International Conference on Advances in Materials, Computing and Communication Technologies
In Association with International Journal of Scientific Research in Science and Technology
Volume 9 | Issue 1 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)

A Review On Plant Recognition System

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ABSTRACT

Nature is closely related to man. Information technology has revolutionized and automated many fields and has not left nature too. In that manner, automated recognition systems for plant have been formulated by researchers in order to perform classification and identification in an efficient and accurate manner. The recent advancement in Science and technology has made it possible through feature extraction in image processing. This paper encompasses the plant recognition system analyzed by researchers. The paper discusses about various features which accounts for the classification and recognition of the plants.

Keywords : Noise Removal, Classifier, Feature Extraction, Leaf Recognition, Image Processing

I. INTRODUCTION

Plants have been classified by humans binomially based on their physical and morphological characteristics. Visual means for classification cannot be made by all except Botanists. Normal humans find it difficult to map the exact group to which a plant belongs. In order to solve these issues, an automated classification technique has been constructed. Various classification techniques such as SVM, KNN, PNN, RBPNN Classifier Radial basis probabilistic neural network and k-means classifier are analysed to obtain better results. The shape, texture and colour of a leaf are the important characteristics for classification. The appropriate features are extracted for classification.

II. LITERATURE SURVEY

Plants are used in a variety of industrial applications such as herbs and ingredients in ayurvedic medicines, biofuels, biomass, etc. India has vast history of using plants as a source in various fields including medicine. With the aid of advanced information technology, image processing and machine learning techniques, automatic plant identification and classification will enhance the automatic enhancement systems with more functionality, such as automatic labeling and flexible searching. Image segmentation and object recognition are two aspects of digital image processing which are being increasingly used in many applications including leaf recognition.

Digital image processing is the use of the algorithms and procedures for operations such as image enhancement, image compression, image analysis, mapping, geo-referencing, etc. The influence and impact of digital images on modern society is tremendous and is considered as a critical component in variety of application areas including pattern recognition, computer vision, industrial automation and healthcare industries. Image processing can be roughly categorized as follows: imaging, image de-noising, image restoration, image coding, image segmentation, image transformation, object representation and recognition, and content-based image retrieval. Typical tasks for computer vision are scene interpretation, object recognition, optical character recognition, registration, feature extraction and video tracking. Edge detection methods utilize intensity gradients to detect the boundaries of objects. However, edge detection methods usually generate edges that are not closed contours, and this causes difficulties for later processing such as object recognition.

Swati P. Raut et al. in her paper for plant recognition discusses about the identification of plants by capturing the image of the leaf in smart phone and uploading in cloud, where trained images and related information are already stored. Plant classification result is obtained by matching the images with the database. The features of leaf extracted for matching and classification include shape, area, perimeter, ratio of major and minor axis length, vein structure indicating angle of sub-veins with major vein and texture. The leaf image is converted into binary in order to get proper edges which facilitate in extraction of features easily.

Aparajita Sahay and et al. carried her research on leaf analysis for plant recognition in which the query image is pre-processed to remove unwanted noise. Then interesting points and computing SIFT descriptors are identified. Weighted K-Nearest Neighbor (KNN) search methodology is used to compare features of query image with images in database and top three matching plant species are returned as a result. The system is implemented as a Windows phone app.

Md. Majedul Islam et al. proposes a method where Convolutional Neural Network (CNN) technique is used to classify plants using leaf images. Usage of Adam optimizer and automatic Learning Rate reduction technique the model provides promising accuracy. This system was trained on 3600 RGB leaf images of 2 categories for 6 different plant species. The model reported promising results with validation accuracy as 95.86% and training accuracy as 96.54%. Different pre-processing techniques such as background whitening, noise removal are used.

Amgad Muneer et al. analyses two classifiers, namely Support Vector Machine (SVM) and Deep Learning Neural Network (DLNN). The two models have been tested on dataset, which contains 1000 leaves. The experimental results showed that SVM achieved 74.63% recognition accuracy, and DLNN achieved 93% recognition accuracy for both the experimental model and the developed mobile app. Furthermore, the processing time was 4 seconds for SVM and 5 seconds for DLNN classifier, while the processing time using the mobile app was 2 seconds only.

