A Project Report On

“AUTOMATED LEAF DISEASE DETECTION AND SPRAYING ROBOT”

Submitted by

Mr. Pratik Shankar Yadav (Roll No.16)
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Mr. Shriprasad Jotiram Kadam (Roll No.18)
Mr. Saipratap Reddy Rami Reddy Mule (Roll No.39)
Mr. Prajwal Ramakrishna Surushe (Roll No.44)

Under the Guidance of

Dr. S. D. Bhopale

D Y PATIL
COLLEGE of
ENGINEERING & TECHNOLOGY
(AN AUTONOMOUS INSTITUTE)
KASABA BAWADA, KOLHAPUR

Department of Electronics & Telecommunication Engineering

D.Y.Patil College of Engineering & Technology, Kasaba Bawada, Kolhapur

(An Autonomous Institute)

[2023-24]

D Y PATIL
COLLEGE of
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CERTIFICATE

This is to certified that,

1. **Pratik Shankar Yadav (Roll No.16)**
2. **Shivraj Balaram Kumbhar (Roll No.17)**
3. **Shriprasad Jotiram Kadam (Roll No.18)**
4. **Saipratap Reddy Rami Reddy Mule (Roll No.39)**
5. **Prajwal Ramakrishna Surushe (Roll No.44)**

has successfully completed the Project Phase entitled **"Automated Leaf Disease Detection and Spraying Robot"** under my supervision, in the partial fulfillment of Bachelor of Technology in Electronics & Telecommunication Engineering of Shivaji University, Kolhapur.

Date:

Place: Kolhapur

Dr. S. D. Bhopale
Project Guide

Prof. S. B. Patil
DRC Coordinator

External Examiner

Dr. T. B. Mohite Patil
Head of Department

Dr. S. D. Chede
Principal

ACKNOWLEDGEMENT

I would like to take this opportunity to express my gratitude to the people who helped us to complete this project on an “**Automated Leaf Disease Detection and Spraying Robot**.”

Our sincere thanks to respected principal, management and our project guide **Dr. S. D. Bhopale** for their constant guidance, support, and motivation throughout this project. Their valuable insights and suggestions helped us stay on track and improve the quality of our work.

We wish extend thanks to our HOD **Dr. T. B. Mohite-Patil** and all teaching and non-teaching staff who directly and indirectly helped us for completion of our project.

I would also like to thank all our colleagues, for their assistance and collaboration during this project. Their expertise and willingness to help were greatly appreciated. I would also like to thank to our parents else who has supported us in this project. This project would not have been possible without their help.

Date:

Place: Kolhapur

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NOMENCLATURE

CNN: Convolutional Neural Network
CPU Central Processing Unit
RAM: Random Access Memory
SoC: System on Chip
FoV: Field of View
Wi-Fi: Wireless Fidelity
IC: Integrated Circuit
SBC: Simple Board Computer
UART: Universal asynchronous receiver/transmitter
VCC: Voltage at the common collector
GND: Ground
USB: Universal serial bus

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SYNOPSIS

1. SYNOPSIS

D. Y. Patil College of Engineering and Technology, Kasaba Bawada, Kolhapur 416006

(An Autonomous Institute)

SYNOPSIS ON

"Automated Leaf Disease Detection and Spraying Robot"

PRATIK SHANKAR YADAV (16)
SHIVARAJ BALARAM KUMBHAR (17)
SHRIPRASAD JOTIRAM KADAM (18)
SAIPRATAP REDDY RAMI REDDY MULE (39)
PRAJWAL RAMKRUSHNA SURUSHE (44)

Dr. S. D. Bhopale — **Guide**

Prof. S. B. Patil — **DRC Coordinator**

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Department of Electronics and Telecommunication Engineering

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Academic Year 2023-24

Synopsis of Proposed Work:

1. **Name of the College:** D. Y. Patil College of Engineering and Technology, Kolhapur.

2. **Name of the Course:** B. Tech (Electronics and Telecommunication Engineering)

3. **Name of the Students:**

   Mr. Pratik Shankar Yadav (16)
   Mr. Shivaraj Balaram Kumbhar (17)
   Mr. Shriprasad Jotiram Kadam (18)
   Mr. Saipratap Reddy Rami Reddy Mule (39)
   Mr. Prajwal Ramkrushna Surushe (44)

4. **Academic Year:** 2023-24

5. **Name of the Guide:** Dr. S. D. Bhopale.

6. **Proposed Title:** Automated Leaf Disease Detection and Spraying Robot.

7. **Place of Work:** Department of Electronics and Telecommunication Engineering,
   D. Y. Patil College of Engineering and Technology, Kolhapur.

8. **Introduction:**

   India is a cultivated country and about 70% of the population depends on agriculture. Farmers have large range of diverseness for selecting various suitable crops for cultivation. And with cultivation of crops, it also brings disease on the plant which leads to the significant reduction in both the quality and quantity of agricultural products. The study of plant diseases refers to the study of visually observable patterns on the plants. Monitoring of plant and protecting it from diseases plays an important role in successful cultivation of crops in the farm.

   In early days, the monitoring and analysing of plant disease were done manually by an expert person on field. This requires tremendous amount of work also requires more processing time. So, introducing image processing technique in agriculture for the plant disease detection can help to detect the disease and treat it in time. In most of the cases disease symptoms are observed on the leaves, stems and fruit. The plant leaf for the detection of disease is considered as it is easier to study the leaf patterns. The type of plant disease is identified using image processing by taking the leaf image and running through algorithms like CNN. It provides information about the disease which infected the plant.

In this project we are developing a robot which uses CNN to identify and classify plant disease based on the type. With plant disease it is coded to provide the suitable pesticide to treat it. In addition to this a spraying mechanism on-board is used to spray the suitable pesticide on the plant.

9. Problem Statement:

The major problem which is faced by farmers is 'Lack of yield due to crop diseases.' Due to various diseases that are increasing day-by-day and appropriate farming techniques are responsible for the current state of the agriculture sector. Majority of the farmers live in rural India do not know to deal with the diseases of the plants and are unaware of which fertilizer or pesticides to be used. So, farmers do not get the desired result, which is a main reason for giving up farming.

10. Literature Survey:

[1]. Pranesh Kulkarni, Atharva Karwande, Akshay Joshi, Medha Wyawahare, Department of Electronics and Telecommunication, Vishwakarma Institute of Technology, Pune, India (2021): **Plant Disease Detection Using Image Processing and Machine Learning.**

This paper proposes a smart and efficient technique for detection of crop disease which uses computer vision and machine learning techniques. The proposed system was able to detect 20 different diseases of 5 common plants with 93% accuracy

[2]. K. Veenanand, Seema Afreen Khan, M. Venkata Vijay, T. Raja, V. Raja Rajeswari. Dept of ECE, DVR Dr. HS MIC College of Technology Kanchikacherla, AP, India (2023): **Leaf Disease Detection System and Automatic Pesticide Spraying Control Robot Using Raspberry Pi.**

This project proposed a system using image processing. It automatically detects signs of disease whenever they appear on the leaves of the plant. It automatically detects symptoms of the disease by image processing by the CNN algorithm.

[3]. Dr. Shankaragowda B B, Shaik Abrar Ahamed, Department of Master of Application, BIET Davanagere. July 2022: **Leaf Disease Detection and Spray Pesticide Robot using Image Processing.**

This robot detects the leaf disease using image processing and Machine learning is deployed. This robot also monitors the field condition such as quality of crops and sprays the required amount pesticides for achieving the good yield in agriculture. The robot is designed using an advanced processor known as yolov5 which is integrated with machine learning model.

[4]. A O Santhosh, A Sagar, Govindaswamy M, Sarina Anees, Monica K M International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol. 12 Issue 05, May-2023: **Agni - A Plant Disease Detection Robot**

In this project, we aim to build a bot which uses algorithms to study various visually observable patterns on the leaf to detect and classify the disease. Crops such as tomato, potato and chili are considered in the project to detect their respective plant disease.With plant disease detection it will also be programmed to suggest the suitable pesticide to cure the disease of the plant.

[5]. Vijay Kumar V, Vani K S, Acharya Institute of Technology, Bangalore Karnataka, India. International Journal of Computational Intelligence Research ISSN 0973-1873 Volume 14, Number 7 (2018): **Agricultural Robot: Leaf Disease Detection and Monitoring the Field Condition Using Machine Learning and Image Processing.** This robot detects the leaf disease using image processing and Machine learning. This robot also monitors the field condition such as soil moisture, quality of crops and sprays the required amount of water and pesticides for achieving the good yield in agriculture. The robot is designed using an advanced processor known as Lattepanda which is integrated with machine learning model.

[6]. S. D. Khirade and A. B. Patil, International Conference on Computing Communication Control and Automation, 2015, pp. 768-771, **Plant Disease Detection Using Image Processing.**

Authors have elaborated different techniques for the detection of plant disease using the images of leaves. They have implemented Otsu's thresholding followed by boundary detection and spot detection algorithm to segment the infected part in leaf. After that they have extracted the features such as color, texture, morphology, edges etc. for classification of plant disease. BPNN is used for classification i.e. to detect the plant disease.

[7]. Ranjitha B N, Harshith U, Bhagappa, Pushparani M K International Journal of Engineering Research & Technology (IJERT) RTESIT - 2019 Conference Proceedings ISSN: 2278-0181, **Application of Raspberry-Pi model for Plant Disease Detection.**

The proposed work uses Artificial Neural Network to classify the Banana plant diseases and Artificial neural network-based training and classification. Finally, a system is developed that extracts the features from images and classifies the diseases.

11. Objectives:

i. Early identification of disease in a plant.

ii. Automated Selection of the diseased leaf and spraying pesticide on it.

iii. Reduce the wastage of pesticides.

iv. Development of Agriculture field suitable mobility bot/vehicle.

12. Proposed Work:

12.1 Block Diagram:

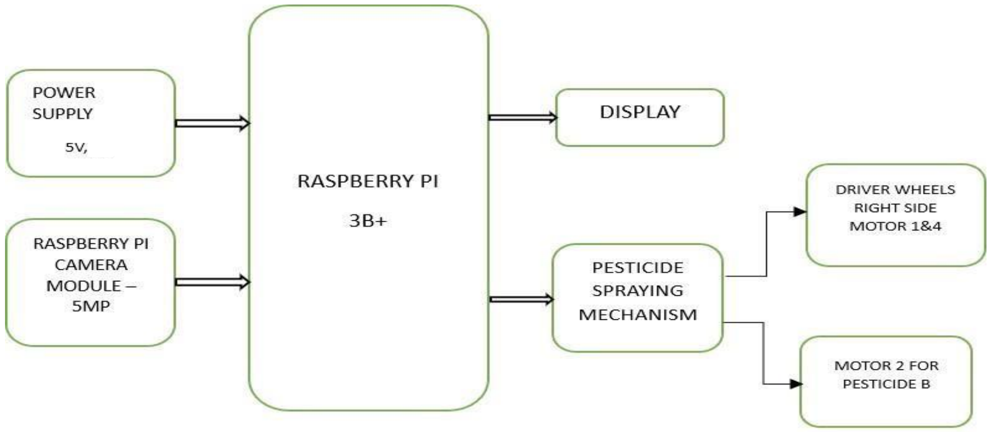

Figure 1: Block Diagram of Proposed System

12.2 Flowchart:

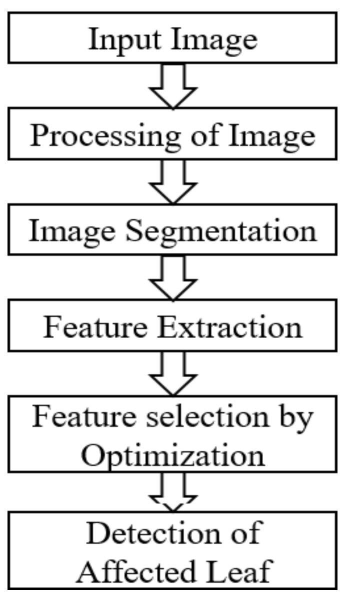

Figure 2: Flowchart of Proposed System

12.3 Explanation:

The block diagram of the project is illustrated in the above figure. The Figure shows the circuit controlled by the Raspberry pi. It consists of Raspberry Pi camera module of 5MP which capture the image of leaves of plant and Raspberry pi circuit processes on the input data and displays the result on display module. According to the information further pesticide spraying mechanism works.

The steps in image processing:

- Image acquisition
- Image Pre-processing.
- Image segmentation.
- Feature extraction.
- Detection and classification of plant disease.

13. Facilities Available:

Hardware lab, Innovation lab, computer lab with good internet facility, Software-IDE tools.

14. Expected Date of Completion: March 2024.

15. Approximate Expenditure: Rs.20,000/-

16. References:

[1]. Pranesh Kulkarni [2021]: "Plant Disease Detection Using Image Processing and Machine Learning." Department of Electronics and Telecommunication, Vishwakarma Institute of Technology, Pune, India. Submitted on: 20 Jun 2021 https://arxiv.org/abs/2106.10698

[2]. K. Veenanand, Seema Afreen Khan, M. Venkata Vijay, T. Raja, V. Raja Rajeswari, "Leaf Disease Detection System and Automatic Pesticide Spraying Control Robot Using Raspberry Pi," Dept of ECE, DVR Dr. HS MIC College of Technology kanchikacherla, AP, India. 2023 IJRTI | Volume 8, Issue 4 | ISSN: 2456-3315.

[3]. Dr. Shankaragowda B B, Shaik Abrar Ahamed, Department of Master of Application, BIET Davanagere: "Leaf Disease Detection and Spray Pesticide Robot using Image Processing," International Journal for Research in Applied Science & Engineering Technology (IJRASET). Volume 10 Issue VII July 2022.

[4]. A. O. Santhosh, A. Sagar, Govindaswamy M, Sarina Anees, Monica K M: "Agni - A Plant Disease Detection Robot," International Journal of Engineering Research

& Technology (IJERT) ISSN 2278-0181 Published by : www.ijert.org HYPERLINK "http://www.ijert.org/" Vol. 12 Issue 05, May-2023.

[5]. Vijay Kumar V, Vani K S: "Agricultural Robot: Leaf Disease Detection and Monitoring the Field Condition Using Machine Learning and Image Processing." Acharya Institute of Technology, Bangalore Karnataka, India. International Journal of Computational Intelligence Research ISSN 0973-1873 Volume 14, Number 7 (2018).

[6]. S. D. Khirade and A. B. Patil: "Plant Disease Detection Using Image Processing," 2015 International Conference on Computing Communication Control and Automation, 2015, pp. 768-771, doi: 10.1109/ICCUBEA.2015.153.

