Predictive Model to Identify a Medical Plant and Assess Its Health

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Abstract: This The term “medicinal plant” include various types of plants used in Ayurveda and herbalism ("herbology" or "herbal medicine"). Plants have been used for medicinal purposes long before prehistoric period. Among ancient civilizations, India has been known to be rich repository of medicinal plants. The forest in India is the principal repository of large number of medicinal and aromatic plants, which are largely collected as raw materials for manufacture of drugs and perfumery products. About 8,000 herbal remedies have been codified in AYUSH systems in INDIA. Ayurveda, Unani, Siddha and Folk (tribal) medicines are the major systems of indigenous medicines. Among these systems, Ayurveda and Unani Medicine are most developed and widely practiced in India. Recently, WHO (World Health Organization) estimated that 80 percent of people worldwide rely on herbal medicines for some aspect of their primary health care needs. According to WHO, around 21,000 plant species have the potential for being used as medicinal plants. Numerous plants in india are undiscovered the medical qualities, properties and the nutrients. A fully automated method for the recognition of medicinal plants using computer vision and machine learning techniques has been presented. Leaves from 24 different medicinal plant species were collected and photographed using a smart phone in a laboratory setting. A large number of features were extracted from each leaf such as its length, width, perimeter, and area, number of vertices, color, perimeter and area of hull. Several derived features were then computed from these attributes. The best results were obtained from a SVM classifier using a 10-fold cross-validation technique. With an accuracy of 90.1%, SVM classifier performed better than other machine learning approaches such as the k-nearest neighbor, Naïve Bayes, KNN and neural networks.

I. INTRODUCTION

Ayurveda is the ancient Indian system healing using medicinal plants available naturally in the Indian subcontinent, also called as the mother of healing arts. History says, Ayurveda originated more than 5,000 years ago and was developed by 18 siddhars in the Tamil Siddha tradition. They are Agasthiyar, Thirumoolar, Korakkar, Pulipaani etc., Tamil Siddhars has said that all herbs on the earth contains medicinal values, curing the diseases and also teaches us how to balance of our body, sense of organs, mind and soul. According to World Health Organization (WHO), 65% to 80% of world population currently use medicinal plants as remedies for various diseases. Because of environmental factors and lack of awareness about medicinal plants in human beings, plants are becoming extinct and rare. Botanist identify the medicinal plants based on biological characteristics. This is lengthy process and consumes more time to identify plants species because one plant may have a similar kind of morphological features with another plant. Incorrect identification will create a bad impression about Ayurvedic medicines and produce unexpected side effects in human beings. It is difficult for a person to remember names of every medicinal plant hence it is very much essential to build an automatic identification and classification system for greater benefit. The purpose of automatic identification and classification of medicinal plants is to educate and provide correct knowledge to common people and farmers, which will help to increase the cultivation of medicinal plants. This system also provides medicinal information details and species database to the suppliers, agents, pharmacy students, pharmaceutical companies, research students, Ayurveda practitioners, herbal plant researchers, botanists and to the cosmetic industry. Plants are identified based on leaves, flowers, bark, seed, fruits, roots, stem and other parameters like height, region of its growth and environmental factors. This paper will give brief review about medicinal plants identification and classification using different technologies used in preprocessing, feature extraction and classification / segmentation phases. An image contains important information that can be retrieved by using some computational method. Image segmentation is a task for partitioning an image into smaller parts that are more meaningful. Interestingly, it can best at identification and classification of some region of interest. The segmentation is performed based on some common properties of the objects present in an image like color, texture and, shape etc. Image segmentation is a preprocessing step for image processing generally performed by using two methods

(i)Traditional method and

(ii) Soft computing method.

II. RELATED WORK

Identification and classification of a medicinal plant leaf and its disease is a complicated task to perform. Many researchers have worked on both traditional and soft computing approached for Identification and classification of a medicinal plant and the segmentation of infected area of leaves from the disease. In this part, we try to encapsulate some of the soft computing approaches that have been utilized to perform this task. Support vector machine with radial basis function being its kernel has been used most often to identify and classify the disease present with an image of leaf with the disease. The neural network with its learning and training capabilities has also been deployed for this task.

