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Leaf disease detection by using image processing

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ABSTRACT— for the detection and prevention of disease of plants from getting spread, this paper discussed a system using raspberry PI. For the image analysis, the k-means clustering algorithm was used. It has many advantages for the use in big farms of crops and thus it automatically detects signs of disease whenever they appear on leaves of the plant. In pharmaceutical research of leaf disease detection is necessary and important topic for research because it has advantages in monitoring crops in field at the form and thus it automatically detects symptoms of disease by image processing by k-means clustering algorithm. The term disease means the type of damage to the plants. This paper provides the best method for detection of plant diseases using image processing and alerting about the disease caused by sending email, SMS and displaying the name of the disease on the monitor display of the owner of the system. To upgrade agricultural products, automatic detection of disease symptoms is useful. The design and implementation of these technologies which is totally automatic and it will significantly help in the chemical application. It will reduce the cost required for the pesticides and other products. This will lead to increase in productivity of the farming.

KEYWORDS—component; formatting; style; styling; insert (key words)

I. INTRODUCTION

India is well known for its agriculture production. Most of the of the population is dependent on agriculture. Farmers have variety of options to cultivate crops in the field. Still, the cultivating these crops for best harvest and top quality of production is done in a technical way. So the yield can be increased and quality can be improved by the use of technology. Generally, whenever there is disease to a plant, we can say that leaves are the main indicator of the disease caused to the plant. Mostly we can see the spots on the leaves of it due to disease. However when the amount of disease to the plant is large then the whole leaf gets covered by the disease spots.

In most of cases plant diseases are caused by pathogens, microorganism, fungi, bacteria, viruses, etc. Sometimes unhealthy environment include soil and water is also responsible for diseases in plants. There are lots of techniques to detect the different types of diseases in plants in its early stages. Conventional method of plant disease detection is naked eye observation methods and it is non effective for large crop. Using digital image processing method, the disease detection in plant is efficient, less time consuming and accurate. This technique saves time, efforts, labours and use of pesticides. Different authors propose different techniques with the help of digital image processing for accurate plants disease identification. Lots of algorithms have developed by different researchers for image processing.

II.DISEASES

A. Bacterial disease symptoms:

The disease is mainly referred to as "bacterial leaf spot" Symptoms begin as small, yellow green lesions on young leaves which usually seen as deformed and twisted, or as dark, water-soaked, greasy-appearing lesions on older foliage as shown in Fig.1.5.A.

Figure1.5.A.Bacterial disease on leaf

B. Viral disease symptoms:

All virus disease presents some degree of reduction in production and the length of life of virus infected plants is usually short. The most accessible symptoms of virus-infected plants are usually those appearing on the leaves, but some viruses may cause strike on the leaves, fruits and, roots. The Viral disease is very difficult to diagnose. In Fig.1.5.B Leaves are seen as wrinkled, curled and growth may be stunted due to the virus.

Figure 1.5.Bviral disease on leaf

C. Fungal disease symptoms*:*

It is a type of plant pathogen and is responsible for the serious plant diseases. Most diseases in vegetable are caused by fungi. They damage plants by killing cells. The main Source of fungal disease is the infected seed, soil, crop, and weeds. It is spread by the wind and water and through the movement of contaminated soil, animals, workers, machinery, tools. In, initial stage it appears on lower or older leaves as water-soaked, gray-green spots. Later, these spots darken and then white fungal growth spread on the undersides. In downy mildew yellow to white streak on the upper surfaces of older leaves occurs. These areas are surrounded with white to Gray fungal growth on the undersides as shown in Fig.1.5.C.

Figure1.5.C. Fungal disease on leaf-downy mildew

III.LITERATURE SURVEY

Image processing technique for Rice disease identification and considered the two most common diseases in the north east India, namely Leaf Blast (Magnaporthe Grisea) and Brown Spot (Cochiobolus Miyabeanus). Image acquisition is basic step, after that author use segmentation, boundary detection and spot detection method for feature extraction of the infected parts of the leave. In this we have to use zooming algorithm in which SOM (Self Organising Map) neural network is used for classification diseased rice images. There are two methods to make input vector in SOM. First method is the padding of zeros and the second method is the interpolation of missing points. For fractional zooming to normalize the spots size, interpolation method is applied. Image transformation in frequency domain does not give better classification. For testing purposes, four different types of images are applied; the zooming algorithm gives satisfactory results of classification for test images.