[7]. Ranjitha B N, Harshith U, Bhagappa, Pushparani M K: "Application of Raspberry-Pi model for Plant Disease Detection," International Journal of Engineering Research & Technology (IJERT) RTESIT - 2019 Conference Proceedings ISSN: 2278-0181

[8]. S. C. Madiwalar and M. V. Wyawahare: "Plant disease identification: A comparative study," 2017 International Conference on Data Management, Analytic and Innovation (ICDMAI), 2017, pp. 13-18, doi: 10.1109/ICDMAI.2017.8073478.

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Academic Year 2023-24

ABSTRACT

2. ABSTRACT

The aim of this project is to explores building a robot that can automatically identify the diseased leaf in crops and automatically spray on that. Imagine a machine that roams your field, taking pictures of leaves, and using its super-brain to recognize signs of trouble. If it spots a sick leaf, it blasts it with a targeted spray to stop the disease in its tracks. This is exactly what our automated leaf disease detection and spraying robot aims to achieve.

By combining camera technology with clever computer programs, the robot will learn to distinguish healthy leaves from those under attack by disease. This will allow for precise treatment, saving crops from harm and reducing unnecessary pesticide use. Our project dives into the exciting world of robotics and artificial intelligence, showcasing how they can be harnessed to create a helpful guardian for your precious plants.

The population of the world is increasing rapidly in order to fulfill their diet needs the production of food must be increased but this must come at a cost affordable to everyone. Mechanization of agriculture enables conservation of inputs by precision in ensuring better distribution, reducing quantity required for better response or prevention of losses or waste of inputs applied Mechanization reduces unit costs of production through higher productivity levels and the input conservation. The all agricultural equipments are often hardly modernized due to its low productivity In India farming is done by traditional ways, besides that there has been large development of industrial and service sector as compared to that of agriculture sector. The spraying of pesticides and insecticides a traditionally done by farm worker carrying backpack type sprays which requires more human effort Giving attention to these important problems an attempt is made to develop an equipment which will be beneficial to the farmer for the spraying operations. This equipment is easy to use and operate It makes use reciprocating pump that creates the required pressure for the spraying action This multifunction device will come in handy that can be put to use in different spraying stages of farming as per process requirement.

INTRODUCTION

3. INTRODUCTION

India is a cultivated country and about 70% of the population depends on Agriculture. Farmers have large range of diverseness for selecting various suitable craps for cultivation and swab inhibition of crops, it also brings disease on the plant which leads to the significant reduction in both the quality and quantity of agricultural products. The study of plant diseases refers to the study of visually observable patterns on the plants. Monitoring of palm and protecting it from diseases plays an important role in successful cultivation of crops in the farm.

In early days, the monitoring and analyses of plant disease were done manually by an expert person on field. This requires tremendous amount of work also requires more processing time. So, introducing image processing technique in agriculture for the plant disease detection can help to detect the disease and treat it in time. In most of the cases disease symptoms are observed on the leaves, stems and fruits. The plant leaf for the detection of disease is considered as it is easier to study the leaf patterns. The type of plant disease is identified using colour detection in image processing by taking the leaf image and running through algorithms like CNN. It provides information about the disease which infected the plant

In this project we are developing a robot which uses colour detection to identify and classify plant disease. With plant disease it is coded to provide the suitable pesticide to treat it. In addition to this a spraying mechanism on-board is used to spray the suitable pesticide on the plant.

This project explores building a robot that can automatically identify and fight disease in crops. Imagine a machine that roams your field, taking pictures of leaves, and using its super-brain to recognize signs of trouble. If it spots a sick leaf, it blasts it with a targeted spray to stop the disease in its tracks! This is exactly what our automated leaf disease detection and spraying robot aims to achieve.

By combining camera technology with clever computer programs, the robot will learn to distinguish healthy leaves from those under attack by disease. This will allow for precise treatment, saving crops from harm and reducing unnecessary pesticide use. Our project dives into the exciting world of robotics and artificial intelligence, showcasing how they can be harnessed to create a helpful guardian for your precious plants.

3.1 PROBLEM STATEMENT

Plant diseases have turned into a dilemma as it can cause significant reduction in both quality and quantity of agricultural products. Automatic detection of plant diseases is an essential research topic as it may prove benefits in monitoring large fields of crops, and thus automatically detect the symptoms of diseases as soon as they appear on plant leaves. The major problem which is faced by farmers is ‘Lack of yield due to crop diseases.’ Due to various diseases that are increasing day-by-day and inappropriate farming techniques are responsible for the current state of the agriculture sector. Majority of the farmers live in rural India do not know to deal with the diseases of the plants and are unaware of which fertilizer or pesticides to be used. So, farmers do not get the desired result, which is a main reason for giving up farming. The proposed system is a software solution for automatic detection and classification of plant leaf diseases.

Challenges Faced by Farmers in Detecting and Treating Crop Disease Detecting and treating crop disease is a constant battle for farmers. Large fields require a lot of walking and close examination of each plant, taking precious time away from other tasks. Catching disease early is essential to prevent it from spreading and causing major damage. But relying solely on the human eye can be tricky, especially in the early stages. Misidentifying a healthy leaf as diseased can lead to unnecessary use of pesticides, which is bad for the environment and costs money. Applying pesticides can be risky for farmers' health if proper precautions are not taken. These challenges can lead to frustrated farmers, lower crop yields, and even potential health problems.

Our project aims to address these issues by developing a solution that is, the robot can cover large areas quickly and tirelessly, spotting diseases that might be missed during manual inspection. By using advanced technology, the robot can identify signs of disease even before they become obvious to the human eye. The robot can target only the affected areas, minimizing pesticide use and saving money. The robot takes on the task of applying pesticides, reducing the risk of exposure for farmers.

3.2 OBJECTIVES

- Early identification of disease in a plant.
- Automated Selection of the diseased leaf and spraying pesticide on it.
- Reduce the wastage of pesticides.
- Development of Agriculture field suitable mobility bot/vehicle.

The objectives of our project is early identification of disease in a plant. If early identification of disease in a plant is not done then the disease will not only spread in the plant about it will also spread to the nearby plants. Suggesting and spraying a suitable pesticide for the plant based on the disease. Based on the identified plant disease the suitable pesticides for plant are suggested and robot will spray the pesticide. Agricultural field suitable mobility bot/vehicle. The bot will design in such a way that it will suitable for moving in the agriculture field.

This robot aims to find diseases on plant leaves early on, before they cause too much damage. Once the robot spots a disease, it will automatically spray the right medicine to fight it off. This robot can save farmers time and effort by scouting fields for disease and taking care of spraying. By finding diseases early, this robot can help farmers avoid losing crops to illness. Less spraying by hand means less exposure to pesticides for farmers. The robot can be programmed to use only the amount of medicine needed, which is good for the environment and saves money. It will spray in selected time slot.

To provide safety to the farmers and the main objective of this work is to provide precision farming. Here, Robots will be replacing laborers for the farm activities like detection of pests, spraying of pesticides/fertilizers etc. whose operations will be automated or can be controlled by the farmer.

3.3 SCOPE

This type of robot has very useful in agriculture and reduces workload. It saves time and money by reducing the amount of pesticide liquid that needs to be sprayed. It will assist farmers in working in any season and under any conditions. It would lessen the risk of various breathing and physical problems for farmers. It can be built to grab and analyze data of the farming field and to do pre-defined tasks autonomously. Additional use of renewable resources, such as wind energy, will also help reduce the need for more batteries. Usage of voice controlled navigation for robotic movements can be used.

3.4 METHODOLOGY

Part 1-

A. A bot which moves around the crop field.

B. Captures the images of the plants.

Part 2-

A. With the aid of machine learning, quick and effective image processing algorithms can be created.

B. The first phase of the algorithms works with separating the healthy crop from the diseased crop and the second task of the algorithms is focused on identifying the crop disease.

The steps in image processing-

- Image acquisition
- Image Pre-processing
- Image segmentation
- Feature extraction
- Detection and classification of plant disease.

Part 3-

A. After disease detection, the suitable pesticide will be given.

B. The bot will spray the pesticide on the diseased plant.

LITERATURE REVIEW

4 LITERATURE REVIEW

1. Pranesh Kulkarni, Atharva Karwande, Akshay Joshi, Medha Wyawahare, Department of Electronics and Telecommunication, Vishwakarma Institute of Technology, Pune, India (2021): Plant Disease Detection Using Image Processing and Machine Learning. This paper proposes a smart and efficient technique for detection of crop disease which uses computer vision and machine learning techniques. The proposed system was able to detect 20 different diseases of 5 common plants with 93% accuracy.

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4. A O Santhosh, A Sagar, Govindaswamy M, Sarina Anees, Monica K M International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol. 12 Issue 05, May-2023: Agni - A Plant Disease Detection Robot. In this project, we aim to build a bot which uses algorithms to study various visually observable patterns on the leaf to detect and classify the disease. Crops such as tomato, potato and chili are considered in the project to detect their respective plant disease. With plant disease detection it will also be programmed to suggest the suitable pesticide to cure the disease of the plant.

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Condition Using Machine Learning and Image Processing. This robot detects the leaf disease using image processing and Machine learning. This robot also monitors the field condition such as soil moisture, quality of crops and sprays the required amount of water and pesticides for achieving the good yield in agriculture. The robot is designed using an advanced processor known as Lattepanda which is integrated with machine learning model.

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7. Ranjitha B N, Harshith U, Bhagappa, Pushparani M K International Journal of Engineering Research & Technology (IJERT) RTESIT - 2019 Conference Proceedings ISSN: 2278-0181, Application of Raspberry-Pi model for Plant Disease Detection. The proposed work uses Artificial Neural Network to classify the Banana plant diseases and Artificial neural network-based training and classification. Finally, a system is developed that extracts the features from images and classifies the diseases.

8. "Robot Control Design Using Android Smartphone" by Mrumal.K.Pathak, Javed Khan, Aarushi Koul, Reshma Kalane, Raunak Varshney: This paper explains the controlling of robot through phone adopting Bluetooth technology and some of its features, mobile component and robot. The solutions derived are very much comfortable and they act as platform for robot building. The cost is very less, computation speed and sensing of the control device, smartphone are good he paper aims to provide simple robot hardware architecture with sophisticated android domain which is powerful enough.

9. "Smart Phone Controlled Robot Using ATMEGA328 Microcontroller" by Aniket R. Yeole, Sapana M. Bramhankar,Monali D. Wani, Mukesh P. Mahajan. The paper is about robot designing making use of the application of android phone. In this paper, the direction of the robot and what is the distance of the robot from the obstacle will becommunicated.

10. Android Mobile Phone Controlled Bluetooth Robot Using 8051 Microcontroller" by Ritika Pahuja, Naren.

    A robot can be defined as electro-mechanical machine governed by programming computer and electronic hardware. Robots are been used in factories all over the world in the Manufacturingunits. In this paper, motion of the robot is controlled by the buttons of the android application. Bluetooth module is used for interfacing of smartphone and the controller. This is done throughthe help of UART protocol.

11. "Robot Controlled Car Using Wi-Fi Module" by S R Madkar, Vipul Mehta, Nitin Bhuwania, Maitri Parida

    In this paper, robot controlled car designed in android application making use of Wi-Fi in the smartphone. The devices can be controlled even though android phone is not physically present through the SMS. In this project, inclusion of spy camera using which live videos can be streamed to the user making use of Wi-Fi. Instead of using normal lithium ion battery, this project makes use of solar cells leading to energy efficiency.

12. "Agriculture robotic vehicle based pesticide sprayer with efficiency optimization"

    This paper deals with explanation of how robotics are often applied to different fields of agriculture. The foremost important occupation in a developing country like India is agriculture. It's important to boost the effectiveness and productivity of agriculture by swapping laborers with intelligent machines like robots using new technologies. The paper proposes a brand new strategy to interchange humans in various agricultural operations like detection of presence of pests, spraying of pesticides, spraying of fertilizers, etc. there by providing safety to the farmers and precision agriculture. The developed system involves developing a prototype which uses simple cost effective elements like microprocessors, wireless camera, different motors and terminal elements which helps the farmers in different crop field activities.

13. "Agricultural robotics, unmanned robotic service units in agricultural tasks"

    The usage of agricultural appliances into precision agriculture has accomplished a rise in investment and exploration because of the utilization of robotics applications within the machinery development and task executions. Precision autonomous farming is that the functioning, counselling, and control of autonomous machines to hold out agricultural tasks. Itinspires agricultural robotics.

It’s expected that, within the near future, autonomous vehicles are at the guts of all precision agriculture applications. The goal of agricultural robotics is over just the appliance of robotics technologies to agriculture. Nowadays, most of the automated agricultural appliances used for weed spotting, agrochemical dispersal, terrain levelling, irrigation, etc. are human controlled**.** An autonomous execution of such vehicles can give the continual supervision of the farm, because information related to the environment is autonomously acquired, and therefore the vehicle can then perform its task accordingly.

14. “An advance air-induced-assisted electrostatic nozzle with enhanced performance”

There is an important need of latest chemical implementation sprayer for tiny scale farmland in Indian agricultural pesticides spraying. A replacement air-assisted electrostatic nozzle has been designed and developed for tiny scale farms with a selected specialize in Indian agricultural and rural developing economies. Air-assisted based electrostatic nozzle combines of an induction depend electrostatic charging system and air assisted nozzle. Spray particles are electrified to over 10 mC/kg charge-by-mass proportion by charging voltage minimum to 2.5 kV at liquid flow of 150 ml/min and power consumption minimum to 75 mW. Greater charge-to-mass ratio guaranteed the long range spraying distance to beat the charge neutralization process by recombination of naturally occurring ions present within the environment and charged liquid droplets. The outcomes of applied induction electrification process were identified by a charge-to-mass ratio and also the outcomes are in nice accordance with the theoretical matters. There is 2–3 times rise of liquid discharge with better equivalence on the hidden along with front target. This nozzle is low weight, extremely efficient, decreases pesticide usage and human health risks, and is eco-friendly.

15. “Review of electrostatic system parameters, charged droplets characteristics and substrate impact behavior from pesticides spraying”

Electrostatic spraying application is adopted in crop protection to forestall pest infestation, to boost product quality and to maximize yield. It involves a superposition of charges to pesticide spray droplets to draw in substrate ions at obscured surfaces. The droplets wraparound effect decreases off-course deposition, enhances on-course spray and invariably improves spray efficiency. Electrostatic spraying system functions productively at ideal parameters together with charging voltages, application pressures, spraying height regimes, flow rate, travel speed, electrode material, and nozzle orientation. Many groups of system parameter settings are systematically utilized by scientists for electrostatic application, yet there are unsure specific optimum parameters groups for pesticide spraying. Since droplets chargeability effects the efficacy of the electrostatic spraying process, the specifications that generate optimum charge by mass ratio decide the functionality of spraying deposition, retension and surface coverage. This paper, hence, examines electrostatic system parameters which generate suitably charged droplets attributes for successful impacting behavior of pesticides on the substrates. Increasingapplied voltages accordingly increases charge-by-mass ratio to ideal an**d** starts decreasing beyond more increase in voltages beyond a juncture. This paper further proposes the choice ofan ideal electrostatic parameters combination which gives best droplets chargeability in the pesticide application. Also, it's necessary to research the charge characteristics of the substratesbefore pesticide application so as to superpose the proper opposite charge on the spray droplets at burst time during electrostatic spraying system.