Generally, it has been seen from the literature that SVM has been applied for the identification of plant diseases. Whereas the learning ability of CNN also contributes for the same purpose. As it is seen from the survey authors have majorly focused on the identification of a disease from the specific plant because it is a hard task to identify and categorize the disease among different categories. As deep learning algorithms are appearing in the number of applications a novel work introduced by Yang Lu et al. have applied convolution neural network for the identification of rice diseases. Manojkumar P., Surya C et al. [1] collected 20 random Ayurvedic front and back side leaves of 40 different species. The Weka tool is used for identification of medicinal plants using machine learning algorithms. Color and texture features of leaves are extracted from color and binary images. Support Vector Machine (SVM) and Multilayer perceptron (MLP) classifiers are used to identify the leaves based on following features Geometric, centroid-radii (CR) distances, colour features, texture features, HU invariant moments and Zernike moments. MLP (94.5%) out formed than Support Vector Machine (SVM).

Authors proposed a system for recognition of medicinal leaves using neural network [2]. Five species of medicinal plants leaves are considered. The leaf edge detection is done by Prewitt Edge detection algorithm. The data is trained by Artificial Neural Network (ANN) classifier and compare to others leaves, bilva leaf (90.584%) and castroil leaf (83.084%) yield good accuracy. Using machine learning techniques, Adams Begue et al. proposed a method for automatic identification of medicinal plants [3] using leaf features. Five different classifiers are used for classification purpose. Among them 90.1% accuracy is obtained from random forest classifier than k-nearest neighbour, naive Bayes (NB), SVM and neural networks. To identify and classifying the medicinal plants in Traditional Chinese Medicine (TCM) [4] system, shape features and texture features of leaves are considered. Extracted features are feed into the Support Vector Machine (SVM) classifier and recognition accuracy is 93.3%. Texture and color features of flowers are extracted from Gray-Level Co-occurrence Matrices (GLCM) and Color moment. Extracted features are feed into the Neural Network [5] classifiers. The individual accuracy of GLCM and Color moment is 40% and 65%. The Hybrid combination of accuracy is 95%.

Authors considered three different datasets for classification of flowers based on color and shape features, namely Oxford Flower 17 and Oxford Flower 102 and Jena Flower 30 dataset [6]. Different methods are used for fusion, pooling, extraction and detection of flowers. Compared to other two data set, Jena Flower 30 dataset having highest classification accuracies of 94%. Electronics and Telecommunication Engineering students [7] developed automatic recognition system for mango fruits using edge and color based segmentation methods. K-means clustering, and canny edge detection methods used in image segmentation. Color based algorithm outperform and yield 85% than edge-based algorithm.

In paper [8] Authors have done a brief review on following classification methods used in medicinal plants identification namely Probabilistic Neural Network, Support Vector Machine and Principal component analysis. In their proposed work they have taken the shape, color and vein features of neem leaves and for identification purposes, they have calculated the Aspect Ratio, Centroid, Area, Perimeter and Roundness feature of leaf. To develop fruit recognition system [9] authors considered fruit shape, color and texture features. The extracted features are trained by three different classifiers namely, K – Nearest Neighbour (k-NN), Binary Classification Tree and Support Vector Machine (SVM). Best result yield by SVM classifier with the accuracy of 100%. A novel approach is proposed for classifying Ayurvedic plants based on leaf morphological feature. Authors created a 208-leaf image dataset using 26 different species. For edge detection Laplacian filtering method is applied. Leaf factors are calculated from the morphological features of the leaf images to find the most matching leaf from the training and testing database [10]. The proposed algorithm yield the 93.7% of accuracy.

III. GENERALIZED MODEL

Figure 1 illustrate the General model of medicinal plants identification and classification system. Following are the steps used in image processing technique for identification of medicinal plants.

- Plants images are captured from digital cameras, scanners, smart phones and plant dataset. Collected images are considered as input image to the system.
- Input image is preprocessed to remove noise, enhance, segment, filtering, cropping and resizing the images before applying classification techniques. The objective of this step is to focus only interest parts

of the image and remove unrelated data from the picture. This will increase the system performance and computational speed.

- Next step is to extract the features from original plants images and then feed into the classifier for recognition purpose. Features extraction and classification is done by many image processing techniques few of them are listed in figure 1.

