Application of Image Processing Techniques in Object Shape Recognition

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Abstract- Plants are among the earth's most beautiful products of nature. Plants have been crucial to mankind's survival. The urgent need is that many plants are at risk of extinction. About 50% of ayurvedic medicines are prepared using plant leaves and many of these species belong to endanger group. So it is indispensable to set up a database for plant protection. We believe that the first step is to teach a computer how to classify for plant protection. Leaf/ plant identification has been a challenge for many researchers. Several researchers have proposed various techniques. In this project, we have proposed a hybrid architecture for recognizing and identifying plants using shape, texture features which are combined with Zernike moments. Fuzzy rule base was implemented for accomplishing this purpose.

Keywords – Texture features, Shape features, Zernike Moments, Fuzzy rule base, System architecture

I. INTRODUCTION

There are many kinds of plant species on earth. Unfortunately, as human progress, more and more plant species are at the margin of extinction. Therefore, it is important to correctly and quickly recognize the plant species in order to understand, manage and archive them before it's too late.

Plants can be classified according to the shapes, colors, textures and structures of their leaf, bark, flower, seedling and morph. Plant taxonomy methods still adopt traditional classification method such as morphologic anatomy, cell biology and molecular biological approaches. The traditional method is time consuming and requires tremendous efforts from botanists. However, due to the rapid development in computer technologies, there are now opportunities to improve the ability of plant species identification. Computerized plant classification systems are mostly based on two-dimensional images. This makes plant classification based on leaves as the appropriate choice compared to the use of shapes of flowers, seedling and morph of plants which are three-dimensionally complex in structure.

II. SYSTEM DESIGN

A. Problem Definition

Application of image processing techniques is an approach in object identification and orientation. To select a set of appropriate numerical attributes of features from the interested objects for the purpose of classification has been among the fundamental problems in the design of an image pattern recognition system.

One of the approaches that is used in object recognition is Zernike moments with the combination of properties such as rotational and translational invariance, robust to noise and minor variation in shape and expressiveness. Also there is use of texture analysis to extract different features to extract different characteristics to identify the categories of leaves. In this project, image processing techniques will be used to identify objects using properties such as shape, major and minor axis, contrast, entropy and orientation.

B. Proposed System

Objective:

The objective of the proposed system is to provide user interface to identify objects. In this work we have given an interface to recognize leaves which helps the biologists in their research activities.

Brief description of the system architecture:

The system consists of the following major components:

- Domain knowledge:

This step involves collecting samples of images from datasets or capturing images using a camera. In this research, 5 species of different plants were used. Each species includes 15 samples of leaf images. These leaf images come in different sizes, shapes and class

- Image Preprocessing:

In this process, a series of sequential operations were done on the leaf image which are prescribing the image size, converting the gray-scale images to binary images (monochrome) file and modifying the scaling and rotation factors of the image. The digital images are first minimized to 3264*1324 pixel dimensions in order to ease the computational burden. The grey scale images are further converted into binary images. Each image has its own threshold value; therefore the value is not fixed.

- Graphical User interface:

It is a user interface that allows the users to add, search or delete leaf images from the database. Particular username and password is provided.

- Dataset:

It contains all information regarding leaf and its classification.

- Feature extraction:

In this system we extract the shape, color, texture, orientation and veins of the leaves.

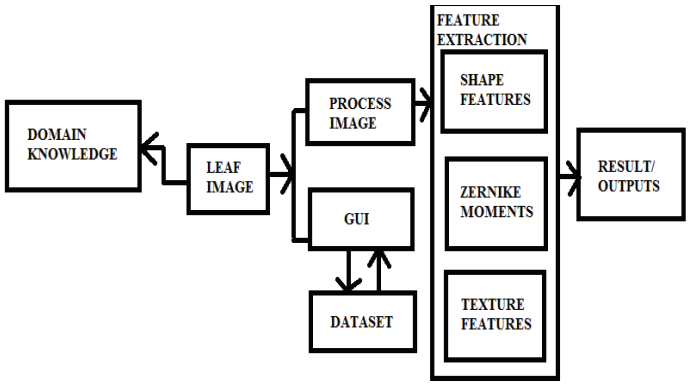


Fig 1: System Architecture

III. OBJECT SHAPE RECOGNITION USING ZERNIKE MOMENTS

In all pattern recognition and images retrieval, shape is one of the important aspects used to characterize objects, beside of colors and textures. Zernike moments form part of the general theory of the geometrical moments. These moments have been used in several applications such as face detection, fingerprint recognition and character recognition.