ANALYTICAL/ EXPERIMENTAL/ LAYOUT DESIGN WORK

5 ANALYTICAL/EXPERIMENTAL/LAYOUT DESIGNWORK

5.1 BLOCK DIAGRAM

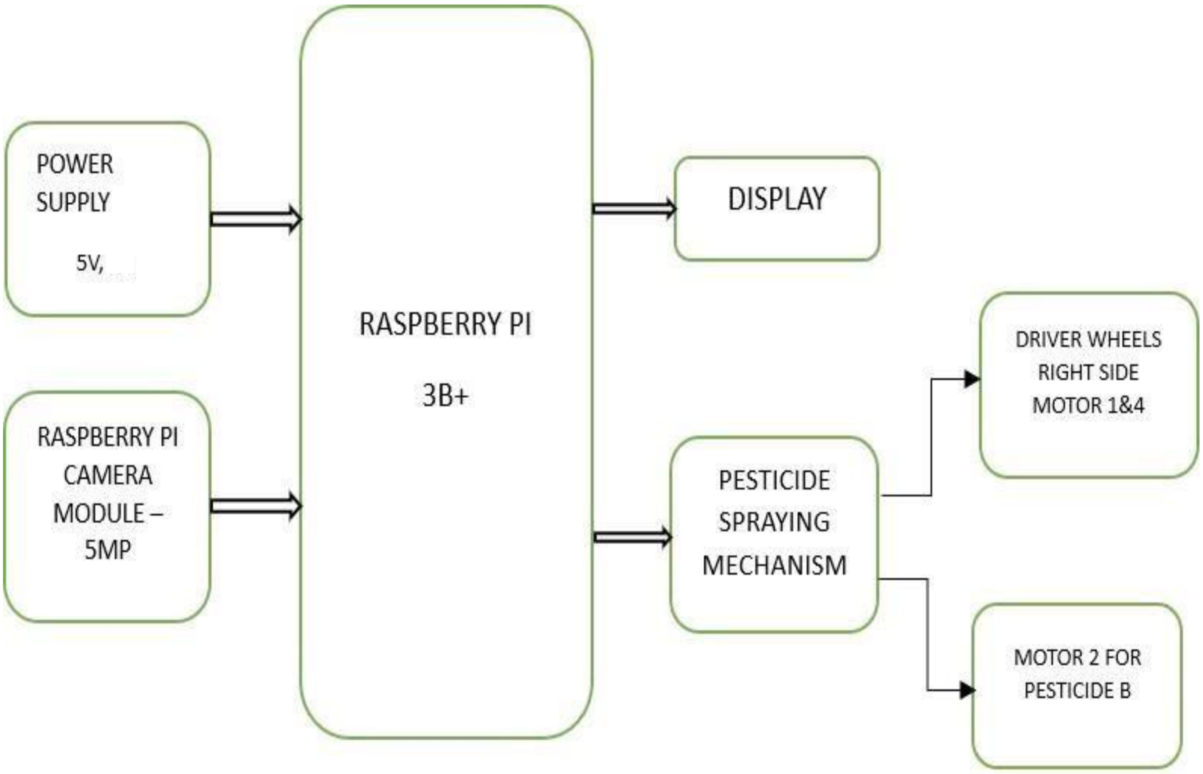


Figure 5.1.1: Block Diagram of Proposed Work

5.2 COMPONENT DESCRIPTION

5.2.1 Breadboard

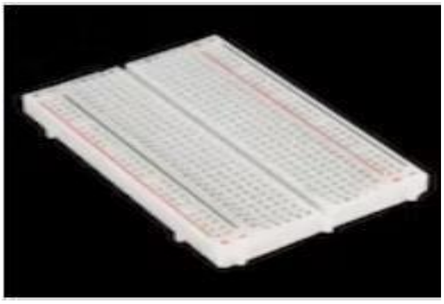


Figure 5.2.1: Breadboard

A breadboard (sometimes called a *plug block*) is used for building temporary circuits. It is useful to designers because it allows components to be removed and replaced easily. It is useful to theperson who wants to build a circuit to demonstrate its action, then to reuse the components in another circuit. A breadboard consists of plastic block holding a matrix of electrical sockets of a size suitable for gripping thin connecting wire, component wires or the pins of transistors and integrated circuits (ICs). The sockets are connected inside the board, usually in rows of five sockets. A row of five connected sockets is filled in at the top right of the figure. The rows are
2.54 mm apart and the sockets spaced 2.54 mm apart in the rows, which is the correct spacing for the pins of ICs and many other components.

5.2.2 DC Motors

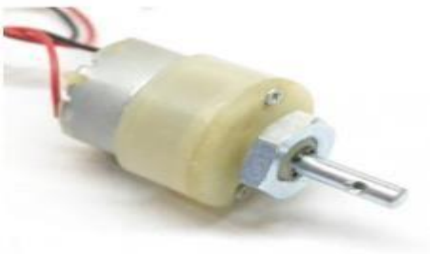


Figure 5.2.2: DC Motor

A DC motor is an electrical machine that converts electrical energy into mechanical energy. In a DC motor, the input electrical energy is the direct current which is transformed into the mechanical rotation.

Actual rated voltage	6V
Voltage range	1V-6V
Speed at 3v	17000-18000 rpm
Current	0.35A-0.4A
Dimensions	20 x 15 x 25
Axis length	8mm
Shaft diameter	2mm
Weight	0.15 kg

Table 5.2.2: Specifications Of DC Motor

5.2.3 Wheels

Figure 5.2.3: Wheels

Wheels are the cornerstone of a robot's mobility, providing the necessary support and movement capabilities required for various tasks. These are durable wheels with rubber grip.

5.2.4 Raspberry Pi 3B+

Figure 5.2.4: Raspberry pi 3b+

The Raspberry Pi is a credit card-sized computer. The Raspberry Pi 3 Model B+ is an improved version of the Raspberry Pi 3 Model B. It is based on the BCM2837B0 system-on-chip (SoC), which includes a 1.4 GHz quad-core ARMv8 64bit processor and a powerful Video Core IV GPU. The Raspberry Pi can run a full range of ARM GNU/Linux distributions, including Snappy Ubuntu Core, Raspbian, Fedora, and Arch Linux, as well as Microsoft Windows 10 IoT Core.

The Raspberry Pi 3 Model B+ has many performance improvements over the Model B including a faster CPU clock speed (1.4 GHz vs 1.2 GHz), increased Ethernet throughput, and dual-band WiFi. It also supports Power over Ethernet with a Power over Ethernet HAT (not included). The MagPi Magazine has a blog post with performance benchmarks comparing various Raspberry Pi models.

The dual-band wireless LAN comes with modular compliance certification, allowing the board to be designed into end products with significantly reduced wireless LAN compliance testing, improving both cost and time to market.

CPU	1.4 GHz quad-core BCM2837B0 ARMv8 64bit
RAM	1 GB
Ethernet port	Yes
WiFi	dual-band (2.4 GHz and 5 GHz) IEEE 802.11.b/g/n/ac wireless LAN
Bluetooth	4.2
Bluetooth Low Energy	Yes

USB Port	4
Mounting holes	4
Dimensions	3.35″ × 2.2″ × 0.8″
Weight	50 g
SD socket	microSD

Table 5.2.5: Specifications Of Raspberry Pi

5.2.5 Raspberry Pi Camera Module

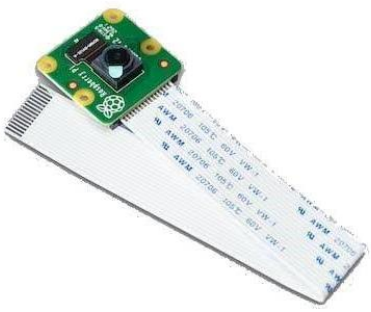


Figure 5.2.5: Raspberry Pi Camera Module

This 5megapixel sensor with OV5647 camera module is capable of 1080p video and still images that connect directly to your Raspberry Pi. This is the plug-and-play-compatible latest version of the Raspbian operating system, making it perfect for time-lapse photography, recording video, motion detection and security applications. Connect the included ribbon cable to the CSI (Camera Serial Interface) port on your Raspberry Pi, and you are good to go!

The board itself is tiny, at around 25mm x 23mm x 9mm and weighing in at just over 3g, making it perfect for mobile or other applications where size and weight are important. The sensor has a native resolution of 5 megapixel, and has a fixed focus lens on board. In terms of still images, the camera is capable of 2592 x 1944 pixels static images and also supports 1080p30, 720p60 and 640x480p90 video.

Size	Around 25 × 24 × 9 mm
Weight	3g
Still resolution	5 Megapixels
Video modes	1080p30, 720p60 and 640 × 480p60/90

Sensor	OmniVision OV5647
Sensor resolution	2592 × 1944 pixels
Sensor image area	3.76 × 2.74 mm
Pixel size	1.4 µm × 1.4 µm
Optical size	1/4"
Focus	Fixed
Depth of field	Approx 1 m to ∞
Focal length	3.60 mm +/- 0.01
Horizontal Field of View (FoV)	53.50 +/- 0.13 degrees
Vertical Field of View (FoV)	41.41 +/- 0.11 degrees
Focal ratio (F-Stop)	F2.9
Maximum exposure times (seconds)	0.97
Lens Mount	N/A

Table 5.2.6: Specifications Raspberry Pi Camera Module

5.2.6 Sprayer

Figure 5.2.6: Sprayer

A sprayer is a device used to spray a liquid, where sprayers are commonly used for projection of water, weed killers, crop performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients.

5.2.7 Battery

Figure 5.2.7: Battery

A battery can be defined as an electrochemical device (consisting of one or more electrochemical cells) which can be charged with an electric current and discharged whenever required. Batteries are usually devices that are made up of multiple electrochemical cells that are connected to external inputs and outputs.

5.2.8 L298N Motor driver

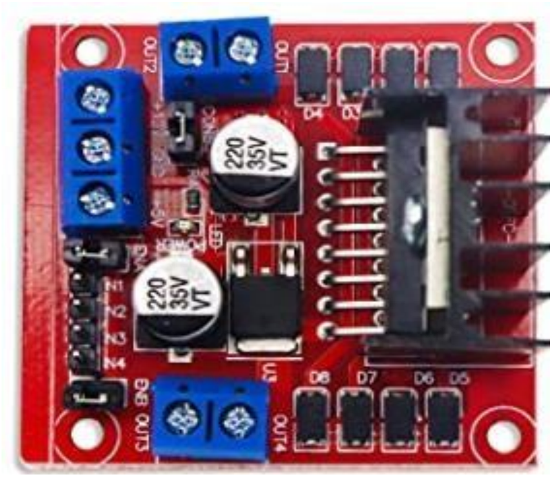


Figure 5.2.8: L298N Motor driver

The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time. The module can drive DC motors that have voltages between 5 and 35V, with a peak current up to 2A.

Parameter	Specification
Operating Voltage (Vcc)	4.5V to 7V
Motor Supply Voltage (Vs)	4.8V to 46V
Output Current (per channel)	2A (continuous), 3A (peak)
Total Power Dissipation	25W
Logic Input Voltage	Low: -0.3V to 1.5V High: 2.3V to 7V
Control Logic Voltage	5V (typically from Arduino/Raspberry Pi)
Output Voltage Drop	1.8V to 3.2V (depending on load and temperature)
Operating Temperature Range	-25°C to +130°C
Number of Channels	2 (can control 2 DC motors or 1 stepper motor)
PWM Frequency	Up to 40 kHz
Protection Features	Over-temperature protection
Package Type	Multiwatt15 and PowerSO20
Dimensions	Varies depending on package type

Table 5.2.8: Specifications of L298N Motor driver

On the other hand, for controlling the rotation direction, we just need to inverse the direction of the current flow through the motor, and themost common method of doing that is by using an H-Bridge. An H-Bridge circuit contains four switching elements, transistors or MOSFETs, with the motor at the center forming an H-like configuration. By activating two particular switches at the same time we can change the direction of the current flow, thus change the rotation direction of the motor. So, if we combine these two methods, the PWM and the H-Bridge, we can have a complete control over the DC motor. There are many DC motor drivers that have these features and the L298Nis one of them.

5.2.9 5V 4 Channel Relay Module

Figure 5.2.9: 5V 4 Channel Relay Module

Specification	Description
Relay Channels	4
Operating Voltage	5V DC
Trigger Voltage	0V (Low-level trigger)
Relay Type	SPDT (Single Pole Double Throw)
Max Switching Voltage	250V AC / 30V DC
Max Switching Current	10A at 250V AC / 10A at 30V DC
Power Consumption	Approximately 70mA per relay
Optocoupler Isolation	Yes
Control Signal	Digital, 0V to activate
LED Indicators	Yes, for power and each relay status
Board Size	Varies by manufacturer, typically around 7 cm x 5 cm
Mounting Holes	Yes, typically 3mm diameter
Operating Temperature	-40°C to +85°C
Weight	Approximately 60 grams
Connection Terminals	Screw terminals for relay outputs, pin headers for control input

Input Pins	VCC, GND, IN1, IN2, IN3, IN4
Relay On Time	Typically less than 10ms
Relay Off Time	Typically less than 10ms

Table 5.2.9: Specifications Of 5V 4 Channel Relay Module

This relay module is 5v active low. Low active means relay will get trigger when low voltage/signal supplied to in pin. This is a 5v 4-channel relay interface board, be able to control various appliances, and other equipment with large current. It can be controlled directly by microcontroller (arduino, 8051, avr, pic, dsp, arm, arm, msp430, TTL logic). 5v 4-channel relay interface board, and each one needs 15-20mA driver current equipped with high-current relay, AC 250v 10a DC30v 10a the 8550 transistors drive, drive ability workingvoltage 5 v.