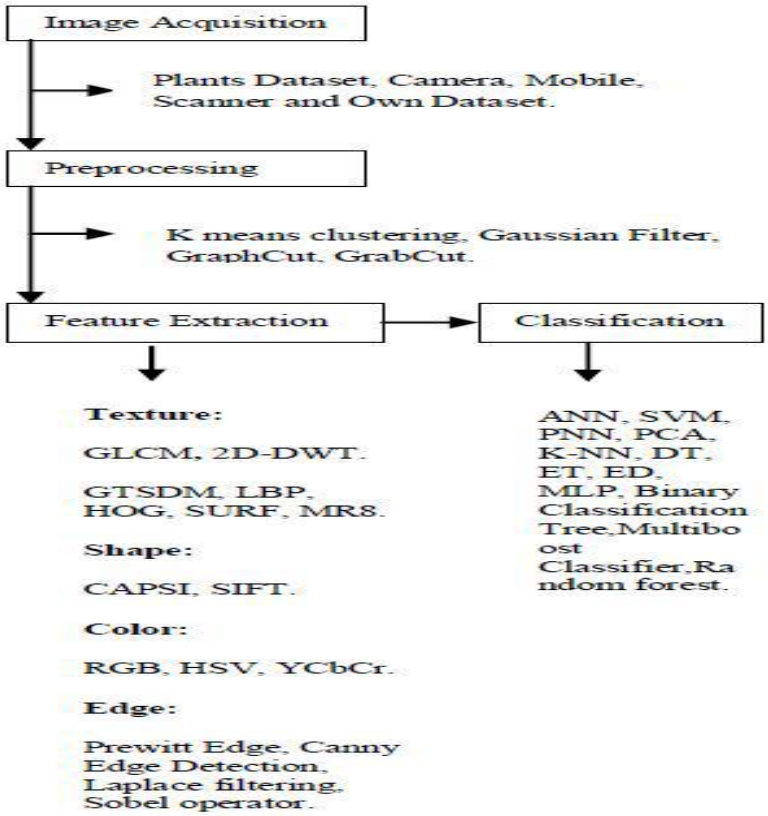

Fig.1 Image Capturing and segmentation Processes Flow

- For plants identification purpose many of the authors used texture, shape, color and edge features of leaves, flowers and fruits/seeds. Different classifiers are used for identification purpose. The comparative study of classifiers and feature extraction techniques are shown in table 1.

Title	**Table Column Head**		
	Features	***Methods***	***Accuracy (%)***
Identification of Ayurvedic Medicinal Plants	Leaves Color, Texture	SVM, MLP	MLP : 94.5
Herbal Plant Identification	Leaf texture	HOG, LBP SURF and Multiclass SVM	91.4
Recognition of Medicinal Leaves	Leaves	Prewitt Edge detection algorithm & ANN	Bilva leaf : 90.584 Castroil leaf: 83.084
Identification of Medicinal Plants	Leaves	Random forest classifier	90.1
Classification of Medicinal Plants	Leaves shape and Texture	SVM	93.3
Classifying Ayurvedic Plants	Leaves morphological features	Laplacian filtering method	93.7

Table 1: Summary of Related Works

IV CONCLUSION

History of Ayurveda says every plant has a medicinal value, so the identification of which part of the plant has medicinal value and for which disease this medicine is going to use is very essential to mankind. Medicinal plant parts like leaves, flowers, bark, seeds, fruits, roots, and stem are used in many disease diagnosis. Through these

plants parts botanists and herbal practitioners are identifying the medicinal plants manually which is time consuming process. The objective of this study is to reduce manual work and increase the efficiency by the automatic identification of medicinal plants using image processing techniques. From the literature survey the majority of the researchers used leaf features for the classification of medicinal plants and less research work was done in classification of medicinal plants using flowers and fruits/seeds. Our work is to enhance the research in identification and classification of medicinal plants as herbs, shrubs and trees using leaves. Automatic identification and classification of medicinal plants will provide medicinal knowledge to common people and farmers which helps in increasing production of such essential plants. This automatic classification system also helps botanists, consumers, forestry services, taxonomists, pharmaceutical companies and Ayurveda practitioners to identify and classify the medicinal plants without any human assistance.

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