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Ayurvedic Herb Detection using Computer Vision

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***Abstract* - About 40% of land in India is under forest cover. India has many biologically important forests with abundant flora and fauna. All medicines that we use today have been derived from plants and herbs found in our surroundings. However, most of the medicinal herbs remain undetected due to a lack of information among the masses. Plants' leaves have eclectic shapes, colors, sizes, and medicinal uses accordingly. By performing contour formation, canny edge detection, and computer vision, we can identify as well as differentiate between medicinal plants which, according to Ayurveda, can cure various diseases. The application of proposed system can be found in places where modern medicines are not at users' disposal. Even botanists and pharmacognosists can make use of this system for discovering and learning about the ayurvedic use of certain plants.**

***Index Terms* - computer vision, contour formation, canny edge detection, herb classification, gaussian blurring.**

I.INTRODUCTION

Plants play an essential role in Earth's ecology by providing sustenance, shelter and maintaining a healthy atmosphere. According to Ayurveda, every plant on Earth has some medicinal value. It is considered a form of alternative to allopathic medicine in the world. Automated recognition of plant leaf is a challenging problem in computer applications and has become an active field for research. An efficient Ayurvedic plant leaf recognition system will be beneficial to many sectors of society which include medicinal field, botanic research, and similar technical streams. With the help of image processing, pattern recognition and advanced computer vision, we can easily recognize the leaf images and provide a way for categorization. Leaf recognition, under normal circumstances, is based on the observation of the morphological characteristics of the leaf. However, it will not be an easy task for experienced botanists to identify the plants because of the large number of leaves existing in the world. In this case, it helps develop an efficient plant recognition system based on a computer to identify the leaves. For removal of noise in the image, different pre-processing techniques are considered (Example- Image Blurring, Image smoothing).

II. LITERATURE SURVEY

The parameters considered for leaf are its texture, color, diameter, leaf perimeter etc. This scheme makes use of many classifiers and compares them based on accuracy [1].

The approach by authors is in-depth for consideration of leaf features like aspect ratio, compactness, dispersion, eccentricity. This method also employs the procedure of chemical identification [2].

Grayscale conversion: The image converting to grayscale. The grayscale images were subjected to the process of image contrast and intensity enhancement techniques and then stacked together as slices for further processing. Binary conversion: Thresholding can be used to create binary images from a grayscale image. A Binary image is a digital image that has only two possible values for each pixel. Commonly, the two colors used for a binary image are black and white. Noise Removal: Digital images are prone to a variety of types of noise. Noise is the result of errors in the digital image acquisition process that result in pixel values [5].

Major differentiation factors are mentioned as below: aspect ratio calculated as length/width Rectangularity, Narrow factor, vein feature extraction [11].

The Authors demonstrated a comprehensive study of different machine learning classifiers used along with their accuracies and a need for better use of newer technologies in the field of medicinal plants research [13].

III. PROPOSED SYSTEM

The proposed system aims to identify and classify the leaves captured into an image format using computer vision trained model in a fast and accurate manner. The image of leaf taken by the user is deconstructed into a greyscale format for the reduction in complexity for comparing it with the reference image used for training. After processing the image, the user gets results in the form of the common name of the plant; it is biological name; it's uses and description.

