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REVIEW ARTICLE

A Review on Off-line Leaf Recognition Using Neural Network

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Abstract— ***Plants growing around play a very crucial role in the surrounding and in the lives of human beings from medicinal & economic point of view. To provide understanding and managing of plants in botany, medicine, industry and food sector leaf recognition systems can be used. By recognizing leaf, trees and flowery plants can be easily classified. This paper discusses the leaf recognition which enables the user to recognize the type of leaf using a approach that depends on neural network. Scanned images are being introduced into the computer initially, image enhancement and reduction of noise modifies their quality, further followed by feature extraction. Selection of feature points from the geometric centre of the leaf image and compares them with the already trained feature points of database leaf image is the basis for leaf recognition system. Different stages like image pre-processing, feature extraction and leaf through neural network are being discussed in this paper.***

Keywords— ***leaf recognition, neural network, feature extraction, geometric centre, Image pre-processing, pattern recognition***

I. INTRODUCTION

One of the most important techniques to be used in research area in the field of personal identification is the feature point extraction. This paper uses the feature point extraction method for leaf recognition.

To recognize the specific plant the system is to be developing using MATLAB software uses feature point extraction and artificial neural network (ANN) as an algorithm and leaves are use as medium to recognize the plant by comparing them with the leaves of known plants in the database. This technique solves the problem very efficiently. Figure 1 shows the conceptual diagram for leaf recognition system.

Leaf Recognition is so different with the character recognition, because Leaf is often unreadable and it seems it is just an image with particular shape and size that represent the type of plant. The complete leaf image having a special distribution of pixels and representing a particular Shape and Size. There are many existing systems and studies that are based on different methods of recognition [5]. The algorithms used have given accurate results. The process starts from input leaf images database into the computer, then improve quality through image enhancement and noise reduction techniques, separates the leaf from its background, normalization and digitization of leaf followed by feature point extraction method and artificial neural network training and finally successful recognition of input leaf whether it is of particular plant or not [1,2,3,4]. This system shows successful recognition of input leaf that artificial neural network was trained for, but has poor performance when artificial neural network was not trained for.

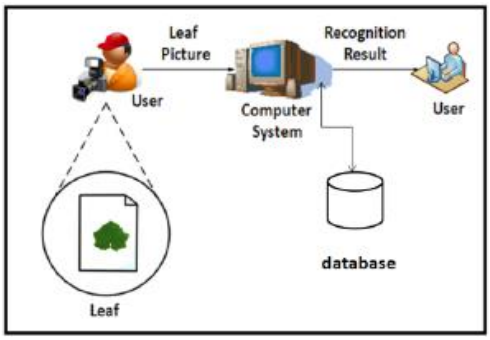

Fig 1. The leaf recognition system conceptual diagram

A. Image Processing and Computer Vision Techniques

Computer vision techniques are used for coffee industry, tea industry, a tool for botanical student, agricultural applications, such as detection of weeds in a field, sorting of fruit on a conveyer belt in fruit processing industry, etc. The underlying approach for all of these techniques is the same. First, digital images are acquired from environment around the sensor using a digital camera. Then image-processing techniques are applied to extract useful features that are necessary for further analysis of these images. After that, several analytical discriminant techniques, such as statistical, Bayesian or neural networks will be used to classify the images according to the specific problem at hand. This constitutes the overall concept that is the framework for any vision related algorithm. The first phase is the image acquisition phase. In the second phase image preprocessing is completed. Usually the images that are obtained from the first phase are not suited for classification purposes because of various factors, such as noise, lighting variations, etc. In the third phase, segmentation is completed to discover the actual boundary of the leaf in the image. Later on, feature extraction is completed based on specific properties among pixels in the image or their texture. After this step, certain statistical analysis tasks are completed to choose the best features that represent the given image. Finally, classification is completed using detection algorithms.

II. LITERATURE SURVEY

Leaf recognition is pattern recognition task performed specifically on leaves. It can be described as classifying a leaf a leaf either known or unknown, after comparing with known leaves. Computational models of leaf recognition must address several difficult problems. This difficulty arises from the fact that leaves must be represented in a way that best utilizes the available leaf information to distinguish a particular leaf from all other leaves. In the past decade, agricultural applications using image processing and pattern recognition techniques have been attempted by various researchers. Object shape matching functions, color-based classifiers, reflectance-based classifiers and texture based classifiers are some of the common methods that have been tried in the past. There are about 250,000–270,000 plants species that have been named and classified in the world (Guo *et al.*, 2004). Therefore, it is not feasible for one person to know every kind of plant leaf. Many researchers have tried to identify plant leaves by applying several techniques that are briefly reviewed below. The following sections will discuss some past work done using these methods. So many approaches are their which use for the leaf recognition.