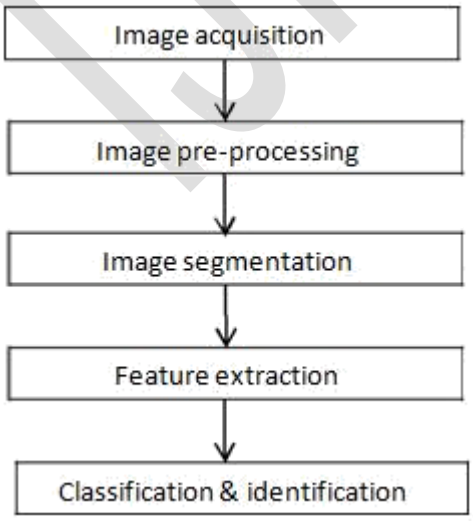
Image-processing technique for Leaf & stem disease detection. The author used a set of leaf images from Jordan's Al-Ghor area. The five plant diseases namely: Early scorch, Ashen mold, Late scorch, Cottony mold and Tiny whiteness is tested by image processing technique. In this technique at starting, image acquisition is obtained and then K-Means clustering method is used for segmentation. After that in feature extraction, CCM (Colour Co-occurrence Method) is used for texture analysis of infected leaf and stem. Lastly paper presents Back propagation algorithm for neural network in classification of plant diseases. Result of this image processing technique shows accurate detection and classification of plant diseases with high precision around 93%.

Authors used both LABVIEW and MATLAB software for image processing to detect chilli plant disease. This combined technique detects disease through leaf inspection in early stage. The Image is captured using LABVIEW IMAQ Vision and MATLAB Operations of image processing. Image pre-processing operations are Fourier filtering, edge detection and morphological operations. In feature extractions, the colour clustering is used to distinguish between chilli and non-chilli leaves. Then image recognition and classification determine the healthiness of each chilli plant. This technique results in reducing use of harmful chemicals for chilli plant which reduces production cost and increases high quality of chilli.

IV.METHODOLOGY

A. **Proposed System**

Images of various leafs is acquired using digital camera. After acquiring those images further image pre-processing techniques are applied followed by segmentation and extraction. After that several analytical techniques are used to classify images according to specific problem at hand.



In the initial step, RGB images of all the leaf samples were picked:

1) RGB image acquisition
2) Image Pre-processing
3) Image segmentation
4) Image extraction
5) Classification & identification of disease

1. Image Acquisition

The image acquisition stage involves pre-processing, such as scaling. Firstly, the RGB colour images are captured using a digital camera with required resolution for good quality .construction of an image database is clearly dependent on the application.

2. Image Pre-processing

Image pre-processing is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image. A familiar example of enhancement is when we increase the contrast of an image because it looks better.

3. Image Segmentation:

Image segmentation is the process of separating or grouping an image into different parts. There are currently many different ways of performing image segmentation, ranging from the simple thresholding method to advanced colour image segmentation methods. These parts normally correspond to something that humans can easily separate and view as individual objects. In general, the more accurate the segmentation, the more likely recognition is to succeed. Segmentation step find out the infected region. Segmentation mostly can be done by k-mean clustering, edge detection algorithm. Here we had done segmentation using k-means clustering. First RGB image is converted into lab format. Then after that reshaping of image. And then k-means clustering is applied to the images. The next step is to extract the useful segments.

