

# Development of Smart Pesticide Spraying Robot

Pvr Chaitanya, Dileep Kotte, A. Srinath, K. B. Kalyan



**Abstract:** India is the farmland with a population of three-fourths in agriculture. In accordance with the climate and other resources accessible to them, farmers will grow multiple plants in their field. But some technical abilities along with technological assistance are required to achieve high output and excellent quality. The management of food crops includes very close surveillance, particularly with regard to the treatment of

Illnesses, which will cause severe effects after harvest. Disease is recognized in crops as the shift or deficiency of the plants ordinary functions that will generate certain symptoms. The disease that causes agents in plants is mainly defined as any agent's pathogens. Most of these pathogenic agents signs are seen in the leaves, stems and branches of the crops. Consequently, the diagnosis of disease and the proportion of disease produced in crops is compulsory for effective and successful plant cultivation. This can be done through taking input images using camera, analyzing them using machine learning process. This displays the disease presented on the leaf, stem or plant. This also displays the exposed area to disease and also predicts the remedies, turn on the pesticide sprayer which sprays the respective pesticide on the exposed area to disease. This is very necessary for effective spraying of the pesticide. The movement of robot is done with L293d motor driver and the processor or embedded system is done through Raspberry pi3. We use python code for machine learning which trains the robot with pre-defined images. Since this can be controlled from anywhere without working in the field and being exposed to pesticides, it will be a profit for the farmer. He will stay unaffected by his health condition.

**Index Terms:** Image Processing, Pesticide spraying, Disease diagnosis, Raspberry Pi, agriculture Robot, Machine Learning, and Python.

## I. INTRODUCTION

Farming is India's cornerstone. In our nation, approximately 215.6 million acres of soil is irrigated crop region. The Economic Survey says that there is a need to improve farm mechanization in the nation. Increasing Pest infestation productivity control plays a significant role. The farmers are facing significant issues in managing pest infestation.

Manuscript published on January 30, 2020.

\* Correspondence Author

**Pvr Chaitanya\***, Department of Mechatronics & Robotics, Koneru Lakshmaiah Education Foundation (Deemed to be University), Vaddeswaram, Guntur (Andhra Pradesh) India.

**Dileep Kotte**, Professor, Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation (Deemed to be University), Vaddeswaram, Guntur (Andhra Pradesh) India.

**Dr. A. Srinath** Professor & HOD, Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation (Deemed to be University), Vaddeswaram, Guntur (Andhra Pradesh) India.

**K. B. Kalyan**, Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation (Deemed to be University), Vaddeswaram, Guntur (Andhra Pradesh) India.

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an [open access](http://creativecommons.org/licenses/by-nc-nd/4.0/) article under the CC-BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

Pests are undesirable insects or germs that interfere with human activity and can bite, ruin food plants or make life more hard for farmers. A key point in crop management is early detection and avoidance of pests. Effective control of pests needs some understanding of pests and their habitats. Farmers are currently spraying pesticides around their fields. The main disadvantages with regard to this method are: the pesticide may come into contact with the farmer during spraying, which may trigger skin cancer and asthma illnesses. Increased pesticide spraying can impact consumer health as it enters the food chain. Pesticides are also sometimes sprayed on non-affected crops resulting in the same waste.

We have therefore created an automated robotic system that can spray pesticides in restricted quantities only if pests are discovered to solve the above-mentioned problems. Not only does this save the farmer from life-threatening illnesses and physical issues, but it also saves his cash because of restricted pesticide use. That is why it helps farmers, in turn the nation, to develop economically. Using this form of robots Time consumption is decreased in spraying the pesticide liquid and it will also assist farmers to decrease the workload and in any season and conditions to do job.

In India, farming is performed using worldly methods. The absence of adequate understanding for most of our farmers makes it even more erratic. The projections are based on a big part of farming and agricultural Operations, which sometimes fail. Farmers must bear enormous losses and sometimes the source of suicide. Since we know the advantages of proper soil moisture and its consistency, air quality and irrigation, these criteria cannot be ignored in crop growth. Therefore, we produced a fresh concept of using IoT to monitor crops and to use intelligent farming. Because of its reliability and remote monitoring, we think our idea will be a benchmark in the agribusiness. Our concept is digitalization of agriculture and farming operations so farmers can track crop requirements and predict their development correctly. Surely this idea will speed up their company to achieve new heights and be more lucrative as well. Implementing our project relies mainly on farmers consciousness, which we think will be readily generated owing to its countless benefits.

## II. METHODOLOGY

It has induced plant diseases a huge post-effect scenario as it is possible. The quality and quantity of agricultural products decreases significantly. Early detection of pests is a major problem for planting. First phase includes the crop being carefully and periodically monitored.

## Development of Smart Pesticide Spraying Robot

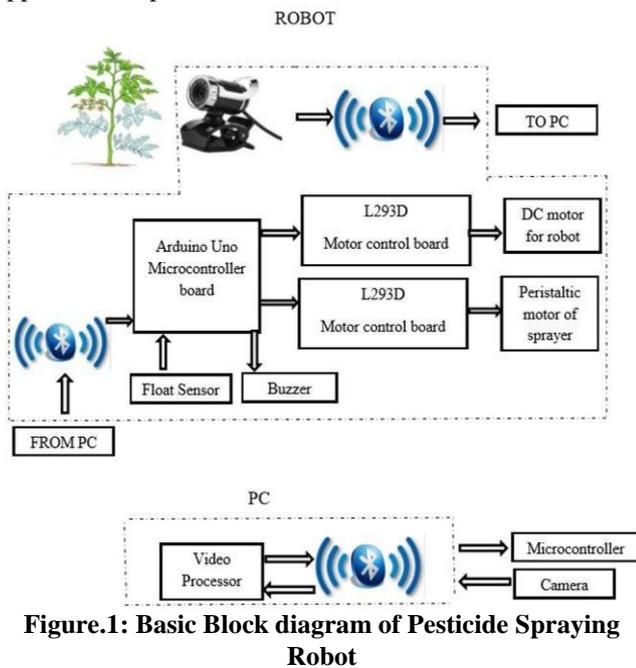
The affected plants are then identified and photographs are obtained for the affected crop component using scanners or cameras. Then these objects are pre-processed, transformed and grouped. Then these images are sent to the processor as input and images are compared by the processor. If the picture is contaminated, an automatic sprayer of pesticides is used to spray.

