. Leaves, flowers and fruits can be used for classification of plants. Since flowers and fruits will not be available on all the days of the year it makes classification difficult and more time consuming so usually plant leaf is used for classification.

Steps for leaf classification are as follows:

- Image acquisition
- Image preprocessing
- Morphological feature extraction
- Perform classification technique
- Identify the plant species

[1] Content based leaf image retrieval (CBLIR) using shape, color and texture features

This paper proposes an efficient CBLIR method based on plant leaf image extracting Texture, Color features. Here HSV color model is used to extract the various features of leaf samples. For texture feature extraction, Log-Gabor wavelet is applied to the input image. To extract the feature points of the leaf image Scale Invariant Feature Transform (SIFT) is incorporated. SIFT transforms an leaf image sample into a large collection of feature vectors that illuminates changes. Local extrema detection, orientation
assignment, key point descriptor and scale space extrema are the four modules of SIFT. For each image sample, \( L(x, y) \), and \( e \) gradient magnitude, \( m(x, y) \) is computed using the pixel differences as shown in equation 1 and equation 2:

\[
m(x,y) = \sqrt{\left(\frac{L(x+1) - L(x-1,y)}{2}\right)} + \left(\frac{L(x,y+1)}{2}\right)
\]

\[
\theta(x, y) = \tan^{-1} \left\{ \frac{L(x,y+1) - L(x,y-1)}{L(x+1,y) - L(x-1,y)} \right\}
\]

The proposed system shows 97.9% accuracy on 45 different types of leaves.

[2] A Leaf Recognition Technique for Plant Classification Using RBPNN and Zernike Moments

This paper proposes techniques for recognizing and identifying plants using color, texture, vein, shape features which are combined with Zernike movements. As a classifier Radial basis probabilistic neural network (RBPNN) has been used. Zernike moment of repetition \( m \) and order \( n \) is defined as for a continuous image function is defined as

\[
An = \frac{n+1}{\pi} \int_{x^2+y^2<1} f(x,y)R_{nm}(p, \theta) \, dx \, dy
\]

in \((x,y)\) image plane and the real valued radial polynomial \( R_{nm} \) is defined as

\[
R_{nm}(p) = \sum_{s=\max(-n,m)}^{\min(n,m)} \left(\begin{array}{c} n+1 \\ s \end{array}\right) (-1)^{(n-s)} p^s m^{n-s}
\]

93.82% of accuracy has been achieved in this paper.


To implement general purpose automated leaf recognition for plant classification, the author has employed PNN with image and data processing techniques. Five basic geometric features are obtained they are as follows: Leaf perimeter, Physiological Width and Length, Leaf Area, Diameter. 12 digital morphological features are defined for leaf recognition based on these five basic features and those are Vein features, Smooth factor, Perimeter ratio of physiological length and physiological width, Aspect ratio, Perimeter ratio of diameter, Rectangularity, Form factor. 5 principal variables that form the input vector of the PNN are extracted by those 12 leaf features. The accuracy has been rated upto 90%.

[4] Plant species identification using Elliptic Fourier leaf shape analysis

Elliptic Fourier (EF) and discriminant analyses were used to identify velvetleaf (Abutilon theophrasti Medicus), redroot pigweed (Amaranthus retroflexus), young soybean (Glycine max (L.) merrill) and
sunflower (*Helianthus pumilus*) plants. Shape descriptor is the feature extracted for leaf identification. Based on leaf boundary, Elliptic Fourier, Chain encoded harmonic functions are computed. The leaf shape feature complexity index is computed using the difference between consecutive EF functions. To prepare species identification models, Canonical discriminant analysis is analyzed based on leaf shape feature during the germination phase (second to third week of the plant growth). A truncated Fourier series expansion is extracted using the chain code, which is given as follows:

\[
x_N(t) = a_0 + \sum_{n=1}^{N} a_n \cos \left(\frac{2\pi nt}{T}\right) + b_n \sin \left(\frac{2\pi nt}{T}\right)
\]

\[
y_N(t) = c_0 + \sum_{n=1}^{N} c_n \cos \left(\frac{2\pi nt}{T}\right) + d_n \sin \left(\frac{2\pi nt}{T}\right)
\]

The discriminant model correctly classified 81.6% of velvetleaf, 76.4% of redroot pigweed, 91.5% of soybean leaf, 93.6% of sunflower.

[5] Leaf Recognition Algorithm Using Neural Network Based Image Processing

In this paper, Multilayer Perceptron and neural network is employed to implement automated leaf recognition. Ten digital morphological features are used such as Solidity, Extent, Major Axis Length, Orientation, Minor Axis Length, Convex Area, Eccentricity, Filled Area, Perimeter, Equiv Diameter are extracted. They have used 4 models and those are Single input neuron, Multilayer Perceptron Architecture, Multilayer preceptron, multiple input neuron. Experimental result indicates that the accuracy of the algorithm is 94%.

[6] Leaf color, area and edge features based approach for identification of Indian medicinal plants

Plant identification process has been proposed based on its leaf features such as edge histogram, color histogram and area. Experimental analysis was conducted on few medicinal plant species such as Mentha, Hibiscus, Ocimum, Leucas, Centella, Betle, Murraya, Vinca and Ruta. Only the images of mature leaves of a plant can be considered for in this work. The accuracy is rated up to 93.6%.