N. Valliammai et al. discloses a computerized plant recognition that mainly suppresses noise in the input image leading to stable feature extraction of plants. A system where both multiple Gaussian and speckle noise can be removed and restored is proposed, so that the image becomes noise free and produces clear vein and shape of the leaf which are highly essential for further process. Hybrid filter method is developed to remove the noise, enhance the quality of image and thereby for producing better results compared to other traditional filters. Different parametric metrics are used to evaluate the performance of the hybrid filter by giving suitable results when compared to other traditional filters. However, compared with the flower, fruit, stem, branches, and other organs, plant leaves exist in most of the year and can be easily

collected. Plant leaves contain a lot of essential feature information, such as the leaf blade, margin, texture and other information. Meanwhile, these features can be directly observed, and also can be captured efficiently and accurately by digital equipment to obtain the corresponding digitized images. From the above papers, we can come to a conclusion that Leaf is an ideal organ for image-based plant recognition.

III. PLANT RECOGNITION SYSTEM

In general, predicting and identifying the plant automatically through image processing follows the following process. The system captures image, preprocesses the captured image, extracts the required features and matches the features with the database containing the stored results and finally recognizes the image.

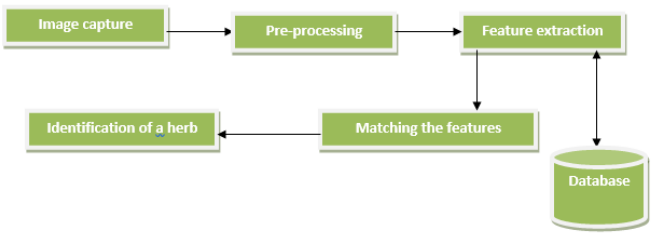

Fig. 1 Plant Recognition System

Image Acquisition

Leaf images were taken using a portable webcam. When the herb sample is captured by webcam, the captured image is sent to open CV-python wirelessly and is shown directly in the GUI after the image push button in the proposed graphics interface is pressed.

Image Pre-Processing

In order to extract any specific information, pre-processing image steps have been performed before the actual image data analysis. The processing step began with the conversion of the RGB color image to the grey image, as a wide space is required to hold the RGB image. The red, green and blue (RGB) have their respective intensities been identified.

Feature Extraction

A feature is a kind of object that is different from other objects' corresponding characteristic, or a collection of these characteristics and features. It is the data that can be extracted after measurement or processing. For the image, each image has its own features that can be distinguished from other types of images, some are natural features that can be intuitively felt, such as edge, brightness, color and texture etc.; some can be obtained after transforming or processing, such as variable moments, the histogram and others. In terms of plant leaf recognition, mainly from the leaf shape, texture and color are the three characteristics that determine the plant. The other features are Perimeter Convexity, Standard Deviation of color, Perimeter Ratio of length and width, homogeneity, Compactness, Circularity, Eccentricity, Kurtosis of color, Irregularity, Energy, Skewness of color, Uniformity, Length/perimeter, Contrast, Correlation, Area Convexity, Narrow Factor, Rectangularity, Elliptical eccentricity, Maximum probability, Zernike Moments, Standard deviation, Mean of color, Entropy and Aspect ratio.

IV. CLASSIFICATION

Classification is a very important method of data mining, which is based on the existing data to learn a classification function or construct a classification model (that is, a classifier). The system employs any one of the classifiers such as Support Vector Machine (SVM), Probabilistic Neural Network (PNN), Artificial Neural Network (ANN), k-nearest neighbor (KNN), Classifier Radial basis probabilistic neural network (RBPNN), Random forest classifier (RF), k-Means Classifier and Deep Learning Neural Network (DLNN) based on the need.

Deep Learning Neural Network (DLNN)

The approach used in this study is also commonly known as Tensorflow. The Tensorflow is a learning machine that works on a large scale in heterogeneous situations. It uses dataflow charts to represent computation, shared state, and changes towards this state. It maps the nodes of data flow graphs across multiple machines in bundles and within a system through different computing devices, including multicore Central Processing Unit (CPU) and Graphical Processing Unit (GPU).

