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Leaf Feature-Based Plant Spotting System with Random Forest Classification

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ABSTRACT

Identification and classification of unknown plant species are performed manually by expert personnel who are very few. The important aspect is to develop a system which classifies the plants. This paper presents a new recognition approach based on Leaf Features Fusion and Random Forests (RF) Classification algorithms for classifying the different types of plants. The proposed approach consists of three phases that are preprocessing, feature extraction, and classification phases. Since most types of plants have unique leaves. Leaves are different from each other by characteristics such as the shape, color, texture and the margin. This paper presents a classification approach by Random Forest Classifier algorithm for classifying the different types of plants. This Proposed Approach consists of four phases that are image pre-processing, feature extraction, features fusion and classification phases. Most types of plants have unique leaves. There are many features of leaf such as Color features, Vein features, GLCM features, Shape features and Gabor features. Also calculate Zernike moments such as amplitudes and phase. These all features are fused by concatenating of two vectors. So, the classification approach presented in this research depends on plant's leaves. Experimental results show accuracy and other parameters measured in this approach with fusion of all these features or their different combinations. This is an intelligent system which can identify tree species from photographs of their leaves, and it provides accurate results in less time. "

Keywords

Plan identification; Leaf Features; Gray level cooccurrence matrix; Gabor transform, Zernike moments; RF classifier.

INTRODUCTION

The human visual system has no problem interpreting the subtle variations in translucency and shading in Figure 1. Photograph and correctly segment the object from its background. Let's imagine a person taking a field trip and seeing a bush or a plant on the ground, he or she would like to know whether it's a weed or any other plant but have no idea about what kind of plant it could be. With a good digital camera and a recognition program, one could get some useful information. Plants assume a vital part in our surroundings. Without plants there will be no presence of the world's nature.

Figure 1: Lotus Flower Image

Be that as it may, as of late, many sorts of plants are atdanger of termination. To ensure plants and to list different sorts of greenery diversities, a plant database is a critical stride towards protection of earth's biosphere. There are a colossal number of plant species around the world. To handle such volumes of data, improvement of a snappy and effective characterization technique has turned into a region of dynamic research. Notwithstanding the preservation angle, acknowledgment of plants is additionally important to use their restorative properties and utilizing them as wellsprings of option vitality sources like biofuel. There are a few approaches to perceive a plant, similar to bloom, root, leaf, organic product and so on.

BACKGROUND

This study uses the leaf part of the plant to identify a plant. The continued interest in biodiversity along with the ease of creating digital images, increased the need for processing power of computers and economical methods. In order to gather information, plant identification using computers has become an interesting subject of research. Global shortage of expert taxonomists has further increased the demand for automated tools that would allow non-botanical persons to carry out valuable field work of identifying and characterizing plants. These tools are of importance in several fields including agriculture, forestry and pharmacological science (Cotton Incorporated USA, 2009; National Institute for Agricultural Botany, 2005).

The first step during the design and development of such tools starts with leaf recognition. Compared with other methods, such as cell and molecule biology methods, identification of plants based on leaf image is the most successful and proven method (Wu et al., 2007). Sampling leaves and obtaining a photograph of them is convenient and viable, due to the availability of low-cost digital cameras.

Currently, plant identification through leaf recognition involves finding information about a plant that most matches the species name (key) that has to be known in advance. Though identifying plants using such key is a time-consuming task, correct utilization of key plays a direct role in the success of the plant search. The alternative method of allowing users to provide a leaf image is very convenient, user friendly and eliminates the need for key.

The task combines the challenges of different fields like image processing, machine learning and pattern recognition. Identifying the most favorable algorithms and techniques from these fields, for plant identification through leaf recognition, is the main focus of this study. The rest of the chapter presents the introductory materials related to this topic.

PROPOSED SYSTEM

In Our Proposed Approach, the first step is Leaf Image Acquisition. In this step digital leaf image is captured. Then apply pre-processing step on these leaf image. Prior to the operations, a portion of the leaf pictures are turned physically to help the program to mastermind leaf zenith bearing to the correct side. A short time later, programmed pre-handling procedures are connected to the greater part of the leaf pictures. Pre-processing steps involves converting RGB to Grayscale Image, then apply Median Filtering on it, then converting into binary and apply segmentation on it. After pre-processing, the important and essential task is to measure the properties of an object which is called Feature Extraction because objects have to be detected based on these computed properties.

In Feature extraction, I will extract Features such as Color Features, Texture Features, Shape Features, and Vein Features and also apply Zernike Moments of Leaf Image. After Feature Extraction, the next step is Feature Fusion to combine more than one Feature to get more accuracy for classification.

Once the features have been fused, then these features vectors are to be used to classify and identify plants using RF (Random Forest) classifier to classify plants. A brief explanation on the proposed system is given in the below Figure.