Ye et al. compared the similarity between features to classify plants [11]. Cu et at. Use leaf recognition using skeleton segmentation by wavelet transform and Gaussian interpolation [6]. Wang, X.-F et al use a moving median center (MMC) hyper sphere classifier [13] but this technique isn't fast enough specially when it's compared with approaches which are using Artificial Neural Networks(ANN), other approaches compared the similarity between features to classify plants [5] and these approach have the disadvantage of requiring preprocess work of human to enter keys manually[7], some approaches used Artificial Neural Networks(ANN) to classify *opunt`ia* species [8] although this approach is fast but it's applicable to certain spices, J. Du, D. Huang, X. Wang, and X. Guo use shape recognition based on radial basis probabilistic neural network which is trained by orthogonal least square algorithm(OLSA) and optimized by recursive OLSA.[9] .it performs plant recognition through modified Fourier descriptors of leaf shape, many approaches which are based on leaf shape like the approach introduced by X. Du, D.-S. Huang, X. -F. Wang, and X. G isn't effective when the leaf shape isn't clear or destroyed the previous approach uses a modified dynamic programming algorithm for leaf shape matching. Prof. Meeta Kumar, Mrunali Kamble, Shubhada Pawar, Prajakta Patil, Neha Bonde provide the different classification techniques in Survey on Techniques for Plant Leaf Classification [10]. Anand H. Kulkarni, Ashwin Patil Which is based on Gabor filter for feature extraction and ANN classifier for classification got a better results Applying image processing technique to detect plant disease[14]. This method performs much better than any other off-line signature verification methods. The system by Chomtip

Pornpanomchai, Supolgaj Rimdusit,Piyawan Tanasap and Chutpong Chaiyod extracted 13 features from the leaf image and used a k-nearest neighbor (k-NN) algorithm in the recognition process. In the result display component, the system displayed the results of the classification. The experiment involved 32 species of Thai herbs, with more than 1,000 leaf images. The system was trained with 656 herb leaf images and was tested using 328 leaf images for a training dataset and 30 leaf images for an untrained dataset.

A method by Suhail Odeh and Manal Khalil for offline signature verification and recognition by using MLP neural network that used four features; eccentricity, skewness, kurtosis, and orientation, which can be extracted by image processing[15]. Three new features are extracted from a static image of signatures using this technique. Hong and Chi (2003, 2006) applied neural network methods for vein pattern extraction to recognize leaf images. Jiazhi and He (2008) proposed neural network methods for recognizing digital images of plant leaves. Stephen *et al.* (2007) presented a leaf recognition algorithm for plant classification using a probabilistic neural network. Huang and Peng (2008) studied leaf shape and texture features combined with a probabilistic neural network to recognize 30 kinds of broadleaved trees. Yun *et al.* (2005) proposed leaf vein extraction combined with a cellular neural network for plant recognition. Xiao *et al.* (2005b) used k-nearest neighbor classification and a probabilistic neural network to recognize plant leaves.

III. METHODOLOGY FOR LEAF RECOGNITION

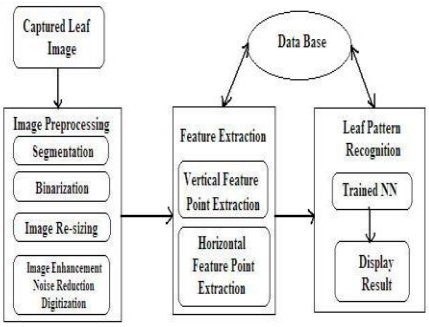

Fig.2. Methodology for leaf recognition[12]

The methodology for leaf recognition has been shown pictorially in figure 2. The work starts from capturing images using digital cameras. These images are gone through the different pre-processing for image quality improvement steps like image enhancement, noise reduction, separates the leaf area from leaf background, normalization and digitization of leaf. Extraction of feature points of leaf image and finally extracted feature points are fed as input to artificial neural network for pattern recognition. There are some major steps in achieving leaf recognition, and each of these steps consists of many methods that contribute to improved results. These steps are:

A. Input Leaf Image:

The very first step in the proposed approach is to capture the leaf image with uniform background from the digital camera and after process of pre-processing, extract the feature points of leaf image. The leaf image captured from digital camera and the feature points are extracted from the leaf image and extracted feature points store in the database. The recognition rate mainly depends on the image quality.