CIRCUIT DIAGRAM

6 CIRCUIT DIAGRAM

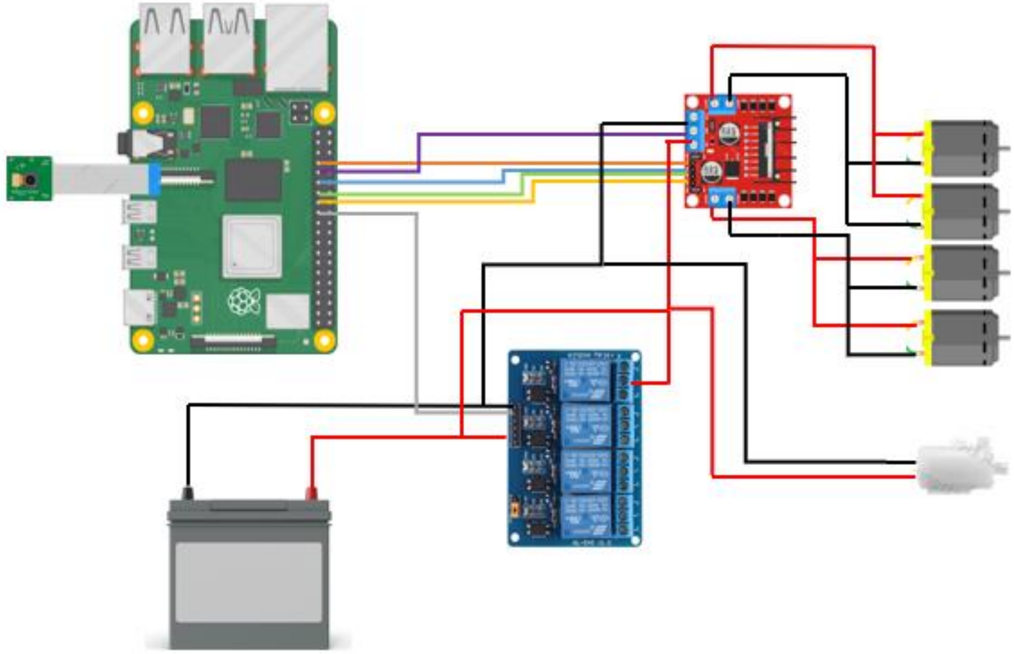


Figure 6.1: Circuit Diagram of Proposed Work

The above circuit diagram shows how exactly all the components are connected to each other via jumping wires. This circuit diagram was made with the help of different components and design features. The components used are Raspberry pi 3B+ module, Raspberry pi Camera Module, 5V 4-Channel relay module, L298D Motor Driver, 4 DC motors, Water Pump, 12V Power Supply.

We have used Raspberry Pi B+ module as a controller in which all software part of the project runs. The DC motors for wheels are connected through motor driver L298D and water pump is directly connected to Relay module which gets powered through 12V battery supply. first of all In this circuit when the connection established by the user in raspberry pi, software on PC and the mobile application by connecting all devices through single IP address of particular parent mobile hotspot.

When user operates robot by giving the instructions from application, the command goes to raspberry and the image captures by camera this image then get processed by the ARMv8 64 bit processor. This processing involves different image processing steps. The ground of whole circuit is made common to 12v power supply. The GPIO pins of the raspberry pi numbered 7, 9, 11, 13, 15, 17 are connected to other devices. When the disease found on leaf the signal goes to relay module and sprayer get started for 3 second. If not found the robot will not command to spray and user move the robot forward.

WORK FLOW OF SYSTEM

7 WORK FLOW OF SYSTEM

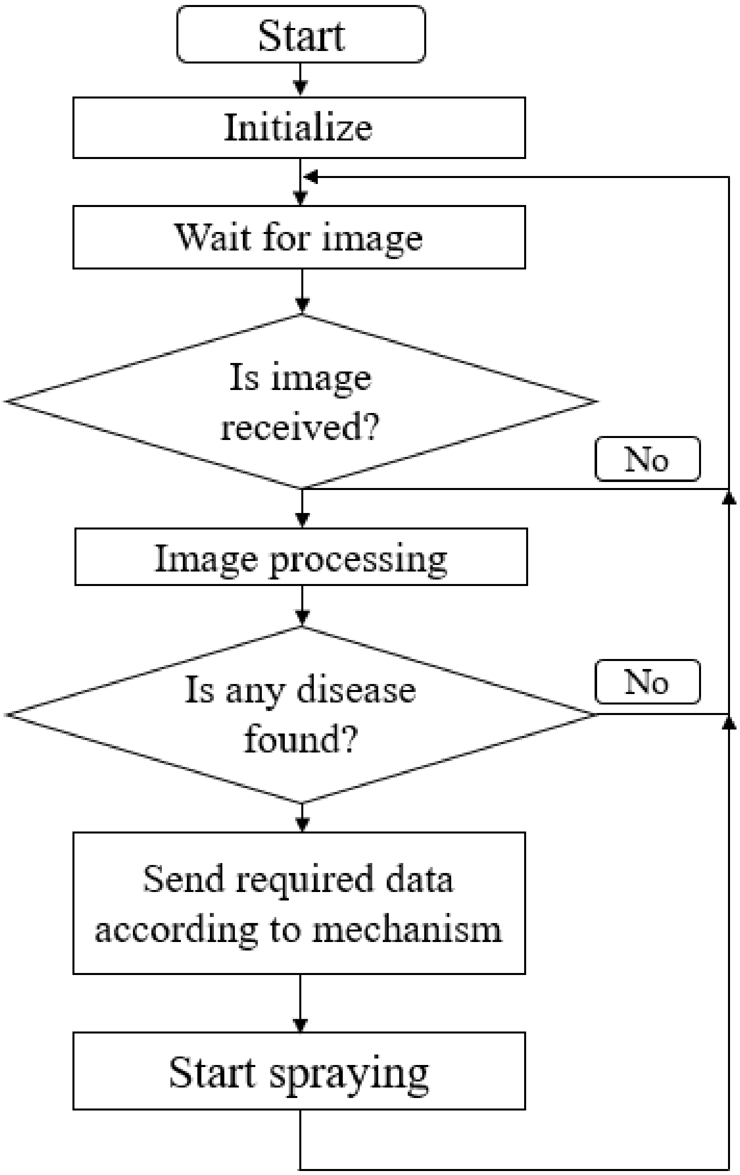


Figure 7.1 : Image processing

When the operation starts the first initalization process of connection establishment takes place. Then the robot gets image from the camera and check the image received if not then wait for the image. Image processing steps are executed by processor. In that image if any disease found then the processor send required data to the motor driver and water pump and the sprayer start spraying. If the disease not found then the whole process get repeated from taking another leaf image and processing on it.

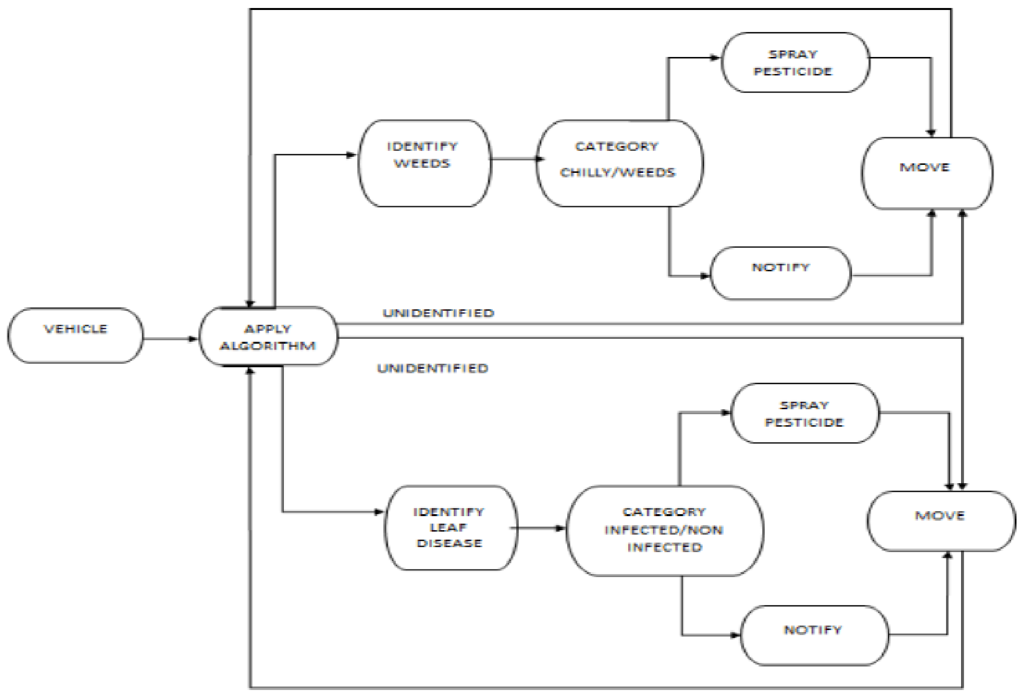


Figure 7.2: Identification of Images

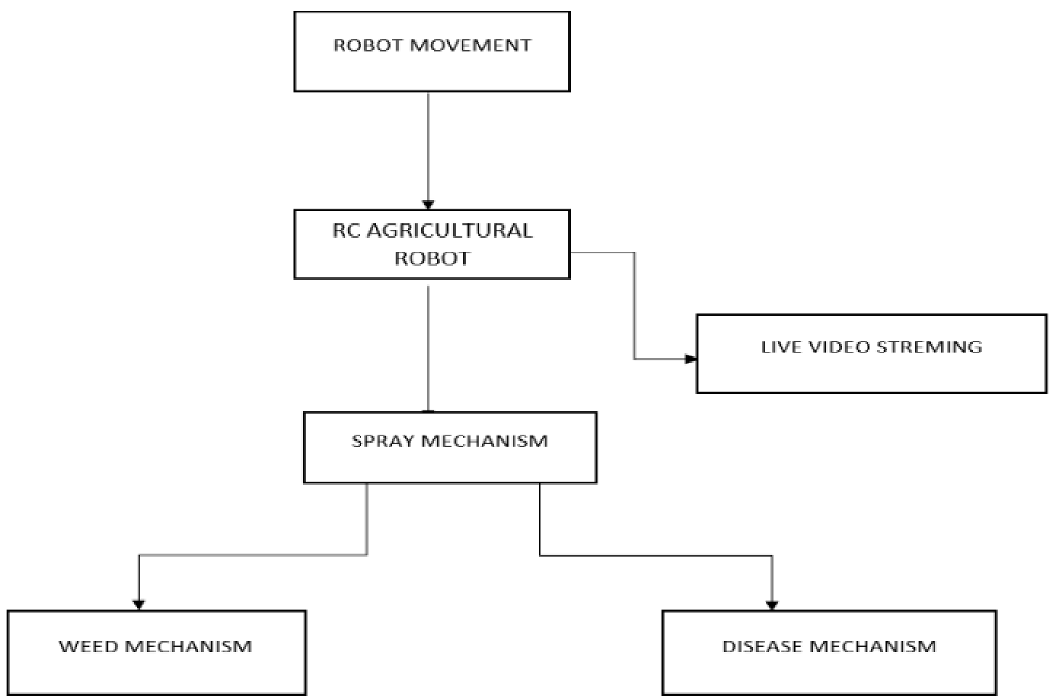


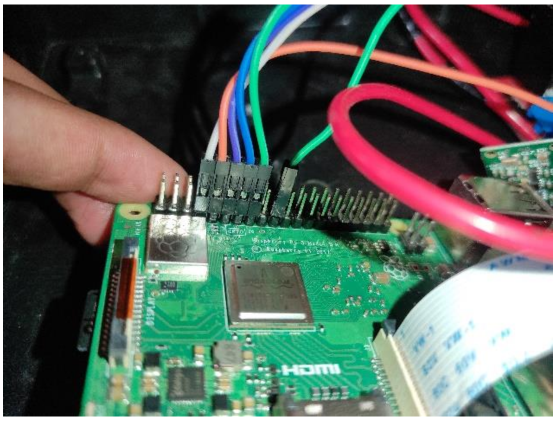
Figure 7.3: Agricultural Robot

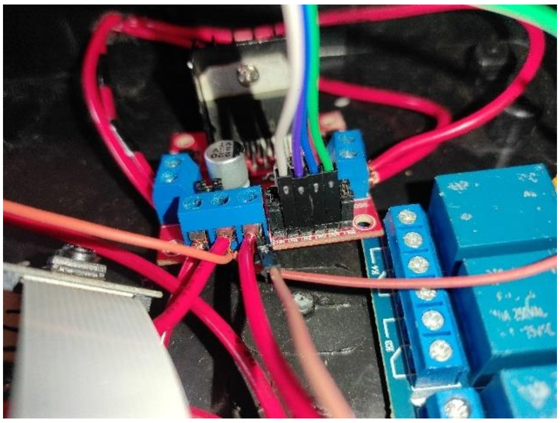
EXPERIMENTAL VALIIDATION/ RESULT

8 EXPERIMENTAL VALIIDATION/ RESULT

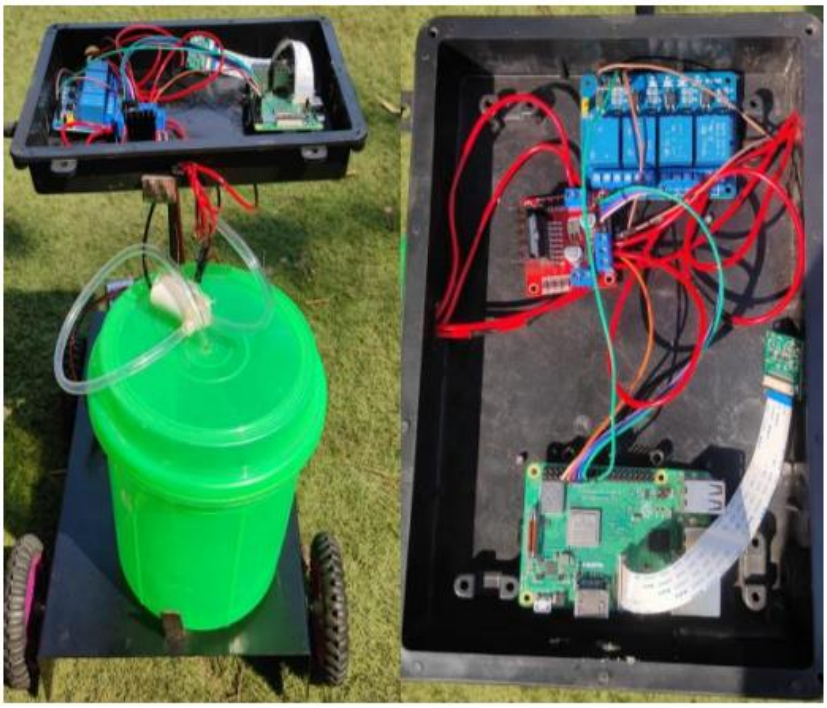
PHASE I RESULT:

In this phase we have done with complete hardware part of our project, we have used solid metal body to implant all the components and our circuit box. We have decided to keep it in single side sprayer to avoid extra complexity and extra work in case of time management. In this we used raspberry pi and its camera module at same side of robot where sprayer attached as both the mechanisms are dependent. We had also reduced the unnecessary wiring of circuit as we shifted from ESP32 to Raspberry Pi 3B+ module.





PHASE II RESULT:



This is updated and modified version of the agri-robot system. In which we have used raspberry pi 3B+ module for execution of whole software part which consist of image processing and image capturing through 5MP raspberry pi camera module. This camera module captures the picture and send this to a processor of raspberry pi.

