Comprehensive Study of Medicinal Plant Classification Using Artificial Intelligent Techniques

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Abstract: Information about medicinal plants has been transmitted gradually from generation to generation. Medicinal plants are used as a medical resource in almost all cultures by ensuring safety, quality and effectiveness of medicinal plants and herbal drugshave become a key issue in industry in developing countries. Awareness of traditional knowledge of medicinal plants can play a key role in the exploitation and discovery of natural plant resources. In order to maintain this knowledge, comprehensive approach and collaboration are needed to maintain historical records on medicinal plants and use these resources in favor of human beings, before they are destroyed forever. There are different techniques that are carried out using some effective features like Area, Color moment, Edge, Shape feature, texture feature etc. There are different types of identification techniques that can be used to find the medicinal plant.

***Index Terms* – Image Processing, Plants leaves ,Artificial Intelligence.**

I. INTRODUCTION

Natural products derived from plants for the treatment of diseases have proved that nature stands a golden mark to show the interrelationship between man and his environment. Plant is an important source of medicine and plays a key role in world health [12]. Medicinal plants may be defined as those plants that are commonly used in treating and preventing specific ailments and diseases. These plants are either “wild plant species” those growing spontaneously in self-maintaining populations in natural or semi-natural ecosystems or the contrasting “Domesticated plants species” those that have arisen through human actions such as selection or breeding and depend on management for their existence [13]. The researches and utilization of herbal medicine in the treatment of diseases is increasing every day.

Herbal medicines [14] proved to be the major remedy in traditional system of medicine. They have been used extensively in medical practices since ancient times. This prompts the development in the practices of medicinal plants. The reasons are because of their biomedical benefits as well as place in cultural beliefs in many parts of world in the development of powerful therapeutic agents. Medicinal herbs or plants have been known to be an important potential source of therapeutics or curative aids. The use of medicinal plants [15] has attained a commanding role in health system all over the world. This involves the use of medicinal plants not only for the treatment of diseases but also as potential material for maintaining good health and conditions. Many countries in the world, that is, two-third of the world’s population depends on herbal medicine for primary health care due to their cultural acceptability, better compatibility and adaptability with the human body and pose lesser side effects [16].

From the records, most of the used drugs contain plant extracts. Some of them contain active ingredients (bioactive components or substances) obtained from plants. Through recent researches, plant-derived drugs were discovered from the study of curative, therapeutic, traditional cures and most especially the folk knowledge of indigenous people and some of these claims and believe of people are irreplaceable despite the recent advancement in science and technology[17]. Some of the drugs believed to be obtained from plants are aspirin, atropine, artimesinin, colchicine, digoxin, ephedrine, morphine, physostigmine, pilocarpine, quinine, quinidine, reserpine, taxol, tubocurarine, vincristine and vinblastine [18]. However, the knowledge of herbal medicines for treatment of diseases is confined to mostly the practicing herbalists or plant scientists with the belief that herbal medicines will lose their potency if revealed to other people. Although some herbs may have medicinal values, sometimes the medicinal preparation inflicts certain side effects. In view of this, the present study focuses on the knowledge on medicinal uses of plants

and the scientific investigation to confirm their medicinal values [19, 20]. Plant recognition framework is mainly composed of three steps: image preprocessing, feature extraction, and pattern classification. The image, found by camera or other devices, generally has some restrictions or interference with noises. Before feature extraction, it is required to carry on image preprocessing admitting image denoising, image segmentation, image enhancement, etc [23].

