Plant Disease Identification and Automatic Chemical Sprayer

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Abstract: *Agriculture is the most important sector for survival of living organisms. There is need for development in agriculture to provide enough food this fast-growing population. The history of agriculture shows that techniques in agriculture improved gradually. There is a huge gap between technologies what we have and present agricultural techniques in India. The equipment what we are building in this project identifies the disease in plants when we take the picture of the diseased plant leaf through camera and later the pesticide is sprayed on crops based on diseased identified. Disease identification is done using image processing techniques with the help of Raspberry pi development board where the programming is done in Python language. Image Pre-processing is done with the help of TensorFlow library which is developed, released and maintained by Google. Plant Diseased leaf part is clustered using the K-means clustering technique which is best to our project. After K-means clustering to be more precise we are using SVM expanded as Support Vector Machine which is used to classify the disease in that particular leaf. After image classification and disease detection, proper pesticide which is stored in container can be sprayed to that plant through the nozzle. By this project plant diseases can be identified at the early stage and can be cured. So that the final yield can be more productive and also chemical free, since we spray only required amount of pesticides which is prescribed by the government.*

Key Words: Plant disease, Segmentation, Chemical Spray Leaf

1. INTRODUCTION

Agriculture has played a key role in the development Decrease in agricultural production will affect the total economy. Therefore, Proper management of various resources such as soil, seed, water, fertilizers is required for sustainability. Detecting the disease plays a major role as diseases are inevitable. The pigmentation, fruit-sets and nutritive value of the fruits are affected by temperature and light intensity. Plant are very susceptible to diseases caused by fungi, bacteria, and viruses.

Quantity and quality of the agricultural products are affected by plant diseases found on plants. Manual plant diseases identification is time consuming and does not give accurate results. Long exposure to pesticides will have health effect on farmers. Automatic spraying of pesticides will reduce the health issues related to farmers. The present work proposes an efficient method to detect the paddy leaf and tomato leaf diseases using image processing techniques. In this paper we have implemented the image processing techniques detect diseases on paddy and tomato leaf. Once the disease is detected spraying of pesticides is done

Most of the plant diseases are triggered by fungi, bacteria, and viruses therefore detection of plant disease is essential. Morphological changes in leaves are the primary stage of Fungi. Bacteria are considered more embryonic than fungi. They have simpler life cycles and identified by morphological changes in leaves. Detection and classification of the natural plant disease is normally performed by bare eye observation and chemical test. In large scale farming it is impossible to observe each and every plant, every day. Farmers are unaware of non-native diseases. Consultation of experts for this might be time consuming and costlier. Unnecessary use of pesticides is dangerous and harmful to natural resources such as water, soil, air, food chain etc. Care has to be taken such that there should be less contamination of food products with pesticides. We need a technique to detect the plant diseases and spray the required amount of chemical to the plant. The proposed study aims for automatic plant disease identification and spray chemicals automatically

Plant disease identification is a challenging task. Generally diseases are seen on the leaves or stems of the plant. Proposed approach is to detect the paddy and tomato leaf diseases using image processing techniques.. The objectives of proposed study are 1. Classification of leaf disease 2. Spraying appropriate pesticide. 3. Reduce time between identification and spraying of chemical.

2. LITERATURE SURVEY

Savita M Ghaiwat [1] developed a system to identify disease identification of chilli plant leaves. Sanjay B[2] proposed a model to automatically identify and classify the diseases in pomegranate fruit[2]. Study found Bacterial Blight, Cercosporin fruit spot, Fruit Rot, Alternaria fruit Spot diseases on pomegranate fruit.

Mrinalini R[3] explains about the image processing steps[3] and Neural Network used in identification for fast and accurate recognition and classification of diseases. It interprets about the vision-based algorithm for image classification. Sachin D Khirade et al, The author presented Artificial Neural Network methods to classify diseases in plants. It classified and detected accurately several plant diseases with the help of image processing procedure.