4. Feature Extraction

Different texture features of images are extracted as given below Mean= Mean is defined as simple average of the numbers. If there are 5 numbers as num1, num2, num3, num4 & num5 then mean is Mean= num1+num2+num3+num4+num5 5 Variance=The variance is defined as average of the squared differences from the Mean. Standard Deviation= The Standard Deviation is a measure of how numbers are spread. Its symbol is σ (the Greek letter sigma). The formula is easy: it is the square root of the Variance. Contrast= contrast is the difference in luminance or colour that makes an object (or its representation in an image or display) distinguishable. In visual perception of the real world, contrast is determined by the difference in the colour and brightness of the object and other objects within the same field of view. The human visual system is more sensitive to contrast than absolute luminance; we can perceive the world similarly regardless of the huge changes in illumination over the day or from place to place. The maximum contrast of an image is the contrast ratio or dynamic range.

5. Classifier:

In the classification phase, co-occurrence features for the leaves are extracted and compared with the corresponding feature values stored in the feature library. The classification is first done using Minimum Distance Criterion. Classification gain can be calculated as G(%)= (Corr/M)*100 Where Corr is the number of images correctly classified and M is the total number of images belonging to the particular texture group.

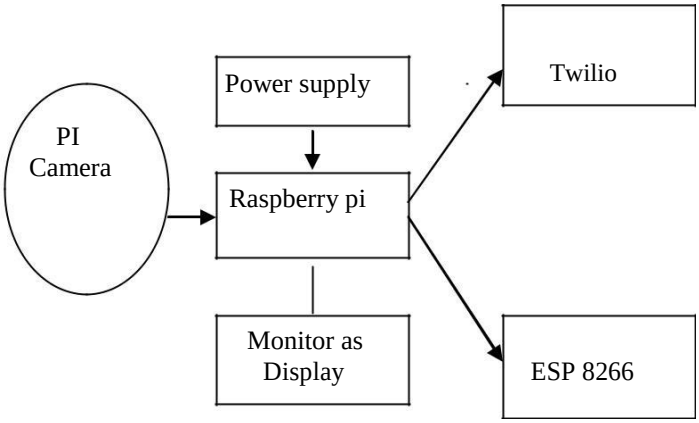


Fig: Block Diagram

Working Principle:

The main objective of this project is the detection, classification of leaf diseases using image processing technique and all information about the disease is sent to the farmer's mobile phone through the GSM module. To increase the speed and accuracy of detection as well as classification of leaf diseases we using Raspberry pi 3 model B modules. One more important benefit of this system is that it gives the name of the pesticide required to use in order to prevent the disease from spreading. It providing exact name of pesticide as per the disease.

RASPBERRY PI

The Raspberry pi 3 model B is the third generation raspberry pi .This powerful credit-card sized single board computer can be used for many application and the original raspberry pi model B+ and Raspberry pi 2 model B . Whilst maintaining and popular board format the Raspberry pi 3 model B brings you a more powerful processor, 10x faster than the first generation Raspberry pi .Additionally it adds wireless LAN and Bluetooth connectivity making it the ideal solution for powerful connected designs.

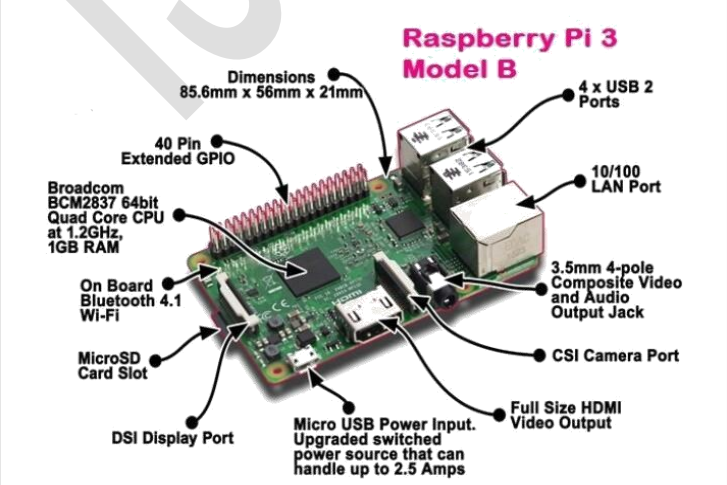


Figure.4.1.Raspberry pi

Ethernet: 10/100 base T Ethernet socket.
GPIO Connector :40 pin 2.54mm expansion header 2x20 strip providing 27 GPIO pins as well as +3.3V,+5V and GND supply lines.
Camera Connector:15 pin MIPI Camera serial interface.
Display Connector: Display serial interface 15 way flat flex cable connector with two data lanes and a clock lane.
Memory Card Slot: Push/Pull micro SDIO.

