Techniques for Plant Species Retrieval using Various Shape Methods

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Abstract -It is important to identify plant species because plants has variety of medicinal and healthy food properties. Several methods have been introduced by researchers to identify objects . Shape is an important aspects in identifying plants. Moment invariants have been most probably used as features extraction for shape recognition. Moment invariants are computed based on the contours and interior portion of leaf. In this research three method were studied to identify plants using shape features was accomplished. Out of them two approaches i.e zernil moments and polar transforms were never been used in plat identification.

Keywords -Moment invariant, zernik moments, plant identification, shape recognition

I. INTRODUCTION

It is well known that many of the plant species on earth have medicinal value or carries significant amount of information for the development of human society. So in order to conserve and preserve correct plants, firstly recognize it, is important step. Plants are usually recognize by their shape, color textures and structure of their bark, flower, leaf and seedling. But it is quite difficult to identify shape of flower and seedling as it is 3D image if based on only 2D images. Color of the leaf changes as per atmospheric change and nutritional measures. So shape methods are more reliable to recognize plants. In this research we have discussed techniques for recognizing plants using various shape methods. Through this study we intend to deliver is the ideal approach in plant classification and recognition that not only applicable to real world but also acceptable in the laboratory.

II. LITERATURE SURVEY

According to C. L. Lee , S. Y. Chen [1] past research in recognizing objects can be broadly classified into two categories : a) contour based and b) region based approaches. The disadvantage of the contour based feature is the difficulty on finding the correct curvature points. Based on the contour of leaf, features were extracted to differentiate species. However contour of leaves have variation even in the same species. For plants identification purpose Wu, et al[2] used shape slimness, defined as ratio of length to width of leaves, shapes roundness, defined as ratio of area of leaf image and perimeter of leaf contour, and shape solidity, defined as ratio of the internal area connecting to valley points and the external area connecting the top points. A paper by Ji- Xiang Du, Xiao-Feng Wang, Guo-Jun Zhang [3] introduce how to extract digital morphological features. The features are extracted from the contours of leaf. The digital morphological features(DMF) generally include geometrical features(GF) and invariable moment features(MF). A paper by Cholhang Im, Hirobumi Nishia and Tosiyasu L. Kunii[4], a method that normalizes shapes of leaves is presented using symmetry of each leaflet with respect to its vein. According to Najjar and Zagrouba [5] had used region based feature for proposed method in order to classifying the leaf. According to C.S Sumathi and A.V.Senthil Kumar in plant classification, the leaf shape plays a significant role. In machine intelligence, the most significant part essential for both decision making and data processing is shape recognition. Valliammal and Geethalakshmi [6], who stated in their publications that leaf image could be categorized based on color, texture, shape or combination of these properties. Later Zhang and Zhang[7] was enhanced that the properties for these features such as surface area, surface perimeter and the disfigurement are inherited from the shape features, variance of red, green and blue channels are belonging to the color features and texture energy. Other research was also used aspect ratio and other basic geometric features to recognize plants. Du,Wang and Zhang used Aspect ratio,rectangularity, area ratio of convex hull,perimeter ratio of convez hull and sphericity [3].

III. TECHNIQUES

In this paper, we have studied four methods for plant species retrieval using shape features. This study is helpful for further researches. Out of the four methods , two of the methods i.e Zernike moments and Polar Fourier Transform are never used in plant species retrieval.

A. Moment Invariants

Moment invariants have been frequently used as features for image processing, remote sensing, shape recognition and classification. Moments can provide characteristics of an object that uniquely represents its shape. Invariant shape recognition is performed by classification in the multidimensional moment invariant feature space. several techniques have been developed that derive invariant features from moments for object recognition and representation. These techniques are distinguished by their moments definition, such as the type of data exploited and the method for deriving invariant values from the image moments. It was Hu(Hu,1962), that first set out the mathematical foundation for two-dimensional moment invariants and demonstrated their applications to shape recognition. Hu defines seven of these shape descriptor values computed from central moments through order three that are independent to object translation, scale and orientation. Translation invariance is achieved by computing moments that are normalized with respect to the center of gravity so that the center of mass of the distribution is at the origin. Size invariant moments are derived from algebraic invariants but these can be shown to be the result of a simple size normalization . from the second and third values of the normalized central moments a set of seven invariant moments can be computed which are independent of rotation. Accordingly , we consider using these Hu moment invariants as classification feature in this paper. Their values can be calculated from the contours using Chen's improved moments [8] as follows :

The chen's improved geometrical moments of order(p+q) are defined as

$$M_{pq} = \int_c x^p y^q \, ds,$$

Where p,q = 0,1,2,…. $\int_c$ is the line integral along a closed contour C and ds =

For the purpose of practical implementation ,Mpq could be computed in their discrete form

$$M_{pq} = \sum x \sum y \, x^p y^q$$

Then the contour central moments can be calculated as follows :

$$\mu_{pq} = \int_c (x-x)^p (y-y)^q \, ds,$$

$$x = M_{10}/M_{00}, \; Y = M_{01}/M_{00}$$

For the discrete case, the above μ_{pq} becomes

$$\mu_{pq} = \sum x \sum y \, (x - x)^p (Y - Y)^q$$

Where y = p+q/2 +1, p+q = 2,3,4,…..

