Leaf Disease Detection and Diagnosis

Pranjali Vinayak Keskar, Shubhangi Nimba Masare, Manjusha Suresh Kadam and Prof. Mrs. Seema U. Deoghare

Abstract: In the research of identifying and diagnosing leaf diseases using computer vision intellectively in the agriculture, feature selection and shape classification is key question in pattern recognition and affects the design and performance of the classifier. Leaf spots can be indicative of crop diseases where leaf spots are usually examined manually and subjected to expert opinion. In this paper leaf disease detection and diagnosis system is developed to automate the inspection of affected leaves and helps identifying the disease type and thus provide corrective action. The developed system consists of four stages which includes HSI transformation, histogram analysis and intensity adjustment. The second stage is segmentation which includes adaption of fuzzy feature algorithm parameter to fit the application in concern. Feature extraction is the third stage which deals with three features, namely; colour, size and shape of the spots. The fourth stage is classification which comprises artificial neural network. Thus the system is applicable for detection and diagnosis of leaf diseases.

Keywords- Feature selection, Healthy leaf image, Disease leaf image, ANN

1 INTRODUCTION

In agriculture mass production, it is needed to discover the beginning of plant diseases batches early to be ready for appropriate timing control to reduce the damage, production cost, increase the income. Leaf batches differ in colour, shape and size according to cause. Leaf batch characteristics play a curial role in differentiating between the different causes. Leaf batches happen as a result of plant pathogen (fungi, bacteria, virus diseases), insect feeding.

The diagnosis of leaf batches may causes some confusion due to the similarities in batch's shape, size and colour but only an expert could identify it. The first step in fighting against these leaf batches is the adequate recognition of their presence that i.e. correct diagnosis. An abnormal symptom is an indication to the presence of the disease, and hence, can be regarded as an aid in diagnosis.

2 ARCHITECTURE OF PROPOSED SYSTEM

To diagnosis the disease, an image processing system has been developed to automate the identification and classification of various disorders.

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The main three components are image analyser, feature repository and classifier. The whole process is divided into two phases: Offline and Online. In offline phase a large set of defected input images was processed by image analyser for extracting abnormal features. These features were stored in the feature repository for later usage by the classifier. In online phase, in which abnormal feature of a specific defected image is extracted by image analyser and then classified by the classifier into a specific disorder. [1]

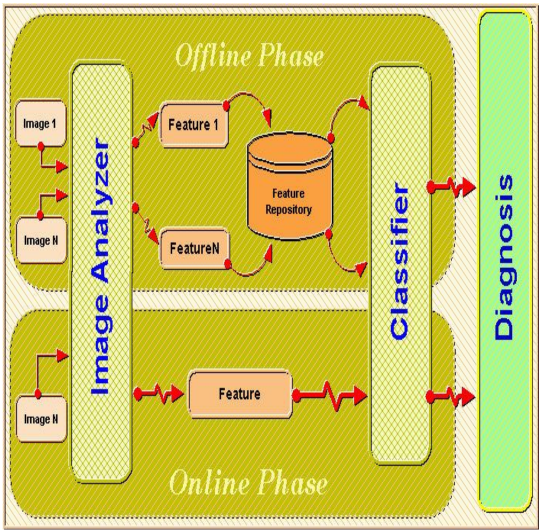


Fig 1. Overall structure of system

3.BLOCK DIAGRAM OF THE SYSTEM

3.1 Block diagram

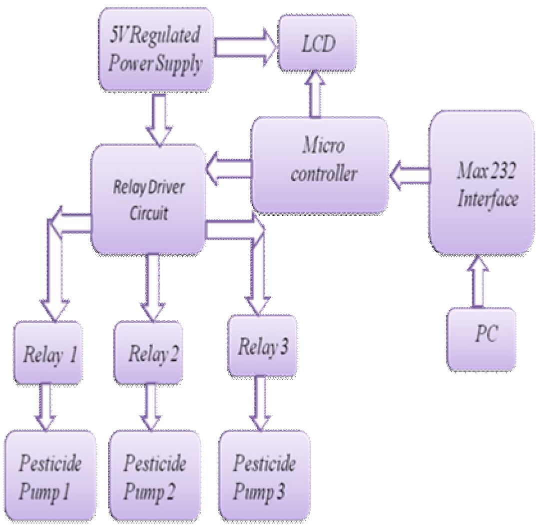


Fig 2. Block diagram of the system

3.2 Explanation

Computer:

The actual database of the project is stored in the PC. The disease affected leaf to be tested is compared with database in the PC which gives more accurate result and displays result.