Figure.4.2.pi Camera

Pi Camera module is a camera which can be used to take picture and high definition video. Raspberry pi board has CSI interface to which we can attach pi camera module directly. This pi camera module can attach to the Raspberry pi CSI port using 15 pin ribbon cable.
Raspistill is a command line application that allows you to capture images with your camera module. Below is an example of this command in use.
To capture an image in jpeg format, type "raspistill-o image.jpg" at the prompt , where "image" is the name of your image.

Features of Pi Camera:

- Resolution-5MP
- It can capture wide ,still images of resolution 2592x1944 pixels
- CSI interface enabled
- 15 cm flat ribbon cable to 15 pin MIPI camera serial interface network.

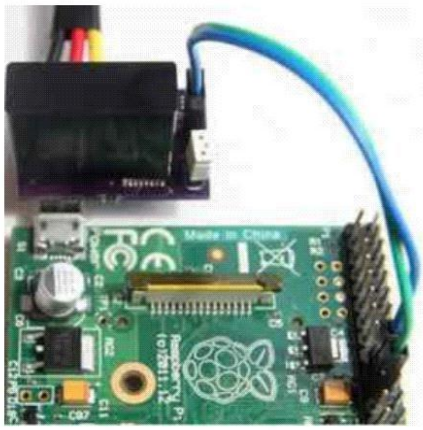
In order to meet the increasing need of Raspberry Pi compatible camera modules. The Ardu CAM team now released a revision C add-on camera module for Raspberry Pi which is fully compatible with official one. It optimizes the optical performance than the previous Pi cameras, and give user a much clear and sharp image. Also it provides the FREX and STROBE signals which can be used for multi-camera synchronize capture with proper camera driver firmware. It attaches to Raspberry Pi by way of one of the two small sockets on the board upper surface. This interface uses the dedicated CSI interface, which was designed especially for interfacing to cameras. The CSI bus is capable of extremely high data rates, and it exclusively carries pixel data. The camera is supported in the latest version of Raspbian, Raspberry Pi's preferred operating system The board itself is tiny, at around 36mm x 36mm. The highlight of our module is that the Lens is replaceable compared to official one, making it perfect for mobile or other applications where size and image quality are important. It connects to Raspberry Pi by way of a short ribbon cable.

ESP 8266

Figure.4.4. ESP 8266

The ESP 8266 Wi-Fi module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network .The ESP8266 is a capable of either hosting an application or offloading all Wi-Fi networking function from another application processor. The is an extremely cost effective board with a huge, and ever growing community.

POWER SUPPLY



Raspberry Pi Power supply

This system requires 5V, 1A power supply .The Raspberry pi model B has the special connection provided. Using that USB connection the power supply can be provided. The power requirement of the Raspberry pi increase as you make use of the various interface on the Raspberry pi. If you need to connect a USB device that will take the power requirements above 1Amp, than you must connect it to an externally powered USB hub.

TWILIO

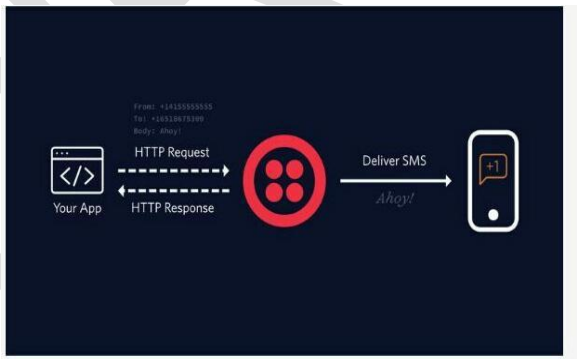


Figure.4.6.twilio

It is easy to send an outgoing MMS using Twilio. To send an MMS, you also make an HTTP POST request to the messages resource but this time specify a parameter for the URL of media, such as an image.

