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PLANT PATHOLOGY DETECTION AND CONTROL USING RASPBERRY PI

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ABSTRACT
The main objective of this paper is detection of diseases at the early stage. In this paper, we mainly focus on image processing techniques. This includes a series of steps from capturing the image of leaves to identifying the disease through the implementation in Raspberry PI. Raspberry PI is used to interface the camera and the display device along which the data is stored in the cloud. Here the main feature is that the crops in the field are continuously monitored and the data is streamed lively. The captured images are analyzed by various steps like acquisition, preprocessing, segmentation, clustering. This in turn reduces the need for labor in large farm lands. Also the cost and efforts are reduced whereas the productivity is increased.

Keywords: Raspberry PI, Camera, Cloud, Image-processing, Segmentation

I. INTRODUCTION
Agriculture is the backbone of India. As India is a developing country, its economy mainly depends on agriculture. India experiences variety of climates ranging from tropical in the south to temperate in the north. Due to the unpredictable climatic changes, there is lack of nutrients and minerals to the crops. This leads to deficiency diseases which in turn affects the crop productivity. Plants get affected not only due to deficiency but also caused due to micro organisms like fungi, bacteria, virus and mites. These kind of borne diseases are very dangerous as they affect large farming. And so it is very important to take steps for maintaining the crops. Manual observation over the health of the crops might result in errors and may even be difficult in case of large acres of land. The best approach to overcome requirement of labor as well as the reduction of errors is smart way of monitoring the plant through image processing techniques. Detection of plant diseases can be easily done through leaves as they are the prominent and delicate part of a plant.

II. SYSTEM DESIGN
The module which is used here is Raspberry PI, which is a single board computer. The advantage of using Raspberry PI is that it is a fast processor with low power consumption. It is highly reliable with compactness. Here we use object oriented Programming language which is Python as it is a high level scripting based programming language. The main advantage of using python as a coding language is that the python interpreter and the extensive standard library are available both in source or binary form without charge for all major platforms.

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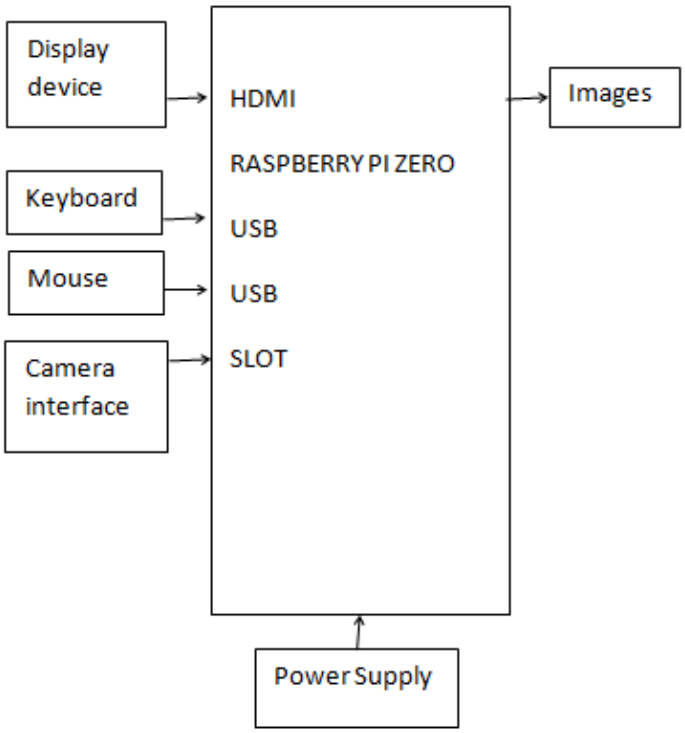
Block diagram of the proposed model:



HDMI cable:
HDMI stands for High Definition Multimedia Interface. It is used for transmitting uncompressed data from a source device like a display controller. It is used for interfacing audio and video data to a compatible monitor or video projector.

Raspberry PI Zero:
Raspberry PI Zero board is the main chip used, that has 1GHz single core CPU with 512MB RAM. It has a mini HDMI port and micro USB OTG port. It is compatible for interfacing camera. It consists of micro SD card of class .

OPEN CV:
OPEN CV stands for Open Source Computer Vision. It consists of many library programming functions that mainly focus on real time applications. Programming languages like C++, Python are supported in this software.

Camera:
Here we use a 21 megapixel camera that focuses on plants for clear image. It is interfaced with the Raspberry PI zero board.

III. METHODOLOGY

The detection of plant diseases is done through image processing techniques. The images of the plant are captured by a digital camera which is interfaced with the raspberry pi board. Various image processing techniques are applied on the acquired image to obtain the features for further analysis. This method of image processing involves a series of steps. They are:

1. Image acquisition
2. Conversion of the RGB image into HSV format.
3. Green pixel masking
4. Removing green pixel masks
5. Segmentation of the components
6. Obtaining the useful segments from the processed image.
7. Colour co-occurrence method
8. Evaluate the texture statistics

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1. Image acquisition

The RGB images from the plant are acquired by the camera module. The camera is of 21 mega pixels and thus the RGB images are obtained with high clarity.