In the area of the seed, pesticide.

For the following reasons, a pesticide sprayer can be used:

- **TASK1:** Identifying flawed and non-faulty leaves in crops.
- **TASK2:** Classification of the type of disease assaulted by the leaves.
- **TASK3:** Sprinkling of pesticides in faulty fields.

Automatic spraying of pesticides is used to inject the pesticide into the targeted zone of the crops contaminated. This scheme is based on two pistons filled with pesticide alternatively. Solenoid valves are under precise control of the inlet and outlet valves. This offers a constant pesticide flow and precision that varies fluid characteristics and flow conditions do not affect. The layout is perfect for spray application of pesticides.



**Figure.1: Basic Block diagram of Pesticide Spraying Robot**

As shown in Figure 1, the robot model Web camera scans the crops up to a height of 3 feet. This live feed from the acquired plant is sent to the Video processor via Wi-Fi, which processes the video using the Video processing algorithm in Raspberry pi 3[2]. Raspberry Pi 3 is used for live video processing. The algorithm analyzes automatically the amount of pests on the plant, particularly the leafy region, using video processing technique.

In order to enhance its characteristics, the video undergoes pre-processing and segmentation by suppressing unwanted distortions and removing noise, it is also split into various components to identify the acquired picture. Morphological operations are performed to process the video based on forms that help the robot spray various pesticides depending on the pest type. Noise removal takes place in two erosion and dilation steps. Erosion is performed

to remove the unwanted pixels detected as pests. To recover the pixels of pests in the video, dilation is performed. The algorithm code indicates the time to spray pesticide based on the number of plagues.

Processor data above is supplied to the Arduino Microcontroller board with an ATmega328p chip via Bluetooth. The instructions for controlling robot motion are supplied via the L293D Motor Control Board, which is used as a driver circuit for the Robot DC Motor and Peristaltic Motor. DC Motor is used for wheel motion and Peristaltic Motor is used for pesticide spraying. To detect pesticide levels, a Float sensor is linked to the Arduino Uno Microcontroller board. If the amount of pesticide in the spraying bottle is above the threshold level, the spraying of pesticides is performed on the basis of the number of pests and if it is below the threshold value, a Buzzer alerts the farmer. The robot is then stopped for the pesticides to be refilled.

### III. LITERATURE SURVEY

[1] Dr. M.G. Sumithra, G.R. Gayathiri proposed in their paper “Leaf Disease Diagnosis and Pesticide Spraying Using Agricultural Robot (AGROBOT)” that Plant diseases have created an immense post-effect scenario as it can significantly reduce agricultural products in terms of both quality and quantity. Early detection of pests is a big issue that concerns planting crops. First phase includes plant observation keenly and frequently. Then the affected plants will be identified and photographs will be collected using scanners or cameras for the affected portion of the plants. Then these images are pre-processed, transformed and clustered. Then these images are sent to the processor as input, and the images are compared by the processor. If the picture is affected, an automated pesticide sprayer will be used to spray the pesticide to the found region of the plant. If not, it will be automatically discarded by the processors and the robot goes on.

[2] Philip J. Sammons, Furukawa Tomonari, and Bulgin Andrew proposed in their paper “Autonomous Pesticide Spraying Robot for use in a Greenhouse” That an engineering solution includes spraying potentially toxic chemicals in the confined space of a hot and steamy glasshouse to the current human health hazards. This is done by designing and building an independent mobile robot that can be used in commercial greenhouses for Tools to control insects and prevent disease. The efficacy of this method is shown by the ability of the platforms to maneuver themselves efficiently down the rows of a greenhouse, while the pesticide spraying system effectively covers the plants with spray uniformly in the specified dosages. The results showed that the robot was able to meet the physical standards set by the National Greenhouse Horticulture Centre, so that it could work in its greenhouses. The robot also met the time it had to face and economic constraints. The robot could drive up and down the tracks in the greenhouse.

The rails are sensed effectively by the Induction Proximity Sensors and operated satisfactorily. The spraying system developed by another thesis student, when travelling along the rails, was able to selectively spray designated plant groups in the greenhouse. The spray protection provided adequate and consistent dosage to the crops.

[3] Xu Chengzhi Liu Pingzeng, Bai Xueming, Hou Yingkun, Xu Jian – “Application of Intelligent Control in Spraying Pesticide Simulation System “ in their paper proposed that,

On the basis of configuration embedded software studies, Smart control simulation model is proposed for the spraying of pesticides. In system design, the wireless network of information collection is formed by a Variety of terminals that link to the upper device via a dedicated NC network. We make full use of modular system design methods in terminal design for information collection. By integrating the upper computer with different software modules, intelligent control systems can be easily obtained with different functions. The design of intelligent spraying simulation of pesticides provides conditions for a series of new technique and craft work. Modular structure design approaches for measurement and control system development enhance design performance, integrity, and simple system maintenance, as well as enhance the Universality of the method of measuring-control. Experimental results show that the proposed system can simulate all types of situations under natural conditions. It also increased the efficiency of the test and the research comfort. The proposed system has high accuracy measurement and is reliable in operation. For further research into the precision spraying of pesticide technology, all of these can lay the first stone.

[4] Dr. S.R.Gengaje, Snehal M.Deshmukh in their paper “ARM- Based Pesticide Spraying Robot” proposed that Implementation of the predicated agricultural robot, here the robot scans the plant endlessly. Wireless Camera mounted on a robot that captures the crop video and sends it to the central station. The person sitting at the central station decides on the robot's operation. When the user finds that the crop is defective, the robot will be given command and the kinetic will of that robot will be done and the pesticides will be sprayed over the crop. This will be done by the RF transceiver. Robots are used for industrial purposes in agriculture. For farming, the main use of robotics is for planting, fruit picking, driverless tractor or sprayer is designed to replace human labour. The main objective is to stop manual spraying on the real farm with pesticides. Through replacing humans with a robot, it will be done through transmitting crop video to central station. Instead central station monitors robot movements and pesticide spraying, using real-time processor. This will reduce the plant's excessive use of pesticide. Such devices are most commonly used for the application of agriculture to rising man power. The real-time model can be implemented using ARM LPC2148. The device has the advantage of high speed, high quality, reliability and low cost of storage. This system's future context will be to design the system using robot smartness. As per farm area, the pesticide tank capacity is increased.