V. ALGORITHM

1. Capture the image in RGB format.
2. Generate color transformation structure.
3. Convert color values from RGB to the space specified in that structure.
4. Apply K means clustering for image segmentation.
5. Masking of green pixels (masking green channel).

6. Eliminate the masked cells present inside the edges of the infected cluster.
7. Convert the infected cluster from RGB to HIS.
8. Generation of SGDM matrix for H and S.
9. Calling GLCM function in order to calculate the features of it.
10. Computation of texture statistics
11. Configure k-nn (classifier) for recognition.

Disease detection by using k clustering method .The algorithm provides the necessary steps required for the image detection

of the plant leaf. In the first step, generally the RGB images of all the leaves are captured using camera. In step 2 a colour

transformation structure is formed, and then colour space transformation is applied in step 3.These two steps are to be expected

in order to perform step 4. In this step the images which we have got are processed for segmentation by using the K-Means

clustering technique. These four steps come under phase one, the infected objects detected and determined.

In step 5, the green pixels are detected. Then masking of green pixels is done as: if the green color value of pixel is less than the threshold value which we already have calculated, then the red, green and blue components values of the these pixel are made zero. This is done because these are the unaffected part. That is why there values are made zero which results in reduction in calculations as well. Additionally, the time consumed by the raspberry pi3 for showing the final output will greatly minimize.

In step 6 the pixels having zero value for red, green and blue and the pixels on the edge of the infected clusters are removed completely. Phase 2contains step five and step number six and this phase gives added clarity in the classifying of that disease.

This result with good detection and performance, also generally required computing time should be decreased to its minimum value.

In step number seven, the infected cluster is converted from RGB form to HSI format. After that, the SGDM matrices are created for every pixel of the image. But this is done for only for H and S images and not for the images. The SGDM actually measures the probability that a given pixel at one particular gray level will occur at a different distance and angle of orientation from other pixel, however pixel has a second particular gray level for it. From the SGDM matrices, generation of texture statistics for each and every image is done.

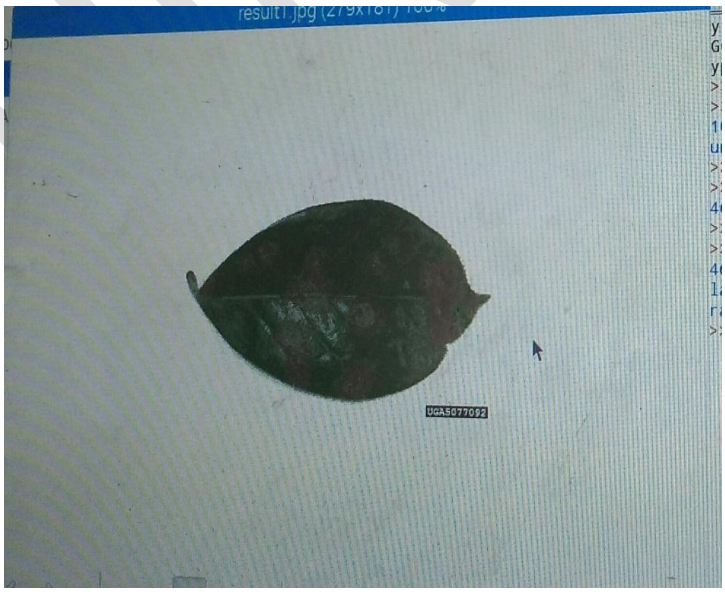
Concisely, the features are calculated for the pixels present inside the edge of the infected part of the leaf. That means, the part which is not affected inside the boundary of infected part gets uninvolved. Steps seven to ten come under phase three. In this phase the features related to texture for the objects being segmented are computed. Finally, the recognition process in the fourth phase was performed. For each image we have captured the steps in the algorithm are repeated each time. After this the result are transferred to GSM module. Using Raspberry Pi the result is sent as e -mail, and also is displayed on monitor.