3. PROPOSED STUDY

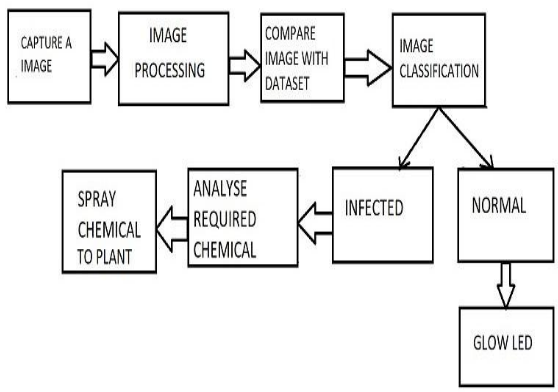


Figure 1: Block diagram of proposed model

A. REQUIREMENTS

1. Hardware Requirements

It has Broadcom BCM2711 CPU with Quadcore Cortex -A72 which is 64-bit system of chips at 1.5GHz. It can have the RAM of 1GB, 2GB or 4GB LPDDR4. It possesses SDRAM depending on the model. It has the 2.4 GHz and 5.0 GHz Wi-Fi Module with wireless 802.11ac wireless, Bluetooth 5.0 with IEEE 802.11ac wireless 802.11ac. It consists of Gigabit Ethernet. It possesses two USB 3.0 ports and two USB 2.0 Ports. It has Raspberry Pi standard 40 pin GPIO header. It basically has two micro HDMI ports. It consists of Display port which has 2-lane MIPI DSI. Camera port of 2 lane MIPI CSI present in this version of Raspberry pi. It has 4-pole audio stereo and composite video port. Also, it has Micro-SD card slot and Debian Linux 10 Operating system.Figur2 shows Raspberry Pi 4 model

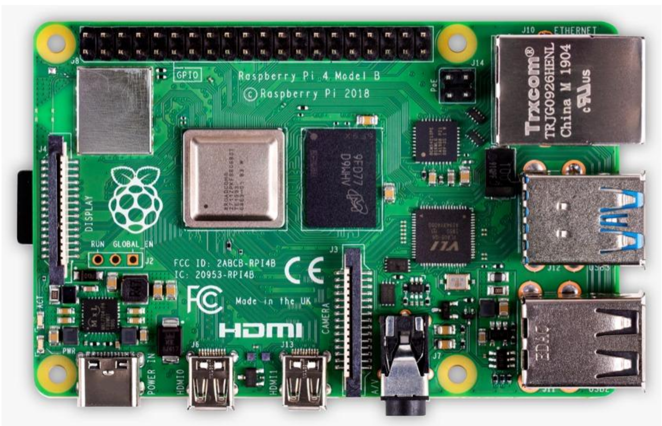


Figure 2: Raspberry pi 4 Model B Board

In the Figure 2 purple color pins are Serial peripherals interface (SPI). SPI used to control components with a master and slave relationship. It requires clock, master out slave in(MISO) and master out and slave in(MOSI) pins to function. Clock used to regulate the data speed. MOSI send order from the Raspberry pi to attached devices and MISO sends order from attached devices to Raspberry pi.

2. Software Requirements

Python is an interactive, high-level, interpreted, object oriented, general-purpose programming language which is created by Guido van Rossum and first implemented in 1991.Python is dynamically typed language and has auto garbage collection feature. It supports multiple programming philosophy both procedural as well as functional programming. Python is basically interpreted as a "batteries included" language code since its comprehensive standard library style. Python interpreters are at hand for many operating systems. A global community of programmers develops and maintains CPython, an open source reference implementation. A non-profit organization, the Python Software Foundation, directs and manages resources for Python and CPython improvement.