[5] Mitul Raval, Supath Mohile and Aniket Dhandhukia in their paper “Development and Automation of Robot with Spraying Mechanism for Agricultural Applications” proposed a scientific alternative to the current human health hazards including the application of potentially toxic substances in the enclosed environment. This is accomplished by designing and building an autonomous mobile robot for use in commercial farming applications for pest control and disease prevention. The efficacy of this system is shown by the ability to navigate successfully down a farm's lines, spray the pesticides efficiently while it is managed from a distance by the farmer. And this pesticide spraying system effectively covers the plants in the specified dosages uniformly with spray. Wireless service will remove and even save health problems from tedious work. It's going to have less resource need. Thanks to remote sensing, effective and health-conscious service. The farmer is expected to control the robot wirelessly from a distant place with the aid of live spraying feed. It is planned that this robot is an all-terrain robot.

[6] Precision farming a worldwide overview by Naiqian Zhang a, Maohua Wang b, Ning Wang proposed that an Overview of global development and existing literature-based precision farming technologies mainly developed over the past 2 years. Themes include variance in natural resources; uncertainty management; management area; effects of precision-farming technologies on farm productivity and environment; technological advances in sensors, controls and remote sensing; Data management; applications worldwide and development of accuracy-farming technologies; and innovation promise in China's agricultural modernization.

[7] Extensive research on robotics has been carried out in controlled environments such as greenhouse grafting robots, harvesting robots for cucumber strawberry and tomato. Jinlin lin and Tony Ein their research paper focuses on the accurate guidance of the agricultural robots in the open fields and not in controlled environment such as greenhouse effect. This robot uses a camera and image processing technique for the supervision of the field. The robot uses a guidance line determination method in which three guidance lines are used 1st line for left crop lines 2nd line for right crop lines and 3rd for the middle segment. First the images are captured from the camera and then processed through image processing and the lines are determined. In earlier versions of agricultural robot only far field FOV camera arrangements was used which was adequate for tall plants but inadequate for small plants.

[8] Philips J Sammons et al. presents a solution to solve the present health hazards spread by the spraying of toxic chemicals in the warm and vaporous glasshouse enclosed space. This can be done by designing an autonomous robot for spraying pesticides in the confined space thus saving the human health hazards. The performance of this system is shown by the efficient ability of the robot to traverse the line, while the spraying of pesticides covers the plants with its efficient dosage spray.

## Development of Smart Pesticide Spraying Robot

This research paper is restricted to the production of greenhouse robot spraying pesticides. Within the greenhouse the optimization of carbon dioxide, fertilizer feed, pest and fungus allows the plant to nourish well in the atmosphere. In the green house, the level of carbon dioxide is five times the normal level of the atmosphere. The ideal temperature and humidity of the greenhouse is quite high all day long. Sometimes the temperature reaches up to 38 ° C, which makes the air very warm for someone wearing masks. This can cause heat strokes, dehydration for the workers working inside and sometimes can also lead to hazardous disease in long time.

The inhalation of pesticide is also very dangerous as it can cause many types of cancer, skin diseases, etc. In order to prevent this type of health hazard this paper has designed a robot which can spray pesticides in the greenhouse. This robot is mounted on hot water pipes. When water Moves through pipes the robot also moves along with it and sprays the pesticides. The robot is able to drive back and forth along a row's greenhouse hot water piping boards, needing manually to switch to the next row in order to continue spraying. This is then repeated in the greenhouse for every line. This constraint helps a working robot to understand the first phase of the robot design.

[9] Chili plant leaf image is captured using digital camera to determine the health status of chili plants. Zulkifli Bin Husin et al, 2014, uses digital camera to capture the image of the leaf and to process the image using MATLAB software. The MATLAB GUI is created with LABVIEW software. And this procedure means that only the diseased plants should be handled with the drug.

### IV. PROPOSED SYSTEM

This agricultural robot decreases farmers general attempts and also improves the work's pace and precision. This robot has been created to improve application precision and yield. As a microcontroller, Raspberry pi is used. Only raspberry pi controls the live video motion, spraying impact and robot movement.

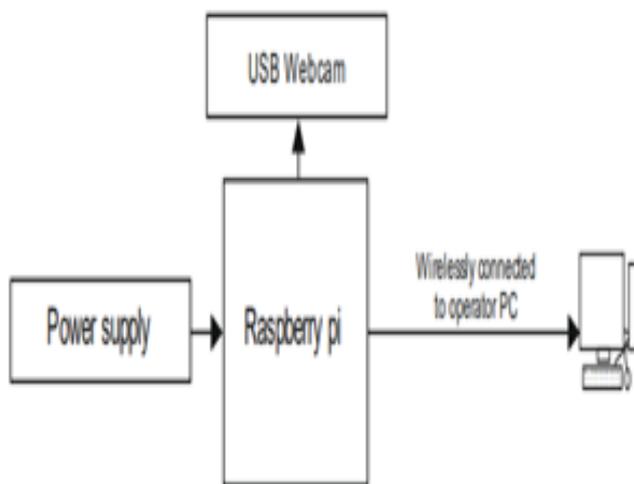


Figure.2: Live Video Streaming

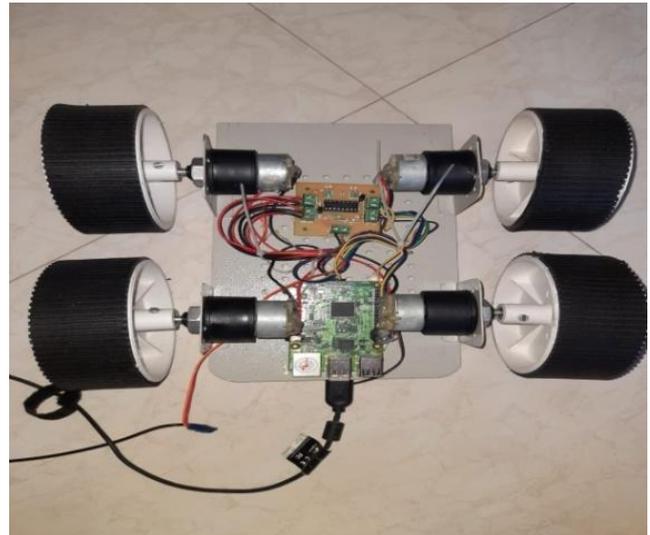


Figure.3: Prototype of Pesticide Spraying Robot

### V. AGRICULTURAL ROBOT

This agricultural robot can display 3 processes, i.e. (a) movement of machine, (b) uploading of video and (c) spraying process for pesticides.

