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# AUTHENTICATION OF LEAF IMAGE USING IMAGE PROCESSING TECHNIQUE

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**ABSTRACT**

The aim of the work is to classify and authenticate the medicinal plant materials and herbs widely used for Indian herbal medicinal preparation. The quality and authenticity of these leaves are to be ensured for the preparation of herbal medicines. The medicinal plant leaves are thoroughly screened, analyzed and compared with the database to give the correct measures of the texture to which category the leaf belongs to. This method is adopted due to the mistaken of look-alike leaves. Using image processing technique the mistaken of look-alike leaves can be authenticated by various parameters of the leaves.

**Keywords:** authentication, standardization, principal component analysis (PCA), pattern recognition.

## 1. INTRODUCTION

Image processing is the recent growing technique in the world. It refers to the processing of digital images by means of a digital computer. Images play a major role in human perception. Image analysis is between image processing and computer vision. There are no clear boundaries for in continuum with image processing and computer vision. The useful paradigms for computerized process in determining the image is classified in to three types arelow-level process: involve primitive operation such as image preprocessing to reduce noise, image enhancement and image sharpening, mid-level: image segmentation and high-level: making sense of image recognized. Nowadays image processing plays a major role in identification of all aspects. Here image processing technique is used for medicinal purpose by extracting the features of herbal leaf and authenticating it medicinal qualities. Leavesplay the major role for the classification of plants. The sample leaves are taken from various places, plants and shape. The image is captured and further work is carried out. Comparison of test sample image with reference not only requires an experienced but is subjective and prone to human errors. By applying advanced technique of image processing and utilizing the capabilities of the recent advanced computing and data/image storage facilities and the use of computer techniques for analyzing the shape, texture, color, aspect ratio, vein structure, entropy, compactness and so on.

Section II deals with the prior and related work in which nearly of 12 to 15 reference paper are considered and the work carried out by various authors and their percentage of accuracy is given. Section III deals with identification methods available for leaf classification is mentioned. Section IV deals with the proposed methodology which clearly explains what are the techniques used and the features taken for plant classification. Section V implies the texture analysis. Section VI is about the leaf classification. In this the initial step alone is explained. Section VII is the result and discussion and section VIII is the conclusion and future work.

## 2. PRIOR AND RELATED WORK

The approach by Ross Lagerwall, SerestinaViriri [9] used PCA based texture classification and complex algorithm for the shape feature produced a result of 89.2% in which the author concentrated on the parameters like aspect ratio, compactness, linearity. The morphological feature extraction technique has been used many a times. Pravin [4] used a chromatography method which gave an accuracy of 95% who used two techniques in this. One method includes chromatography and the other is based on DNA finger printing. In the former method the leaves were dried under sunlight and shade, then powdered used with various solutions like HCl, $H_2SO_4$, KCl and take the powdered sample for testing. Shazia Sultana and Mir Ajab [5] used five features which include shape, texture, color, compactness and shape of the leaf for analyzing the leaf identification which lead to the problem of adulteration and nomenclatural controversy to misuse of this plant for specific disease. Abdul Kadir [6] approached leaf classification using twelve features like shape, color, texture, entropy etc., which gave a result of 93.75% for 32 plant leaves which was improved with the original work which gave result of 90.312%. Abdolvahabehsanirad [1] used two methods GLCM and PCA methods which gave an accuracy of 98.46%. Basawaraj proposed a text based approach for Indian medicinal plants in which a small size leaf of about 2 cm to 5 cm was identified with difficulty. Stephnen Gang Wu used a probabilistic neural network for plant classification which gave a result of 90%. Ching - Ling Lee proposed a classification of leaf image with various features and an average result over 1- NN was 82.33% and contain based method gave a result of 37.6% and 21.7%. Pande Ankita [11] proposed an approach for leaf identification based on computer aided plant species identification technique. The author used a chain code method and linear computer technique for this method in which the linear technique is used with two sets of dataset for identification. Ekshinge Sandip Sambhaji and. D.B. Andor [12], proposed an approach on leaf recognition using neural network based image processing. The author

