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Classification of Tulsi Leaves Based on Texture Analysis

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Abstract: Leaves play a major role in plant species. There are many leaves which have medicinal qualities. Tulsi leaves of various kinds are used for the classification of medicinal qualities. Plants are considered to be sacred which are used in worship. Tulsi leaves are grown in many parts of India. Tulsi leaves have various medicinal properties. Identification of Tulsi leaves under various classes are done here based on its characters. Each leaf hasits own medicinal qualities. Authenticating the leaf based on its texture is a difficult task is shown here. The samples are collected and the features are extracted using GLCM technique.

Key words: Morphological processing · Gray level co-occurrence Matrix (GLCM) · Entropy · Inverse Difference Moment (IDM)

INTRODUCTION

Plants play a major role in environment. These plants have a very good medicinal feature from root to leaf. Different plants have different medicinal qualities and each leaf is characterized by its medicinal features. Leaves are used for various medicinal purposes like skin ailment, memory level increasing, digestion, acne and many. Leaves are differentiated with its medicinal purposes also. The scientific or botanical name for various varieties of tulsi leaves are Ocimum Tenuiflorum (Tulsi), Ocimum basilicum (Barbara), Ocimum amboinicus (RamaTulsi). These tulsi leaves belong to the family Lamiaceae. Generally these family leaves are small in size, hairy, square stem which branches from base upwards. The leaves are oval with a cordate base, coarsely dentate, whitish beneath and grey-green above.

The brief discussion about the further topics is described in this section. This section will be the introduction to each section for simple The next section, section II describes about the prior and related work. In this section a summary of related work is described elaborately with the limitation of the method used. Section III describes about the proposed methodology. In this section the methodology used for the authentication of leaf is explained in a step by step process. Section IV deals about the feature extraction and Texture analysis. Section V deals about the experimental results and discussion obtained by the method used. Section VI gives the conclusion of the work with accuracy specified. This section clearly portraits the drawback of the proposed system, Section VII gives a brief description about the work to be carried out in future. This section gives the explanation of the drawback and how it can be overcome.

Prior and Related Work: Creating a database is the important task for identifying a leaf. Nowadays image processing plays a major part in all fields. On using Zernike moments for extracting the features by Probabilistic Neural Network (PNN) training. The drawback on using this method was that for complex image this technique did not work properly [1]. Enhancement technique is used for using a clear vision of the image. While considering image enhancement contrast stretching is a normal parameter for consideration. The identified drawback of this method is that evaluation time is large and it depends on the memory size of the image. Multiple noises cannot be removed simultaneously [2]. Ant colony algorithm is considered which can identify only primary and secondary venation. Tertiary venation identification is a major drawback in this method [3]. Leaf vein and feature extraction was done which is done by histogram processing on rotating the image to 180degrees. The point of maximum histogram is considered for extraction. Fast Fourier Transform (FFT) method is used based on distance calculated from centroid. Accuracy was not up to the expected level. Only

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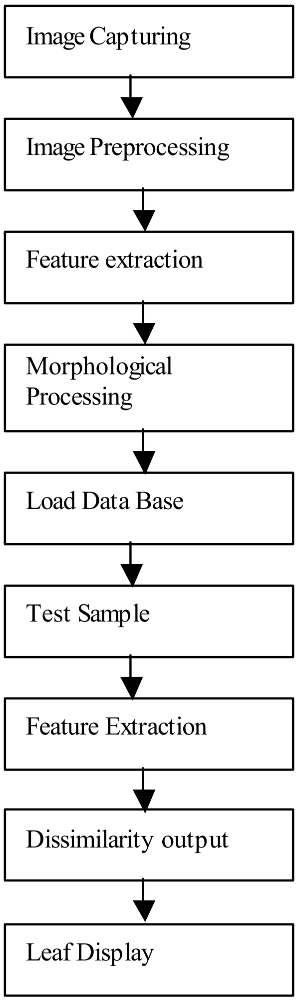

Fig. 1: Proposed Methodology

the main vein of the leaf is taken in to account [4]. Apart from these techniques various methods are used for identifying the medicinal leaves. On feature based approach only mature leaf can be identified [5]. An Intelligent Scissor (IS) method is also used for identifying the vein characteristics. Expected accuracy was not achieved [4]. By extracting the leaf vein based on gray-scale morphology the image was scanned and then fed to the computer. Here the background of the image was close to raw image and hence accuracy was less [7].

