Detection of Plant Leaf Disease Using Image Processing Approach

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Abstract— The identification of disease on the plant is a very important key to prevent a heavy loss of yield and the quantity of agricultural product. The symptoms can be observed on the parts of the plants such as leaf, stems, lesions and fruits. The leaf shows the symptoms by changing colour, showing the spots on it. This identification of the disease is done by manual observation and pathogen detection which can consume more time and may prove costly. The aim of the project is to identify and classify the disease accurately from the leaf images. The steps required in the process are Pre-processing, Training and Identification. The disease considered are Powdery Mildew, Downey Mildew which can cause heavy loss to Grape fruit. For identification of disease features of leaf such as major axis, minor axis etc. are extracted from leaf and given to classifier for classification.

Keywords — disease, features, pathogen, spots.

I. INTRODUCTION

Now days, a new concept of smart farming has been introduced where the field conditions are controlled and monitored using the self operating systems. The self recognition of the disease is based on the identification of the symptoms of disease. So that information about the disease occurrence could be quickly and accurately provided to the farmers, experts and researchers. This in turn reduces the monitoring of large field by human being. In disease recognition from image the key is to extract the characteristic feature of the diseased region. According to the disease the features may vary. The features that are extracted from the image are color,shape,texture etc.Sometimes for detection of the disease more features are extracted and these extracted feature would increase the hardware as well as software cost. This further causes increase in the complexity and the computation time. Hence it is necessary to reduce the feature data.

The occurrence of the disease on the plant may result in significant loss in both quality as well as the quantity of agricultural product. This can produce the negative impact on the countries whose economies are primarily dependent on the agriculture. Hence the detection of the disease in the earlier stages is very important to avoid the loss in terms of quality, quantity and finance. Usually the methods that are adopted for monitoring and management of plant leaf disease are manual. One such major approach is naked eye observation. But the requirement of this method is continuous monitoring of the field by a person having superior knowledge about the plants and its corresponding diseases. Moreover, appointing such a person would may prove costly. Another approach is seeking advice from the expert which may add the cost. Also, the expert must be available in time otherwise it may results in loss. Diagnosis of disease on plant can also be done in laboratory testing. But this method requires satisfactory laboratory conditions along with professional knowledge. The pathogen detection methods can provide more accurate results. As the tests are carried out of field the cost may be high and could be time consuming.

This paper suggests a system which can provide more accurate results related to the identification and classification of disease. It tries to replace the need of the experts to certain extent. Here, the captured image is first preprocessed to resize it and then converted to HSI color space format by using segmentation. The features such as major axis, minor axis, eccentricity are extracted from the image. In the last step, these features are given to the classifier to classify the disease occurred on the leaf.

II. LITERATURE REVIEW

Various techniques of image processing and pattern recognition have been developed for detection of diseases occurring on plant leaves, stems, lesion etc. by the researchers. The sooner disease appears on the leaf it should be detected, identified and corresponding measures should be taken to avoid loss. Hence a fast, accurate and less expensive system should be developed. The researchers have adopted various methods for detection and identification of disease accurately. One such system uses thresholding and back propagation network. Input is grape leaf image on which thresholding is performed to mask green pixels. Using K-means clustering segmented disease portion is obtained. Then ANN is used for classification [1].The other method uses PCA and ANN.PCA is used to reduce the dimensions of the feature data. to reduce the no. of neurons in input layer and to increase speed of NN[2].Sometimes threshold cannot be fixed and object in the spot image cannot be located. Hence authors proposed LTSRG-algorithm for segmentation of image [3]. In cucumber leaf disease diagnosis, spectrum based algorithms are used [4].In the classification of rubber tree disease a device called spectrometer is used that measures the light intensity in electromagnetic spectrum. For the analysis SPSS is used [5].In citrus canker disease detection uses three level system. Global descriptor detects diseased lesion. To identify disease from similar disease based regions zone based local descriptor is used In last stage two level hierarchical detection structure identifies canker lesion [6]. For identification of disease on plant and stems first segmentation is carried using K-means clustering. Feature extraction is done by CCM method. Identification is done by using BPNN[7].With relevance to grapes, the fruit mostly suffer with tree types of diseases viz Powdery Mildew, Downy Mildew and Anthracnose. The two diseases are considered Powdery Mildew and Downy Mildew.

Powdery Mildew: Powdery mildew can infect all green parts of the grapevine. This disease is most easily recognized by the dusty appearance or white powdery growth occurring in patches on fruit or leaves. The white patches of powdery mildew produce millions of spores (conidia) which are spread by wind to cause more infections. Free moisture is not needed for secondary infection; temperature is the most important environmental factor. The image of grape leaf affected with powdery mildew is shown below in Figure1.