The project is enforced in standard approach. Every module is coded as per the requirements and tested and this method is iterated until all the modules are totally implemented

4. IMPLEMENTATIONS

1. Hardware Implementation

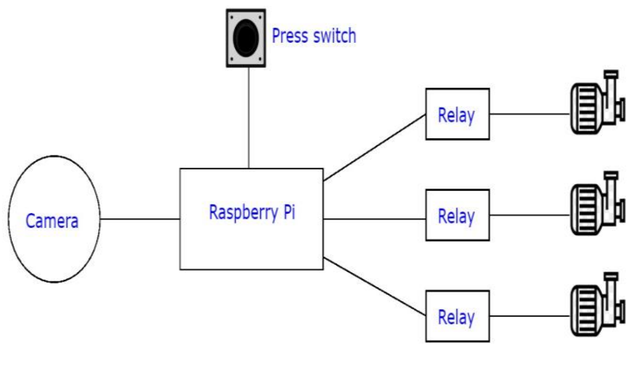


Figure 3: Hardware implementation model

The camera (Web Cam) captures the image of the plant leaf. The captures image is sent to Raspberry pi module for image processing steps. An algorithm runs and detects the plant disease by comparing the captured image with previously set dataset. After identifying the disease required pulses passes from Raspberry pi module to spraying mechanism system which consists of relays, motors and nozzle. The relays get controlled based on which disease is identified. If the leaf is healthy no spraying of chemicals takes place from the system. Figure 3 shows the hardware model

Power supply of 5 Volts and 3 Amperes given to Raspberry Pi. Relay 1,2 and 3 is connected to GPIO (General input-output) 16,20 and 21 Slots of Raspberry Pi module respectively. The switch is connected to GPIO pin 10 of Raspberry Pi.

The Python code is loaded to Raspberry pi module. Then if we press the switch button, the camera (Web Cam) which is connected to raspberry pi module captures the image of the plant leaf. The captured image is sent to Raspberry pi module for image processing steps..

Figure 4 Automatic pesticide sprayer

The algorithm runs and detects the plant disease by comparing the captured image with previously set dataset. After identifying the disease, the disease name, pesticide sprayed is displayed on the OLED module which is also connected to raspberry pi module. In the same timerequired pulses passes from Raspberry pi module to spraying mechanism system which consists of relays, submersible motors and submersible pipe

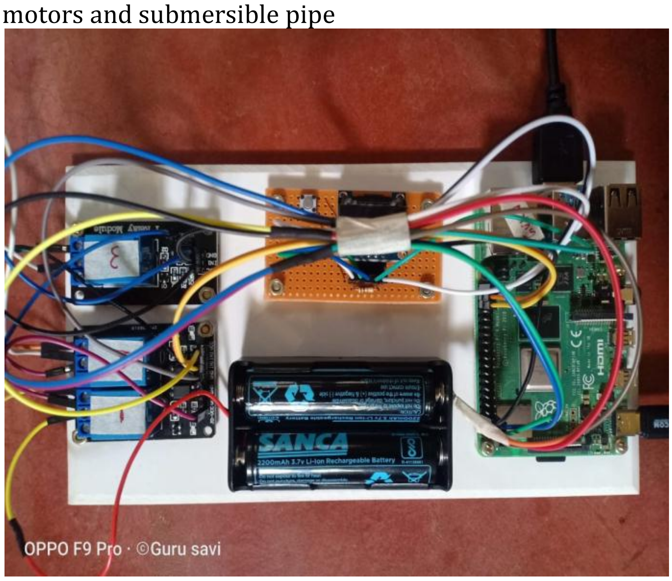


Figure 5: Raspberry pi module connection with relay

Power supply of 5 V and 3 A given to Raspberry Pi. Relay 1,2 and 3 is connected to GPIO (General input-output) 16,20 and 21 slots of Raspberry Pi module respectively. The switch is connected to GPIO pin 10 of Raspberry Pi. The power to relay is given from Lithium ion rechargeable battery. Based on the disease identified the respective relay gets turned on and initiates its submersible motor. Then the specific chemical is sprayed from the tank to the plant through submersible pipe. The proposed study setup is as shown in Figure 4 and Figure 5

2. Software Implementation

After capturing of image from camera the image processing steps/algorithm is applied on the image so that we will get region of interest.