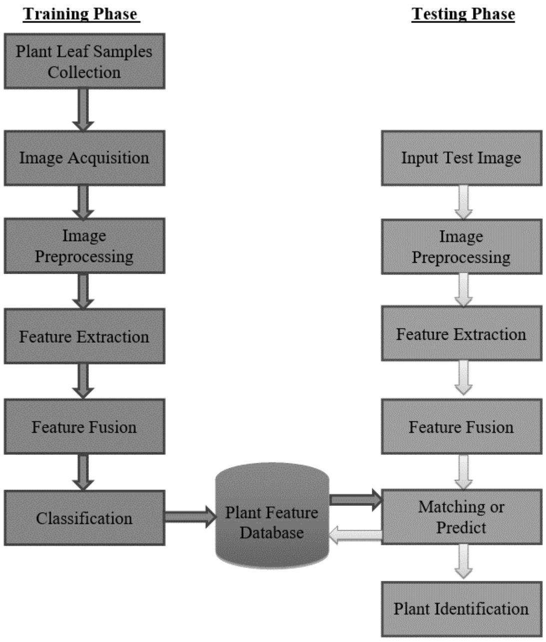

Figure 2: Block diagram of the proposed system

Algorithm:

Step 1. Prepare Training Dataset

1.1. Collect Plant Leaf Samples.

1.2. Acquisition of plant leaf images

1.3. Apply Preprocessing on each plan leaf image includes gray conversion, median filtering and then banalization and segmentation.

1.4. Extract Features of plant leaf such as shape, color, vein, texture etc. and apply Zernike moment.

1.5. Fuse the features based on combination.

1.6. Prepare features vector.

Step 2. Read the testing plant leaf image.

Step 3. Apply Preprocessing on test image including same steps in step 1.3.

Step 4. Extract Features specified in Step 1.4 and fuse them based on combination.

Step 5. Train the training dataset and predicate testing image by using Random Forest Classifier.

Step 6. Finally, identify the plan leaf.

Step 7. Stop.

RESULTS AND ANALYSIS

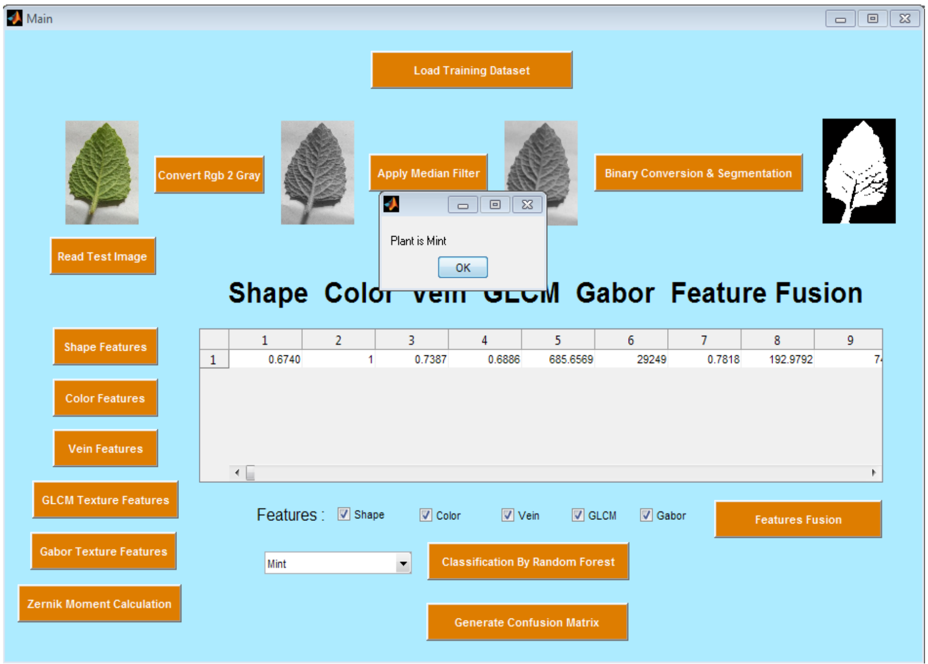

Figure 3: RF Classification GUI Results

Table 1: No of Correctly Recognize Images

No of Test Images	No of Correctly Recognized Images				
	By Shape Features	By Color Features	By Vein Features	By GLCM Texture Features	By Gabor Features
8	4	3	2	3	5

Table 2: Overall Testing Analysis

No of Test Images	6
Shape+Color Features Correctly Recognized	4
Shape+Vein Features Correctly Recognized	5
Shape+GLCM Features Correctly Recognized	4
Shape+Gabor Features Correctly Recognized	3
Color+Vein Features Correctly Recognized	2
Color+ GLCM Features Correctly Recognized	3
Color+ Gabor Features Correctly Recognized	4
Vein + GLCM Features Correctly Recognized	3
Vein + Gabor Features Correctly Recognized	4
GLCM+ Gabor Features Correctly Recognized	3
Shape+ GLCM+ Gabor Features Correctly Recognized	3
Shape+Vien+GLCM+Gabor	6

