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PLANT DISEASE IDENTIFICATION SYSTEM

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Abstract - *Nowadays, we hear the term 'organic farming' everywhere. This type of farming can only be done when no insects affect the plants or leaves. Plants are the main source of food production and also the medicinal plant leaves are the main source for siddha medicines. The medicinal leaves are easily attacked by insects which eats the chlorophyll. Because of the absence of chlorophyll, there is lack of medicinal content in those leaves. Hence, to protect the leaves from the insects it is necessary to detect whether the plant leaf is infected thereby loosing the chlorophyll content. So necessary steps should be taken to protect the plant. This work mainly focuses on identifying whether the medicinal leaf is affected by the disease or not. It is done by implementing the Graythresh algorithm in MATLAB. Manipulating this algorithm is very simple and can be applied for detection of disease in all types of medicinal leaves. Here, the threshold value for the image of the test leaf is found out automatically and then processed for identification of disease. And finally it provides result whether the disease is present or not.*

Key Words: Graythresh Algorithm, Otsu's Method, Image Binarization, Solanum Trilobatum, Chlorosis.

1.INTRODUCTION

The external appearance of leaves of any plant indicates the healthiness of the plant. 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. As per data available over three-quarters of the world population relies mainly on plants and plant extracts for their health care needs. More than 30% of the entire plant species, at one time or other was used for medicinal purposes. The major raw material source from the medicinal plants is leaves. Hence, identifying whether the leaves are healthy and fresh is very important. Curled, droopy, drab-looking leaves means the plant is stressed. Also Yellow leaves indicate plant problems. Chlorosis is a yellowing of leaf tissue due to a lack of chlorophyll. This is because bugs and bacteria eat the cells of the leaves. Thus, making the leaves dead. In this stage, the leaves of the plant becomes useless. Hence identification of dead leaves in the plant is very important. This work concentrates mainly on finding whether the tissue of the leaf is eaten by the chlorophyll eating bugs. It is done using very simple methods in MATLAB. The Otsu's method uses an algorithm called gray thresh algorithm to calculate the threshold value of the image of the leaf. The way of usage of the methods in the work is very as it can be used for detection of all types of leaves. Hence it is a cost effective method to identify the infection of the leaf.

1.1 OVERVIEW

The proposed project is a plant disease identification system for the Medicinal plant, Solanum trilobatum (Thoodhuvalai) that provides findings for the presence or absence of disease. The disease to be identified is a common plant disease called chlorosis which occurs due to the lack of chlorophyll in the leaves. The dead cells or tissues causes lack of chlorophyll also chlorophyll eating bugs causes chlorosis. Hence, color of the leaf changes in this type of disease. Separation of color pigments by converting the image to black and white provides a way for finding the affected areas of the leaves. Thereby it results in diseased or healthy leaf. The importance detecting leaves is because the leaves of this plant are more beneficial to prepare medicine. The detection is taken place in the following manner: Image acquisition, Pre-processing, Segmentation, Image Binarization, Feature extraction, Classification.

1.2 MATLAB FUNCTIONS

OTSU'S ALGORITHM

Image segmentation is one of the most fundamental and difficult problems in image analysis. Image segmentation is an important part in image processing. In computer vision, image segmentation is the process of partitioning an image into meaningful regions or objects. Image segmentation methods are categorized on the basis of two properties discontinuity and similarity. The region based segmentation partitioning of an image into similar areas of connected pixels. There are different type of the Region based method like thresholding, region growing and region splitting and merging. Thresholding is an important technique in image segmentation applications. The basic idea of thresholding is to select an optimal gray-level threshold value for separating objects of interest in an image from the background based on their gray-level distribution. If g(x, y) is a threshold version of f(x, y) at some global threshold T, it can be defined as,

$$G(x, y) = 1 \text{ if } f(x, y) >= 1$$

$$= 0 \text{ otherwise}$$

Thresholding operation is defined as:

$$T=M[x, y, p(x, y), f(x, y)]$$

In this equation, T stands for the threshold; f(x,y) is the gray value of point (x,y) and p(x,y) denotes some local property of the point such as the average gray value of the neighborhood centered on point (x,y).