These new central moments are further normalized using the following formula :

$$n_{pq} = \mu_{pq} / \mu_{00}$$

Consequently, a set of seven invariant moments can be derived from the normalized central moments

$$Hu1 = n_{20} + n_{02},$$

$$Hu2 = (n_{20} - n_{02})^2 + 4n^2_{11},$$

$$Hu3 = (n_{30} - 3n_{12})^2 + (n_{03} - 3n_{21})^2,$$

$$Hu4 = (n_{30} + n_{12})^2 + (n_{03} + n_{21})^2$$

$$Hu5 = (n_{30} - 3n_{12})(n_{30} + n_{12}) [(n_{30} + n_{12})^2 - 3 (n_{30} + n_{21})^2] + (3n_{21} - n_{03})(n_{21} + n_{03})[3(n_{30} + n_{12})^2 - (n_{03} + n_{21})^2]$$

$$Hu6 = (n_{20} - n_{02})[n_{30} + n_{12})^2 - (n_{03} + n_{21})^2] + 4n_{11} (n_{30} + n_{12}) (n_{03} + n_{21}),$$

$$Hu7 = (3n_{21} - n_{03})(n_{30} + n_{12})[(n_{30} + n_{12})2 - 3(n_{03} + n_{21})^2] + (3n_{12} - n_{30})(n_{21} + n_{03})[3(n_{30} + n_{12})^2 - (n_{03} + n_{21})^2]$$

B .Zernik moments

Zernik moments form part of the gereral theory of the geometrical moments. They were introduced initially by F. Zernik in 1934[9]. These momens have been used in several applications such as face detection, fingerprint recognition [10] and character recognition [11]. Zernike moments are the mapping of an image onto a set of complex zernike polynomials. Since zernike poly are orthogonal to each other, Zernike moments can represent the properties of an image with no redundancy or overlap of information between the moments. Zernike moments are significantly dependent on the scaling and translation of the object in an ROI. Nevertheless, their magnitudes are independent of the rotation angle of the object. Hence we can utilize them to describe shape characteristics of the objects. Zernike moments have rotational invariance and can be made and translational invariant, making them suitable for many applications. Zernike moments are accurate descriptors even with relatively few data points. Reconstruction of Zernike moments can be used to determine the amount of moments necessary to make an accurate descriptor.

C.*Polar Fourier Transform*

For analyzing the results polar fourier transform is very popular method in image processing. The advantage of analyzing image in spectral domain over analyzing shape in spatial domain is that it is easy to overcome the noise problem which is common to digital images. However , direct applying 2-D FT on a shape image in Cartesian space to derive feature descriptors is not practical due to property of FT that is not rotation invariant. To overcome that problem , there are 2 kinds of PFT proposed by D.Zhang. one of them is defined as follow :

$$PF_2(\rho,\o) = \sum_r \sum_i f(\rho,\o_i) \exp [\, j2\pi(r/R\ \rho + 2\pi/T\ \o\,]$$

Where

- $0 <= r < R$ dan $\theta_{i=} I\ (2\pi/T)(0<-i<T);\ 0<=\rho<R,\ 0<=\o<T,$
- R is radial frequency resolution
- T is angular frequency resolution

How to compute PFT described as follow. For example , there is an image I = { f(x,y); 0<x<M, 0<y<N)} Firstly, the image is converted from Cartesian space to polar space I_p = { (f(r, ɵ); 0<r<R, 0<ɵ<2Л), where R is the maximum radius from center of the shape. The origin of polar space becomes as centre of space to get translation invariant. The centroid(xc,yc) calculated by using formula:

$$X_c = 1/M \sum_{x=0}^{M-1} x, y_c = 1/N \sum_{x=0}^{N-1} y,$$

In this case,(r, ɵ) is computed by using :

$$R = \sqrt{(x-x_c)2 + (y-y_c)2}\ ,\ \theta = \arctan y - y_c / x - x_c$$

Rotation invariance is achieved by ignoring the phase information in the coefficient . consequently, only the magnitudes of coefficients are retained. Meanwhile, to get the scale invariance, the first magnitude value is normalized by the area of the circle and all the magnitude values are normalized by the magnitude of the first coefficient. So the fourier descriptors are :

$$FD = \left\{ \frac{PF(0,0)}{2\pi r^2}, \frac{PF(0,1)}{PF(0,0)}, \ldots, \frac{PF(0,n)}{PF(0,0)}, \ldots, \frac{PF(m,0)}{PF(0,0)}, \ldots, \frac{PF(m,n)}{PF(0,0)} \right\}$$

Where m is the maximum number of the radial frequencies and n is the maximum number of angular frequencies.

D. Geometric Features

Researcher Du, Wang and Zhang has introduce how to extract digital morphological features. The features are extracted from the contours of leaf. The digital morphology features (DMF) generally include geometrical features(GF) and invariable moment features(MF). The geometrical features consist of aspect ratio,rectangularity,area ratio of convexity,perimeter ratio of convexity,spericity and form factor[3].

Aspect Ratio

The aspect ratio is the ratio between maximum length D_{max} and minimum length D_{min} of the minimum bounding rectangle

$$AR = D_{max} / D_{min}$$

Rectangularity

The rectangularity, representing the ratio of ROI area and the MBR area, is calculated by

$$R = A_{ROI} / D_{max} * D_{min}$$

Area ratio of convex hull

The area ratio of convex hull, representing the ratio of the ROI area A_{ROI} and the convex hull area A_C, is calculated by
$CA = A_{ROI}/ A_C$
Perimeter ratio of convex hull
The perimeter ratio of convex hull, representing the ratio of the ROI perimeter P_{ROI} and the convex hull perimeter P_C is calculated by
$CP = P_{ROI}/ P_C$
The author of [3] has proposed that , besides the above features, the moments are also widely used as the features for image processing and classification, which provide a more geometric and intuitive meaning than the morphological features. So author has implemented geometrical features with invariant moment feature derived by Hu.

IV. CONCLUSION

Here in this research we have studied several shape methods available for plant species retrieval. Based on the study of several shape methods geometrical features has a good chance to be included in plants recognition using feature extraction, Further researches, other aspects, such as colours and textures, should be incorporated to increase the performance of identification system. By incorporating colours the performance of system recognition can be improved.

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