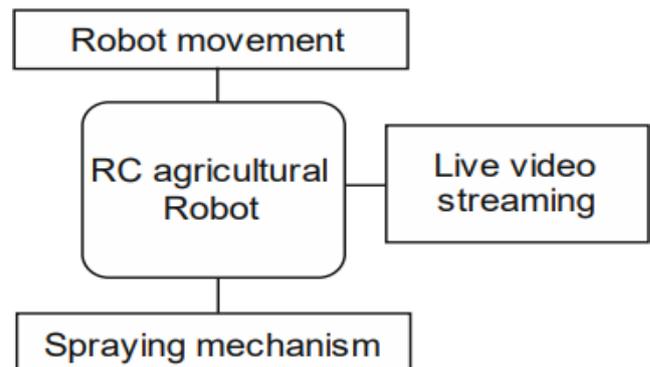


Figure.4: RC Agriculture Robot Mechanism

For the operation of the robot and the spray unit, the operator uses the Android application. The Raspberry pi is connected to an ordinary USB web cam, which is mounted on the robot to stream live video to the operator-connected PC. We use Raspberry Pi programmed with Python's programming code to identify and classify the disease in crops.

#### A. Robot Movement

DC motors are used for the robot's motion that are governed electronically by Arduino UNO with the assistance of L293D. The HC-05 Bluetooth module receives signals from the input and sends them to the controller, which in turn spins the engine. By obtaining the signal, DC motors are switched ON and OFF by allowing Arduino to have a specific pin. An adequate velocity is provided by 300rpm DC motors.

**B. Video Streaming**

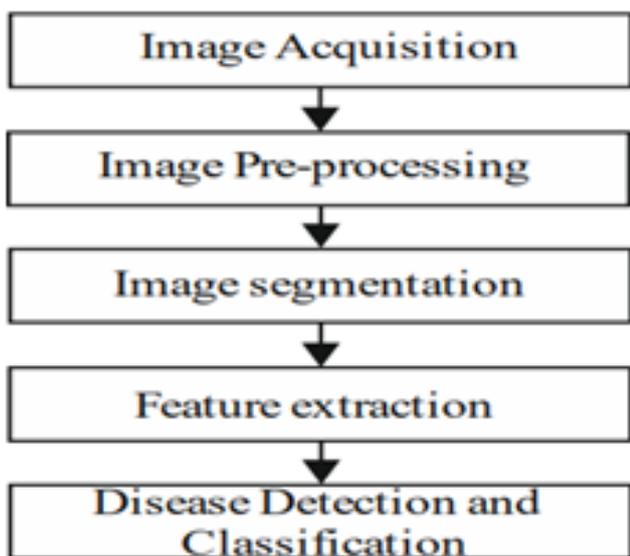
With the aid of the USB webcam and Raspberry pi we stream the video to the operator PC. Video streaming can be achieved in many ways, i.e. by installing gstreamer software on both the raspberry pi and the operator PC or by installing VLC player on both the transmitter side and the receiver side [2]. We prefer to use VLC player to stream the video with https:// followed by raspberry pi's IP address, so it seems simple for operators to take snapshots from the streaming video to detect further disease.

**C. Pesticide Spraying Mechanism**

Bluetooth module connects to the digital key of Arduino UNO, which receives the signal installed on the operator's Smartphone from the Android app. The floating sensor and submersible pump were mounted inside the pesticide tank. The submersible pump is linked to one end of the tiny diameter pipe and the other end is linked to the sprayer nozzle. The operator can use the Android app to spray particular pesticide if the algorithm says the plant is affected by some disease.

**VI. DISEASE DETECTION ALGORITHM**

The first stage of algorithms deals with separating the healthy plants from the impacted one and the second stage of algorithms focusing on discovering the disease on the leaf of the plant. Using PYTHON software, an effective and rapid response algorithm was created [1]. The fundamental steps for image processing classification are shown below,



**Figure.5: Basic measures to diagnose and identify plant disease**

**Image Acquisition:** The picture procurement phase is the first phase of any vision system. Different processing techniques can be applied to the picture after the picture has been acquired to execute the many varying vision functions needed today. However, if the image was not obtained satisfactorily, the expected tasks may not be feasible, even with the aid of some sort of improvement of the picture. The picture captured will be RGB-shaped (red, green and blue) [12]. We have to transform pictures from one form to another sometimes. PYTHON includes all the image processing instruments required that cover all colour space

transformations. The picture loading to the PYTHON software is shown below.

**Image pre-processing:** In order to improve the contrast, different pre-processing methods are regarded to eliminate noise such as cropping, picture smoothing and improvement. Enhancement is a method of improving image visual quality owing to a non-ideal scheme of acquisition. Some of the methods for improvement are edge enhancement, filtering of noise, sharpening [1]. The picture is processed here to make the outcome more appropriate for a particular implementation than the initial picture.

The image's input colour is main, i.e. red, green and blue colours. Because of their range from 0 to 255, it is not feasible to execute apps using RGB [12]. Use colour to convert RGB pictures to gray pictures

conversion equation as below,  

$$F(x) = 0.2989 * R + 0.5870 * G + 0.114 * B$$

Cumulative distribution is used for the distribution of intensity values in order to improve the picture of plant Disease.

**Image segmentation:** Segmentation of the picture is associated with partitioning the picture into its constituent components. Segmentation splits the picture into components or areas of significance. Significant portion can be a full or part of an item. Segmentation algorithms are used to extract areas using picture characteristics [8]. Usually used for segmentation are edge detection, thresholding, border extraction, region growth, dividing and merging. Here the picture of the leaf is split into several sections, not all sections are helpful amounts of data. The patches containing more than 50% of helpful data are therefore used for further assessment [1].

Segmentation implies partitioning or getting some resemblance of the picture into different parts of the same characteristics. Segmentation can be performed using different techniques such as Otsu's technique, clustering k-means, converting RGB picture to HIS model, etc.