We have connected the moving motors and sprayer to raspberry pi through L298D motor driver and 5V 4-Channel relay module respectively. This is how all the circuit and setup for the project looks and work in this manner.

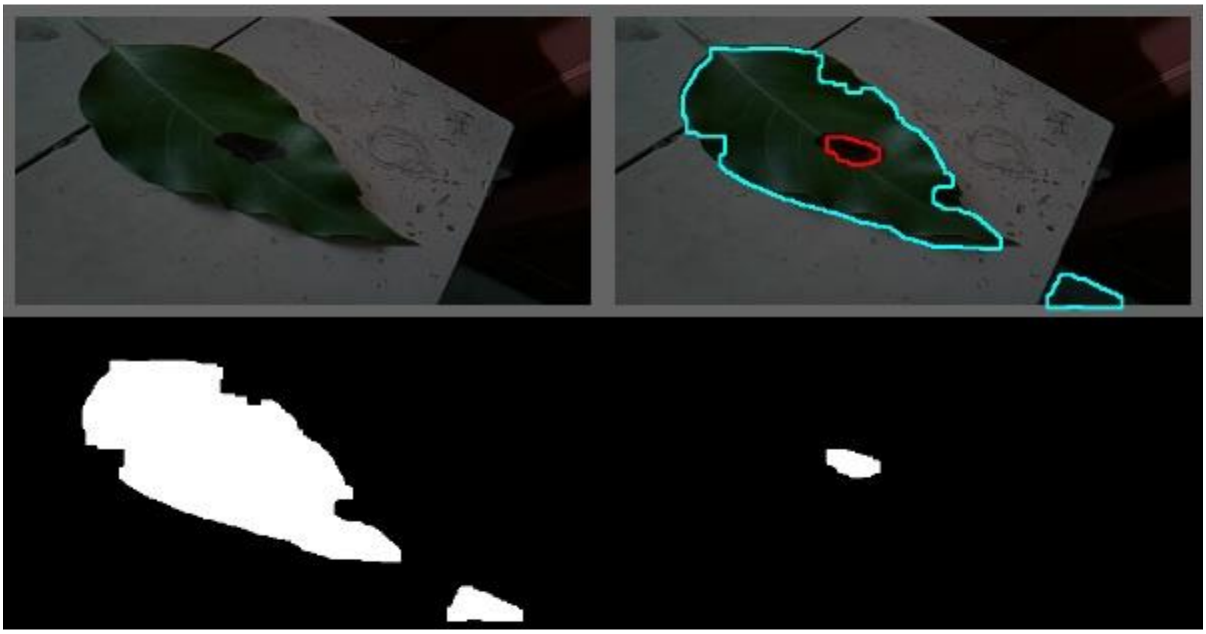
IMAGE PROCESSING PART:

INPUT IMAGE FROM CAMERA

DISEASE MASK WITH LEAF MASK

LEAF MASK

DISEASE MASK



FINAL RESULT OF DISEASE DETECTION

CONCLUSION

9 CONCLUSION

The present study deals with automatic disease detection of plant leaf using image processing techniques. It involves image acquisition, image preprocessing, image segmentation, feature extraction and classification. Development of automatic detection system using advanced computer technology such as image processing help to support the farmers in the identification of diseases at an early or initial stage and provide useful information for its control. The system would like to extend our work further on more plant disease detection. We had made improvements to the robot farmers use, which can now work on controlled by a mobile app. This is important because farmers sometimes use too much fertilizer, and many farmers in India didn't use technology much. Our new system focuses on finding weeds, using special technology that understands the types of weeds found in Indian fields. We also made a special way for the robot to spray pesticides that saves money and is better for the environment. Instead of spraying everywhere, it only sprays where there are weeds, which is safer for farmers and the environment. Incorporating a feedback loop to enhance disease detection and treatment decision-making, as well as connecting the robot to a cloud-based platform for instantaneous data exchange and examination, are our efforts to equip farmers with enhanced resources and knowledge to safeguard their crops and raise the general effectiveness of farming systems. This new robot is easy to use, works in different types of fields. It helps farmers grow crops better and makes farming safer for everyone.

FUTURE SCOPE

10 FUTURE SCOPE

The project for an automated leaf disease detection and spraying robot has a lot of potential for future development. Here are some areas where this technology could be improved:

- Increased Accuracy and Disease Detection Range: The ability to detect a wider range of plant diseases and different types of crops. This could involve using more sophisticated machine learning algorithms and expanding the training data set.
- Improved Spraying Systems: Development of more precise spraying mechanisms that target only the diseased areas of the plant. This would minimize pesticide use and reduce environmental impact.
- Integration with other Farm Management Systems: The ability to connect the robot with other farm management systems, like weather stations and soil moisture sensors. This would allow the robot to make informed decisions about spraying based on environmental conditions.
- Advanced Navigation and Autonomy: Development of more advanced navigation systems that allow the robot to operate in complex field environments and adapt to changing conditions.
- Real-time Disease Analysis and Recommendation: The robot could be linked to a cloud-based system that analyzes disease data in real-time and provides farmers with recommendations for treatment or preventative measures.
- Affordability and Scalability: Making the robots more affordable and easier to use for small and medium-scale farmers. This could involve developing modular designs and using open-source software.

By continuing to develop this technology, automated leaf disease detection and spraying robots have the potential to revolutionize agriculture by improving crop yields, reducing pesticide use, and making farming more efficient and sustainable.

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SOURCE CODE

12 SOURCE CODE

```
from robotModule import Robot
import WebcamModule
import cv2
import utlis
import numpy as np
import os
import tkinter as tk
from tkinter import filedialog
import tcp_listener as srv
from time import sleep
import matplotlib.pyplot as plt
import RPi.GPIO as GPIO

#### Change this for leaf green color ####
lowerGreen = np.array([30, 40, 20])
upperGreen = np.array([90, 215, 191])
########################################

mot = 10
GPIO.setup(mot,GPIO.OUT)
GPIO.output(mot,GPIO.HIGH)

robo = Robot(2,4,17,3,22,27)
# MOT1: Gpio 4 = IN1,  GPIO 17 = IN2
# MO2: Gpio 27 = IN1,  GPIO 22 = IN2
#motor= Motor(23,4,17,24,27,22)          # EnaA,In1A,In2A,EnaB,In1B,In2B
robo.stop(2)

# Define host and port
host = '0.0.0.0'  # Listen on all available interfaces
#host = '192.168.30.55'  # Listen on all available interfaces
```

```
port = 8080  # Choose any available port (above 1024 for non-privileged ports)
def motor_on():
    GPIO.output(mot,GPIO.LOW)
def motor_off():
    GPIO.output(mot,GPIO.HIGH)

def LeafDetection(img):

    mask = utlis.thresholding(img, lowerGreen, upperGreen)      # Color detection, extract
only desired colour

    kernel = np.ones((10,10),np.uint8)

    dilate = cv2.dilate(mask,kernel,iterations = 1)
    #cv2.imshow('Dilate', dilate)
    erode = cv2.erode(dilate, kernel, iterations = 1)
    #cv2.imshow('Erode', erode)
    opened = cv2.morphologyEx(erode, cv2.MORPH_OPEN, kernel)
    #cv2.imshow('Open', opened)

    closed = cv2.morphologyEx(opened, cv2.MORPH_CLOSE, kernel)
    #cv2.imshow('Close', closed)

    final = closed
    result = cv2.bitwise_and(img, img, mask=final)
    #cv2.imshow('Masked', result)

    # Find contours in the image
    contours = cv2.findContours(final, cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)[0]
    print('Total objects', len(contours))

    ## Get the properties of each contour
```

```
    #props = cv2.moments(contours[0])
    ## Print the properties
    #print(props)

    # Draw the contours on the image
    #cv2.drawContours(img, contours, -1, (255, 255, 0), 3)
    #cv2.imshow('Leaf Contours', img)

    #imgStack = utlis.stackImages(0.6, ([dilate, erode], [opened, closed], [img, result]))
    #cv2.imshow("Stacked Images", imgStack)



    #cv2.imwrite('Result.jpg', imgStack)
    return final


def FindDiseaseArea(binImg):
    # Invert image
    inv = cv2.bitwise_not(binImg)

    # Copy the thresholded image.
    im_floodfill = binImg.copy()

    # Mask used to flood filling.
    # Notice the size needs to be 2 pixels than the image.
    h, w = binImg.shape[:2]
    mask = np.zeros((h+2, w+2), np.uint8)

    # Floodfill from point (0, 0)
    cv2.floodFill(im_floodfill, mask, (0,0), 255)

    # Invert floodfilled image
```

```
    disease = cv2.bitwise_not(im_floodfill)
    #cv2.imshow('Disease', disease)

    # Combine the two images to get the foreground.
    wholeLeaf = binImg | disease

    cv2.bitwise_and(wholeLeaf, wholeLeaf, mask=inv)



    return wholeLeaf, disease

def NormalizeImg(img):
    # Read the image
    #img = cv2.imread('image.jpg')

    # Get the EXIF metadata
    #exif = cv2.getEXIFData(img)
    #cv2.normalize(img, img,)

    ## Get the aperture and ISO
    #aperture = exif.get('ApertureValue')
    #iso = exif.get('ISOSpeedRatings')

    ## Print the aperture and ISO
    #print('Aperture:', aperture)
    #print('ISO:', iso)

    normalizedimage = cv2.normalize(img, img, 0, 100, cv2.NORM_MINMAX)
    return normalizedimage

def main(cam = False, keyInt = False):
    curpath = os.getcwd()
    #print(curpath)
```

```
folderName = '/Result/'
resultPath = curpath + folderName
print(resultPath)

if os.path.exists(resultPath) == False:
    print('Folder created')
    os.mkdir(folderName)
else:
    print('Folder present')

root = tk.Tk()
root.withdraw()

if cam == True:
    img = WebcamModule.getImg()
else:
     # Open file dialog, get file path
    file_path = filedialog.askopenfilename()
    if not file_path:
        return -1
    # From file path read image
    img = cv2.imread(file_path)



img = cv2.resize(img, (480, 240), interpolation = cv2.INTER_LINEAR)
white = [255,255,255]     #---Color of the border---
# Draw border around image
img =
cv2.copyMakeBorder(img,10,10,10,10,cv2.BORDER_CONSTANT,value=white )
#cv2.imshow('Orig Img', img)
# Save image
cv2.imwrite(resultPath + 'Orig_Img.jpg', img)
```

```
    img = NormalizeImg(img)

    #cv2.imshow('Norm Img', img)

    # Make a Copy original image
    origImg = img.copy()

    # Detect color of leaf & creaet leaf mask
    final = LeafDetection(img)

    # Detect disease area & create mask
    leaf, dis = FindDiseaseArea(final)

    #cv2.imshow('Leaf Mask', leaf)
    cv2.imwrite(resultPath + 'Leaf_Mask.jpg', leaf)
    #cv2.imshow('Disease Mask', dis)
    cv2.imwrite(resultPath + 'Disease_Mask.jpg', dis)

    # Find contours in the leaf
    contoursLeaf = cv2.findContours(leaf, cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)[0]
    # Draw the contours on the image
    cv2.drawContours(img, contoursLeaf, -1, (255, 255, 0), 2)

    # Find contours in the disease
    contoursDis = cv2.findContours(dis, cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)[0]
    # Draw the contours on the image
    cv2.drawContours(img, contoursDis, -1, (0, 0, 255), 2)
    #cv2.imshow('Contours', img)
    cv2.imwrite(resultPath + 'Contours.jpg', img)

    # Calculate the area of the mask
```

```
    leafArea = np.sum(leaf == 255)
    disArea = np.sum(dis == 255)

    disPer = disArea / leafArea * 100

    print(f"Total leaf area: {leafArea}\nDisease area: {disArea}\nPercent Disease:
{disPer}%")

    imgStack = utlis.stackImages(0.6, ([origImg, img], [leaf, dis]))
    cv2.imshow("Plant Disease Detection", imgStack)

    cv2.imwrite(resultPath + 'Final_Result.jpg', imgStack)
    '''
    plt.imshow(imgStack)
    plt.title('Final Output')
    plt.axis('off')
    plt.show()
    '''



    if disPer > 0:
        print('************ Disease Detected!! ************')
    else:
        print('************ No Disease ************')

    if keyInt == True:
        # if keyboard interrupt required
        key = 0
        while key != 27:            # wait for escape key
            key = cv2.waitKey(1)

            if(key == 27):
                break
```

```
    else:
        key = cv2.waitKey(2000)

    return disPer

if __name__ == '__main__':
    server_socket, serverIp = srv.listnerStartSocket(host, port)
    print("Server Ip: ", serverIp)
    print(f"Listening for connections on {host}:{port}...")

    while True:
        client_socket, client_address = srv.listnerAcceptConnection(server_socket)

        while True:
            data = srv.listnerRecData(client_socket)
            if not data:
                    break # Exit loop if no data is received

            cmd, hdr = srv.listnerParsInputHeader(data)

            cmd2 = str(cmd)

            print("Commad:", cmd2)

            if cmd2.find('State=F') > 0:
                print("Robot Forward")
                robo.stop(0.5)
                robo.forward()                    # Forward
            if cmd2.find('State=S') > 0:
                print("Robot Stop")
                robo.stop()

            if cmd2.find('State=W') > 0:
```

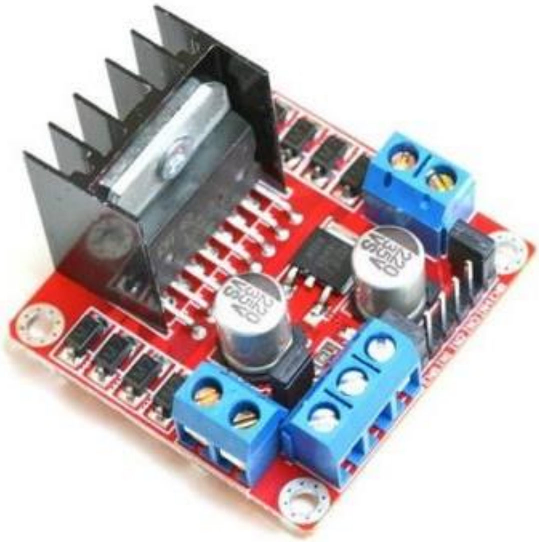
```
    print("Detect command")
    robo.stop(0.5)
    dis = main(True, False)                 # Camera = True, Wait for key = Flase
    if dis > 0:
      print("Starting spray")
      motor_on()
      sleep(3)
      print("Spray off")
      motor_off()

if cmd2.find('State=V') > 0:
    print("Detect command")
    robo.stop(0.5)
    dis = main(False, False)                # Camera = False, Wait for key = Flase
    if dis > 0:
      print("Starting spray")
      motor_on()
      sleep(3)
      print("Spray off")
      motor_off()

if cmd2.find('State=B') > 0:
    print("Robot Backward")
    robo.stop(0.5)
    robo.backward()             # Backward
if cmd2.find('State=L') > 0:
    print("Robot Left")
    robo.left()                 # Left
if cmd2.find('State=R') > 0:
    print("Robot Right")
    robo.right()        # Right

client_socket.send("Received data..\n".encode())
```

ANNEXURE

13 ANNEXURE

1. L298N Dual H-Bridge Motor Driver

This dual bidirectional motor driver, is based on the very popular L298 Dual H-Bridge Motor Driver Integrated Circuit. The circuit will allow you to easily and independently control two motors of up to 2A each in both directions.It is ideal for robotic applications and well suited forconnection to a microcontroller requiring just a couple of control lines per motor. It can also be interfaced with simple manual switches, TTL logic gates, relays, etc. This board equipped with power LED indicators, on-board +5V regulator and protection diodes.



