Leafs based Image Analysis for Managing Chilli Diseases

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ABSTRACT: *We analyse and present the results of the diseases detection of the plants. It has been revealed that the diseases frequently affect the production of Indian plants. To demonstrate our study, we took the chilli plants, the frequently used food item in India. Often the chilli plants are attached by microorganisms and pests. When the chilli plants are attached the manifestation comes through the leaves, stems and fruits. Initially the researchers have used leaves, stems and fruits to detect the pest attacks. Leaves are basically tested to measure the attacks. So the images of the leaves are used to know the chilli diseases. Leaf detection helps to apply solutions and hence image processing techniques are used to detect the attacks. We emphasize that the leaf images can beby used as effective data processing technique and it is proved to be less expensive. It also helps the formers to identifying the disease issues.*

Keywords: Chilli Disease, Leaf Image, Image Processing

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1. Introduction

Plant disease is one of the crucial causes that reduces quantity and degrades quality of product. The ability of disease diagnosis in earlier stage is then very important task in order to be able to timely cure and control such disease for decreasing dissatisfactory products. Chilli is included in the main horticultural commodities. At certain times, it becomes a very high demand in the market because supply is limited. Business chilli indeed belongs in the high-risk plants. Therefore, strategies and technical knowledge and the field became an important matter to be mastered. The systematic and structured should be developing so that it will use by operators to increase the overall production. Many farmers refused to cultivate chilli in the rainy season due to the increase of chilli disease to become high risk for the quality control and productivity. Fig. 1 illustrates the samples of plant chilli disease.

In general, there are two types of factors which can bring death and destruction to chilli plants; living (biotic) and nonliving (a biotic) agents. Living agent's including insects, bacteria, fungi and viruses. Nonliving agents include extremes of temperature, excess moisture, poor light, insufficient nutrients, and poor soil pH and air pollutants. Diseased plants can exhibit a variety of symptoms and making diagnosis was extremely difficult. Common symptoms are includes abnormal leaf growth, color distortion, stunted growth, shriveled and damaged pods. Although pests & diseases can cause considerable yield losses or bring death to the plants and it's also was directly affect to human health. However, crop losses can be minimized, and specific treatments can be tailored to combat specific pathogens if plant diseases are correctly diagnosed and identified early. These need-based treatments also translate to economic and environmental gains.

The remaining paper is organized as below. Section 2 describes the related work. Detail methodology along with all steps for implementation is elaborated in Section 3. An algorithm is presented in Section 4. Results are depicted in Section 5 and finally conclusions are drawn in Section 4.

Figure 1. Samples of plant chilli disease

2. Related Work

The basic techniques and algorithms that can be used for acquiring, processing and extracting useful information from digital images is elaborated in [1]. Particular emphasis is placed on covering methods used for image sampling and quantization, image transforms, image enhancement and restoration, image encoding, image analysis and pattern recognition.

In [2], the sigmoid activation function is used in neural networks with an exponential function that computes nonlinear decision boundaries. This technique acquiesce decision surfaces which approach the Bayes optimal under certain conditions. Another method based on Probabilistic Neural Net-work (PNN) with image and data processing techniques to implement general purpose automated leaf recognition for plant classification is suggested in [3]. Classbased image based recognition and rendering with varying illumination can also be an alternative approach suggested where a single input image of an object, and a sample of images with varying illumination conditions of other objects of the same general class, re-render the input image to imulate new illumination conditions [4]. In color constant indexing is a simple method proposed in [5], where objects can be recognized on the basis of their color only. Since the ratios of color RGB triples form nearby locations are insensitive to the changes. Suggested algorithms and mathematical computations are also proven very useful in analysis [6-7]. A novel shape recognition method based on radial basis probabilistic neural network (RBPNN) is presented [8]. This method uses orthogonal least square algorithm (OLSA) to train the RBPNN and the recursive OLSA is adopted to optimize the structure of the RBPNN.

Figure 2. Healthy Image of Chilli [13]

An idea to overcome the problem of face images taken in different lighting condition by combining the robust illumination normalization, local binary pattern texture descriptor and principal component analysis is considered. Here an image is a known face image when Euclidean distance between a test image and training images is minimum. And if this distance is not attained, it is an unknown face image [9].

In [10-11] authors have presented ideas regarding early detection of chilli disease through leaf features inspection. Leaf image is captured and processed to determine the health status of each plant. Finally conclude that the chemicals only applied when the plants are detected to be effected with the diseases. The image processing techniques are used to perform hundreds of chilli disease images. The plant chilli disease detection through leaf image and data processing techniques is very useful and inexpensive system especially for assisting farmers in monitoring the big plantation area.