Support Vector Machine (SVM)

Support Vector Machines are based on the concept of decision planes that define decision boundaries. A decision plane is one that separates between a set of objects having different class memberships. An SVM training algorithm builds a model that assigns new examples into one category or the other, making it a non-probabilistic binary linear classifier. New examples are then mapped into that same space and predicted to belong to a category based on which side of the gap they fall on. It can be used for classification, regression, or other tasks. Intuitively, a good separation is achieved by the hyper plane that has the largest distance to the nearest training data point of any class (so-called functional margin), since in general the larger the margin the lower the generalization error of the classifier.

k-nearest neighbor (KNN) Classifier

The adjacent algorithm or k-nearest neighbor (KNN) classification algorithm is one of the simplest method in the data mining classification technology. K nearest neighbor is that each sample can be represented by its closest K neighbors. The core idea of the KNN algorithm is that, if a majority of a sample of the k nearest neighbors in feature space belong to a category, then the sample also belong to this category, and has the characteristics of the samples in this category.

Probabilistic Neural Network (PNN) Classifier

The main idea of the Probabilistic Neural Network (PNN) is to use the Bayes decision rule to make the expectation risk minimum of the error classification, and separate the decision space in the multi-dimensional input space. It is a kind of artificial neural network based on the statistical principle and a feed-forward network model using the Parzen window function as the activation function. PNN absorbs the advantages of the radial basis neural network and the classical probability density estimation, which has a more remarkable advantage in pattern classification compared with the traditional feed forward neural network. No matter how complex the classification problem, as long as there is enough training data, it can guarantee the optimal solution of the Bayes criterion.

Radial basis probabilistic neural network (RBPNN) Classifier

It is a new kind of feed-forward neural networks, which are developed on the basis of the radial basis function neural network (RBFNN) and PNN. RBPNN network structure is also divided into input layer, hidden layer, output layer. But the network with two hidden layers, the first hidden layer is nonlinear processing layer, it implements the nonlinear classification of input or the nonlinear transform of the input samples; the second hidden layer is the selective summation and clustering on the first hidden layer outputs.

Hypersphere Classifier

Hypersphere classifier is a kind of classification method to compress the reference samples. By compressing the sample data, effectively reducing the storage space and computing time there is no effect on the recognition rate. The basic idea is to use a hypersphere to represent a cluster point (a sample in a high dimensional space is a point, a category corresponds to a set of points in space). We can use a series of hyperspheres to fit the high dimensional space where the point locates. The overall idea is to

approximate the number of hyperspheres for each sample, and simultaneously, extends the radius of the hyper sphere to include a number of sample points. Reducing the storage quantity of the hypersphere so as to eventually contain all the sample points and the multi sample space.

Back Propagation (BP) Classifier

This neural network is a multi-layer feed-forward network consisting of the nonlinear conversion units, which is composed of the input layer, the hidden layer and the output layer. Under normal circumstances, a three layer BP networks can complete mapping of arbitrary n-dimension to m-dimension, which needs only one hidden layer. When the BP neural network is used as a classifier, the input of the neural network is n components, and that is the n characteristic of plant leaves.

Random forest (RF) Classifier

Random forest classifier builds a forest in a random way, the forest is composed of many decision-making trees, and there is no association between each random decision tree forests. After getting the forest, when there is a new sample, every decision tree of the forest is made to carry on the next judgment to see the sample should belong to which category, and then to see which category is selected the most, predicts the sample for this class.

k-Means Classifier

The k-average or k-means algorithm is a widely used clustering algorithm. It is the mean of all data samples within the clustering subset as the representative of the clustering. The main idea of the algorithm is through an iterative process to make the data set divide into different categories, and makes the evaluation of clustering criterion function achieve the optimal performance, so that the generated cluster is compact. This algorithm is not suitable for processing discrete data, but it has good clustering effect for continuous data.

Other Classifiers

In addition to some commonly used classifiers, with the continuous development of plant identification, there have been some new recognition algorithm or rarely used classification methods: Radial Basis Function (RBF) neural network, Linear Discriminant Analysis (LDA) algorithms, convolutional neural network (CNN) and Hidden naive bays (HNB) classifier.

V. CONCLUSION

There are many techniques relevant for the purpose of automated recognition for plant leaf recognition. This review is used to identify different features and classifiers which are used for recognizing a plant leaf. From the study of above classification techniques we can come to a conclusion on what technique shall be used for identification. Some technique may be simple while the other may be complicated. While choosing the best method performance, accuracy, feasibility and efficiency also has to be noted. Based on the number of training samples used and the drawbacks while choosing the classifier or extracting the features also play a major role in choosing a methodology.

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