A set of orthogonal functions with simple rotation properties which forms a complete orthogonal set over the interior of the unit circle was introduced by Zernike, known as Zernike polynomials.

The form of this polynomial is:

$$V_{nm}(x,y)=V_{nm}(p\sin\Theta,p\cos\Theta)=R_{nm}(p)\exp(jm\Theta).$$

Where, $p\sin\Theta$ and $p\cos\Theta$ represent coordinates of unit circle with radius p. n represents order of Zernike moments and m represents iteration of moment.

Zernike moments are the mappings of an image onto a set of complex Zernike polynomials.

Experiments were conducted on basic shapes such as oval and rectangle with different orientations. The results obtained showed that Zernike moments were able to detect shapes of different orientations.

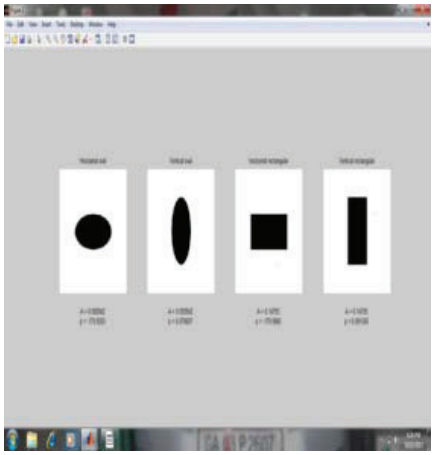


Fig 2: The results obtained after calculating Zernike moments of certain shapes.

Fig 3: Different amplitudes for different leaves.

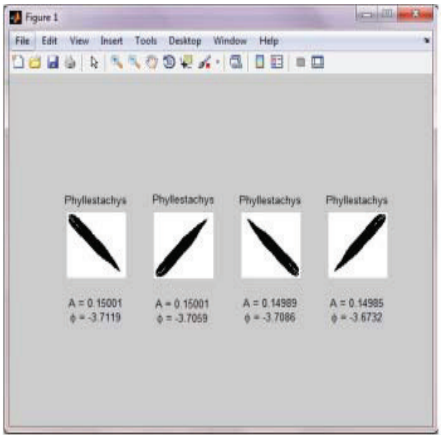


Fig 4: Same amplitude for different orientations of same leaf.

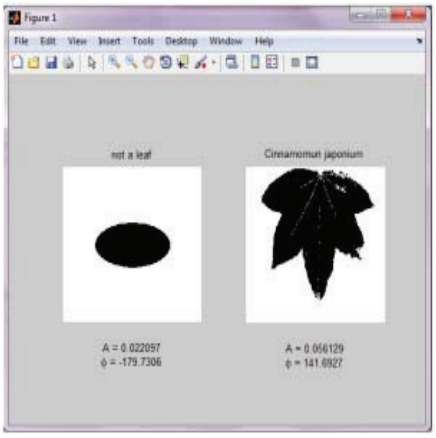


Fig 5: Zernike moments distinguishing between object and a leaf.

Thus we can conclude that experiments which were conducted on leaves and basic shapes were easily recognized by Zernike moments.

IV. OBJECT RECOGNITION USING SHAPE AND TEXTURE FEATURES

More and more images have been generated in digital form around the world. There is a growing interest in finding images in large collections or from remote databases. In order to find an image, the image has to be described or represented by certain features. Shape is an important visual feature of an image.

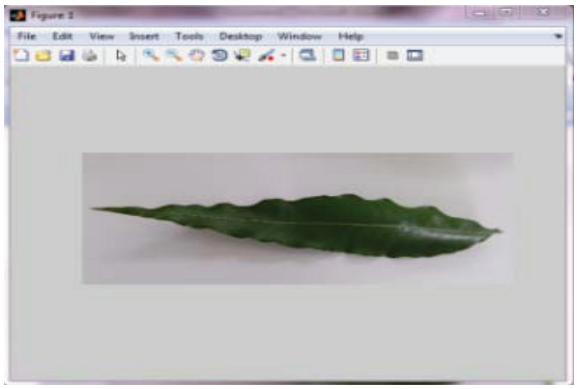
Texture is an innate property of virtually all surfaces the grain of wood, the weave of a fabric, the pattern of crops in a field, etc. It contains important information about the structural arrangement of surfaces and their relationship to the surrounding environment. Although it is quite easy for human observers to recognize and describe in empirical terms, texture has been extremely refractory to precise definition and to analysis by digital computers. Since the textural properties of images appear to carry useful information for discrimination purposes, it is important to develop features for texture.