Proposed Methodology: Creating a database is very essential in all kinds of work. These database acts as reference. Here all medicinal herbal leaves are considered for creating the databases. The images are captured with a high resolution camera under a white background. The proposed methodology is shown in Figure 1. In this proposed methodology an image preprocessing technique is done initially. Image preprocessing is carried out in two steps. They are image conversion and edge detection. Image conversion is nothing but the color image is converted in to gray image since GLCM technique is suitable only for gray image.It is applied for texture analysis. Edge detection is done for better continuity of the image. After the edges are detected then the features are extracted. For extracting the features GLCM technique is used. Using this technique the features like entropy, contrast, homogeneity, eccentricity are calculated. Then sum invariance difference moment, inverse difference moment, sum entropy, sum variances, correlation, energy, mean are calculated. Taking these 11 features into account the database is formed for 127 leaves. It consist of nearly 50 leaves of tulsi of various kinds. Ocimum tenuiflorum or Ocimum sanctum generally called as holy basil are mainly of two types. They are green-leaved called Lakshmi tulsi or purple-leaved called kishna tulsi. It is used in ayurveda for healing properties and also remedies for various ailments.

Ocimum gratissimum (Vana tulsi) generally called as holy basil is also used for various medicinal properties. This is the original wild type that is very high in eugenol--a great adaptogen from the Ayurvedic tradition.

Feature Extraction & Texture Analysis: Features extraction and texture analysis is the important task in authentication of leaf.

Feature Extraction: For the authentication of leaf 8 features are considered. The features are extracted using GLCM technique. GLCM is nothing but Gray Level Co-occurrence Matrix, in this the pixels are converted within the range of 0 to 1. GLCM is mainly used for texture analysis which is explained later in the section.

Contrast: It returns a measure of intensity contrast between pixel and its neighborhood over the whole image. Contrast will be zero for a constant image. It is given by,

$$\text{Contrast}=\Sigma|i-j|^2 p(i,j) \quad (1)$$

Correlation: It returns a measure of how correlated a pixel is to its neighbor over the whole image. The range of this is fronm [-1,1]. Correlation is -1 or 1 for a perfectly positively or negatively correlated image. Correlation is NaN for a constant image.It is given by,

$$\text{Correlation} = \Sigma(i-\mu_i)(j-\mu_j)p(i,j)/\sigma_i\sigma_j \quad (2)$$

Energy: It returns the sum of squared element in GLCM. It is also called as uniformity or uniformity of energy or angular secondary moment. Energy is one for a constant image.

Homogeneity: It returns a value that measures the closeness of the distribution of element in GLCM to GLCM diagonal. It ranges from [0 1]. Homogeneity is 1 for a diagonal GLCM.
It is given by

$$\text{Homogeneity}=\Sigma|p(i,j)|/(1+|i-j|) \quad (3)$$

Inverse Difference Moment (IDM): This is another feature influenced by the homogeneity of the image. It contains a weighting factor resulting in smaller contributions from inhomogeneous areas. So lack of homogeneity in images causes a low value of Inverse Difference Moment.

$$\text{IDM}=\Sigma\ 1/1+(i-j)\ P\ (i,j) \quad (4)$$

Entropy: Frist order entropy is dependent on the homogeneity of the image. Homogeneity lowers the entropy of an image.

$$\text{Entropy}= -\Sigma\Sigma p\ (i, j)\ \log\ (p\ (i,j)) \quad (5)$$

$$\text{Sum Entropy}= -\Sigma p_{x+y}\ (i)\ \log\ (p_{x+y}\ (I)) \quad (6)$$

$$\text{Sum Average}= \Sigma i p_{x+y}\ (I) \quad (7)$$

$$\text{Sum Variance}= [I+\Sigma p_{x+y}\ (I)\ \log\ (p_{x+y}\ (I))]^2\ p_{x+y}\ (I) \quad (8)$$

Texture Analysis: Textures are complex visual patterns composed of entities, or sub patterns, which have characteristic brightness, colour, slope, size, etc. Thus texture can be regarded as a similarity grouping in an image. The local sub pattern properties give rise to the perceived lightness, uniformity, density, roughness, regularity, linearity, frequency, phase, directionality, coarseness, randomness, fineness, smoothness, granulation, etc., of the texture as a whole