There are two types of thresholding methods,

1. Global Thresholding
2. Local Thresholding

Otsu method is type of global thresholding in which it depend only gray value of the image, which is widely used because it is simple and effective. The Otsu method requires computing a gray level histogram before running. However because of the one-dimensional which only consider the gray-level information, it does not give better segmentation result. So, for that two-dimensional Otsu algorithm was proposed which works on both gray-level thresholds of each pixel as well as its spatial correlation information within the neighborhood. Otsu's method was one of the better threshold selection methods for general real world images with regard to uniformity and shape measures. Otsu's method uses an exhaustive search to evaluate the criterion for maximizing the between-class variance.

VARIOUS OTSU ALGORITHMS:

1. Image Segmentation Based on Improved Otsu Algorithm.
2. Comparative Research on Image Segmentation Algorithm.
3. Otsu Thresholding Based on Improved Histogram.
4. Otsu and K-means method.

Here we used comparative research on image segmentation algorithm. This algorithm used Global Thresholding method.

GRAYTHRESH FUNCTION:

It is the algorithm under the hood of the function gray thresh, which was introduced in version 3.0 of the toolbox in 2001. The function gray thresh was designed to work well with the function im2bw. It takes a gray-scale image and returns the same normalized LEVEL value that im2bw uses.

Syntax

level = gray thresh (I)

Description

level = graythresh(I) computes a global threshold (level) that can be used to convert an intensity image to a binary image with im2bw.

Level is a normalized intensity value that lies in the range [0, 1]. The graythresh function uses Otsu's method, which chooses the threshold to minimize the intraclass variance of the black and white pixels. Multidimensional arrays are converted automatically to 2-D arrays using reshape. The graythresh function ignores any nonzero imaginary part of I.

Class Support

The input image, I, can be of class uint8, uint16, or double and it must be nonsparse. The return value, level, is a double scalar.

1.3 CHALLENGES

Environmental challenges – Since this project work processes the binary image of the leaves, the environmental changes like temperature, position, climate, day light, etc., may affect the threshold value. Thus, for each image different threshold value may be obtained. This causes inconsistency in converting the image to binary.

Device challenges – Personal camera like mobile phone camera or Digital camera can be used for capturing the images of the leaf. The pixel count of the image differs for each type of camera. This inconsistency of number of pixels and the lighting effects given by each device differs which affects the automatic calculation of threshold value. Hence, using the same device for capturing the images reduces the inconveniences.

2. LITERATURE SURVEY

Identification of Plant Diseases using Image Processing Techniques.

This research focuses on development of a simple plant leaves disease detection system that provides betterment in agriculture. A bit previous knowledge of any crop health and disease exposure can provide the command on disorder through suitable planning and by applying proper methodology. As India's most of the population depends on Agriculture so for the betterment of the crop and for helping farmer's. This technique will help in the improvisation and productivity of crops. It includes several steps viz. Image acquisition, image pre-processing, features extraction and neural network based classification. Plant diseases detection at early stage by using Image

Processing techniques is implemented successfully System performance is tested and found satisfactory in terms of accuracy and efficiency for both real time as Well as database images. Classification of nine plants images by using three classifiers SVM, k-NN and Neural Network (NN) is done. This technique is used to analyze the healthy and diseased plants leaves. This system has Accuracy between 90% - 100% which made the system most accurate and

precise method for identification of plant diseases. This system also have feature to process real time images. So, monitoring of distant images can be possible [10].

Image Processing System for Plant Disease Identification by Using FCM-Clustering Technique

This paper focuses on providing information about plant diseases and prevention methods. Plants have become an important source of energy, and are a fundamental piece of the puzzle to solve the problem of global warming. There are many types of diseases which are present in plants. Diseases weaken trees and shrubs by interrupting chemical change, the method by that plants produce energy that sustains growth and defence systems and influences survival. This paper presents an improved method for plant disease detection using an adaptive approach. This approach helps to increase the accuracy of the disease level; it provides various prevention methods (type and amount of pesticides to be used), the level of destruction and helps to check whether the disease spreads or not [11].

Medicinal Plant Leaf Information Extraction Using Deep Features

The paper presents improved deep network architecture for automated plant leaf species identification. A vgg16 architecture in PCA space results better with lαβ color space as an input. VGG-16 is trained and tested with the original image transformed to lαβ color space. A new 2+ dimensional capturing device is proposed in this paper that helps in capturing proper shape and texture information with minimum leaf folds. The leaf information is extracted using the multi-scaled deep network and therefore, results a rich feature vector. Finally, the vector is reduced to optimize the classification cost using PCA. It also reduces the curse-fodimensionality. Our experiments on two different datasets proves the robustness and accuracy of our algorithm compared to state-of-the-arts. In future, the work can be directed on reducing further computation cost and proposing a mobile-based application assisting users anywhere-anytime.