VI.RESULT

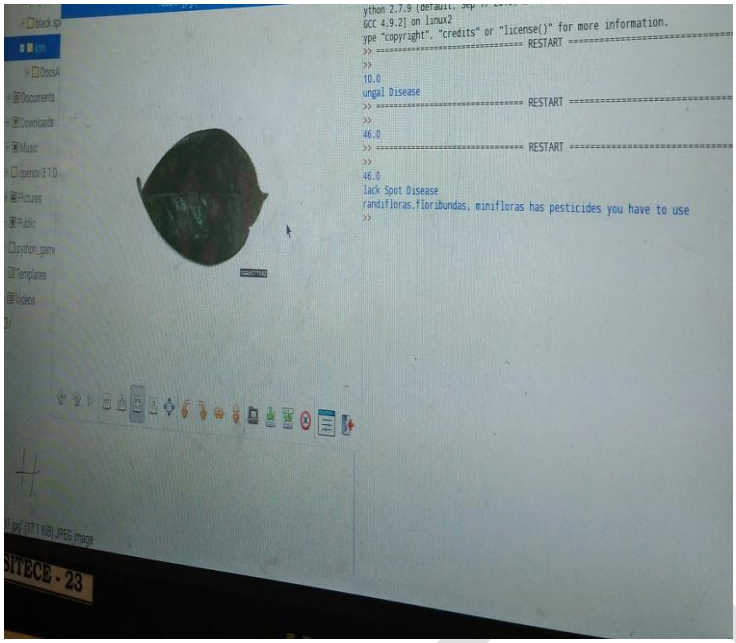
1. **Fungal disease**

Segmentation image

2.Black spot disease

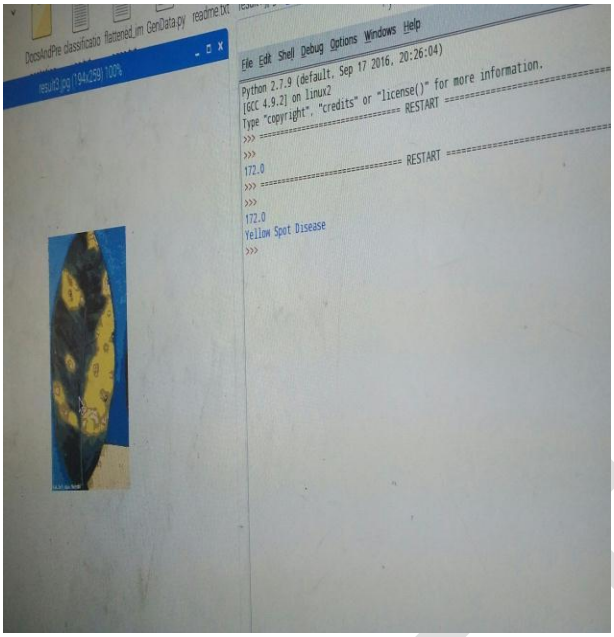


Segmentation image



3. Yellow spot disease

Segmentation image



VII. CONCLUSION

Basically there are three main types of Leaf disease, they are Bacterial, Fungal and Viral. It is important in plant disease detection to have the accuracy in the plant disease detection but at the same time the process should be of high speed. Work can be extended by the use of quad copter for the capturing of images of leaves of the different plants in the farm at field level. This system can be connected to the server for further processing.

The objective of this work is the detection, classification of leaf diseases using image processing tools and all information about the disease is sent to the farmer's mobile phone through the GSM module. To increase the speed and accuracy of detection as well as classification of leaf diseases we using Raspberry pi 3 model B modules. One more important benefit of this system is that it gives the name of the pesticide required to use in order to prevent the disease from spreading. It providing exact name of pesticide as per the disease, to save labor price by eliminating need of labor for regular observation of plants to check whether it is affected by any disease or not . This system will largely contribute in growth in the yield of the farms.

As, SVM is very complex in calculations and it is not the cost effective testing of each instance and inaccurate to wrong inputs. KNN algorithm is effectual classifier would be used to minimize the computational cost. In previous researches it has proved that KNN has high accuracy rate. KNN classifier obtains highest result as compared to SVM. The comparison would be based upon two parameters Accuracy and Detection time. The study reviews and summarizes some techniques have been used for plant disease detection. A novel approach for classification of plant disease has been proposed.

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