SKU: MDU-1049

Brief Data:

- Input Voltage: 3.2V~40Vdc.
- Driver: L298N Dual H Bridge DC Motor Driver
- Power Supply: DC 5 V - 35 V
- Peak current: 2 Amp
- Operating current range: 0 ~ 36mA
- Control signal input voltage range :

Low: -0.3V ≤ Vin ≤ 1.5V.High: 2.3V ≤ Vin ≤ Vss.

• Enable signal input voltage range:

Low: -0.3 ≤ Vin ≤ 1.5V (control signal is invalid).High: 2.3V ≤ Vin ≤ Vss (control signal active).

• Maximum power consumption: 20W (when the temperature T = 75 ℃).

• Storage temperature: -25 ℃ ~ +130 ℃.

• On-board +5V regulated Output supply (supply to controller board i.e. Arduino).

• Size: 3.4cm x 4.3cm x 2.7cm

Figure : Schematic Diagram of L298N Motor Driver

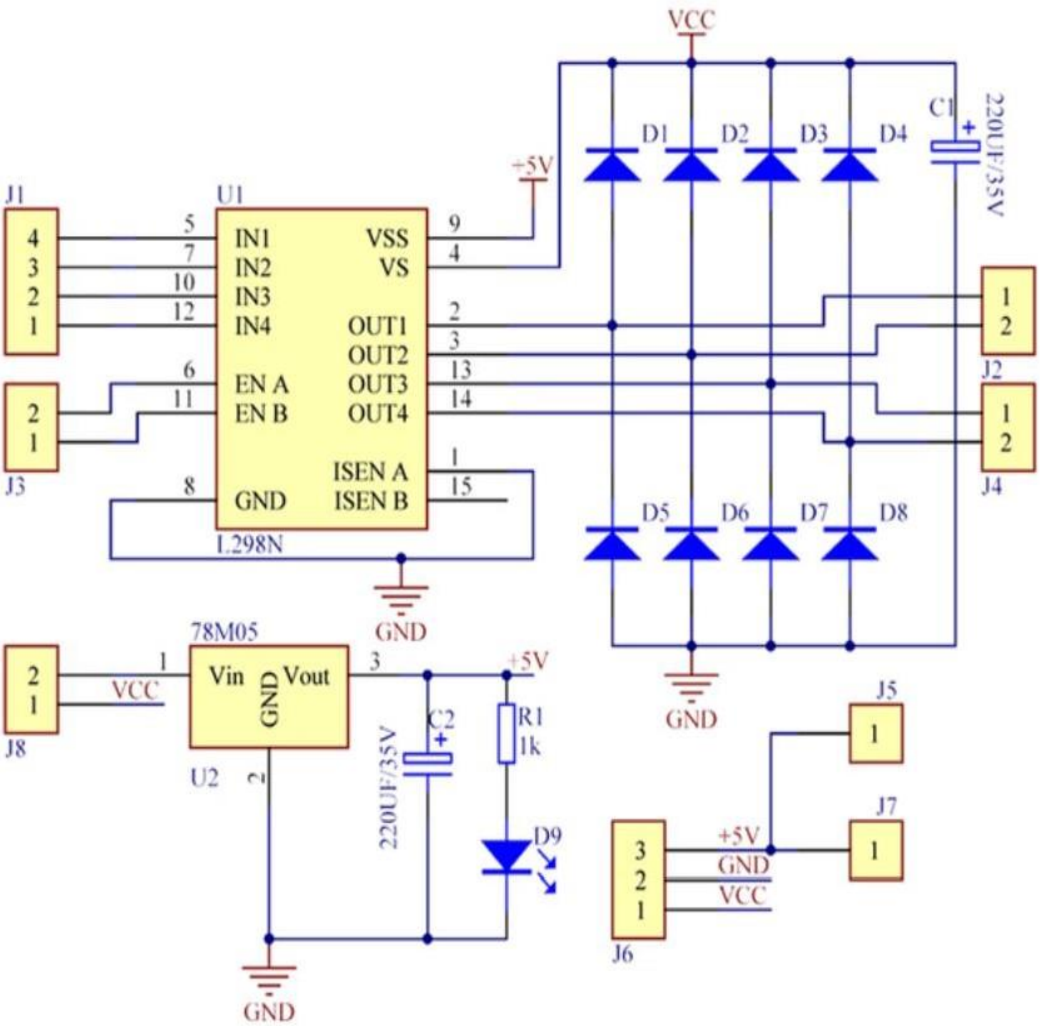


Figure : Board Dimension & Pins Function of L298N Motor Driver

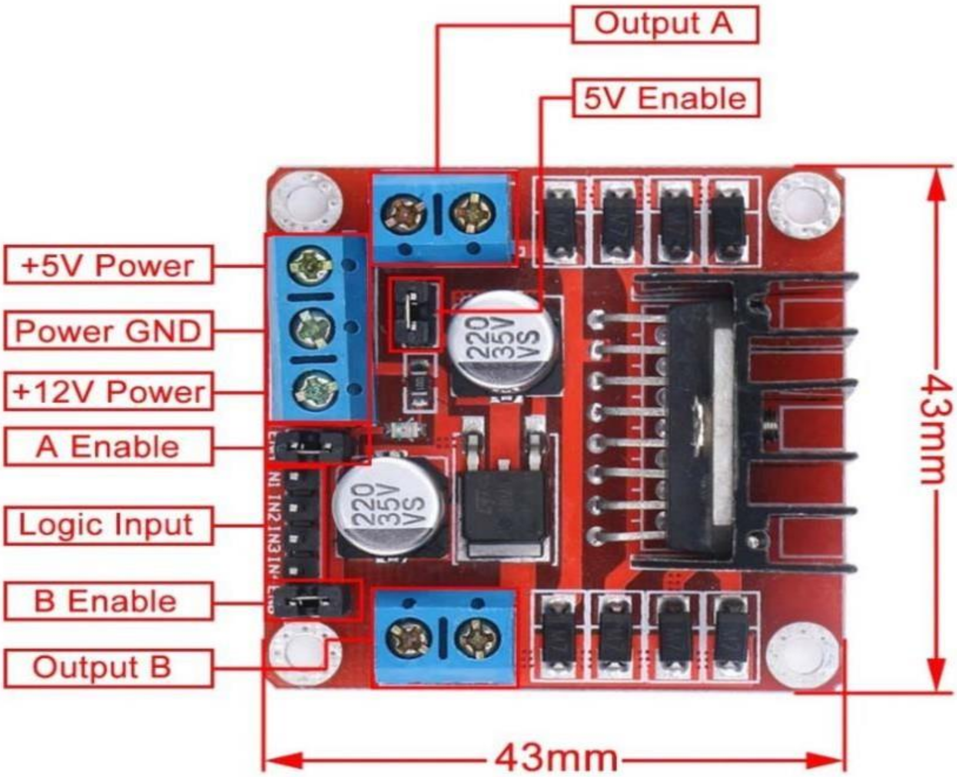


Figure : L298N Motor Driver Pins

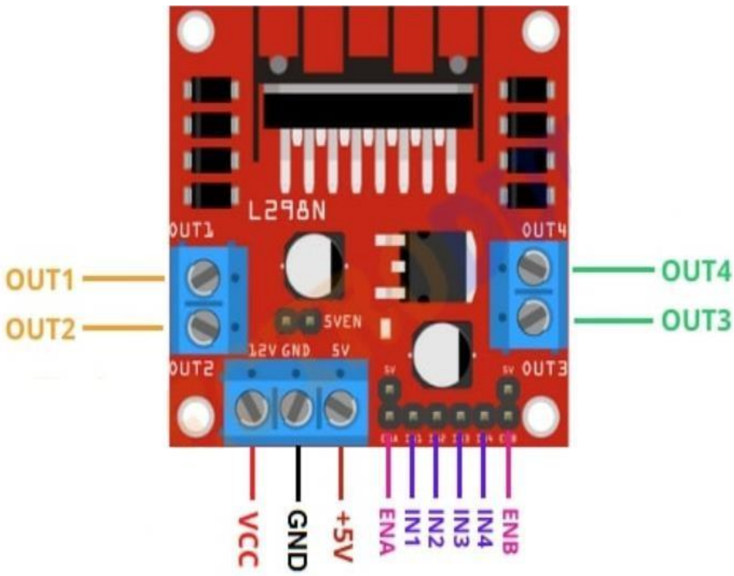


Table : **L298N Motor Driver**

Table : **Power Supply Pins of L298N Motor Driver**

Pin no.	Pin Name	Description
1	VCC	VCC pin is used to supply power to the motor. Its input voltage is between 5 to 35V.
2	GND	GND is a ground pin. It needs to be connected to the power supply ground(negative).
3	+5V	+5V pin supplies power for the switching logic circuitry inside the L298N IC. If the 5V-EN jumper is in place, this pin acts as output and can be used to power up a microcontroller or other circuitry (sensor). If the 5V-EN jumper is removed, you need to connect it to the 5V power supply of the microcontroller.

Table : **Control pins of L298N Motor Driver**

Pin no.	Pin Name	Description
1 & 2	IN1 &IN2	These pins are input pins of **Motor A**. These are used to control the rotating direction of Motor A. When one of them is HIGH and the other is LOW, Motor A will start rotating in a particular direction. If both the inputs are either HIGH or LOW the Motor A will stop.
3	IN3	These pins are input pins of **Motor B**. These are
4	IN4	used to control the rotating direction of Motor A. When one of them is HIGH and the other is LOW, Motor A will start rotating in a particular direction. If both the inputs are either HIGH or LOW the Motor A will stop.

Table : **Speed Control Pins of L298N Motor Driver**

Pin no.	Pin Name	Description
1	ENA	ENA pin is used to control the speed of **Motor A**. If a jumper is present on this pin, so the pin connected to +5 V and the motor will be enabled, then the Motor A rotates maximum speed. if we remove the jumper, we need to connect this pin to a PWM input of the microcontroller. In that way, we can control the speed of Motor A. If we connect this pin to Ground the Motor A will be disabled.
2	ENB	ENB pin is used to control the speed of **Motor B**. If a jumper is present on this pin, so the pin connected to +5 V and the motor will be enabled, then the Motor B rotates maximum speed. if we remove the jumper, we need to connect this pin to a PWM input of the microcontroller. In that way, we can control the speed of Motor B. If we connect this pin to Ground the Motor B will be disabled.

Table : **Output Pins of L298N Motor Driver**

Pin no.	Pin Name	Description
1	OUT1 and OUT2	This terminal block will provide the output for **Motor A**.
2	OUT3 and OUT4	This terminal block will provide the output for **Motor B**.

How Motor Driver Module Works

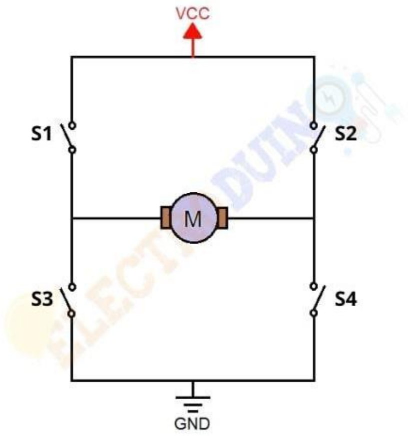
This module uses two techniques for the control speed and rotation direction of the DC motors.These are H-Bridge – For controlling rotation direction and PWM – For controlling the speed.

H-Bridge Techniques

L298n motor driver module uses the H-Bridge technique to control the direction of rotation of a DC motor. In this technique, H-Bridge controlled DC motor rotating direction by changing the polarityof its input voltage.
An H-Bridge circuit contains four switching elements, like transistors (BJT or MOSFET), with the motor at the center forming an H-like configuration. Input **IN1, IN2, IN3, and IN4** pins actually control the **switches** of the H-Bridge circuit inside L298N IC. We can change the direction of the current flow by activating two particular switches at the same time, this way we can change the rotation direction of the motor.

Case 1

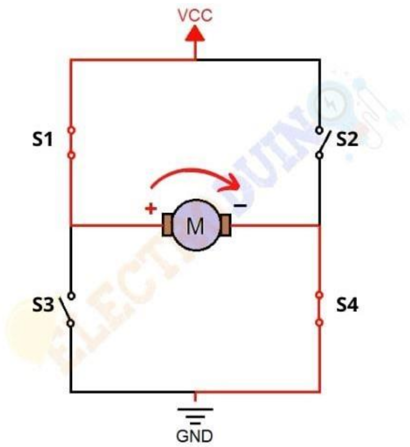
When S1, S2, S3, and S4 all switches are open then no current goes to the Motor terminals. So, inthis condition, the motor is stopped (not working).



L298N Motor Driver Module Working of H-Bridge Case 1

Case 2

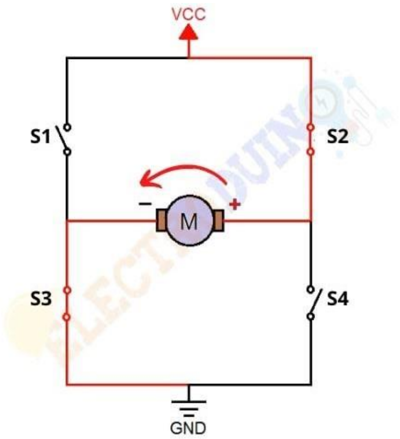
When the switch S1 and S4 are closed, then the motor left terminal is getting a positive (+) voltage and the motor right terminal is getting a negative(-) voltage. So, in this condition motor start rotating in a particular direction (clockwise).