**Segmentation using Boundary and spot detection algorithm:** The RGB picture is transformed to the segmentation HIS model. Detection of boundaries and detection of spots helps discover the infected portion of the leaf as mentioned in [9]. The 8 pixel connectivity is considered for border detection and the algorithm for border detection is applied [9].

**K-means clustering:** The clustering of K-means is used to classify objects based on a set of characteristics in K amount of classes.

Minimizing the sum of squares associated with the element and the cluster. The K-means Clustering algorithm:

1. Pick K cluster centre, either randomly or heuristically based.
2. Assign to the cluster each pixel in the picture which minimizes the distance between the pixel and the middle of the cluster.
3. Calculate the cluster centres again by averaging all the cluster pixels. Repeat steps 2 and 3 until our each convergence.

## Development of Smart Pesticide Spraying Robot

**Otsu Threshold Algorithm:** Thresholding produces binary pictures by setting all pixels below a certain threshold to none and all pixels above the limit. The Otsu algorithm defined as follows:

- a) Separate pixels in two clusters according to the limit
- b) Then discover each cluster's mean.
- c) Square the means distinction.
- d) Multiply in one cluster the amount of pixels by the amount in the other.

The infected leaf demonstrates the disease's symptoms by altering the leaf's colour. It is therefore possible to use the greenness of the leaves to identify the part of the leaf infected. The element R, G and B is obtained from the picture. Using the Otsu method, the limit is calculated. The green pixels will then be masked and replaced if the green pixel frequency is below the measured limit [12].

**Feature extraction:** Extraction function a sort of decrease in dimensionality that effectively reflects interesting components of a picture as a compact vector.

Different characteristics such as colour, texture, entropy, mean deviation and so on are obtained to define the infected region after choosing the segmented portion.

Extraction of features plays a significant role in identifying an object. Extraction of image processing function is used in many applications. Colour, texture, morphology, edges, etc. are the characteristics that can be used to detect plant disease.

Jhuria Monica et al consider colour, texture and morphology as a method for paper disease identification. They discovered that the outcome of morphology is better than the other characteristics. Texture implies how the picture displays the colour, the roughness, the image's hardness. It can also be used to detect infected regions of plants.

**Colour co-occurrence Method:** This technique takes into consideration both colour and texture to obtain distinctive characteristics for that picture. The RGB picture is transformed to the HSI translation for this purpose.

**Detection and classification of disease:** After extraction of the function, the values acquired are contrasted with the values of healthy leaves pre-loaded. Classification of disease is performed on the basis of difference in the values acquired by comparison.

### VII. TYPES OF DISEASES

It collects samples of 75 pictures consisting of various plant diseases such as Alternaria Alternata, Anthracnetic, Safe Leaves, Bacterial bruising, Cercospora foliage spot. For each disease classified in database pictures and input pictures, different numbers of pictures are obtained. The image's key features are based on the shape and texture features. The test screenshots show identification of plant disease using the method of colour segmentation [12].

**Table 1: Measure the intensity of time and estimate area of the infected area.**

Disease forms	Number of images	Time of clustering (s)	Zone of area contaminated (percentage)
Alternaria Alternata	21	Below 20 S	15.0122
Anthracnetic	24	Below 20 S	14.0415
Bacterial bruising	8	Below 20 S	14.0193
Cercospora foliage spot	9	Below 20 S	17.3951

Then the Video capture the disease of the leaf and which type of disease



**Figure.6: Video Streaming**

### VIII. INTERPRETATION

As a Micro Controller device, Raspberry Pi Model B is used here. A 16 GB storage of the SD card is inserted. Raspbian OS is up and running. Raspberry Pi needs an internal 5V power supply. Using software like VNC viewer or Putty, it is obtained later. You can access the Raspberry Pi by entering the default username and password. It basically utilizes programming languages for C++ and Python. It has a built-in WI fi adapter for Internet access.

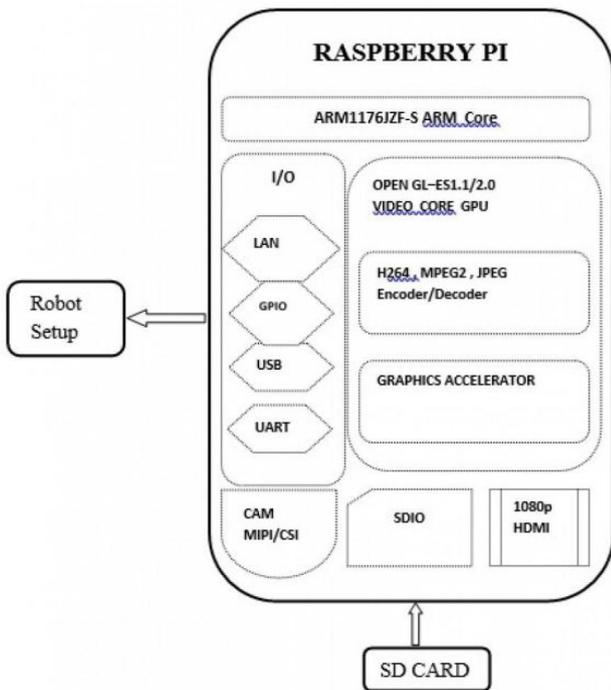


Figure.7: Block diagram of raspberry pi connection

To run the robot motion, a L293D motor driver is used. We installed 4 engines on 4 Robot Frame sides. Two engines of the same hand are linked to one of the engine output and the other two to the remaining engine output. Motor inputs are connected to Raspberry pi and the pins are declared in the program. It operates on supply of 12 volts.