B. IMPLEMENTATION METHODOLOGY

Plant leaf Image processing stages are shown in Figure 6

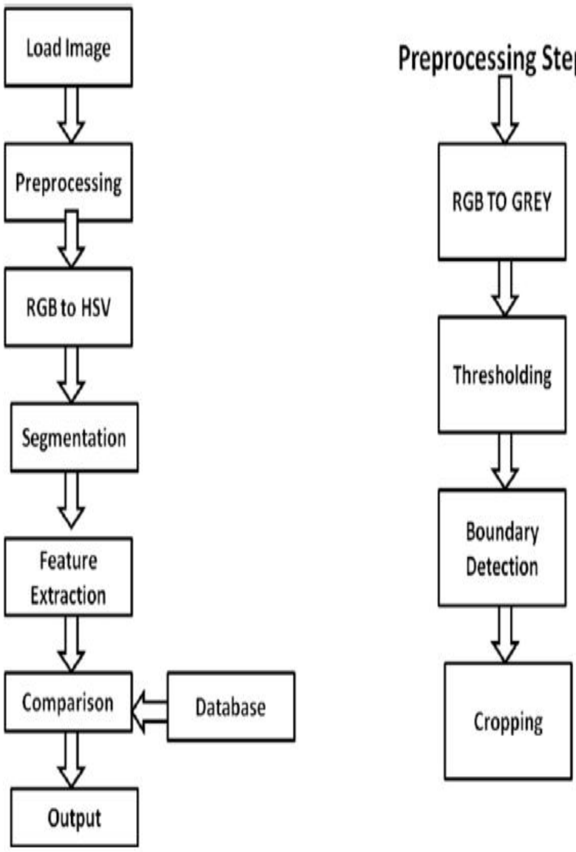


Figure 6 Image processing stepst

1. K-Means Algorithm

K-Means Cluster is a unsupervised learning method. This algorithm can be helpful in finding groups within unlabeled data.

- *Step1:* Insert leaf image (test data set) then capture this data in Python using pandas data base
- *Step2:* Finding the centroids. Once created the Data Frame based on the above data, then import a pair of extra Python modules:
- *Step3:* Randomly assign every information to a cluster: Let's assign random points to a cluster. Compute cluster c: The centroid of data point is calculate using distance formula.
- *Step 4*: Following step-3 Re-assignment of every point to the closest cluster Centre of mass is done. Later Re-computation of clustercentroids Andre-computing the centroids for the clusters is performed.

- *Step 5:* Repetition of steps four and five until no enhancement square measures possible. Likewise, we will repeat the fourth and fifth steps till we reach global optima. Once there being any change of new switching of data points between clusters for ordered repeats. It'll mark the end of the algorithm if not notably specified.

2. SVM Algorithm

Support Vector Machine (SVM) is a supervised machine learning algorithm which is most commonly used for classification issues. Thisalgorithm is used to plot every information item as a degree in n-dimensional area (where n is number of options available) with the value of every feature being the value of a specific coordinate. Classification is performed by finding the hyper-plane that differentiates the two classes in good manner. Figure 7 shows the SVM classifier function

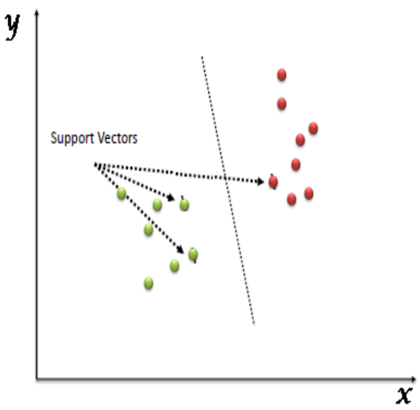


Figure 7 : (a) SVM Classifier

Support Vectors are the co-ordinates of individual observation. The SVM classifier is one of the best classification method.