L298N Motor Driver Module Working of H-Bridge Case 2

Case 3

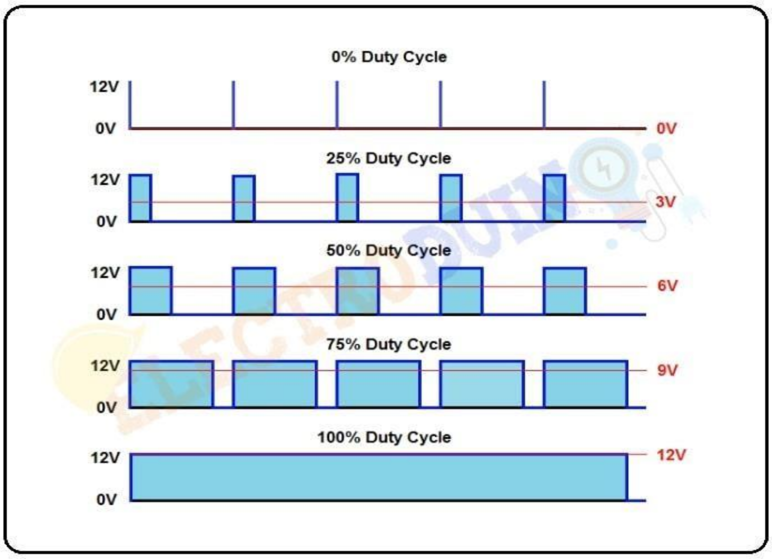
When S2 and S3 switches are closed, then the right motor terminal is getting a positive (+) voltage and the left motor terminal is getting a negative (-) voltage. So, in this condition motor start rotating in a particular direction (anticlockwise).



L298N Motor Driver Module Working of H-Bridge Case 3

<u>PWM (Pulse Width Modulation) Techniques</u>

L298n motor driver module uses the PWM technique to control the speed of rotation of a DC motor. In this technique, the speed of a DC motor can be controlled by changing its input voltage. Pulse Width Modulation is a technique where the average value of the input voltage is adjusted by sending a series of ON-OFF pulses. The average voltage is proportional to the width of the pulses, these pulses known as Duty Cycle. If the duty cycle higher, then the average voltage is applied to the DCmotor (High Speed), and the lower the duty cycle, the less the average voltage being applied to thedc motor(Low Speed).

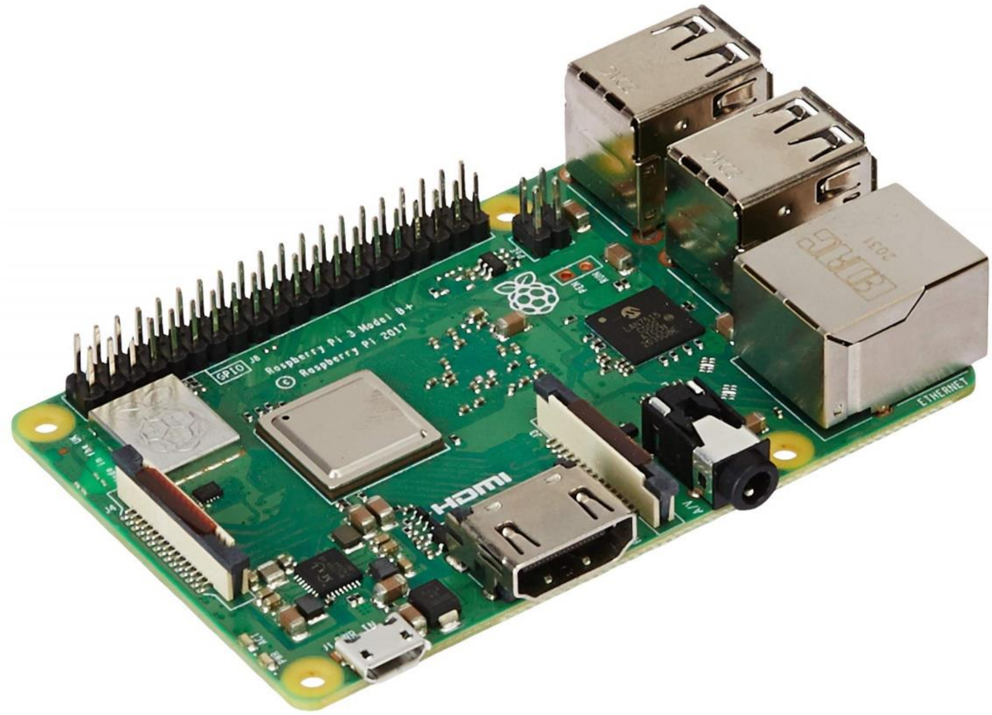


L298N Motor Driver Module Pulse Width Modulation (PWM) technique

Applications

- Control DC motors.
- Control stepping motors
- In Robotics

2. Raspberry Pi 3B+



Raspberry Pi (/paɪ/) is a series of small single-board computers (SBCs) developed in the United Kingdom by the Raspberry Pi Foundation in association with Broadcom. Since 2013, Raspberry Pi devices have been developed and supported by a subsidiary of the Raspberry Pi Foundation, now named Raspberry Pi Ltd.[3] The Raspberry Pi project originally leaned toward the promotion of teaching basic computer science in schools.[4][5][6] The original model became more popular than anticipated,[7] selling outside its target market for diverse uses such as robotics, home and industrial automation, and by computer and electronic hobbyists, because of its low cost, modularity, open design, and its adoption of the HDMI and USB standards.

Raspberry Pi 3 Model B+ has a 64-bit quad-core processor running at 1.4GHz, dual-band 2.4GHz and 5GHz wireless LAN, Bluetooth 4.2/BLE, Gigabit Ethernet over USB 2.0, and PoE capability via a separate PoE HAT. The dual-band wireless LAN comes with modular compliance certification. Raspberry Pi 3 Model B+ maintains the same mechanical footprint as both Raspberry Pi 2 Model B and Raspberry Pi 3 Model B.

Specification

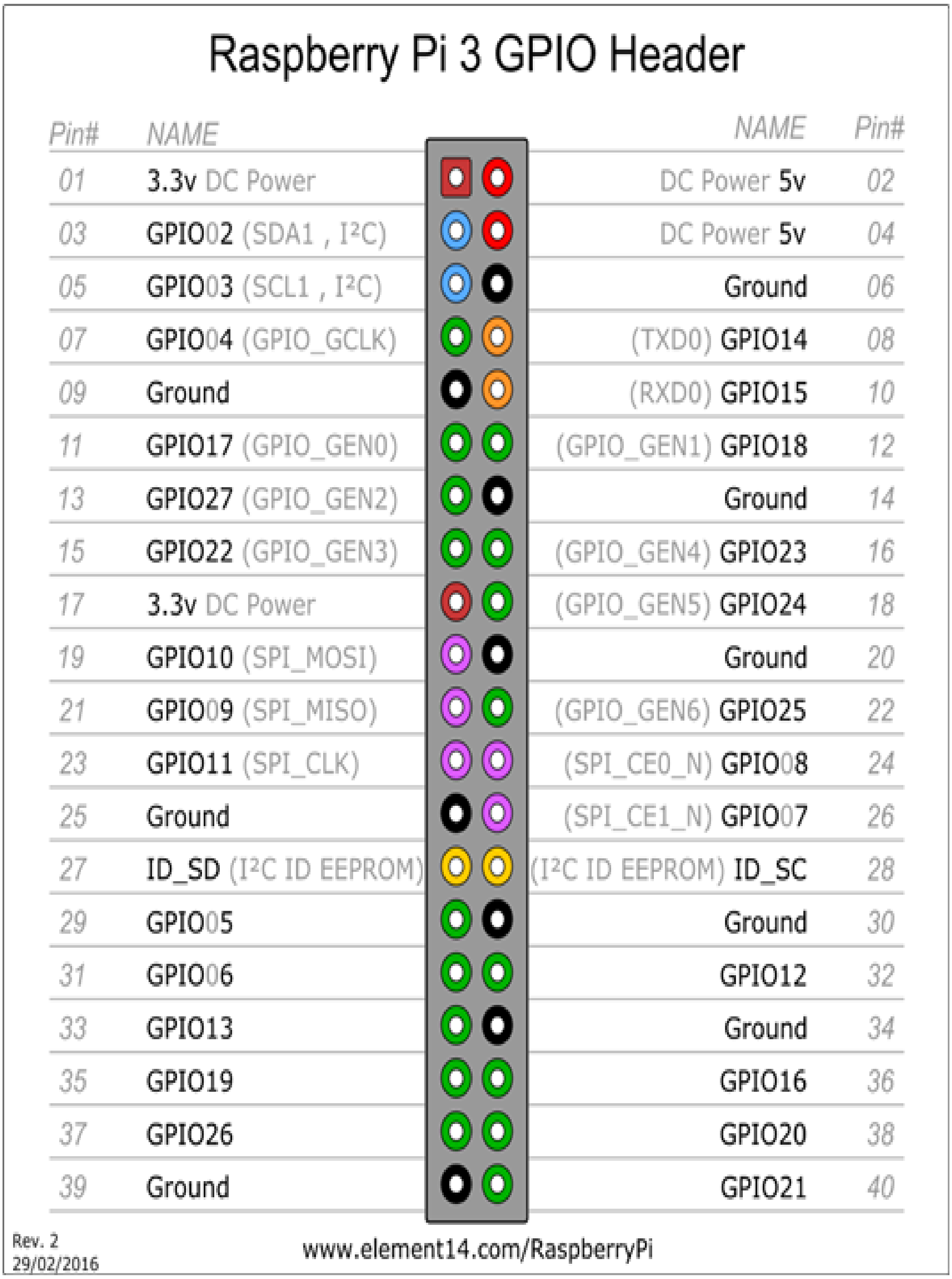
Processor:	Broadcom BCM2837B0, Cortex-A53 64-bit SoC @ 1.4GHz
Memory:	1GB
Connectivity:	• 2.4 GHz and 5 GHz IEEE 802.11b/g/n/ac wireless LAN, Bluetooth 4.2, BLE • Gigabit Ethernet over USB 2.0 (maximum throughput 300Mbps) • 4 × USB 2.0 interface
Video and sound:	• 1 x full size HDMI • MIPI DSI display port • MIPI CSI camera port • 4 pole stereo output and composite video port
Multimedia:	H.264, MPEG-4 decode (1080p30); H.264 encode (1080p30); OpenGL ES 1.1, 2.0 graphics
SD card support:	Micro SD format for loading operating system and data storage
Input Power:	• 5V/2.5A DC via micro USB connector • 5V DC via GPIO header • Power over Ethernet (PoE)-enabled (requires separate PoE HAT)
Operating temperature:	0-50°C

Raspberry Pi 3 B+ Pinout Chart

A Raspberry Pi Pinout Chart is an unengaged digital signal pin on a Pi circuit board that may be used as an input, output, or both and is controllable by software. The Raspberry Pi 3 Model B+ has 40 GPIO (general-purpose input/output) pins that can connect the Raspberry Pi to other electronic components and devices. The pinout of the Raspberry Pi 3 Model B+ is shown below:

1. 3.3V Power
2. 5V Power
3. Ground
4. Ground
5. Ground
6. Ground
7. GPIO4
8. UART0 TXD
9. Ground
10. UART0 RXD
11. GPIO17
12. GPIO18
13. GPIO27
14. Ground
15. GPIO22
16. GPIO23

17. 3.3V Power
18. GPIO24
19. GPIO10
20. Ground
21. GPIO9
22. GPIO25
23. GPIO11
24. GPIO8
25. Ground
26. GPIO7
27. ID_SD
28. ID_SC
29. GPIO5
30. Ground
31. GPIO6
32. GPIO12
33. GPIO13
34. Ground
35. GPIO19
36. GPIO16
37. GPIO26
38. GPIO20
39. Ground
40. GPIO21


Raspberry Pi 3 GPIO Header

Pin#	NAME	NAME	Pin#
01	3.3v DC Power	DC Power 5v	02
03	GPIO02 (SDA1 , I²C)	DC Power 5v	04
05	GPIO03 (SCL1 , I²C)	Ground	06
07	GPIO04 (GPIO_GCLK)	(TXD0) GPIO14	08
09	Ground	(RXD0) GPIO15	10
11	GPIO17 (GPIO_GEN0)	(GPIO_GEN1) GPIO18	12
13	GPIO27 (GPIO_GEN2)	Ground	14
15	GPIO22 (GPIO_GEN3)	(GPIO_GEN4) GPIO23	16
17	3.3v DC Power	(GPIO_GEN5) GPIO24	18
19	GPIO10 (SPI_MOSI)	Ground	20
21	GPIO09 (SPI_MISO)	(GPIO_GEN6) GPIO25	22
23	GPIO11 (SPI_CLK)	(SPI_CE0_N) GPIO08	24
25	Ground	(SPI_CE1_N) GPIO07	26
27	ID_SD (I²C ID EEPROM)	(I²C ID EEPROM) ID_SC	28
29	GPIO05	Ground	30
31	GPIO06	GPIO12	32
33	GPIO13	Ground	34
35	GPIO19	GPIO16	36
37	GPIO26	GPIO20	38
39	Ground	GPIO21	40

Rev. 2
29/02/2016
www.element14.com/RaspberryPi

Raspberry Pi 3 B+ Power Pins:

The Raspberry Pi 3 B+ has 40 pins, including power pins, GPIO pins, and other pins for various purposes. The power pins on the Raspberry Pi 3 B+ are as follows:

- Pin 2 (5V): This pin supplies 5V power to the Raspberry Pi.
- Pin 4 (5V): This pin also provides 5V of power to the Raspberry Pi.
- Pin 6 (GND): This pin is the ground pin, and it is used to complete the circuit and provide a reference voltage for the Raspberry Pi.
- Pin 14 (GND): This is another ground pin on the Raspberry Pi.

It is important to note that the Raspberry Pi 3 B+ can be powered using either the 5V power pins (pins 2 and 4) or the micro-USB port (labeled "PWR IN" on the board). The micro-USB port provides a maximum current of 2.5A, while the 5V power pins can provide up to 3A of current. It is recommended to use a power supply that can provide at least 2.5A of current to ensure the stable operation of the Raspberry Pi.

PWM (pulse-width modulation) Pins on Raspberry Pi Model 3B+

The Raspberry Pi Model 3B+ has a total of 26 GPIO (general-purpose input/output) pins, of which 2 pins (GPIO 18 and GPIO 19) can be used for pulse-width modulation (PWM) output. These pins are marked with a dot in the pin numbering diagram and can be used to control the brightness of LEDs, the speed of motors, or the direction of a servo motor, for example.

PWM is a technique for getting analog results with digital means by quickly switching a digital signal on and off. The duty cycle of the signal determines the amount of time that the signal is on versus off, and this determines the average value of the signal, which can be used to control the brightness of an LED or the speed of a motor, for example.

SPI Pins on Raspberry Pi Model 3B+

Some of GPIO (general-purpose input/output) pins are designated as SPI (serial peripheral interface) pins, which can be used for communication with SPI devices.