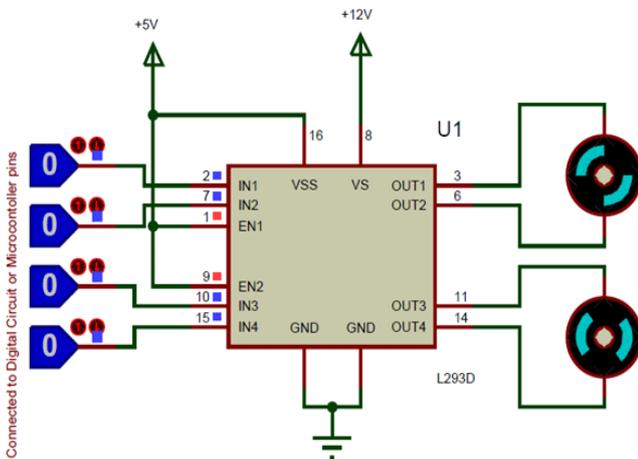


Figure.8: L293d motor driver connections

IX. SOFTWARE REQUIREMENTS

1. Raspbian OS
2. VNC VIEWER
3. CONFIGURATION

To configure the raspberry pi, the following libraries need to be installed in order to install the site packages and operate our software. As this project follows through Embedded Systems, Things Internet, Machine Learning, we need to work on this.

The necessary libraries are:-absl, astor, GPIO, matplot lib, tensor flow, tf learning, mock, numpy, tqdm, cyclcr, dateutil, gast, wheel, pbr.

3.1 GPIO

It is possible to install the package in the Raspbian repository using apt-get. First you need to update the software versions available:

```
sudo apt-get update
Then try to install the package RPi.GPIO: sudo apt-get install rpi.gpio.
```

If it is not already installed, it will be installed. If it is already enabled, if a newer version is available, it will be updated.

3.2 ABSL

To install the package, simply run: pip install absl-py  
Or install from source: python setup.py install Running Tests

To run Abseil tests, you can clone the git repo and run bazel:  
git clone https://github.com/abseil/abseil-py.git  
Cd abseil-py bazel test absl/...

3.3 TENSOR FLOW

1.Download the framework for Python development on your machine.

Python 3  
Check the configuration of your Python environment:  
Requires Python > 3.4  
Python3 —version pip3 —version virtualenv —version Skip to the next stage if these packages are already installed. Then, download Python and Virtualenv, the pip package manager:

```
Sudo apt update sudo apt install python3-dev python3-pip
sudo pip3 system-wide install -U virtualenv #
```

2. Build a (recommended) virtual environment using Python virtual environments to separate the installation of packages from the framework.

Create a new virtual environment through the choice and development of a Python interpreter. /venv: Virtualenv —system-site-packages -p python3. /Ventil

Use a shell-specific command to trigger the virtual environment: Source./venv / bin / disable # sh, bash, ksh or zsh

Your shell prompt will be prefixed with (venv) when virtualenv is involved.

Deploy packages without impacting the configuration of the host device in a virtual environment. Start with pip update: deploy pip —upgrade pip

Pip list # Display Virtual Environment Installed Packages and Exit Virtualenv later: Deactivate # Do not exit until Tensor Flows is used.

3.Install the pip module from TensorFlow Choose one of the following modules to install from PyPI:

Tensorflow — The latest robust CPU-only update (recommended for beginners)

Tensorflow-gpu — GPU support for the latest stable release (Ubuntu and Windows)

Tf-nightly — CPU-only (unstable) nightly summary

Tf-nightly-gpu — Tensorflow==2.0.0-alpha0 — Test TF 2.0 Alpha build for CPU-only (unstable) nightly build with

# Development of Smart Pesticide Spraying Robot

GPU support (unstable, Ubuntu and Windows)  
Tensorflow-gpu==2.0.0-alpha0 — Alpha prototype with GPU support TF 2.0 Preview (unstable, Ubuntu and Windows)

Software dependencies will be activated automatically. These are specified in the REQUIRED\_PACKAGES setup.py folder.

Download pip3 —user —upgrade tensorflow # in \$HOME  
Test the installation:

```
python3-c"importtensorflow as tf;
tf.enable_eager_execution();
print(tf.reduce_sum(tf.random_normal([1000, 1000])))"
Success: TensorFlow is now installed.
```

### 3.4 NUMPY

By default, Raspberry Pi have python 3 installed but does not have pip/setuptools/wheel installed. To install pip, run:

```
sudo apt-get install python-pip
This will install setup tools and wheel along with pip.
You can then use pip to install packages you will need. To install NumPy: pip3 install --user numpy
```

Or  
sudo pip3 install numpy

### 3.5 TQDM

To install tqdm 4.31.1, Enter the following command in command prompt of raspberry pi 3 pip3 install tqdm  
Then the tqdm will be installed successfully.

### 3.6 DATE UTIL

dateutil can be installed from PyPI using pip3 (note that the package name is different from the importable name):  
pip3 install python-dateutil

### 3.7 GAST

To install gast, Enter the following command in command prompt of raspberry pi 3  
pip3 install gast  
Then the gast will be installed successfully.

### 3.8 PROTO BUF

You should install protobuf compiler. On OS X you can do it with command  
brew install protobuf  
Install this library with pip install protobuf3  
Then you can generate files in similar way like in original protobuf: protoc --python3\_out=gen foo.proto

### 3.9 L293d

You will have to install a pip library called l293d that makes it super simple. Run in the terminal  
pip install l293d  
or maybe  
sudo pip install l293d

## X. PROGRAMMING

We need to clone the code from GITHUB  
<https://github.com/2052sagar/PlantDiseaseDetection>

After cloning to pi/home, open the folder  
Then run cnn.py file using python 3.4  
Then the scheme will be taught by machine. The training is taking place at this point. Samples of 500 leaves are predefined by which training is conducted. The ui.py file is later executed in such a way that we import the live footage

and then recognize the disease by comparing it with the training. Remedies are also recognized when the disease is shown. The water pump is laid on / off based on the remedies to spray the required quantity of pesticide.

## XI. RESULTS

To train the system, open the cnn.py program.  
Then open the ui.py program and run the module after completion of the training.

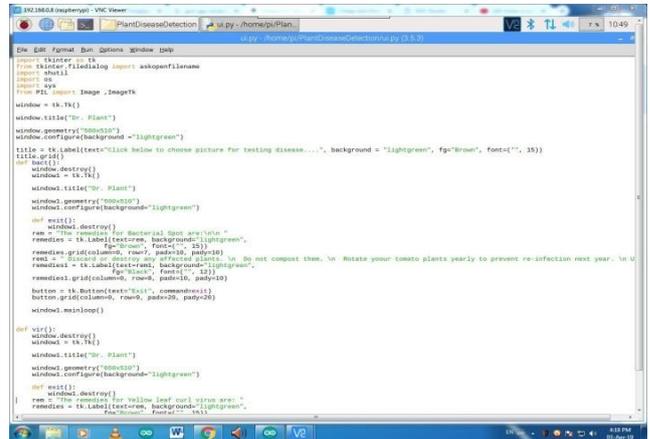


Figure.9: Output Step 1

Go to the Run option and run the module afterwards. For Get Photo, a window will be exhibited.  
Then pick the picture taken using Webcam to save it at a predefined place.