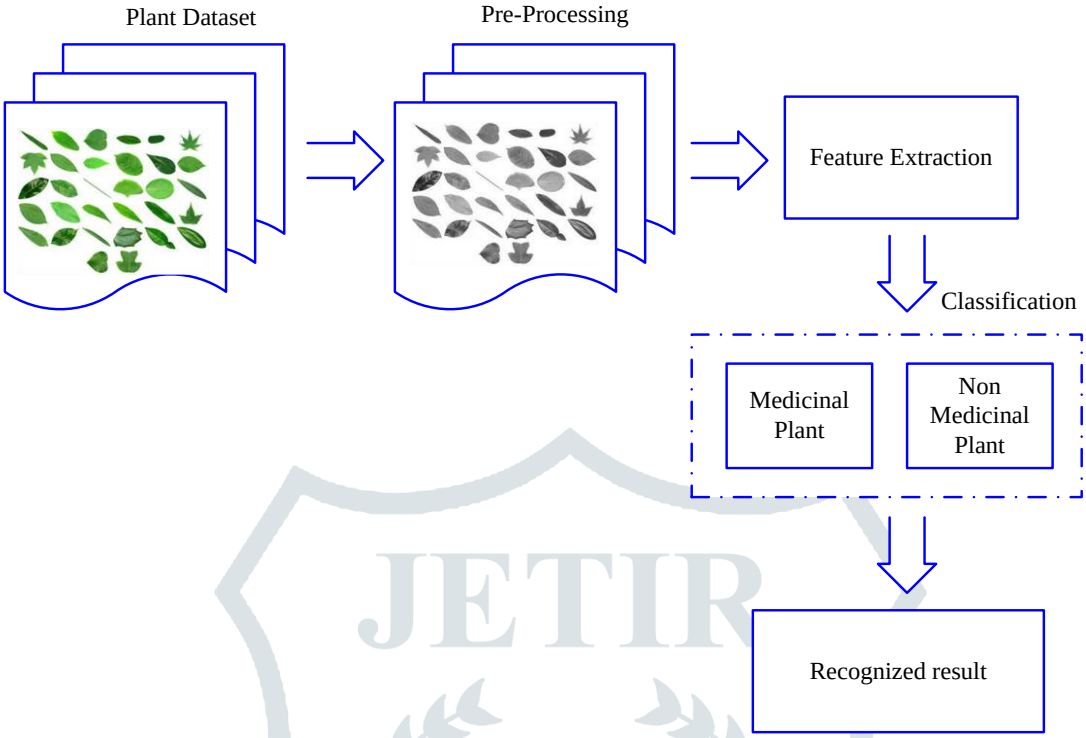

Figure 1: General structure of medicinal plant classification model

Figure 1 is the typical process of plant leaf classification procedure using image preprocessing. Initially image preprocessing is carried out to eliminate noisy contents, and then the features of leaf images are extracted. Generally speaking, leaf feature consists of shape information, texture information, and color information. Shape information can be extracted by computing various shape descriptors [21]. In the stage of image classification, all extracted features are taken as the feature vector. And then these vectors are classified by the classifier [22]. Finally, the recognition results are obtained from this we can see that feature extraction and classification are the key techniques.

II Literature survey

For the large proportions of world's population medicinal plants continue to demonstrate a dominant role in the healthcare system and this is mainly true in developing countries, where herbal medicine has continuous history of long use. Many researchers have created an attempt to improve the plant classification system efficient plant classification system for medicinal use by exploiting pattern recognition and image processing techniques established on plant leaves, flowers, barks and fruits. In order to identify plants that are unfamiliar and to differentiate the medicinal plants with similar features, it is necessary to classify them with distinguishing features. The connected literature survey has been carried out to know the state of the art.

Research articles related to medical plant identification

For the large proportions of world's population, medicinal plants continue to show a dominant role in the healthcare system and this is mainly true in developing countries, where herbal medicine has continuous history of long use. Several researchers have made an attempt to develop plant classification system for medicinal use by exploiting pattern recognition and image processing techniques based on plant leaves, flowers, barks and fruits. Thus, in the literature, several works related to plant classification using artificial intelligence techniques can be found.