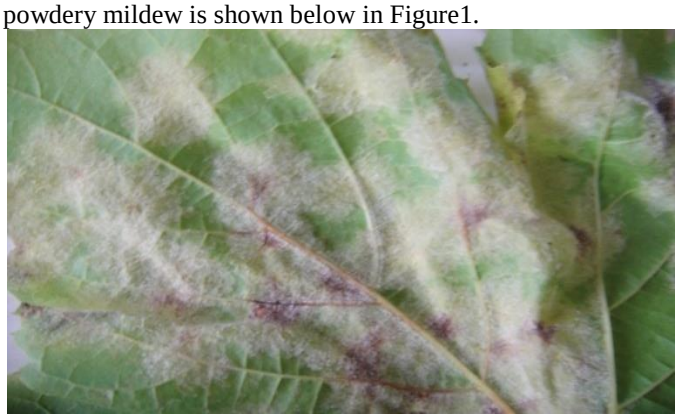


Figure 1: Leaf infected with Powdery Mildew

Downy Mildew: Early in the season, infected leaves develop yellowish-green lesions on their upper surfaces. As lesions expand, the affected areas turn brown, necrotic, or mottled. Severely infected leaves may curl and drop from the vine. The disease also attacks older leaves in late summer and autumn, producing a mosaic of small, angular, yellow to red-brown spots on the upper leaf surface. Downy mildew is favoured by warm, wet growing seasons.The image of leaf infected with downy mildew is shown below in Figure 2.

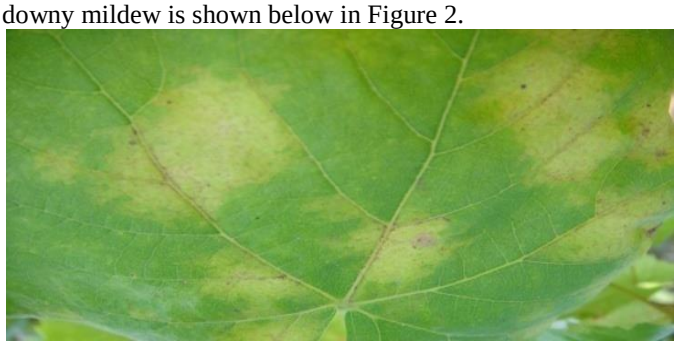


Figure2: Leaf Infected with Downy Mildew

III. Methods and Methodology

This section explains in detail about the methods and methodology adopted.

A. DATABASE CREATION

The database contains images of Powdery Mildew and Downy Mildew. These images were captured by camera model DSC T-90 of Sony Company. All the images are in JPEG format and were taken from farms nearby Nasik city.

B. Design of the system

The methodology adopted for the system is shown in Figure 3 below.

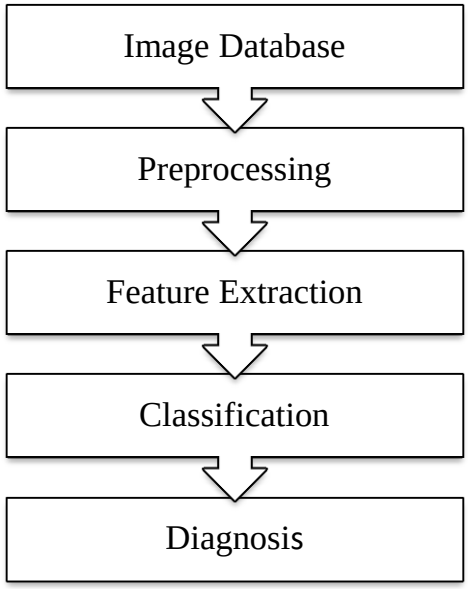


Figure 3: Flow of system

At first the damaged image should be pre-processed. This pre-processing can reduce the influence made by the background. The image enhancement consists of following steps - Transformation of the defected image into HSI colour space. Analysing the histogram of the intensity channel to get the threshold by which we can increase the contrast of the image. Adjust the intensity of the image by applying thresholds.

C. Feature Extraction

Features are extracted from image using Gabor filtering method. These features are very important for the colour and morphology of the leaf spots and they provide critical information about its visual representation. The features correspond to colour characteristics are the mean and variance of the gray level of the red, green and blue channel of the spots; and other features correspond to morphological and geometrical characteristics of the spots. It is assumed the shape of leaf is identical to the ellipse. Ellipse and its parameters are shown in Figure 4.

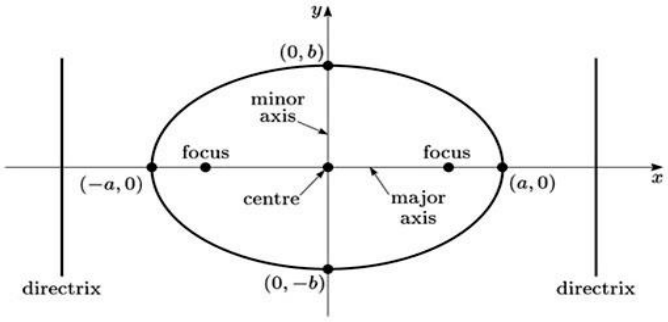


Figure 4: Ellipse and its parameters

1) Length and ratio of principal axes:

Major and Minor axes length is the length of the major and Minor axes of the ellipse that has the same normalized second Inertia moments as the spot, and ratio of principal axes length is major axis length divided by Minor axis length.