There are four major issues in texture analysis:

- Feature extraction: to compute a characteristic of a digital image able to numerically describe its texture properties;
- Texture discrimination: to partition a textured image into regions, each corresponding to a perceptually homogeneous texture (leads to image segmentation);
- Texture classification: to determine to which of a finite number of physically defined classes (such as normal and abnormal tissue) a homogeneous texture region belongs;
- Shape from texture: to reconstruct 3D surface geometry from texture information. Feature extraction is the first stage of image texture analysis. Results obtained from this stage are used for texture discrimination, texture classification or object shape determination.

Fig. 2: Original Tulsi Image

Fig. 3: Converted Image

Texture Analysis Is Categorized Into: *Structural*- Provides a good symbolic description of image. Powerful tool for structural texture is provided by mathematical morphology. It is based on the arrangement image primitives such as description of texture based on regularly spaced parallel lines.

Statistical- It is a quantitative measure of arrangement. The approach is based on multidimensional co-occurrence matrix. The statistical approach is used to characterize the texture of the region as: smooth, coarse and grainy. For considering the statistical moment on texture analysis the moment, mean uniformity, entropy is taken.

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.

Texture content is an important quantity used to describe a region.

Experimental Results & Discussion: The experimental results are based on the partial work done. The original image is shown in Figure 2.

The converted image is shown in Figure 3. The color image is converted into gray level image for equal distribution of pixels and also for easy

Fig. 4: Prewitt Edge Detection

Fig. 5: Dilated Image

Fig. 6: Eroded Image

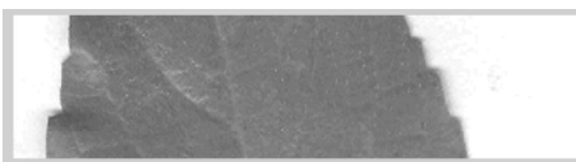

Fig. 7: Cropped Image

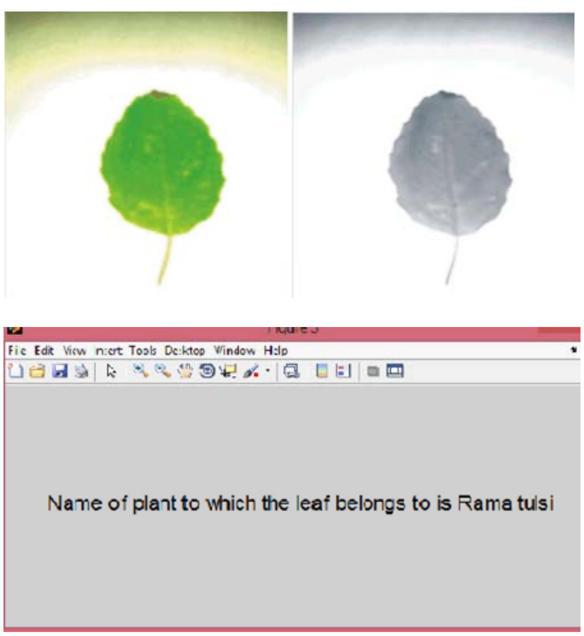

Fig. 8: Display of Rama Tulsi Leaf

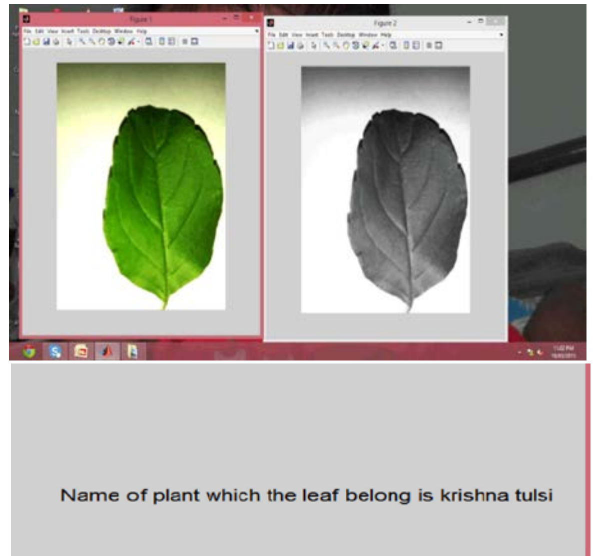

Fig. 9: Krishna Tulsi Leaf Output Display

Table 1: Values of GLCM properties

S.No	Leaf Name	Energy	Homogeneity	Correlation	Contrast
1.	Krishna Tulsi	0.3360	0.9410	0.9795	0.1301
2.	Karun Tulsi	0.3303	0.9461	0.9914	0.1379
3.	Rama Tulsi	0.3497	0.9631	0.9907	0.0902

processing. The second stage of preprocessing is edge detection, here prewitt mask is used for detecting the edge.