Leaf Shape Extraction For Plant Classification

This research paper presents the leaf shape extraction for plant classification. Leaves are very important component of the plant which actually identifies and classify the plants. Classification of the plant by their leaf biometric features is commonly performed task of trained botanist and taxonomist. To perform this task they need to perform various set of operations. Because of this the task of classification of plants manually is time consuming. There are many biometric features of leaves of the plants for classification. Here the shape of leaves of the plant species are extracted for plant classification. In this paper, various operators are studied for the leaf extraction from images by using the image processing techniques.

3. PROPOSED SYSTEM

3.1SYSTEM ARCHITECTURE

Our proposed Plant Disease Identification System is composed of four modules (Fig - 2): a Image Acquisition Module, Image Binarization Module, Pixel Count Module, Classification Module. The Image acquisition module contains all the input train images for the system. The images are loaded in the MATLAB. The image is captured in the format suitable for processing. This reduces the complex work of extracting the particular leaf from complicated background. In the next module the captured image is processed to convert it into binary image. Hence the image looks black and white. This is done by calculating the threshold value for the train image. Here the need for otsu algorithm and graythresh function is met. Then comes the pixel count module which counts the number of white pixels in the image. This helps the system extract the feature of the image. Thus the system comes into a conclusion whether the system is diseased or not. This is the final stage of the project work. Classifying the test image as diseased or healthy.

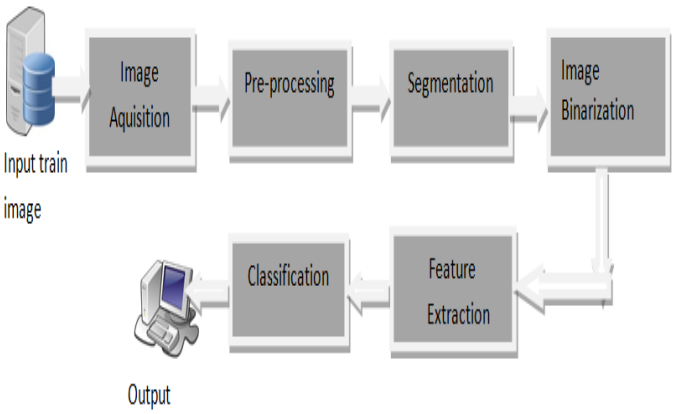

Fig 1 – System Architecture

3.2 IMPLEMENTATION

IMAGE ACQUISITION

The first stage of any vision system is the image acquisition stage. After the image has been obtained, various methods of processing can be applied to the image to perform the many different vision tasks required today. However, if the image has not been acquired satisfactorily then the intended tasks may not be achievable, even with the aid of some form of image enhancement. This module also includes the process of fine-tuning the picture known as pre-processing stage. Pre-processing is a common name for operations with images at the lowest level of abstraction -- both input and output are intensity images. The aim of pre-processing is an improvement of the image data that suppresses unwanted distortions or enhances some image features important for further processing. So

that the test image specifications match with the train image. In this work, the leaves are captured with a white background. Since the image is going to be converted into black and white, the white background reduces the complication in work. There is no need of changing the leaf background to white colour. After the pre-processing has been done, the image is read for further detection process.

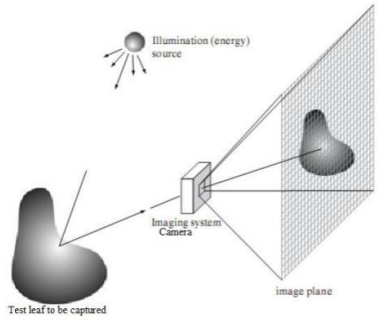

Fig 2 – Process of image acquisition.