B. Leaf image Database:

The next step in the work is the formation of the leaf image database. These leaf images from database are used for training the artificial neural network as well as for testing of input leaf image. The formation of leaf image database is clearly dependent on the application. The leaf images are capture in specific manner. The background use for the leaf images is of uniformed colored this propose work uses the white colored background. The leaf image database in the propose work consisting of 200 leaves images.

C. Image Pre-processing:

The use of leaf image data for leaf database requires several preprocessing procedure. These procedures include; reading, displaying and resizing of the image, segmentation, binarization and fast Fourier transform (FFT), and image enhancement, noise reduction, digitization which improves the leaf image quality. The techniques used in this process may vary. These image preprocessing techniques doesn't affect the leaf image content. The goal of digital image preprocessing is to increase both the accuracy and the interpretability

of the digital data during the image processing phase. In the work proposed image pre-processing methods are applied to the captured image which are stored in image database. A successful implementation of this step produces improved results and higher accuracy rates. After an image is acquired, it goes through different levels of processing as mention above before it is ready for the next step of feature extraction. The following are the reasons why image preprocessing is important:

- It is important technique for creating a level of similarity in the general features of leaf image, like the size aspect. This enhances the comparison between leaf images.
- It is use for noise reduction and image enhancement.
- It improves the quality of image information.
- It eases the process of feature extraction, on which the recognition depends.

Before the process of feature points extraction some adjustment should be done with the segmented and binarized leaf image [7]. The feature points are calculated by using geometric centered. The Leaf is moved to the centre by taking the leaf image into a fixed calculated frame and removes the unnecessary white spaces without affecting the Leaf image such that the leaf image is in the centered of the frame. For this first divide the whole frame of the leaf image into 10*10 squares row-wise and column wise and find the variance (Leaf is considered to be binary and consists of only black and white pixels).If a square block has a zero variance we remove that square, otherwise restore.

IV. ALGORITHM

Algorithm for Leaf Recognition System.

The proposed algorithm is as shown below:

Step 1: Get the input leaf image.
Step 2: Convert color leaf image into grayscale image.
Step 3: Convert gray scale leaf image into black and white image.
Step 4: Get geometric centre.
Step 5: Split leaf image vertically and obtained vertical feature points.
Step 6: Split leaf image horizontally and obtained horizontal feature points.
Step 7: Repeat the step 1 to step 7, for all leaf images in database use for training.
Step 8: Train the feedforward back propagation neural network for all leaf images use in database.
Step 9: Get the input leaf image to be recognized.
Step 10: Perform step 1, Step 2, Step 3, Step 4, Step 5 and Step 6.
Step 11: Compare the feature point of leaf image to be recognize.
Step 12: Display the recognize leaf image, name of leaf image and recognition time.
Step 13: Display the time require for feature extraction and training .

V. CLASSIFICATION

Image classification is the final step in any pattern recognition problem.

It is of two types. They are:

i) Supervised classification and
ii) Unsupervised classification

In supervised classification, a priori knowledge of the images to be classified is known. Hence, the classification is simply a process of testing whether the computed classification agrees with the priori knowledge.

In unsupervised classification, there is not any priori knowledge on the images to be classified. Hence, the classification is a little bit more tedious since we have no prior knowledge of the various data classes involved. There are various classification techniques. In this paper, classification approach is artificial neural network based on the supervised classification.

VI. CONCLUSION

Image processing techniques are used for extracting the morphological parameters that are having some significance and effect on the classification of the leaves. For recognizing the correct image of leaf the leaf recognition system is implemented. This system proves useful for those that finds trouble to recognize correct leaf. This system is for those people keeping in view who use the plant leaves for making the Ayurveda medicine as well as it can be use as best learning tool for botany students. The leaf recognition system is developed by using neural network and feature points extraction. Before extraction of feature points some

preprocessing technique are applied like segmentation, binarization and digitization to leaf images.. All horizontal and vertical feature points are extracted and trained with neural network and compare the input leaf image with the leaf images in database to recognize the correct plant leaf. The recognition is based on the percentage of similarity[12].

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