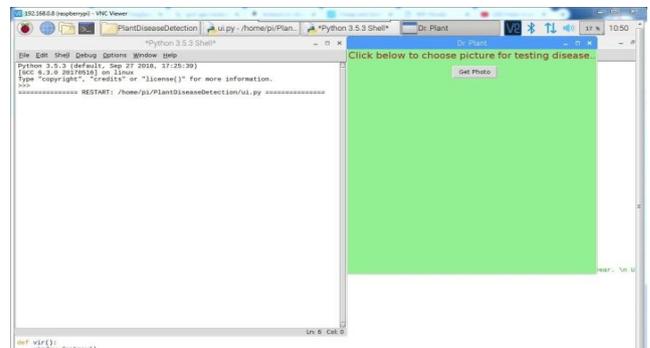


Figure.10: Output Step 2

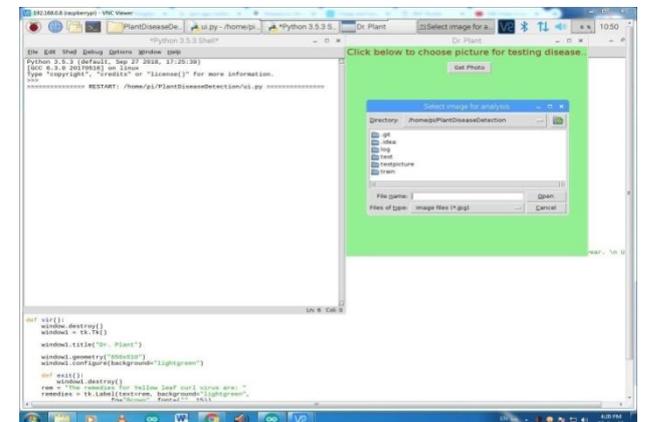


Figure.11: Output Step 3

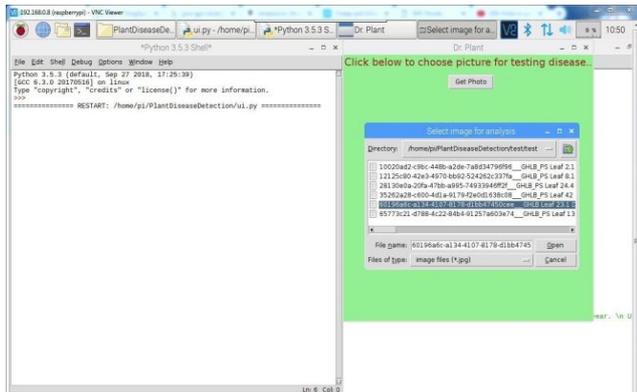


Figure.12: Output Step 4

The disease is recognized and shown after the completion of the analysis.

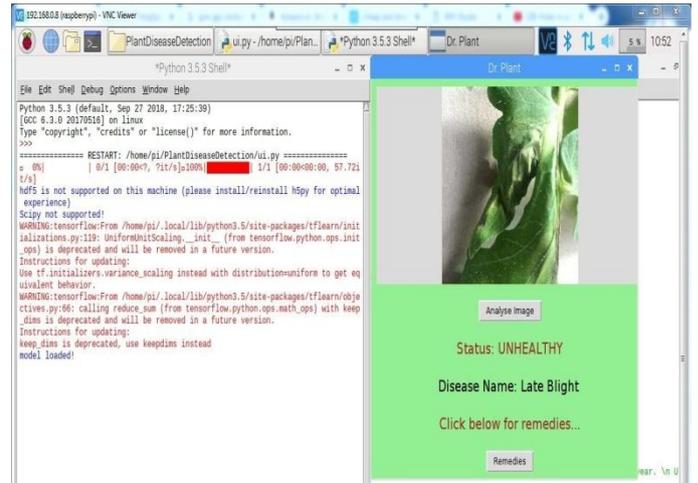


Figure.16: Output step 8

Then, by pressing Remedies, it shows what further action to Take to resolve the disease.

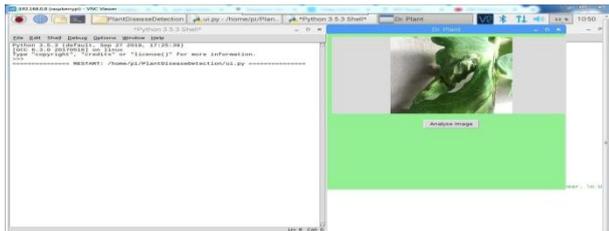


Figure.13: Output step 5

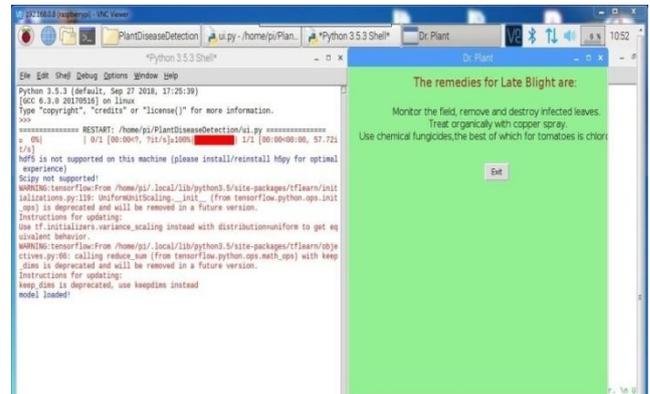


Figure.17: Output step 9

To begin the analysis, click on the analysis picture

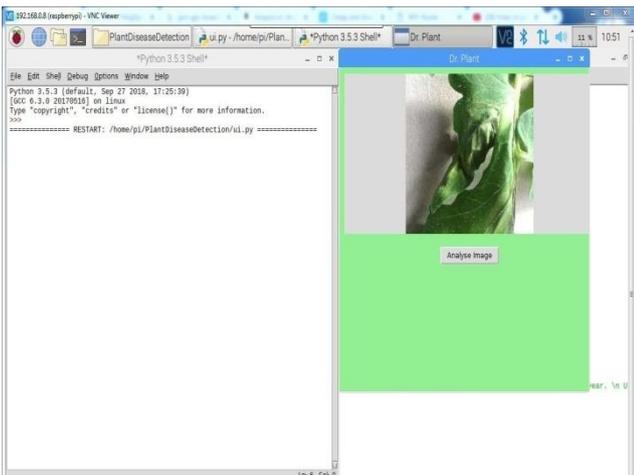


Figure.14: Output step 6

The high-pressure pesticide sprayer is switched on/off by considering these variables.