Fig 3.1 – healthy leaf **Fig 3.2 – diseased leaf**
Samples of the data sets collected

IMAGE BINARIZATION:

Image binarization converts an image of up to 256 gray levels to a black and white image. Frequently, binarization is used as a pre-processor before OCR. In fact, most OCR packages on the market work only on bi-level (black & white) images. Since thresholding is the efficient technique in Binarization, the simplest way to binarize the image is to choose a threshold value, and classify all pixels with values above this threshold as white, and all other pixels as black. The problem then is how to select the correct threshold. In many cases, finding one threshold compatible to the entire image is very difficult, and in many cases even impossible. Therefore, adaptive image binarization is needed where an optimal threshold is chosen for each image area. Thus, threshold for each train image is calculated using the inbuilt GRAYTHRESH function in MATLAB which uses Otsu's Algorithm to calculate the threshold value automatically. Otsu's thresholding method involves iterating through all the possible threshold values obtained from each image and calculating a measure of spread for the pixel levels each side of the threshold, i.e. the pixels that either fall in foreground or background. The aim is to find the threshold value where the sum of foreground and background spreads is at its minimum. Thus the threshold for the image is fixed. And the pixels are converted to 0's and 1's according to the comparison of threshold. Thus a pixel matrix purely comprised of 0's and 1's is obtained.

```
max,s,t = 0;
for ss: 0 to L-1 do
    for tt: 0 to L-1 do
        evaluate tr(S_b);
        if tr(S_b) > max
            max = tr(S,b);
            s = ss;
            t = tt;
        end if
    end for
end for
return s,t;
```

Fig 5 – Otsu's method to calculate threshold of image.

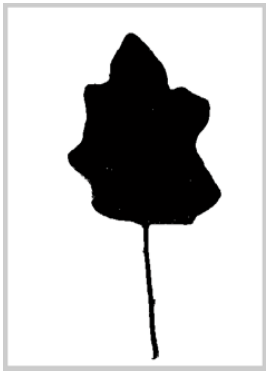

Fig 4.1 – binary image of Healthy leaf. **Fig 4.2 – binary image of Diseased leaf.**

PIXEL COUNT MODULE:

After binarization of all the input train image, the white pixels within the boundary of the test leaves are counted for each image so that a common value is chosen. That common value is used for deciding whether the leaf is affected. The method of counting is done in the following manner:

1. The first black pixel(0's) in the first row of the pixel matrix is identified.
2. The last black pixel in the last row of the pixel matrix is identified from the reverse.

3. Since the background is white the two start and end black pixel are marked to know the boundary of the leaf.
4. Now, the white pixels(1's) inside the boundary of the leaf is counted.
5. By the count of white pixels of the all train images the common value is obtained.

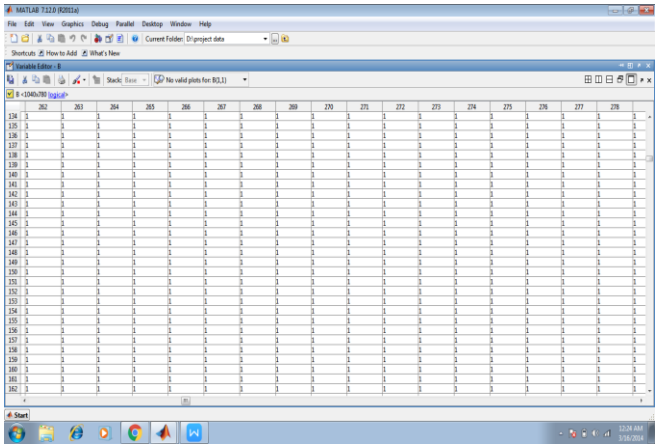

Fig 5.1 – Pixel Matrix of binarized image of Healthy leaf

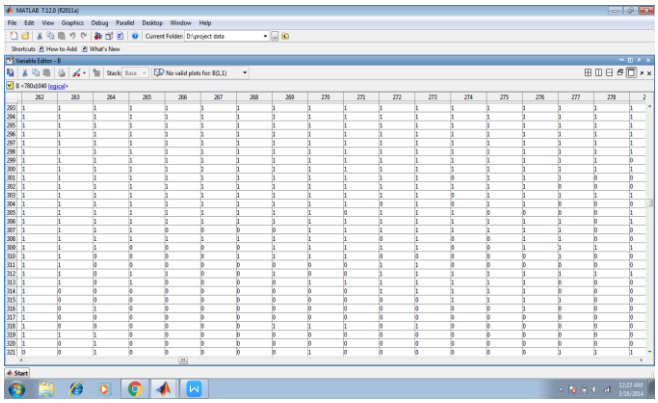

Fig 5.2 – Pixel Matrix of binarized image of Diseased leaf.