Max 232:

The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply 232 voltage levels from a single 5-V supply. Each receiver converts 232 inputs to 5-V TTL/CMOS levels.

AVR ATmega16:

The AVR is a modified Harvard Architecture 8-bit RISC single chip microcontroller. ATmega16 has features like high-performance, Advanced RISC Architecture, 16K Bytes of In-System Self-programmable Flash program memory, high speed.

LCD, relay, computer are interfaced with the microcontroller. So all the controlling actions are taken by the AVR microcontroller.

LCD Display:

We are using LCD display for displaying various massages. We can display type of the disease and pesticide to be sprayed . We are going to use 16 x 2 alphanumeric LCD having inbuilt LCD drivers .

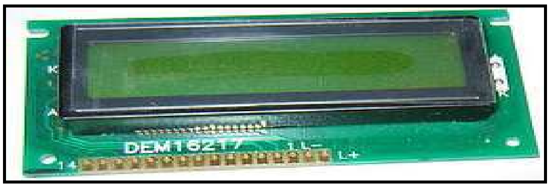


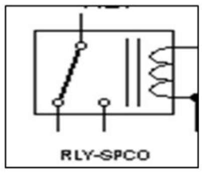
Fig 3. LCD Display

Relay driver IC ULN2003:

We are going to use relay driver IC ULN2003 to drive the relays that will control the pumps used for sprinkling of different pesticides.When the input to relay driver is logic 1, then it will turn on the relay by providing 0V (gnd) at the input of the relay. If logic 0 is applied at input of relay driver then it will go into the tristate.

Relay:

We have used 4 relays to control the pump for sprinkling the 4 different types of pesticides. After sprinkling the desired quantity of pesticide, the particular relay will get turned off. These relays are controlled by relay driver IC.



(a) (b)

Fig 4. (a) Relay (b) Internal structure of relay

4 SOFTWARE PROCESSING (MATLAB FLOW):

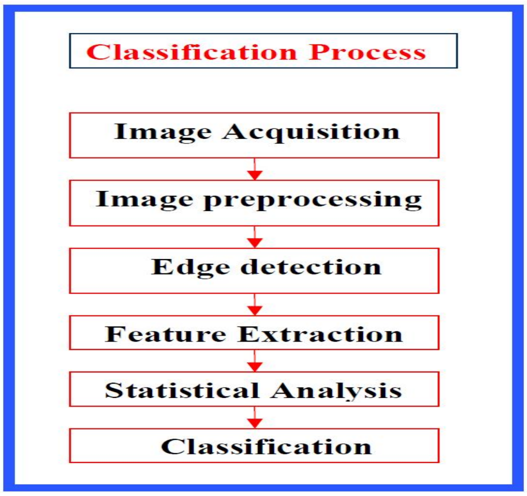


Fig 5. Flow of proposed System

Image Analyser

The main purpose of image analyser is to extract the abnormal symptom. Image analyser consist of Image enhancement, image segmentation, feature extraction.[1]

4.1 Image Acquisition

The images are captured by using high resolution camera. The image from the camera is digitized into a 24 bit image with resolution 720 x 540 pixels.[3]

4.2 Enhancement phase

Appearance of an image is improved by image enhancement technique, also the Important features of the image can be highlighted. From the inspection of the infected leaves it was found that, the spots has intensity values higher than the other normal tissues. To extract that abnormal tissues, the enhancement processing consists of three steps: transformation of HSI to colour space, analysing the histogram of intensity channel to get the threshold, intensity adjustment by applying the threshold.[1]

5. HSI TRANSFORMATION

HSI (Hue Saturation Intensity) system is commonly used colour space in an image space, which is more intuitive to human vision. HSI system separates colour information of an image from its intensity information. Colour information is represented by hue and saturation value. While intensity describes the brightness of an image. This makes an image good for human perception.