3. Methodology

Chilli which is the fruit of capsicum family plant is almost a delicacy in Asian menu. This fruit has a high local demand and can fetch a very handsome economic yield. An attack by disease-causing organisms generates a complex immune response in a plant, resulting in the production of disease specific proteins involved in plant defense and in limiting the spread of infection. Louse also produce proteins and toxins to facilitate their infection, before disease symptoms appear such as the leaf color will change. These leaf colors play vital role in the development of plant disease detection.

Image processing is traditionally concerned with preprocessing operations such as Fourier filtering, edge detection and morphological operations. Computer vision extends the image processing paradigm to include understanding of scene content and object classification [1]. Therefore, this paper demonstrates the use of image processing techniques to detect the plant chilli disease through leaf image.

3.1 System Overview

The system consists of two major parts (refer to Figure 3) such as the digital camera and the LABVIEW software tools to build Graphical User Interface (GUI). The first part of the project is to take image photos of chilli leaf. Picture need to be taken in a group of chilli leaf. MATLAB is the software chosen to perform image processing on the captured image photos. Image processing of an image photo requires numerous standard procedures and steps to be able to identify and recognize the color in an image photo. It has step-by-step procedure showing the image processing of an image photo which the user only needs a few clicks on the GUI itself. Figure 3 illustrates the block diagram system [1].

3.2 Image Acquisition

It is another important step in which the images of chilli fruit are taken. Total 20 image samples of chilli fruit are gathered. This image set was further classified into four types which are fully affected, moderately affected, partially affected and the healthy which is normal. Images are taken from the digital camera having high resolution and keeping specific distance between digital camera and chilli fruit. The sample image is shown below.

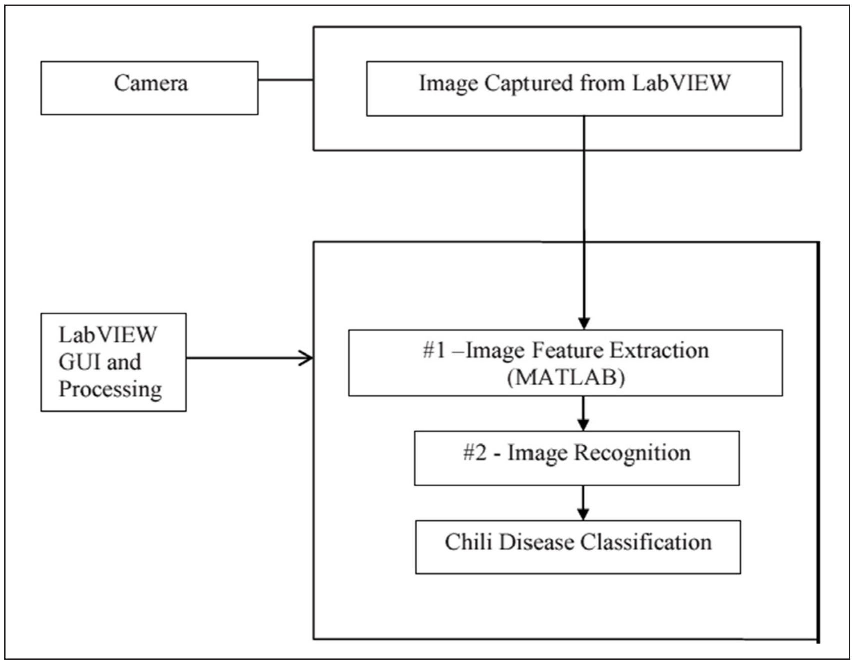

Figure 3. Chilli Plant disease detection system block diagram

3.3 Preprocessing

In this process different operation like filtering, intensifying the image and removing unwanted noise from an image are involved. Median filtering method that replaces the value of pixel by the median of gray level in the neighborhood of that pixel:

$$f(x,y) = median\ \{g\ (s,t)\}$$

Figure 4. Diseased Image of Chili [13]

The original value of pixel is included in computation of the median .these filter are quite popular because certain type of random noise, they provide excellent noise reduction capabilities, with considerably less blurring than linear smoothing filter of similar size.

The image sample is now intensified and converted into binary image. While converting image contrast and brightness of the image keeping with respect to specific value for obtain better results. Preprocessing is done to improve the quality of the acquire image.