2. Conversion of the RGB image into HSV format

The RGB images are converted into Hue Saturation Value colour space, which is an ideal tool for colour perception. The RGB is used as an ideal representation for colour generation.

Hue is nothing but a colour attribute that represents the pure colour similar to the perseverance of the observer.

Saturation is described as the representation of the amount of white light added to the Hue of the image or it is referred to relative purity. Value is referred to the amplitude of light.

The Hue component is taken into analysis whereas the Saturation and Value components are dropped in the analysis as they do not provide any extra information for analysis.

3. Green pixel masking

Masking is defined as the process of setting the pixel value in an image to zero or any other background value. The pixels that are mostly coloured in green are identified from this step.

4. Removing green pixel masks

It is followed by setting the green pixels to zero based on the specified threshold value that is computed for the pixels. The red, green and blue components in the pixel are given a value of zero by RGB component mapping. Here the healthy areas in the leaf are represented through the green coloured pixels and so they do not help for identification of diseases.

5. Segmentation

The infected portion of the leaf is extracted and segmented into number of segments that are of equal size.

6. Obtaining the useful segments from the processed image

All the segments do not contain significant information. The segments that have considerable amount of information are chosen for analysis.

7. Colour co-occurrence method

The texture features are derived from the statistical distribution of observed combinations of intensities at positions specifically relative to each other in the image.

8. Evaluate the texture statistics

The contrast, local homogeneity, energy, correlation are computed for the hue content of the image. The contrast returns a intensity value between a pixel and its neighbour which is given by

$$Contrast = \sum_{i,j=0}^{N-1} (i,j)^2 C(i,j)$$

Homogeneity is the value of closeness of distribution of elements which is given by

$$Homogeneity = \sum_{i,j=0}^{N-1} C(i,j)/(1+(i-j)^2)$$

Energy gives the sum of square elements which is given by

$Energy = \sum_{i,j=0}^{N-1} C(i,j)^2$

The energy is 1 for a constant image.

Correlation is a measure of how a pixel is correlated with its neighbour pixel. It can be found by

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$$Correlation = \sum_{i=0}^{G-1}\sum_{j=0}^{G-1}\frac{\{i\times j\}\times P(i,j)-\{\mu_x-\mu_y\}}{\sigma_x\times\sigma_y}$$

After performing these series of steps, the Raspberry PI indicates the presence of disease in the plant. The name of the disease along with the control measures is indicated in the output. Further these data are stored in the cloud platform and eventually forwarded to the client.

IV. DIFFERENT TYPES OF DISEASES IN CUCUMBER ARE

1. **Boron deficiency:**
   Colour: Broad yellow border at margins of older leaves
   Appearance: Upside folded leaf

2. **Magnesium deficiency:**
   Colour: Yellowing of older leaves and light tan burn in yellow region and veins retain narrow green border
   Appearance: leaf folded downwards

3. **Potassium deficiency:**
Colour: Yellowing and scorching at the edges of the leaf

4. **Red Spider mites**
Colour: pale brown leaf and red insect will be present

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Appearance: pale mottling on upper surface of leaf

5. White Fly:

Colour: Yellow minute spots on leaf and white insect will be presented.

6. Aphids:

Colour: Yellow and necrotic spots on leaves and there will be yellow and black insect.

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V. ALGORITHM

1. The image is captured using the 21 megapixel camera module.
2. The captured image is pre-processed in the Raspberry PI zero board using Image processing techniques that were discussed above.
3. The image analysis is done by following steps:
   - Two images are compared and the mean square error between the images is calculated.
   - The main condition is that the two images must have the same dimension.
   - Minimize the errors until the two images become similar.
   - The structural similarity is also calculated between the images.
   - The lower range and the upper range colour is assigned to the variable.
   - Then the image is converted into binary gray for corner detection.
   - Assign the binary gray to 32 bit floating point.
   - Assign the length of the dots.
   - Corner colour is assigned to red BGR.
   - Find the significant colour in the image.
   - Merge the masked image using AND operation.
   - The images are converted into Gray scale.
4. The command window displays the output of the processed image indicating the name of the disease along with the control measures.
5. The data about the plant disease is pushed into the cloud platform.
6. The results can be viewed in the mobile or any other display devices like projector, monitor or tablet.
7. The above actions are performed again in the same manner for the detection of any other disease.

VI. RESULT

The output gives the information of the disease of the plant along with the control measures. This way the health conditions of the crops are continuously monitored and necessary steps for the prevention of disease are taken.

VII. CONCLUSION

This method of disease detection is done periodically by the processor such that the spreading of disease can be easily controlled. It is an efficient method as it requires less man power and yields high productivity. Through this the accuracy of image processing is maximized

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