V. RESULTS AND ANALYSIS

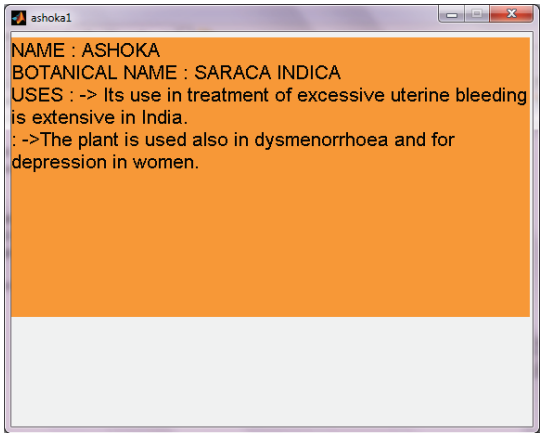
ASHOKA PLANT

Snapshot 5.1

Snapshot 5.2



Snapshot 5.3

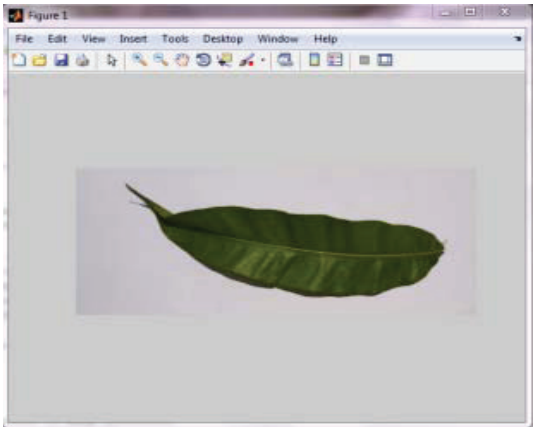


Snapshot 5.4

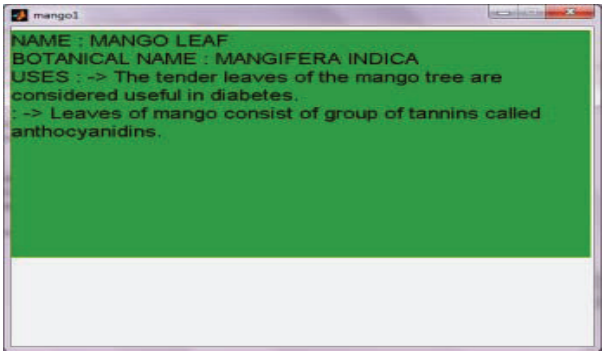
MANGO PLANT

Snapshot 5.5

Snapshot 5.6



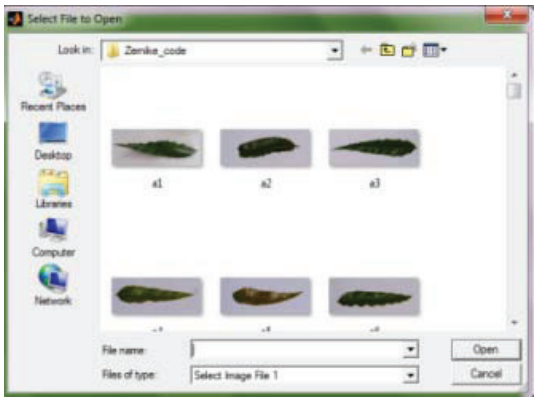
Snapshot 5.7



Snapshot 5.8

INTERFACE

Snapshot 5.9



Snapshot 5.10

VI. CONCLUSION

We started with project learning about Zernike moments and how it could be used to detect various shapes with different orientations. We extended this concept to leaves but it failed to detect them correctly.

We went on to consider the shape and texture features of leaves for recognizing 5 different categories of leaves namely Hibiscus, Tickseed, Rose, Mango, Asoka. Each category had different types of leaves including young, dry and cut leaves. Our system was able to detect these categories of leaves with considerable amount of accuracy.

During implementation, we found that the rules were same for mango and Asoka leaves. To resolve these clashes, we considered the Amplitude of Zernike moments as an additional parameter. It was able to detect Asoka and mango leaves successfully. We also found that the system was not able to detect some of the hibiscus leaves since the rules clashed with those of tickseed and even after considering the amplitude parameter it couldn't resolve the conflict.

Limitations:

1] As the categories of leaves increased in number the rule base increased exponentially and led to complex processing.

2] Some leaves of a particular category couldn't be recognized.

3] The images should be taken in bright sunlight and shadows should be avoided.

4] The images should be taken with a constant background.

5] The image should be within 1396MB of memory used by MATLAB environment.

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