Aitwadkar et al. [2] have introduced an identification of Indian medical plant by using ANN. This method was to extract edge, area and color based features from leaf images. The result proves that this method is a simple and efficient. Similarly, Renann et al. [3] have presented an image processing techniques in conjunction with artificial neural network to extract relevant features related to leaf in order to detect and identify some Philippine herbal plants. Chaki et al [13] have developed a methodology of characterizing and recognizing plant leaves using a combination of texture and shape features. Texture of the leaf is modeled using Gabor filter and gray level co-occurrence matrix (GLCM) while shape of the leaf is captured using a set of curvelet transform coefficients together with invariant moments. It was tested on the Flavia dataset.

Similarly, Nithiyanandhan and Bhaskara [6] have explained a ANN based medicinal leaf classification. Here, leaf edge detection is done by Prewitt Edge detection algorithm. The data is trained by Artificial Neural Network (ANN) classifier and compare to other leaves, bilva leaf (90.584%) and castroil leaf (83.084%) yield good accuracy. Moreover, Riddhi et al. [7] have presented a Texture and color features based flower classification. Initially, Gray-Level Co-occurrence Matrices (GLCM) and Color moment are extracted from each flower. Then, these features are given to the ANN to classify a flower classes. A. Bakhshipour and A. Jafari [25] discovered a method to integrate several shape features to establish a pattern for each variety of the plants. To enable the vision system in the detection of the weeds based on their pattern, support vector machine and artificial neural networks were employed. Four species of common weeds in sugar beet fields were studied. Shape feature sets included Fourier descriptors and moment invariant features.

Kan et al. [8] have explained a medical plant identification using support vector machine. Medicinal plants are the main source of traditional Chinese medicine (TCM), which provides the basic protection of human health. The research and application of medicinal plant classification methodology has important implications in the TCM resource preservation, TCM authentication, and the teaching method of TCM identification. This paper proposes an automatic classification method based on leaf images of medicinal plants to address the limitations of manual classification method in identifying medicinal plants. The approach will first preprocess the leaf images of medicinal plants, then it will compute the ten shape feature (SF) and five texture characteristics (TF), finally, it will classify the leaves of medicinal plants using support vector machine (SVM) classifier.

Moreover, Manojkumar et al. [9] have explained an Identification of Ayurvedic Medicinal Plants by Image Processing of Leaf Samples. Here, Color and texture features of leaves are extracted from color and binary images. Then, 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. To identify and classify the medicinal plants in Traditional Chinese Medicine (TCM) Kan et al. [10] developed by considering shape features and texture features of leaves. Extracted features are fed into the Support Vector Machine (SVM) classifier and recognition accuracy of 93.3% is obtained. V.N.T. Le et al [24] have developed an algorithm which was based on the combination of Local Binary Pattern (LBP) operators, for the extraction of crop leaf textural features and Support vector machine (SVM) method, for multiclass plant classification. It presents the accuracy of combined LBP algorithms, trained using a large dataset of canola, radish and barley leaf images captured by a testing facility under simulated field conditions.

In 2015, T. Munisami et al [11] have developed recognition system capable of identifying plants by using the images of their leaves. A mobile application helps to allow user to capture pictures of leaves and upload them to server. The server runs pre-processing and feature extraction techniques on the image before a pattern matcher compares the information from this image with the ones in the database in order to get potential matches. The length of leaf, width of leaf, area of leaf, hull area, perimeter of the leaf etc are the features extracted.

D. Hall et al [22] have evaluated the effectiveness of traditional hand-crafted features and proposed the use of deep convolutional neural network (ConvNet) features. They introduced a range of condition variations to explore the robustness of these features, including: translation, scaling, rotation, shading and occlusion. Evaluations on the Flavia dataset demonstrate that the plant recognition under the complex background, the accuracy was up to 97.3 %.