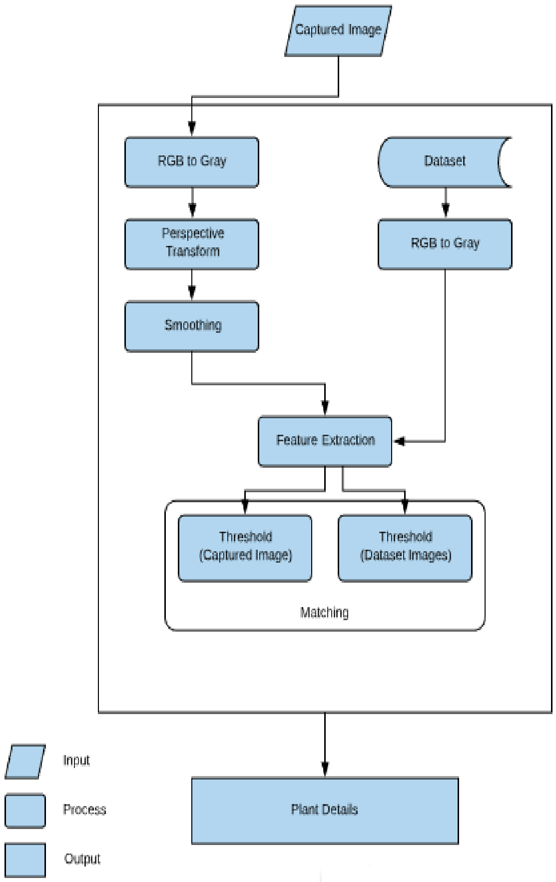

Fig .1. Working model of the proposed system

IV. TOOLS AND TECHNOLOGIES

A. Gaussian Blurring and Filtering

The Gaussian blur is a type of image-blurring filters that uses a Gaussian function (which also expresses the normal distribution in statistics) for calculating the transformation to apply to each pixel in the image. In one dimension, the Gaussian function is:

$$G(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{x^2}{2\sigma^2}}$$

When working with images, we need to use the two-dimensional Gaussian function. This is simply the product of two 1D Gaussian functions (one for each direction) and is given by:

$$G(x, y) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

Where:

- x is the distance from the origin in the horizontal axis,
- y is the distance from the origin in the vertical axis,
- σ is the standard deviation of the Gaussian distribution.

B. Contour Detection and Approximation

Contours can be explained simply as a curve joining all the continuous points (along the boundary), having the same color or intensity. The contours are useful tools for shape analysis and object detection and recognition - a path in the complex plane over which contour integration is performed to compute a contour integral. When choosing a contour to evaluate an integral on the real line, a contour is generally chosen based on the range of integration and the position of poles in the complex plane. In OpenCV, finding contours is like finding a white object from a black background. So, the object to be found should be white, and the background should be black.

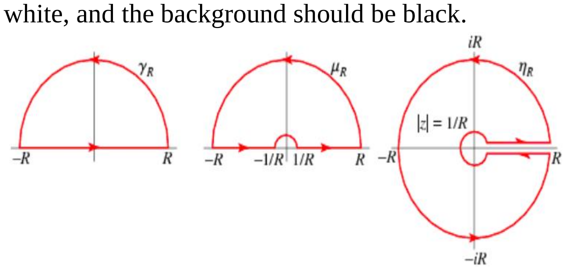

Fig .2. Contour Detection

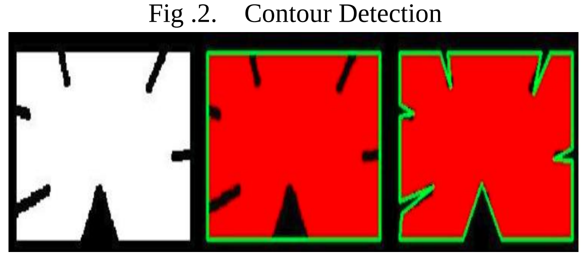

Fig .3. Contour Approximation

C. Canny Edge Detection

Canny edge detection is a technique to extract useful structural information from different vision objects and dramatically reduce the amount of data to be processed. Since the mathematics involved behind the scenes are mainly based on derivatives edge detection results are highly sensitive to image noise. The Gradient calculation step detects the edge intensity and direction by calculating the gradient of the image using edge detection operators. When the image is smoothed, the derivatives ‘Ix’ and ‘Iy’ w.r.t. ‘x’ and ‘y’ are calculated. It can be implemented by convolving ‘I’ with Sobel kernels ‘Kx’ and ‘Ky’ respectively. The non-maximum suppression algorithm goes through all the points on the gradient intensity matrix and finds the pixels with the maximum value in the edge directions. The double threshold step aims at identifying three kinds of pixels: strong, weak, and non-relevant. Based on the threshold results, the hysteresis consists of transforming weak pixels into strong ones, if and only if at least one of the pixels around the one being processed is a strong one.