3.4 Segmentation

The aim of segmentation is to subdivide an image into number of regions. The regions obtained correspond to the physical parts or objects of a scene (3-D) represented by the image (2-D). In general, autonomous segmentation is one of the most difficult tasks in digital image processing. The color image segmentation is more complex to process than gray image segmentation, because at the time of processing image, the color and result could be altered. Color image segmentation involves detection of edges or regions by deterministic or stochastic labeling procedure, based on information from intensity and/or spatial information. That wise we first convert RGB image into gray scale image. Thresholding is used to extract an object from its background by assigning an intensity value T (threshold) for each pixel such that each pixel is either classified as an object point or a background point. In band separating we observe three separate color band images. Then we apply masking process for color image segmentation.

3.5 Feature Extraction

In this step image is observed in different pixel value. According to Pixel values, number of spot and area of each spot or blobs observed. We extract the desired features from the sample image for the analysis of pathogenic affected region of the chilli fruit. Size, Shape, Volume, Color and Texture are the main features that separate diseased chilli from the normal chilli. Color is one of the most important parameter in feature extraction process. Depending upon this parameter of feature extraction we define or identify the quality of an image. Other important parameters are size, shape and volume. The cost is indirectly depends upon the size. But it is more complex if shape and size of the chilli is irregular. The shape is subjective type parameter which is based on human view. It is also indirectly affected to the cost. The most important parameter of feature extraction is texture. Texture can play an important role in color image segmentation process.

3.6 Color Feature Extraction

There are four color models namely RGB, HIS, CMY, YIQ. We used RGB color model for analysis. The RGB model is commonly used color model, in which each sensor captures the intensity of the light in the respectively red (R), green (G) or blue (B) bands. In an RGB model basically Red, Green and Blue component of the image sample is extracted. We also extract the total count of red, green and blue pixels in the chilli fruit. We also extract the total count of pixels occupied by entire chilli, which gives the total area of chilli. After texture feature extraction Process is done [14].

3.7 Converting color from RGB to HSI

Given an image in RGB color format, H component of each RGB pixel is obtained using the equation,

$$H = \{\theta \ \ if\ B \leq \mathrm{G}$$

$$360 - \theta \text{ if } B > G$$

With

$$\theta = \mathrm{Cos}^{-} \theta\ \{1/2\ [(R - G) + (R - B)]$$

$$[(R - G)^2\ (R - B)\ (G - G)]^{1/2}]\}$$

The saturation component is given by ,

$$S = 1 - 3 \div (R + G + B)\ [min\ (R, G, B)].$$

Finally, the intensity component is given by,

$$I = 1/3\ (R + G + B).$$

It is assumed that RGB values have been normalized to the range [0, 1]and that angle is measured with respect to the red axis of the HIS space can be normalized to the range [0, 1] by dividing by 360^0. The other two HIS component already in the range if the given RGB values are in the interval [0, 1].

3.8 Converting color from HSI to RGB

Given values of HSI in the interval [0, 1, the applicable equation depends on the values of H. There are three sectors of interest, corresponding to the 1200 interval in the separation of primaries. We begin by multiply 3600 which returns the hue to it's original range of $[0^0, 360^0]$.

RG sector ($0^0 \leq H < 120^0$): When H is in this sector, the RGB component is given by the equations

$$B = I(1 - S)$$

$$R = I[\,1 + S\cos H \div \cos(600 - H)]$$

And

$$G = 1 - (R + B)$$

GB sector ($120^0 \leq H < 240^0$):
If the given value of H is in the sector, we first subtract 120^0 from it:

$$H = H - 120^0$$

Then RGB component are

$$R = I(1 - S)$$

$$G = I[1 + S\cos H \div \cos(600 - H)]$$

And

$$B = 1 - (R + G).$$

BR sector ($240^0 \leq H \leq 360^0$): Finally if H is in this range, we subtract 2400 from it:

$$H = H - 2400$$

Then the RGB components are

$$G = I(1 - S)$$

$$B = I[1 + S\cos H \div \cos(600 - H)]$$

And

$$R = 1 - (G + B).$$

3.9 Texture Features Extraction
In texture Feature Extraction important parameter considers. Important texture features like correlation, homogeneity, entropy and contrast are extracted along with color features. For this we use Gray Level Co-occurrence Matrix. The gray co-occurrence matrix function creates a gray level co-occurrence matrix by calculating how frequently a pixel with the particular intensity value *i* occurs in a specified spatial relationship to a pixel with value *j*. Gray Level Co-occurrence Matrix was proposed by Haralick. GLCM is a texture description method is not much so difficult, which is based on the repeated occurrence of some gray-level configuration in the texture [14-17].

3.10 Classification
Percentage of affected area is the key parameter for calculation. Major classification is into partially affected, moderately affected, severely affected and the rest which are normal affected. For classification we cluster the affected area i.e., spot on chilli and depending upon their size and number. We classify the input images to disease chilli and normal chilli [13, 15].