Eid, H.F. et al [30] have presented an efficient computational model for plant species identification using digital images of leaves. The proposed identification system combines the leaf biometric features, where shape and venation features are used for leaf image classification. 10 combined biometric leaf features are extracted and passed to Hidden naaive bays classifiers for categorization. Several experiments are conducted and demonstrated on 1907 sample leaves of 32 different plant species taken form Flavia dataset. Where, the proposed plant identification model shows a consistent performances of 97% average identification accuracy.

III.CATEGORIZATION AND ITS DISCUSSION

Even today, the fight against diseases must be carried on relentlessly. Traditional plant medicines still enjoy significant position in the modern-day drug industries due to the minor side effects as well as the synergistic action of the combination of compounds. Here all the articles taken for the survey are categorized, based on three different criteria: technique, application, and parameter-based measures.

3.1 Categorization Based On Techniques

References	Year	Features	Algorithm	Accuracy	Total images used
[1]	2018	Area , color	ANN	75%	50
[2]	2017	Color moment	ANN	98.61%	600
[3]	2017	Edge	ANN	92%	534
[4]	2017	GLCM, color moments	ANN	95%	200
[5]	2017	Shape feature (SF) and texture characteristics	SVM	90%	240
[6]	2016	Color, texture	SVM	94.5%	20
[7]	2017	Color, shape	SVM	93.3%	12
[8]	2015	length of leaf, width of leaf, area of leaf, hull area, perimeter of the leaf	KNN	83.5%	640
[9]	2015	Shape, Texture	ANN	87.1%	930

[10]	2015	Translation, scaling, rotation, shading and occlusion	Deep Convolutional Neural Network	97.3 %.	1907
[11]	2015	shape and venation	Hidden Naaive Bays Classifiers	97%	1907
[24]	2019	Texture features	SVM	91%	30,000
[25]	2018	Shape features	ANN and SVM	ANN-93.33% SVM-96.67%	120

Table 3.1: Overall analysis of survey 2015 – 2019

Here total 13 articles related to medicinal plant classification are taken from literature which was analyzed from 2015 to 2019. Five types of classifiers namely ANN, SVM, KNN, CNN and NB are implemented. Before classifying the plant images, the relevant features are extracted and those extracted features are fed into its proposed classification algorithm. Finally, its accuracy was tested with different input images in terms of percentage measure and tabulated in the above table 3. But some serious issues like global warming and lack of awareness of plant knowledge, the plant categories are becoming rare and many of them are about to extinct.