Fig .4. Canny Edge Detection

V. RESULTS

The results of proposed system, based on a database of around 140 plants with around 10-15 images each, is quite impressive in accordance with the existing leaf identification algorithms due to the use of computer vision. There are four windows open in front of the user when it starts the system. 1st one is the main frame which is showing the image captured by the webcam. Its exact purpose is to capture the leaf image without filtering. 2nd frame is of matching operation which will try to compare the captured image with the image in the data set. It will extract the leaf image shape from the rest of the shape. 3rd frame is corrected perspective, which will show the output of the compared image from the dataset. If the dataset has the image, then it redirects the user to the desired web page. If not, then it will try to compare unless and until the user will close the system. 4th frame of contour will show the shape of the filtered curve from the rest of the curves. The final output is shown on the web browser.

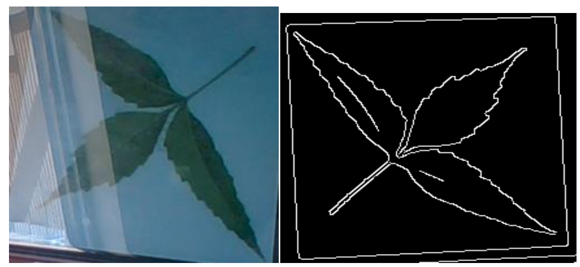

Fig .5. Sample input to the system with noise (left) and its contour frame with noise removal (right)

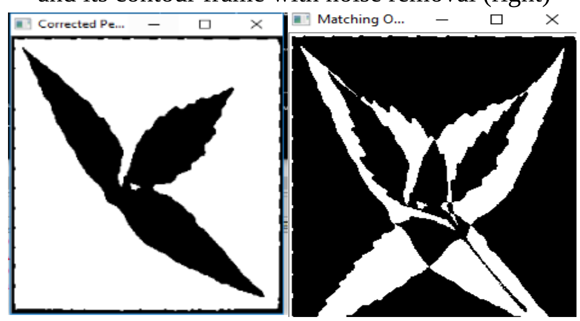

Fig .6. The Corrected frame (left) and the matching frame from the database model (right)

The results include the plant’s common name, biological name, and a brief description of the primary medicinal uses of the respective plant. Example, for the sample image shown in Fig.5, the result is:

Neem (Azadirachta indica): The neem tree has been recognized as possessing powerful health-promoting properties for healthy skin, reducing excess heat, blood immunity booster (cleaning of ama from the body) and controlling blood sugar.

VI. CONCLUSION

This system introduces a statistical method for plant leaf identification. The proposed method is verified for a database of 140 plants. This system proposes the identification of selected medicinal plant leaves from a stored database of the leaves by processing an image of their leaves. The shape color features of the leaves are used for identification of leaf varieties. Such automated classification mechanisms can be useful for efficient classification of plant leaf species. The accuracy of the current method was found to be competitive.

VII. FUTURE SCOPE

Future work would involve, combining venation and texture features to the present shape color features to improve recognition accuracy. One major drawback of the implementation is that the client and server are on the same machine. We will be intended to use a dedicated server which will run round the clock. So, Future work can be directed in that way to make the implementation more efficient. The implementation is a little bit computationally expensive. Further optimization of the logic can result in better implementation.

VIII. APPLICATIONS

This system has varied applications. Pharmacognosy – the branch of the pharmacy where medicines are made from different medicinal plants. The system is extremely useful in tribal localities where modern medicines are not widely available. Botanists – these are the professionals who study and understand plants; they can make use of this application for quickly recognizing plants during field visits.

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