The gray scale image is dilated with the structuring element which is nothing but the binary image. Figure 5 shows the dilated image.

Erosion is another step in morphological processing. It is the process of removing zeros in an image. Figure 6 shows the eroded image.

The image is cropped for getting the region of interest of an leaf. Here the middle portion of the leaf is considered since it is having the maximum width. The GLCM technique is applied for extracting the features of the leaf. From the formed database the values of some extracted features are shown in the following Table 1. The values in the table show the various kinds of tulsi leaves used. Here three varieties of tulsi leaf are used for the creation of database. They are classified as Karun tulsi, Krishna tulsi and Rama Tulsi.

The table shown above gives features of GLCM. Energy, Homogeneity, Correlation and contrast are calculated for tulsi leaves alone. Eleven parameters are extracted and the leaves are identified.

From the features extracted the dissimilarity output is calculated and the output is displayed.

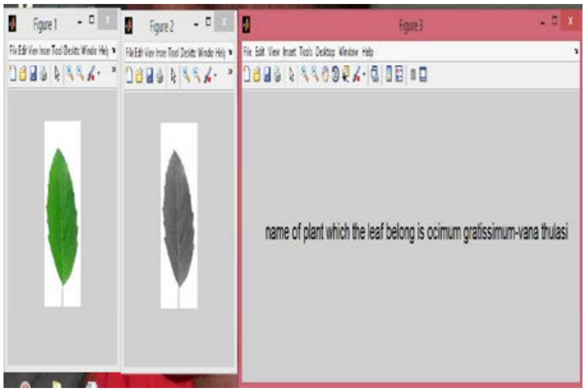

Fig. 10: Vana Tulsi Output Display

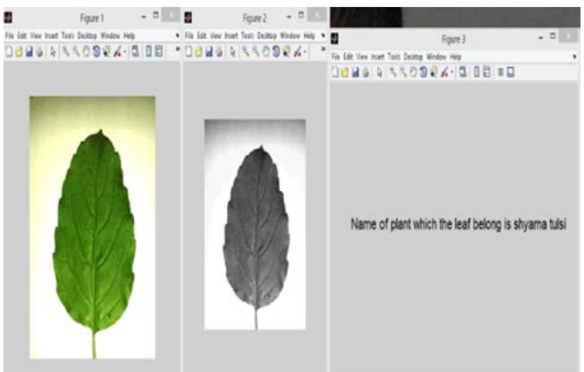

Fig. 11: Shyama Tulsi Ouput

Table 2: Dissimilarity Output

S.No	Image	Dissimilarity Output	Leaf Name
1.	Image01	0.069	Krishna Tulsi
2.	Test03	0.045	Rama Tulsi
3.	Test21	1.432	Vana tulsi
4.	Image40	0.6532	Podhi Tulsi
5.	Test23	0.8355	Shyama Tulsi

Figure 8 displays the output of Rama Tulsi leaf which shows the dissimilarity of 0.045 from the database. The least dissimilarity is calculated from the database images. Figure 9 displays the output of Krishna tulsi leaf and it has the dissimilarity output of 0.069. Figure 10. Shows the output of vana tulsi and it has the dissimilarity of 1.432 and Figure 11 shows the output for shyama tulsi leaf ehich has the dissimilarity output of 0.8355. The dissimilarity is calculated by the difference obtained from the parameters determined with respect to the database images.

CONCLUSION

The main aim of this work is to find the exact match of the leaf with test parameters. The texture analysis is done with the morphological processing which is nothing but the structuring elements of binary images. The features are extracted with the GLCM technique. The classes of tulsi leaves are identified with the features determined. In future this work can be extended for all medicinal herbal leaves.

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