4. Algorithm

Following equation is used to calculate the percentage of the affected, i.e. % healthy area of chilli = (healthy area of chilli / total area of chilli) * 100

Where,

Healthy area = Number of Green pixels in chilli fruit.

Total area = total size of chilli fruit

% affected area = 100 – % healthy area of chilli.

4.1 Algorithm
1. Accept the input image.

2. Change the RGB image into to the HSV model.

3. Show the H, S, V bands.

4. Apply threshold on HSV bands.

5. Arrange the relevant binary mask.

6. Apply mask on HSV bands to obtain segmented image.

7. Analyze each spot for its color, size and texture feature.

8. Calculate the features based on the color, size and texture.

9. Compare the input feature value with predefine value and decide the grade.

10. Classify the input chilli image into disease chilli and normal chilli and display the results.

4.2 Experimental Samples

The photo image prepared as experiment sample for this research paper have some fixed details. Both of the healthy and diseased leaf samples were used for the experimental purpose of this system. For better result, the leaves sample should be in good condition and sharp. See Figure 5.and Figure 6. Throughout the photo capturing section, the distance of the camera and the leaf was adjustable in order to get a clear shot of leaf pattern. The input photo image is a JPG image file and the size of resolution is 3872 x 2592 pixels.

$$a = imread\,('A(1).JPG');$$

$$A = imresize\,(a, [800\ 536]);$$

The imread function is read image from graphics file. The imresize function is to returns an image of the size specified by [m-rows n-cols]. Images are resized for easier image processing [5], [11] MALTAB and LABVIEW software are used for the simulation purpose, LABVIEW is an advance software [12] used for the simulation and GUI formation.

Figure 5. Healthy of plant Chilli

Figure 6. Diseases on Chilli plant

5. Results and Discussion

For the implementation and experimentation, we have taken seven samples of chilli plants with some healthy leaf sample around five and some diseased leaf samples around 2 and tested using implemented system. The system can be tested with image of 800x536 pixels. The method implemented in this research paper is effective and fastest method in detection of plant chilli disease. The overall result was about 80% which is satisfying and is considered as a successful project.

Sample Green	Yellow	Cyan	Green	Healthy/Disease
1	0.000	0.000	4.259	Healthy
2	0.014	0.007	22.916	Healthy
3	0.190	18.519	0.000	Healthy
4	0.033	11.1999	0.060	Healthy
5	4.022	3.234	0.639	Risky
6	1.107	24.883	14.29	Risky
7	1.825	0.001	17.16	Risky

Table 1. The plant chili healthy and risky result

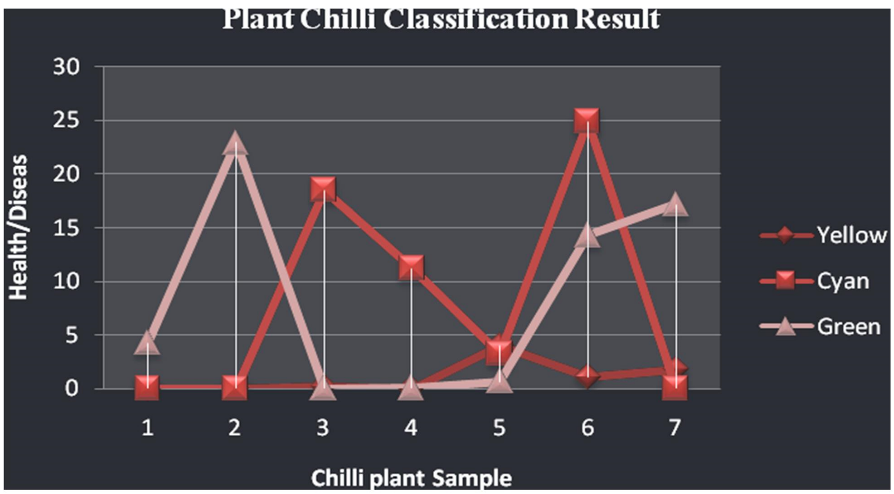

Figure 7. Plant Chilli Classification Result

6. Conclusion

This Paper presents the methods for effective detection of the diseases for enhancing the product quality of plants. DIP is used to Chilli Plant Disease Detection. The GUI design using LABVIEW and MATLAB software gives result as either risky or Healthy condition of plant. In this paper image processing for image and color recognition techniques are used for the detection. The method used in this paper is effective and fastest method in detection of plant chilli disease. It is also concludes that this method is one of the best methods among others for early detection of plant chilli disease through leaf inspection.

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