## XII. CONCLUSION

We conclude that the use of machine learning and image processing helped to overcome the plant disease diagnosis. By this we minimized diseases within leaf, stem, plant by efficiently spray pesticide. Since this can be controlled from anywhere without working in the field and being exposed to pesticides, it will be a profit for the farmer. He will stay unaffected by his health condition. Apart from that, it does not require any supervision for operating. It only needs pesticide level refilling, recharging the battery. It can be operated with a rechargeable Mobile Power bank. Solar technology for self-recharge can also be imported in future. This paper suggests the effective use of technology to meet the agricultural growth. This a cost effective and one time investment project. It saves learn cost which also saves total cost for a farmer.

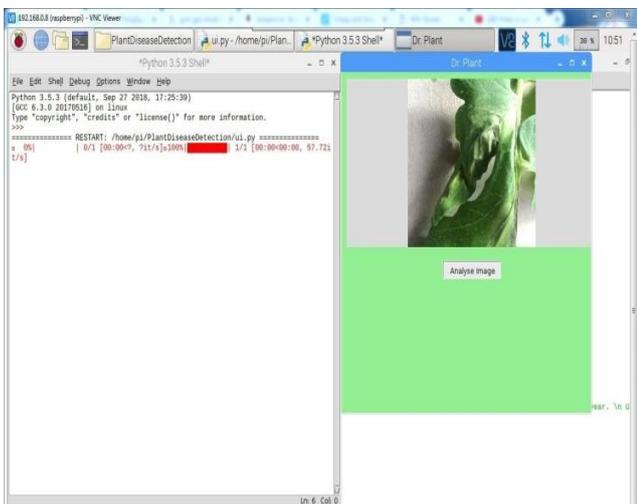


Figure.15: Output step 7

# Development of Smart Pesticide Spraying Robot

By the removal of the disease from crop, a farmer gets more productive output which results in wealth maximization of the farmer. This can be said as an advanced step in the agricultural sector, which avoid food crisis, attract the youngsters, and shows the fragrance of agriculture.



**K. B. Kalyan**, has Completed his Bachelor of Technology in Mechanical Engineering at Koneru Lakshmaiah Education Foundation (Deemed to be University), Vaddeswaram, Guntur district.

## REFERENCES

1. 1 Prakash M. Manikar, Shreekant Ghorpade, Mayur Adawadkar, "Plant Leaf Disease Detection and Classification Using Image Processing Techniques," International Engineering Journal, Volume 2, Issue 4, 2015.
2. 2 Prof. Bhavana Patil, Mr. Hemant Panchal, Mr. SHUBHAM Yadav, Mr. Arvind Singh, Mr. Dinesh Patil, "Plant Monitoring Using Image Processing, Raspberry PI and IOT," Journal of Engineering and Technology, Volume 4, Issue 10, 2017.
3. 3 Navin V. Dumare, Prof. S. S. Mungona, "Identification of Cotton Leaf Diseases Using Raspberry PI," Volume 5, Issue 5, 2017, International Journal on Recent and Technology Trends in Computing and Communication.
4. Prathamesh. K. Kharde, Hemangi. H. Kulkarni, "A Special Method for the Detection of Grape Leaf Diseases," International Journal of Scientific Research, Volume 2, Issue 4, 2016.
5. Jayaprakash Sethupathy, Veni S, International Journal of Engineering and Technology, Volume 8, No 5, 2016, "Open CV Based Disease Detection of Mango Leaves."
6. Basavaraj Tigadi, Bhavana Sharma, "Detection and Grading of Plant Disease Using Image Processing," International Journal of Engineering Science and Computing, Volume 6, Issue 6, 2016.
7. Jundare Manisha. A, Jundare Pallavi. T, Jundare Pragati. V, Prof. C.S.Aryan, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Volume 5, Issue 3, 2016, "Plant Disease Detection and Image Processing."
8. T.V.Sathya Sankari, V.R.S.Mani, "Image Segmentation Implementation Using Raspberry PI," Trends and Science International Conference on Energy Engineering, 2016.
9. A.A.C.Fernando, and C.Ricardo, "Robotics for Agriculture, Unmanned Robotic Service Units for Agricultural Tasks," IEEE Industrial Electronics Magazine, pp. 48-58, Sep 2013.
10. B.L.Theraja and A.K.Theraja, "The Electrical Technology Text Book in S.I. Units, Volume II, AC & DC machines, Technical Publications for S.Chand.
11. K. Padmavathi and K. Thangadurai, "Implementation of RGB and Gray Scale Images in Plant Leaves Disease Detection-Comparative Research," Indian J. in Sci. and Tech., vol. 9, pp. 1-6, Feb. 2016.
12. <http://www.scribd.com/document/363944416/Pesticide-Spraying-Agriculture-Robot>

## AUTHORS PROFILE



**Pvr Chaitanya\***, is Pursuing his Masters of Technology in Mechatronics & Robotics at Koneru Lakshmaiah Education Foundation (Deemed to be University), Vaddeswaram, Guntur district.



**Dileep Kotte\***, Completed his M.Tech in Aerospace Engineering. He currently works as an Assistant Mechanical Engineering Professor at Koneru Lakshmaiah Education Foundation (Deemed to be University). He is having 7 years Industrial experience and 3 years teaching experience.



**Dr. A. Srinath\***, Professor and HoD of Mechanical Engineering in Koneru Lakshmaiah Education Foundation. He is Former UGC- Research Awardee 2012-14, Research Excellence Award 2018, Institute for Exploring Advances in Engineering; 45<sup>th</sup> Young Engineer Award 2012, IN-India, Vijayawada. NK Iyengar .