Formula for HSI

H=ArcTan(√3(G-B)/(R-G)+(R-B)….1

I=(R+G+B)/3………………………2

S=1-(min(R,G,B)/I)…………………3

5.1 Feature extraction phase

The purpose of feature extraction is to reduce the image data by measuring certain features or properties of each segmented regions such as colour shape or texture. This phase consist of two steps viz spot isolation and spot extraction

5.2 Spot isolation

Often, a segmented image consists of a number of spots. In order to extract features from the individual spot, it is necessary to have an algorithm that identify each spot. To identify each spot, we label each spot with unique integer and the largest integer label gives the number of spots in the image. Such identification algorithm is called component labelling. The following fig shows the binary segmented image and the labelled image after applying the component labelling algorithm.[1]

6. Feature extraction

In order to recognise the spot catagory, we measure several number of features in segmented image, to be later use for classification. These features correspo- nds to colour characteristics of the spots such as:[2]

1) Mean:

Mean of the gray level of the red, green and blue channel of spot. other feature corresponds to morphological characteristics of the spots such as: the length of principal axis, major and minor axis length of spot.

2) Length of principal axes:

Major and minor axes length is major and minor length of the ellipse.

3) Eccentricity:

The ratio of the distance between the foci and major axis length of the ellipse. Its value lies between 0 and 1.The spot whose eccentricity ratio is 0 is a circle while the spot whose eccentricity ratio is 1 is a line. It is given by

*2*sqrt(((major/2)^2-(minor/2)^2)/major)*

4) Equidiameter:

The diameter of the disk with the same area as spot is calculated as:

Sqrt(4 spot area/pi)*

5) Solidity:

Also called as compactness, gas a value between 0 and 1,if the spot has a solidity value equal to 1, i.e. fully compact.

spotArea/convexArea

6. CENTER OF GRAVITY:

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

$X=(1/N)*\sum\sum x \qquad Y=(1/N)*\sum\sum y$

6.1 Features Database

It is the component used to store the outputs of the feature extraction stage for the later usage by the classifier. The database is relational one, which consists of two tables namely a disorder table which is used to keep the track of disorder that have been processed and feature table, which is used to store the spot features for each disorder.

7. THE CLASSIFIER

An artificial neural network was used to perform our classification task. There are many different types of ANNs. The most widely used is back propagation ANN. This type of ANN is excellent for performing classification task. This configuration includes the number of layers, the number of neurons for each layer and the minimal number of training samples. This configuration is also called as the topology of ANN.

RESULTS

By using this system we successfully detected different types of diseases on a leaf which are stored in database. We compared different parameter values of healthy and disease affected leaf. Since there was very large difference in disease affected leaf parameter values with reference to healthy leaf parameter values, presence of disease was clearly identified. Also we sprinkled various pesticides according to type of disease detected.

Healthy leaf:

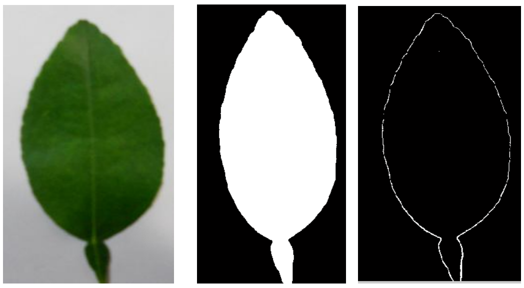


Fig 6.(a) healthy image (b)binary image (c)Segmented image

Disease affected leaf:

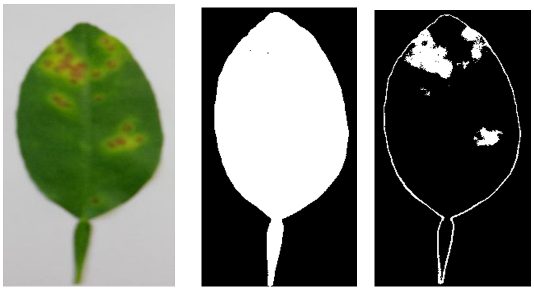


Fig 7. (a) citrus canker affected leaf image (b)binary image (c)segmented image

Result Table

Comparison table of healthy leaf and disease affected leaf

Parameter	Healthy Leaf	Disease Affected Leaf
Leaf area	326.075275 cmsq	301.819010 Cmsq
Spot area	175.727591 cmsq	28.7184613 Cmsq
Major axis	105.83 cm	79.37 cm
Minor axis	79.37 cm	105.83 cm
Centre of gravity X Y	177.99 177.99	173.46 173.46
Equidiameter	105.51	42.67
Eccentricity	6.804563	0.000000
Solidity	0.15	0.03

Conclusion

We have developed leaf disease detection and diagnosis system with the help of image processing which is capable of diagnosing disorders. A set of features was selected to be extracted using feature extraction phase, and those features were stored in the feature database, which is designed for this purpose. The captured leaf image parameters were compared with the parameters of healthy leaf and disease was detected. According to disease pesticide control was done.

Reference

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