2) Centre of Gravity:

For a spot surface described by function f(x,y) consisting of N pixels, the centre of gravity coordinates (x,y) can be calculated as:

$$\bar{x} = \frac{1}{N}\sum \bar{x} \ , \bar{y} = \frac{1}{N}\sum \bar{y}$$

3) Moments of Inertia:

The moments of inertia for an spot described as f (x,y) can be defined as:

$$\mu_{pq} = \iint_R f(xy) x^p \, y^q dx \, dy$$

where p,q=0.1.2…….. in the binary images

4) Orientation:

Orientation is defined as the angle between the major axis of spot and the horizontal axis. Because the major axis exhibiting the minimum moment of inertia, it can be calculated as:

$$\theta = \frac{1}{2} arc \ \tan\left(\frac{2\mu_{1,1}}{\mu_{2,0} - \mu_{2,0}}\right)$$

5) Eccentricity:

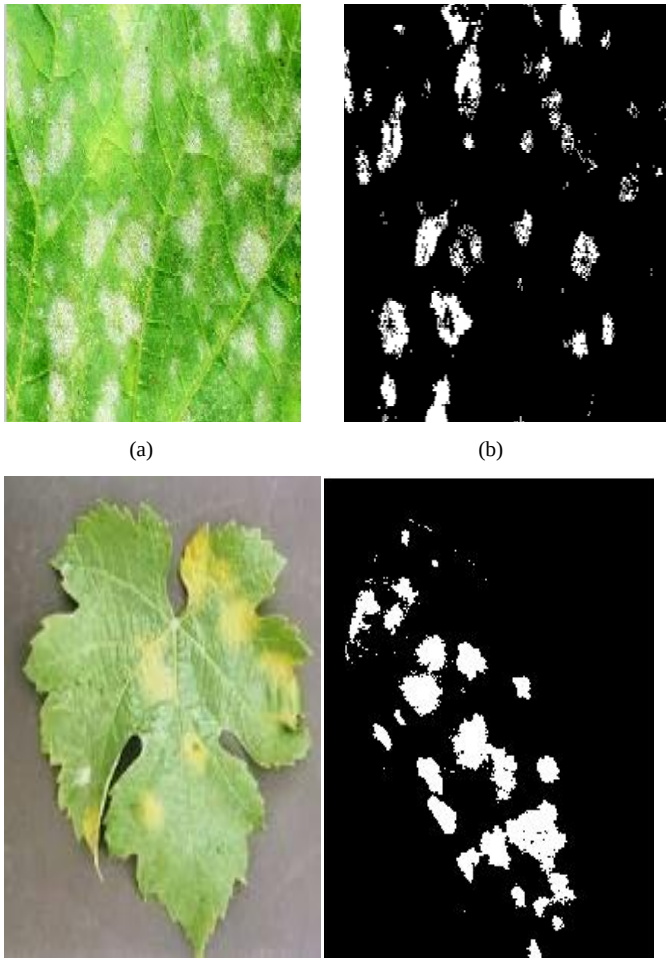
The ratio of the distance between the foci and major axis length of the ellipse that has the same second-moments as the spot, also called circularity ratio. Its value is between 0 and 1, the spot whose eccentricity ratio is 0 is actually a circle, while the spot whose eccentricity ratio is 1 is a line.

D. Classification

The features extracted are used for classification of the disease. For classification purpose Artifitial Neural Network is used. After training the samples in the database the disease is classified as Powdery Mildew or Downy Mildew.

IV. Results of Segmentation

The segmentation is based on two principles-discontinuity and similarity. Discontinuity extracts the regions having different properties like intensity, colour, texture etc. Similarity groups the image pixels into groups with some predefined criteria. Based on pixel similarity with the neighbouring pixel, the algorithm used is region based. In leaf disease identification, segmentation is used to identify the diseased area. From this, features of a region are computed. Figure 5 shows the results of the segmentation for extracting spot features.



(a) (b)

(c) (D)

Figure 5: Segmentation Results
(a) Original image of Powdery Mildew (b) Segmentation of Powdery Mildew (c) Original image of Downy Mildew and (d) Segmentation of Downy Mildew

V. Conclusion

The use of automated monitoring and management systems are gaining increasing demand with the technological advancement. In agricultural field loss of yield mainly occurs due to widespread of disease. Mostly the detection and identification of the disease is noticed when the disease advances to severe stage. Therefore, causing the loss in terms of yield, time and money. The proposed system is capable of detecting the disease at the earlier stage as soon as it occurs on the leaf. Hence saving the loss and reducing the dependency on the expert to a certain extent is possible. It can provide the help for a person having less knowledge about the disease. Depending on these goals, we have to extract the features corresponding to the disease.

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