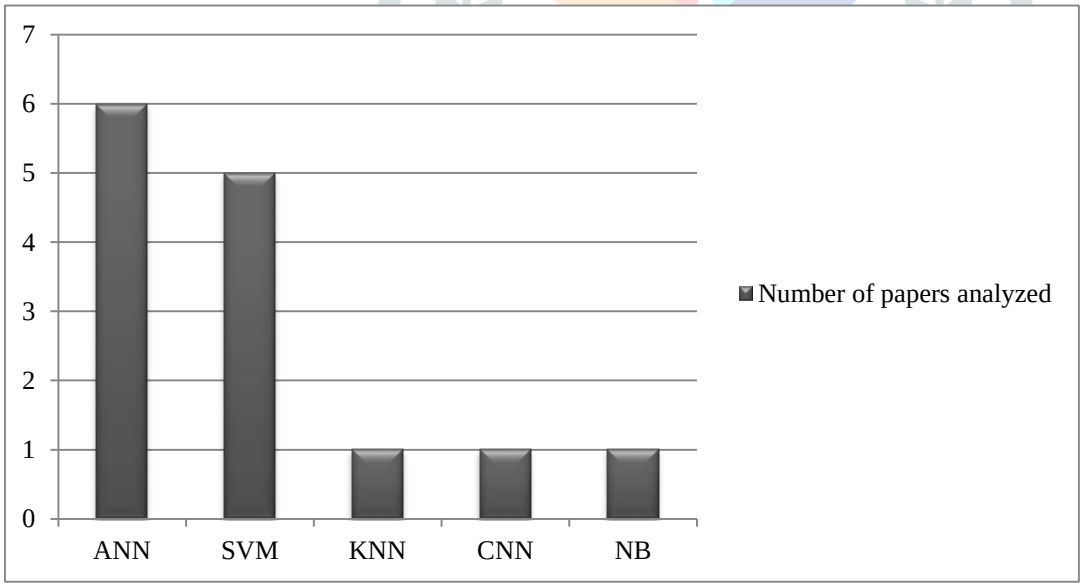

Figure 2: A comparative study of different classifiers used

The above graph shows that ANN and SVM methods for plant classification better result when compared to other approaches. Compared to ANN, there are various advantages in SVM. The main advantage of SVM is its simple geometric interpretation and a sparse solution. Unlike Artificial neural networks, the computational complexity of SVMs does not depend on the dimensionality of the input space. One of the drawbacks of the SVM is the large number of support vectors used from the training set to perform classification task. However, SVM is still considered to be powerful classifier, soon mayreplac the ANN.

IV.CONCLUSION

Medicinal plants have been playing an essential role in the development of human culture. As a source of medicine, Medicinal plants have always been at forefront for all cultures of civilizations. Medicinal plants are considered as rich resources of traditional medicines and from these plants many of the modern medicines are produced. For thousands of years medicinal plants have been used to treat health disorders, to add flavor and conserve food and to prevent diseases epidemics. In this survey, a brief overview of the notion of Plant classification and its importance in recent years. We have also discussed the different ways in which the problem of accurate plant leaf classification has been formulated in literature, and have attempted to show the comparative analysis in this work. An overview of the literature on various techniques that can be used for extraction and classification of texture feature are also discussed. Current researches are going on new techniques to be applied for more accurate methodology for plant leaf classification.

V. FUTURE SCOPE

There is a promising future of medicinal plants as there are about half million plants around the world, and most of them are not investigated yet for their medical activities and their hidden potential of medical activities could be decisive in the treatment of present and future studies.

REFERENCES

[1] Aitwadkar, Deshpande, Savant, "Identification of Indian Medicinal Plant by using Artificial Neural Network", International Research Journal of Engineering and Technology, vol.5, no.4, 2018

[2] RenannBaldovino, Anton Louise De Ocampo, Ira Valenzuela and Alvin B. Culaba, "Identification of philippine herbal medicine plant leaf using artificial neural network",IEEE conference, 2017.

[3] K.Nithiyanandhan and T. Bhaskara Reddy, “Analysis of the Medicinal Leaves by using Image Processing Techniques and ANN”, Vol 8, No. 5, 2017

[4] Riddhi H. Shaparia, Dr. Narendra M. Patel and Prof. Zankhana H. Shah,” Flower Classification using Texture and Color Features”, International Conference on Research and Innovations in Science, Engineering &Technology, vol.2, pp. 113–118, 2017.

[5] H. X. Kan L. Jin and F.L. Zhou, "Classification of medicinal plant leaf image based on multi-feature extraction", journal of Pattern Recognition and Image Analysis vol. 27, no.3, pp. 581–587, 2017.

[6] Manojkumar P., Surya C. M., and Varun P. Gopi, “Identification of Ayurvedic Medicinal Plants by Image Processing of Leaf Samples”, 2017 Third International Conference on Research in Computational Intelligence and Communication Networks (ICRCICN), pp 978-1- 5386-1931-5.

[7] H. X. Kan, L. Jin, and F. L. Zhou,” Classification of Medicinal Plant Leaf Image Based on Multi-Feature Extraction”, Pattern Recognition and Image Analysis, Vol. 27, No. 3, 2017, pp. 581–587,

[8] Munisami, T., Ramsurn, M., Kishnah, S. and Pudaruth, S., 2015. Plant leaf recognition using shape features and colour histogram with K-nearest neighbour classifiers. Procedia Computer Science, 58, pp.740-747.