here used a multilayer perceptron. They used a sample of 9 leafs for recognition the accuracy was about 94%. C. Ananthi [13], proposed a technique using pattern recognition of medicinal leaves using image processing techniques. The author used Statistical Package for the Social Science (SPSS) software for determining the dataset. It retrieved the entire value for determining the closest match. The author followed a canny detector for determining the edges and a neural network algorithm. The recognition rate not exceeded between 65-71%. Pallavi. P [14] proposed the recognition using Zernike moment. The image of the leaf was resized and the calculation was done. The identified using Zernike moment is somewhat complex for classification. N. Valliammai [15], proposed a hybrid for enhancement of plant leaf recognition. The author here used histogram equalization for better enhancement. They have also concentrated on adaptive thresholding where different thresholds are used in different region. They have also take peak noise to signal ratio (PSNR) for leaf identification. PSNR is defined in logarithmic scale in decibels. It is the ratio of peak signal power to noise power. The evaluation time is also taken for execution. James S Cope, Paolo Remagino, Sarah Barman and Paul Wilkin [16], concentrated on the vein characteristics of the leaf using ant colony algorithm. They done a pixel by pixel operation and also on the level of pheromone, which is the indicator, deposited by ants to signal to other ants the value of the pixel. Kue-Bum Lee and Kwang- Seok Hong [17], implemented a leaf recognition system using leaf vein and shape. They proposed the algorithm using leaf contour extraction. Projection histogram was used to identify the vein and then the features were extracted. The experimental result showed an accuracy of 97.19%.

## 3. IDENTIFICATION METHODS

Identifying leaf image was done by various methods: Chemical Methods- which includes flame tests and chemical tests. Flame and chemical methods are time consuming methods in which the identification of leaf is done by a long procedure. In the above method it nearly takes fifteen to twenty days for identifying the single leaf. If the samples are of large it nearly takes a minimum of long period for authentication. Instrumental Methods- includes spectroscopy, mass spectroscopy and thermal leaf is considered which uses an ultraviolet radiation for drying the leaf for identifying the pattern of the leaf to which class it belongs to. Once the method is analyzed a technique using chemo metric is also used for identification. The dried leaf is powdered and it is mixed with various solutions for extracting the class it belong it. An optical method includes digital image processing technique. Optical method is more advantageous than other techniques. In this method the image is converted in to gray image and the features are extracted by various techniques to compare the image with the database. In image processing method pattern recognition is considered. For pattern recognition method various characteristics of the leaf including the shape, texture and color is taken for identification. Ant colony algorithm is used for pattern recognition. Vein extraction is taken but tertiary is less reliable.

## 4. PROPOSED METHODOLOGY

In the proposed methodology identification of leaf is done through image processing algorithm. The leaf is classified and fed in to software which retrieves the related information about the leaf. The proposed network will be user-friendly. A step by step process is illustrated in Figure-1. The image of the leaf is taken using a digital camera of above than 12 megapixel, under a white background for detecting the sharp features of the leaf and also for better clarity. The features are extracted which includes low level feature, curvature, image motion, shape, aspect ratio, compactness, entropy, skewness and etc. For the second step initially preprocessing of the image is done. Preprocessing of the image includes reduction of noise or distortion, image enhancement for better view and image sharpening for detecting the sharp edges of the leaf. The next step is pattern recognition which includes pixelization, linear filtering, and quantization. A pattern is an arrangement of descriptors. Feature is often used in pattern recognition determines the descriptors. A pattern is of which has the common properties in the family pattern. Since here the leaf is used for authentication discriminant analysis can be used. The leaf varies with its size, length, width, texture and color it is better to go with discriminant analysis for the classic feature selection. The other technique of pattern recognition is pixelization which includes pixel by pixel operation in software. The next and final step is software implementation were the captured features are extracted and compared with the data base and the result is obtained. The database is to be formed with various samples of nearly 50 leaves. More samples are taken for identifying the parameters to get the exact match with the database. Initially the features are extracted with a single leaf to avoid the complexity and error. Later all the samples will be taken for the feature extraction. A computer algorithm is used for testing the leaf image, which gives the user friendly relationship between the user and PC. In this method of analysis various parameters are concentrated for getting a 100% result. The parameters like aspect ratio, entropy, skewness, krutoksis, edge detection, shape, texture, uniformity, inverse element difference moment, maximum probability, element difference moment, vein features etc. The principal components of the descriptors includes mean vector, covariance matrix.

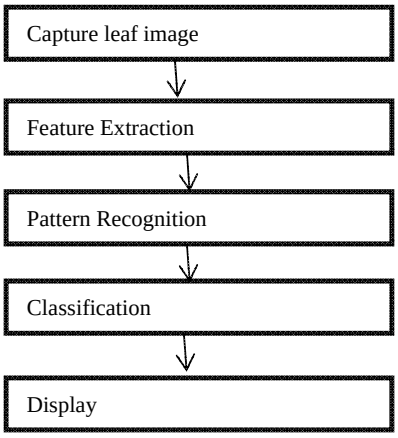


**Figure-1.** Proposed methodology block diagram.

The method of venation can also be done for identification of leaves. It uses a set of classifiers for detecting vein. For determining the classifiers pair of bounds is decided. When the pixel values are within the pair of bounds then it is classified as vein. The leaf with closest similarity will be considered as the result.