Identify the Cluster for test data: Here, we have three cluster data (A, B and C) and all are segregating the classes well. Now let's analyze how can we identify the right class?

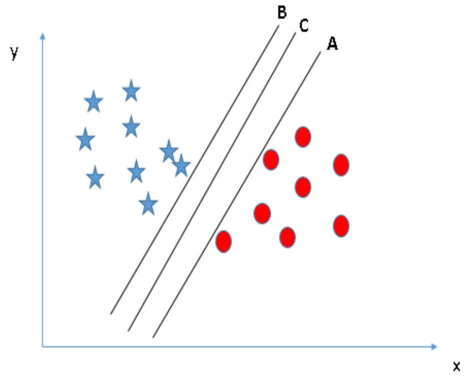


Figure 7 (b) SVM Classifier

Right classification decision is done by maximizing the distances between nearest data point (either class) and cluster data.This distance is called as **Margin**.

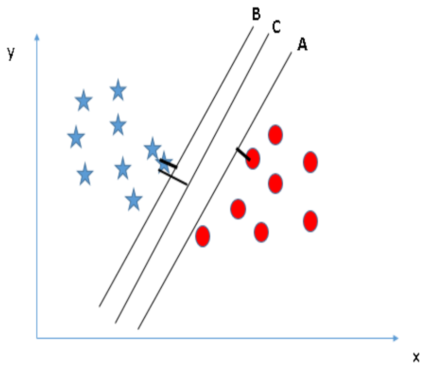


Figure 7 (c) SVM Classifier

Right classification is named as C. because by observation we saw margin for cluster C is high as compared to both A and B. Hence, Robustness is the primary factor for selecting the cluster with higher margin. Selecting a classification having low margin will leads to high chance of miss-classification. Figure 8 shows System Testing and Result analysis

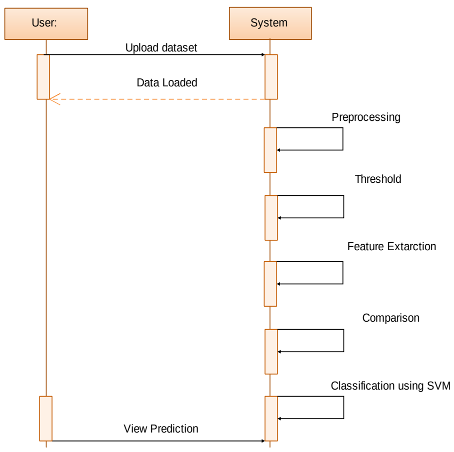


Figure 8 System Testing and Result analysis

5. RESULTS

1. Database Images

Figure 9 Input Images

Figure 9 shows input data base leaf images used for analysis purposes. Output obtained at dDifferent stages of operation on leaf images are shown in Figure 10, Figure 11, Figure12and Figure13