CLASSIFICATION MODULE:

The process of sorting or arranging pixels in an image into classes or clusters is the main theme of classification. Classification of binarized data is used to assign corresponding levels with respect to groups with homogeneous characteristics, with the aim of Discriminating multiple objects from each other within the image. Classification is also a type of pattern recognition. Here the pattern of images of healthy and diseased leaf is recognized and the conclusion is made.

As said in the pixel count module, a common value obtained from all the images is used to classify between the affected leaf and healthy leaf.

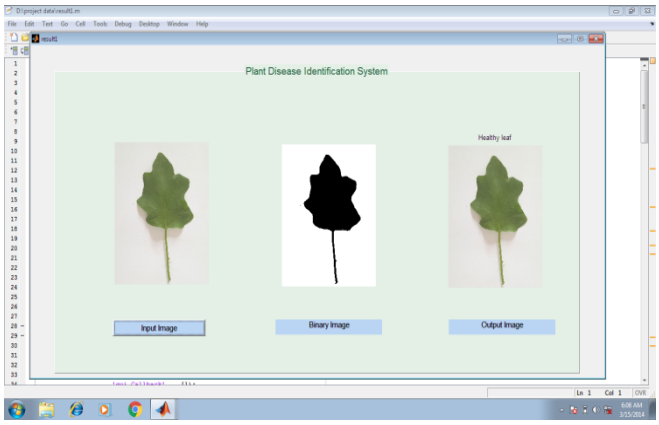

Fig 6.1 – Sample output for detection of healthy leaf.

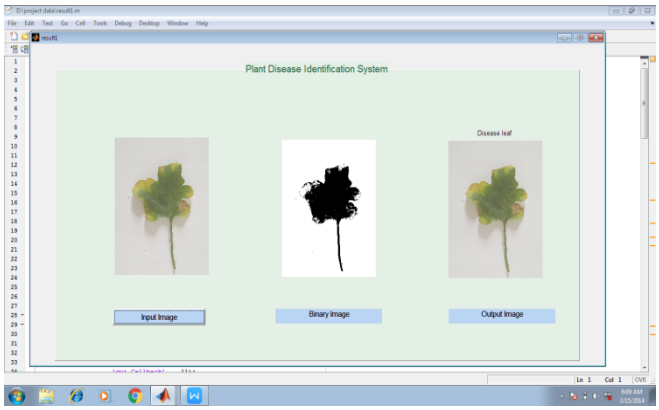

Fig 6.2 – Sample output for detection of diseased leaf.

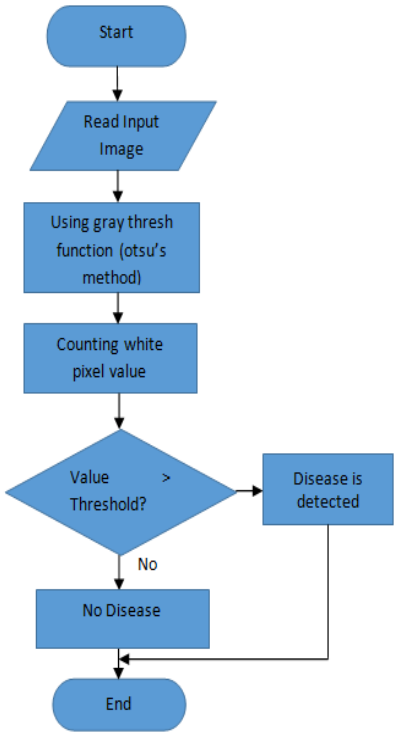

Fig 7 – Flowchart for Working of the identification system.

4. CONCLUSION

Our proposed system has been implemented in MATLAB for processing of test image and application development. All the tasks are divided into small modules to work efficiently. The data is approached and processed by using matrix laboratory programming language. The disease of the plant Solanum trilobatum is identified in this system. This system can be implemented similarly for all types of leaves. Hence this system analyzes the healthy and diseased plant leaves. No complex process has been involved in order to make the detection process understandable and easy for all users of the system. The proposed system is efficient, simple and cost effective. Also the MATLAB has friendly user interface.

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