## FEATURES OF LEAF

- **Shape:** The best feature for identifying a leaf. By means of a highly developed algorithm for identification of shape is possible through image processing.
- **Venation:** It varies in all leaves. It plays the major role for identification of leaves.
- **Texture:** The other feature for identifying leaf is its texture. It is a powerful regional descriptor that helps in retrieval process. It does not have the capability of finding similar images.
- **Color:** It is a good identification parameter when there is a variation in color in leaves of different species. But while using color as a feature, it may change due to loss of chlorophyll.

## PARAMETERS USED

### Shape-geometric features

- **Aspect ratio:** Ratio of width of the leaf to the length of the leaf or it is the ratio of maximum axial length to the minimum axial length of the leaf.
- **Compactness:** Defined as the ratio of the product of area with 4*pi to the square of perimeter. It is also referred to as roundness.
  Compactness = 4*pi*area/ (perimeter)^2
- **Centroid:** The centroid co-ordinate of the leaf is obtained and labeled as centroid x and centroid y.
- **Eccentricity:** It is a characteristic feature of any conic section. It is given by
  Eccentricity = sqrt(1-(b/a)^2)
  Where b and a refer to minimum and maximum axial length respectively for an ellipse.
- **Dispersion:** It is defined as the ratio between the radius of the maximum circle enclosing the region and minimum circle that can be contained in the region. Dispersion is insensitive to slight discontinuity in the shape such as crack in the leaf.

Dispersion=max(sqrt(($x_i$-x)^2+($y_i$-y)^2))/min(sqrt(($x_i$-x)^2+($y_i$-y)^2))

Where ($x_i$,$y_i$) is the co-ordinate o the pixel in the leaf and (x,y) is the centroid of the leaf.

## 5. TEXTURE ANALYSIS

Texture can be considered as a similarity grouping in an image. Texture analysis are categorized into

- **Structural:** Provides a good symbolic description of image. Powerful tool for structural texture is provided by mathematical morphology.
- **Statistical:** It is a quantitative measure of arrangement. The approach is based on multidimensional co-occurrence matrix.
- **Model based:** It is not suitable for describing local image structure.
- **Transform method:** It uses Fourier descriptors, Gabor descriptors and wavelet transform. Gabor filter provides better spatial localization.

## 6. LEAF CLASSIFICATION

A class of tulsi leaf is taken here for medicinal quality identification. Just a sample picture of tulsi leaf is taken with a high resolution camera Figure-2(a). Image processing is done; the color image is converted into gray scale image Figure-2(b).

a. Original image b. Converted image

**Figure-2.** Sample Tulsi leaf.

For detecting the edge of the leaf 'Sobel' edge detection is used. The advantage of sobel mask is it has better noise suppression characteristics. After detecting the edge the image is dilated and the holes are removed.

**Figure-4.** Sobel edge detection.

## 7. RESULT AND DISCUSSIONS

Single leaf is considered initially for the purpose of working. The initial step done here is the preprocessing in which the color image is converted into gray scale, and then the edges are detected for determining the sharp features of the image. Histogram processing is done for better enhancement of the image. Sobel mask is used as it suppresses the noise compression characteristics. In order to form the database a minimum of 50 samples of leaves are to be considered and programmed. By the method of principal component analysis (PCA) the accuracy reached was 89.2% with considering six features of the leaf. Morphological operations are to be performed as it works well on plants for identifying the better continuity of edges. By the approach of morphological operation the exact shape of the leaf can be determined which will be useful for further identification.

## 8. CONCLUSION AND FUTURE WORK

The target is to find the most efficient combination of texture features for quick and reliable identification. A larger database will ensure better reliability. For texture analysis shape, texture, feature and venation of leaf are to be tried. The main aim is that it should give a result of 100 % accuracy. The future work to be carried out is the formation of database. After the formation of database the features are to be extracted using gray-level co-occurrence matrix (GLCM) or principal component analysis (PCA) method or using any technique. Then the test samples are taken and compared with the database to identify the closest match. The identified leaf is to be labeled. Using Arduino the identification is to be implemented which makes the system even more user-friendly. The work is started to form the database in arduino also simultaneously. Particularly the vein parameter is to be concentrated for which is the signature parameter of any leaf. The process is started and it will be carried out in future.

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