2. Grey Scale Leaf Image

Figure 10: Leaf image

3. Threshold Leaf Image

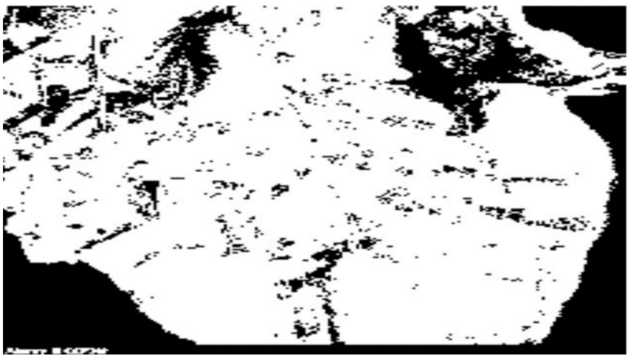


Figure11 Threshold leaf image

4. M-Segmented Image

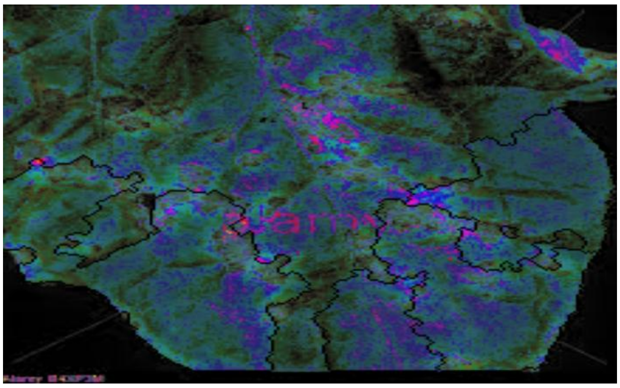


Fig 12: M-Segmented Image

5. Detection

Figure 13 Detection of Scanner Window

6. Region of Interest (ROI)

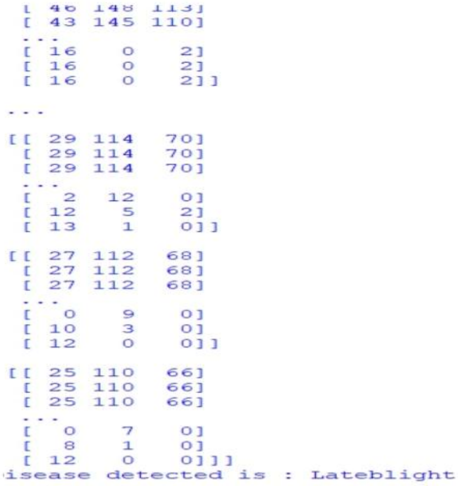
```
Image Data
[[[ 51 151 116]
  [ 48 148 113]
  [ 43 143 108]
  ...
  [ 16   0   2]
  [ 16   0   2]
  [ 16   0   2]]

 [[ 50 150 115]
  [ 48 148 113]
  [ 44 144 109]
  ...
  [ 16   0   2]
  [ 16   0   2]
  [ 16   0   2]]

 [[ 48 150 115]
  [ 46 148 113]
  [ 43 145 110]
  ...
  [ 16   0   2]
  [ 16   0   2]
  [ 16   0   2]]
```

Figure14 Region of Interest

7. Output (Disease)



```
 [ 46 148 113]
 [ 43 145 110]
 ...
 [ 16   0   2]
 [ 16   0   2]
 [ 16   0   2]]
...
[[ 29 114  70]
 [ 29 114  70]
 [ 29 114  70]
 ...
 [  2  12   0]
 [ 12   5   2]
 [ 13   1   0]]
[[ 27 112  68]
 [ 27 112  68]
 [ 27 112  68]
 ...
 [  0   9   0]
 [ 10   3   0]
 [ 12   0   0]]
[[ 25 110  66]
 [ 25 110  66]
 [ 25 110  66]
 ...
 [  0   7   0]
 [  8   1   0]
 [ 12   0   0]]]
isease detected is : Lateblight
```

Figure 15 Output

When the disease is identified the respective information is displayed on the OLED module. Plant disease detected is shown in Figure 16

Figure 16 Result on OLED module

6. CONCLUSIONS

This proposed study identified the tomato plant leaf disease with various image processing technique. Study focuses on finding the disease and spraying pesticide..Farmer's health related issues are reduced by automatic spraying of pesticides. Also wastage and unnecessary spraying of pesticide is minimized to a greater extent .The proposed model can help to improve the productivity of cotton in India.

The proposed model is manual further it can made autonomous by applying the technology to unmanned Ariel vehicles or Drones. Then it becomes much easier use equipment for the farmers

Future Scope

Study can be extended to detect more number of diseases in Tomato plant and cotton plant. Also over usage of pesticides can be avoided with proper control

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Authors Profile

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