[9] Chaki, J., Parekh, R. and Bhattacharya, S., 2015. Plant leaf recognition using texture and shape features with neural classifiers. Pattern Recognition Letters, 58, pp.61-68.

[10] D. Hall, McCool, C., Dayoub, F., Sunderhauf, N. and Upcroft, B., 2015, January. Evaluation of features for leaf classification in challenging conditions. In 2015 IEEE Winter Conference on Applications of Computer Vision (pp. 797-804). IEEE.

[11] Eid, H.F., Hassanien, A.E. and Kim, T.H., 2015, August. Leaf Plant Identification system based on hidden naive bays classifier. In 2015 4th International Conference on Advanced Information Technology and Sensor Application (AITS) (pp. 76-79). IEEE.

[12] Azwanida, N.N., 2015. A review on the extraction methods use in medicinal plants, principle, strength and limitation. Med Aromat Plants, 4(196), pp.2167-0412.

[13] Yuan, H., Ma, Q., Ye, L. and Piao, G., 2016. The traditional medicine and modern medicine from natural products. Molecules, 21(5), p.559.

[14] Ropiak, H.M., Ramsay, A. and Mueller-Harvey, I., 2016. Condensed tannins in extracts from European medicinal plants and herbal products. Journal of pharmaceutical and biomedical analysis, 121, pp.225-231.

[15] Paralikar, P. and Rai, M., 2017. Bio-inspired synthesis of sulphur nanoparticles using leaf extract of four medicinal plants with special reference to their antibacterial activity. IET Nanobiotechnology, 12(1), pp.25-31.

[16] Asadi-Samani, M., Kafash-Farkhad, N., Azimi, N., Fasihi, A., Alinia-Ahandani, E. and Rafieian-Kopaei, M., 2015. Medicinal plants with hepatoprotective activity in Iranian folk medicine. Asian Pacific Journal of Tropical Biomedicine, 5(2), pp.146-157.

[17] Li, F.S. and Weng, J.K., 2017. Demystifying traditional herbal medicine with modern approach. Nature plants, 3(8), p.17109.

[18] Kumar, S., Paul, S., Walia, Y.K., Kumar, A. and Singhal, P., 2015. Therapeutic potential of medicinal plants: a review. J. Biol. Chem. Chron, 1, pp.46-54.

[19] Lee, K.B., Chung, K.W. and Hong, K.S., 2013. An implementation of leaf recognition system based on leaf contour and centroid for plant classification. In Ubiquitous information technologies and applications (pp. 109-116). Springer, Dordrecht.

[20] Chaki, J. and Parekh, R., 2012. Designing an automated system for plant leaf recognition. International Journal of Advances in Engineering & Technology, 2(1), p.149.

[21] Anami, B.S., Suvarna, N. and Govardhan, A., 2008. A text based approach to content based information retrieval for Indian medicinal plants. International Journal of Physical Sciences, 3(11), pp.264-274.

[22] Anami, B.S., Nandyal, S.S. and Govardhan, A., 2010. A combined color, texture and edge features based approach for identification and classification of indian medicinal plants. International Journal of Computer Applications, 6(12), pp.45-51.

[23] Kruse, O.M.O., Prats-Montalbán, J.M., Indahl, U.G., Kvaal, K., Ferrer, A. and Futsaether, C.M., 2014. Pixel classification methods for identifying and quantifying leaf surface injury from digital images. Computers and electronics in Agriculture, 108, pp.155-165.

[24] V.N.T. Le, Apopei, B. and Alameh, K., 2019. Effective plant discrimination based on the combination of local binary pattern operators and multiclass support vector machine methods. Information processing in agriculture, 6(1), pp.116-131.

[25] A. Bakhshipour and A. Jafari, 2018. Evaluation of support vector machine and artificial neural networks in weed detection using shape features. Computers and Electronics in Agriculture, 145, pp.153-160.