[7] A Combined Color, Texture and Edge Features Based Approach for Identification and Classification of Indian Medicinal Plants

In this work different classes of plant species such as Tulasi, Papaya, Neem, Aloe and Garlic are considered. The author presents two descriptors namely edge and color. These descriptors have low-dimension, effective and simple. Further, the rotation invariant texture descriptors namely, gradient histogram and directional difference are used. The author maintained 900 images of medicinal plants and features are extracted from this database. Here two classifiers - radial basis exact fit neural network (RBENN) and SVM are used to classify image samples of three classes. Since majority of the plants have green color, classification based on color histogram feature gives lower accuracy. Hence by combining
texture (edge) and color features, the good results are obtained. The accuracies of the classification for edge texture is 80% and color features is 74%. With combined texture and color features the accuracy rate is improved up to 90%.

[8] Leaf recognition for plant classification using GLCM and PCA methods

In order to classify the plants, image processing techniques has been used in this paper. The Principal Component Analysis (PCA) algorithms and Gray-Level Co-occurrence Matrix (GLCM) are used to extract texture features. The author has stored 390 images in database and for testing 65 new leaf images are stored. For the GLCM method different degrees were used and it was found out the accuracy rate is 78.46% in the 0° which is more efficient. Therefore, it is considered that the GLCM is very sensitive in giving the new leaf image for test or in any changes for images. In addition, the PCA method yields 98.46% accuracy which is more efficient compare to the GLCM method.

[9] Plant Leaf Recognition using Shape based Features and Neural Network classifiers

In this paper two different shape modeling techniques are being used and those are Centroid-Radii (C-R) model and Moments-Invariant (M-I) model. An edge detector has been used for the C-R model to identify the leaf shape boundary. The normalized central moments (first four) for the M-I model have been considered and studied in various combinations to produce optimum results. Hybrid set of features involving both the C-R and M-I models has been generated to further improve the accuracy, and Neural networks are used as classifiers. The accuracy rate is ranges from 90% to 100%.

[10] MedLeaf: Mobile Application For Medicinal Plant Identification Based on Leaf Image

This paper proposes MedLeaf as a new mobile application for identification medicinal plants based on leaf image. This mobile application runs on the Android operating system. For feature extraction the author has used Local Binary Pattern and to classify the image Probabilistic Neural Network is used. LBP is given by:

\[
LBP_{p,r}(x_c, y_c) = \sum_{p=0}^{P} S(g_p - g_p)2^p
\]

(7)

LBPV histogram is computed as:

\[
LBPV_{p,r}(k) = (x + a)^n \sum_{i=0}^{n} \sum_{j=0}^{m} w(LBP_{p,r}(i,j), k)
\]

(8)

With

\[
w(LBP_{p,r}(i,j), k) = \begin{cases} VAR_{(i,j)}, & LBP_{p,r}(i,j) = k \\ 0, & \text{otherwise} \end{cases}
\]

(9)

The result shows that the accuracy rate of MedLeaf identification is 56.33%.

First, the author extract certain features from the sample leaf images, then RGB image sample is converted to Grayscale image. Then Grayscale image is converted to Binary image. Canny edge detection algorithm is used for segmentation. Canny edge detection can be computed as:

$$ G = \sqrt{G_{x}^2 + G_{y}^2} $$  

(10)

After this they have used morphological algorithm. After morphological processing the image data are applied to Neural Network. That should be compared with several leaf data trained in the neural network. Finally accuracy rate is given up to 83%.

II. CONCLUSION

In this study, the classification of various plant leaves has been summarized using different classifiers. Different feature extraction methods have been proposed for classification of leaves and it can be summarized in table1:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Features</th>
<th>Plants</th>
<th>Classifiers</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Texture, Color and Shape</td>
<td>General</td>
<td>Content based leaf image retrieval</td>
<td>97.9%</td>
</tr>
<tr>
<td>2</td>
<td>color, texture, vein, shape</td>
<td>General</td>
<td>classifier Radial basis probabilistic neural network</td>
<td>93.82%</td>
</tr>
<tr>
<td>3</td>
<td>Leaf perimeter, Physiological Width, Leaf Area, Physiological Length, Diameter</td>
<td>General</td>
<td>Probabilistic Neural Network</td>
<td>90%</td>
</tr>
<tr>
<td>4</td>
<td>Shape</td>
<td>redroot pigweed, young soybean, velvetleaf, sunflower</td>
<td>Elliptic Fourier analysis</td>
<td>85%</td>
</tr>
<tr>
<td>5</td>
<td>Solidity , Extent, Major Axis Length , Orientation, Minor Axis Length etc.</td>
<td>General</td>
<td>Neural Network</td>
<td>94%</td>
</tr>
<tr>
<td>6</td>
<td>Edge, Color, Area</td>
<td>Medicinal plants</td>
<td>Neural Network</td>
<td>93.6%</td>
</tr>
<tr>
<td>7</td>
<td>Color, Color, Area</td>
<td>Medicinal plants</td>
<td>radial basis exact fit neural network</td>
<td>90%</td>
</tr>
<tr>
<td>8</td>
<td>Texture</td>
<td>General</td>
<td>Principal Component Analysis (PCA) and Gray-Level Co-occurrence Matrix (GLCM)</td>
<td>78% for GLCM and 98% PCA</td>
</tr>
<tr>
<td>9</td>
<td>Shape</td>
<td>General</td>
<td>Neural Network</td>
<td>90-100%</td>
</tr>
<tr>
<td>10</td>
<td>Texture, Shape, Color</td>
<td>Medicinal plants</td>
<td>Probabilistic Neural Network</td>
<td>56.33%</td>
</tr>
<tr>
<td>11</td>
<td>Shape, Texture</td>
<td>Medicinal plants</td>
<td>Neural Network</td>
<td>83%</td>
</tr>
</tbody>
</table>

III. References