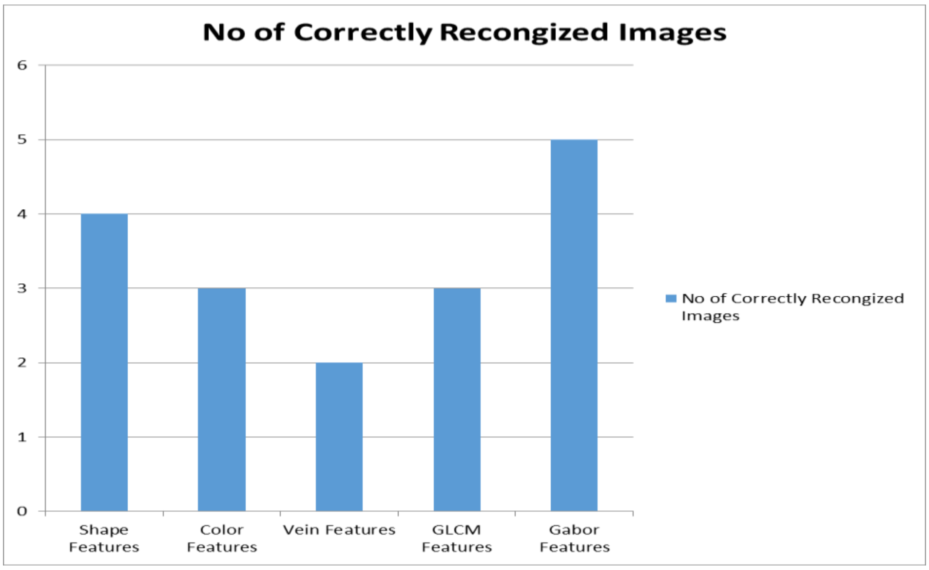

Figure 4: All Features Comparison

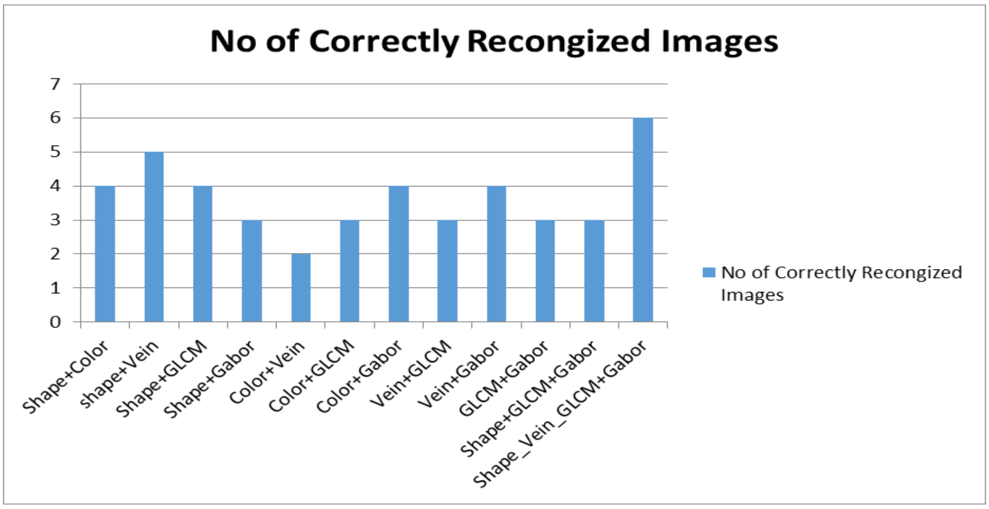

Figure 5: No of Recognized images

Table 3: Analysis Parameters

No of test Images	2
Confusion Matrix	1 0 0 1
Accuracy	1.0000, 0.7500
Sensitivity	1.0000, 0.5000
Specificity	1.0000, 1.0000
Precision	1, 1
Recall	1.0000, 0.5000
Fscore	1.0000, 0.6667
Gorder	1, 2

CONCLUSION

A method for leaf classification has been developed. The method incorporates shape and vein, color, and texture features and uses RF as a classifier. Fourier descriptors, slimness ratio, roundness ratio, and dispersion are used to represent shape features. Color moments that consist of mean, standard deviation, and skewness are used to represent color. Twelve textures features are extracted from lacunarity. We conclude that incorporating Zernike moments for feature descriptors is a feasible alternative for classifying structurally complex images. They offer exceptional invariance features and reveal enhanced performance than other moment-based solutions. Gabor and GLCM give better texture approximations and hence make classification easier. Random Forest Classifier gives better accuracy than any other classifier. We have used features fusion with Zernike moments to recognize plant leaf with accuracy more than 95%. Although the performance of the system is good enough, we believe that the performance still can be improved. Hence, other features will be researched in the future.

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