The specific pins that are designated as SPI pins on the Raspberry Pi 3B+ are as follows:

- Pin 19 (MOSI)
- Pin 21 (MISO)
- Pin 23 (SCLK)
- Pin 24 (CE0)
- Pin 26 (CE1)

These pins can connect the Raspberry Pi to SPI devices, such as sensors, displays, and other peripherals. In addition to these pins, the Raspberry Pi also has a dedicated EEPROM (electrically erasable programmable read-only memory) pin, which is used to store the device’s bootloader. This pin is designated as Pin 27.

I2C Pins on Raspberry Pi 3B+

The Raspberry Pi 3B+ has two I2C pins (SDA and SCL) that can communicate with I2C devices. These pins are usually located on the bottom right of the board, near the HDMI port. In most cases, you can use these pins as they are without any additional wiring.

However, if you need to use multiple I2C devices with the Raspberry Pi, you may need to use a level shifter or other means of electrically connecting the devices to the I2C pins. You can also use software-based I2C interfaces, which are generally less reliable and not recommended for most applications.

UART Pins on R-Pi 3B+

The Raspberry Pi 3B+ has 40 pins, including 26 GPIO pins. The pins used for UART are GPIO 14 (TX) and GPIO 15 (RX). These pins are used to transmit and receive data, respectively. They can be used to connect the Raspberry Pi to other devices using a serial communication protocol.

The Processor of _Raspberry Pi 4:

Pi has a more powerful quad-core Cortex-A72 64-bit CPU running at 1.5GHz and Broadcom VideoCore VI GPU running at 0.5GHz. It can handle 4k videos, H.265 encoding 2 HDMI outputs. It has a fully functional Gigabit Ethernet interface and USB 3.0 port.

RAM Memory:

The new Raspberry Pi 3 comes with an option of 2GB, 4GB, and 8GB of RAM options. It has LPDDR4 RAM. Also, you get a heat sink for the RAM chip as it gets hot while operating.

Ethernet Controller:

This Pi board has a Broadcom BCM54213 Gigabit ethernet controller. It falls to a slower speed if the network speed is slow.

- Software-driven router
- Media server
- A bridge between Wi-Fi and Ethernet networks

USB Controller:

VL805 chip is the USB port controller for Raspberry Pi 3. The Pi has 2 x USB 3.0 and 2 x USB 2.0 ports. VL805 chip is a USB 3.0 Host controller. it allows the PCI Express platform to interface with USB Super-Speed (5 Gbps), High-Speed (480 Mbps), Full-Speed (12 Mbps), and Low-Speed (1.5 Mbps) devices. The root hub is consists of four downstream facing ports, it enables simultaneous operation of multiple peripheral devices.

Power Circuitry:

The Pi3 uses the MXL7704 it was developed specifically for Raspberry. This chip reduced the complexity of the Pi board and also delivers more power to all the peripheral to run at more power. Due to this chip cost of the board has also been reduced as the number of components has been reduced.

3. Raspberry Pi Camera Module

There are now several official Raspberry Pi camera modules. The original 5-megapixel model was released in 2013, it was followed by an 8-megapixel Camera Module 2 which was released in 2016. The latest camera model is the 12-megapixel Camera Module 3 which was released in 2023. The original 5MP device is no longer available from Raspberry Pi.

All of these cameras come in visible light and infrared versions, while the Camera Module 3 also comes as a standard or wide FoV model for a total of four different variants.

Features-

- 8MP SONY IMX219 image sensor
- Wider image, capable of 3280x2464 stills, 1080p30 video and so forth
- Small and light
- Fixed focus lens on-board
- Integral with IR (infrared) filter
- 150mm CSI camera cable included
- 8-megapixel native resolution sensor-capable of 3280 x 2464 pixel static images
- Supports 1080p30, 720p60 and 640x480p90 video
- Size 25mm x 23mm x 9mm
- Weight just over 3g
- Connects to the Raspberry Pi board via a short ribbon cable (supplied)
- Camera V2 is supported in the latest version of Raspbian, Raspberry Pi's preferred operating system

Pin Description

Pin Number	**Pin Name**	**Description**
1	Ground	System Ground

2,3	CAM1_DN0, CAM1_DP0	MIPI Data Positive and MIPI Data Negative for data lane 0
4	Ground	System Ground
5,6	CAM1_DN1, CAM1_DP1	MIPI Data Positive and MIPI Data Negative for data lane 1
7	Ground	System Ground
8,9	CAM1_CN, CAM1_CP	These pins provide the clock pulses for MIPI data lanes
10	Ground	System Ground
11	CAM_GPIO	GPIO pin used optionally
12	CAM_CLK	Optional clock pin
13,14	SCL0, SDA0	Used for I2C communication
15	+3.3V	Power pin

Raspberry Pi Camera Module Camparison :

	Camera Module v1	Camera Module v2	Camera Module 3	Camera Module 3 Wide	HQ Camera
Net price	$25	$25	$25	$35	$50
Size	Around 25 × 24 × 9 mm	Around 25 × 24 × 9 mm	Around 25 × 24 × 11.5 mm	Around 25 × 24 × 12.4 mm	38 x 38 x 18.4mm (excluding lens)
Weight	3g	3g	4g	4g	
Still resolution	5 Megapixels	8 Megapixels	11.9 Megapixels	11.9 Megapixels	12.3 Megapixels
Video modes	1080p30, 720p60 and 640 × 480p60/90	1080p47, 1640 × 1232p41 and 640 × 480p206	1080p50 / 720p100 / 640 x 480p120	1080p50 / 720p100 / 640 x 480p120	2028 × 1080p50, 2028 × 1520p40 and 1332 × 990p120
Sensor	OmniVision OV5647	Sony IMX219	Sony IMX708	Sony IMX708	Sony IMX477]
Sensor resolution	2592 × 1944 pixels	3280 × 2464 pixels	4608 x 2592 pixels	4608 x 2592 pixels	4056 x 3040 pixels
Sensor image area	3.76 × 2.74 mm	3.68 x 2.76 mm (4.6 mm diagonal)	6.45 x 3.63mm (7.4mm diagonal)	6.45 x 3.63mm (7.4mm diagonal)	6.287mm x 4.712 mm (7.9mm diagonal)
Pixel size	1.4 µm × 1.4 µm	1.12 µm x 1.12 µm	1.4 µm x 1.4 µm	1.4 µm x 1.4 µm	1.55 µm x 1.55 µm
Optical size	1/4"	1/4"	1/2.43"	1/2.43"	1/2.3"
Focus	Fixed	Adjustable	Motorized	Motorized	Adjustable
Depth of field	Approx 1 m to ∞	Approx 10 cm to ∞	Approx 10 cm to ∞	Approx 5 cm to ∞	N/A
Focal length	3.60 mm +/- 0.01	3.04 mm	4.74 mm	2.75 mmm	Depends on lens
Horizontal Field of View (FoV)	53.50 +/- 0.13 degrees	62.2 degrees	66 degrees	102 degrees	Depends on lens
Vertical Field of View (FoV)	41.41 +/- 0.11 degrees	48.8 degrees	41 degrees	67 degrees	Depends on lens
Focal ratio (F-Stop)	F2.9	F2.0	F1.8	F2.2	Depends on lens
Maximum exposure times (seconds)	6	11.76	112	112	670.74
Lens Mount	N/A	N/A	N/A	N/A	CS- or M12-mount

PAPER PUBLICATION RESEARCH AND CERTIFICATE

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III. METHODOLOGY

The following steps are given to explain the methodology of the project:

STEP 1
1) A Model which moves around the crop field.
2) Take the images of plants and leafs.

STEP 2
1) With the help of CNN and Machine learning disease will Detect.
2) The initial stage of the algorithms involves distinguishing between healthy and diseased crops, whereas the subsequent task involves determining the type of crop disease.

The steps in image processing:
1) Input Image
2) Image Pre-processing
3) Image segmentation
4) Feature extraction
5) Detection of disease

STEP 3
1) After disease detection, the accurate pesticide will be sprayed on the leaf.
2) The bot will sprays the pesticide on the diseased Plant or that particular leaf too.

IV. LIVE STREAMING

Our special farming robot is helping farmers work faster and more accurately. It uses a small computer called Arduino to control everything. This robot can do a few important jobs: it watches live video, sprays pesticides, and moves around the farm by itself. Live streaming allows farmers or agricultural experts to monitor the disease leaf detection and spraying process in real-time. They can observe the robot's operation remotely, enabling them to intervene or make adjustments if necessary. integrating live streaming capabilities into disease leaf detection and spraying robots enhances efficiency, effectiveness, and accountability in agricultural practices. It facilitates real-time monitoring, troubleshooting, training, and data-driven decision-making, ultimately contributing to improved crop health and productivity.

Here's how it works:
1) Live Video: The robot has a camera that sends live video to the computer. The computer checks the video to see if there are any weeds or sick plants.
2) Pesticide Spraying: If the computer finds any weeds or sick plants, it tells the robot to spray pesticides on them to help them get better.
3) Moving Around: The robot knows where to go because Arduino tells it. It can move by itself and spray pesticides on all the plants that need it.
By using this robot, farmers can do their work more easily and make sure their crops stay healthy. It's like having a helper that takes care of the farm for them.

V. INPUTS FROM CAMERA

ORIGINAL IMAGE :

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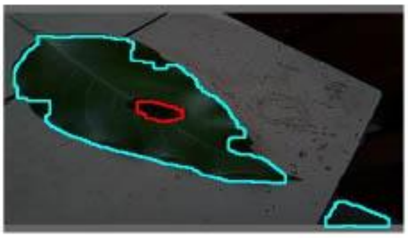
LEAF MASK

DISEASE MASK

DESEASE MASK WITH LEAF MASK :



FINAL RESULT OF DESEASE DETECTION :

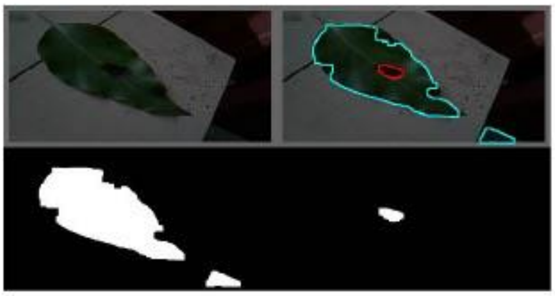


Fig -1: Live streaming block diagram

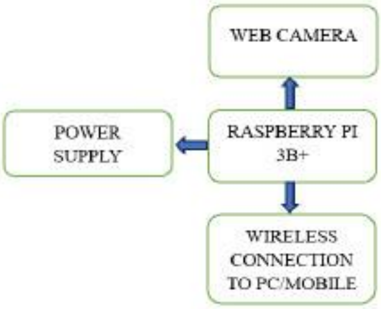


Figure 1 shows the live streaming block diagram. We used a raspberry pi 3B+ and an CAM module for computational processes. Overall, our raspberry pi -controlled agricultural robot represents a significant advancement in precision farming, offering a comprehensive solution to optimize pesticide application and improve crops yield while minimizing labor and environmental impact.

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VI. FLOW CHART OF SYSTEM

This flowchart represents a general overview of the image processing pipeline and may vary depending on the specific application or requirements. Each step in the process plays a crucial role in extracting meaningful information from the input image for various tasks such as object detection, recognition, or analysis. Image processing refers to the manipulation of digital images using algorithms and techniques to enhance, analyze, or extract information from the images. It involves converting an input image into a digital form and performing various operations on it to achieve desired results.

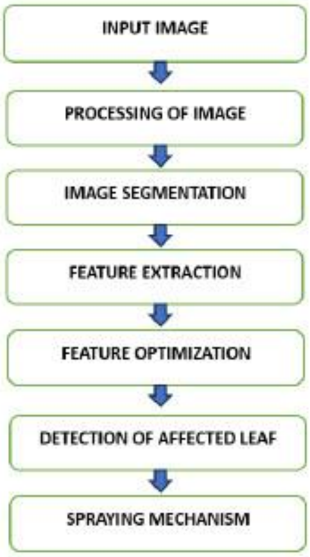
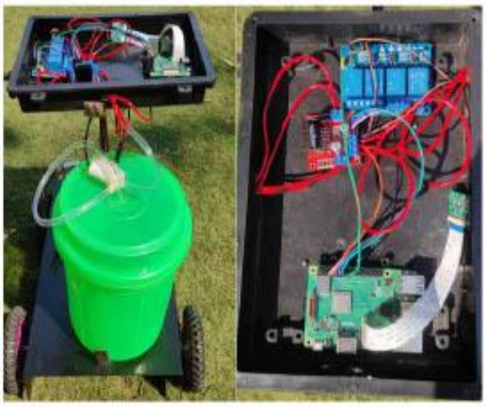


Fig -2: Flow chart of the system.

VII. HARDWARE PHOTOGRAPHS



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VIII. ADVANTAGES

Improved Efficiency: The robot can quickly scan crops for signs of disease, allowing for early detection and intervention.

Labor Savings: Farmers no longer need to manually inspect crops or apply treatments, saving time and labor costs.

Reduced Health Risks: Since the robot handles the spraying of chemicals, farmers are not exposed to potentially harmful substances, reducing health risks associated with traditional pesticide application methods.

Real-time Monitoring: The robot continuously monitors crop health and disease progression, providing farmers with valuable insights in real-time.

IX. CONCLUSIONS

We've made improvements to the robot farmers use, which can now work on controlled by a mobile app. This is important because farmers sometimes use too much fertilizer, and many farmers in India don't use technology much. Our new system focuses on finding weeds early using special technology that understands the types of weeds found in Indian fields. We've also made a special way for the robot to spray pesticides that saves money and is better for the environment. Instead of spraying everywhere, it only sprays where there are weeds, which is safer for farmers and the environment.
Incorporating a feedback loop to enhance disease detection and treatment decision-making, as well as connecting the robot to a cloud-based platform for instantaneous data exchange and examination, are our efforts to equip farmers with enhanced resources and knowledge to safeguard their crops and raise the general effectiveness of farming systems.
This new robot is easy to use, works in different types of fields, and is cheaper to maintain. It helps farmers grow crops better and makes farming safer for everyone.

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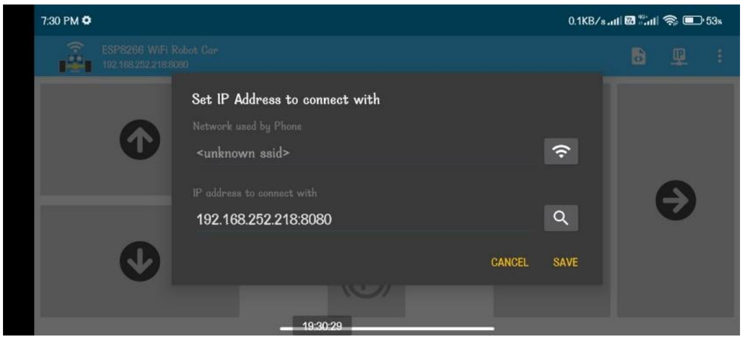
OPERATING MANUAL

15 OPERATING MANUAL

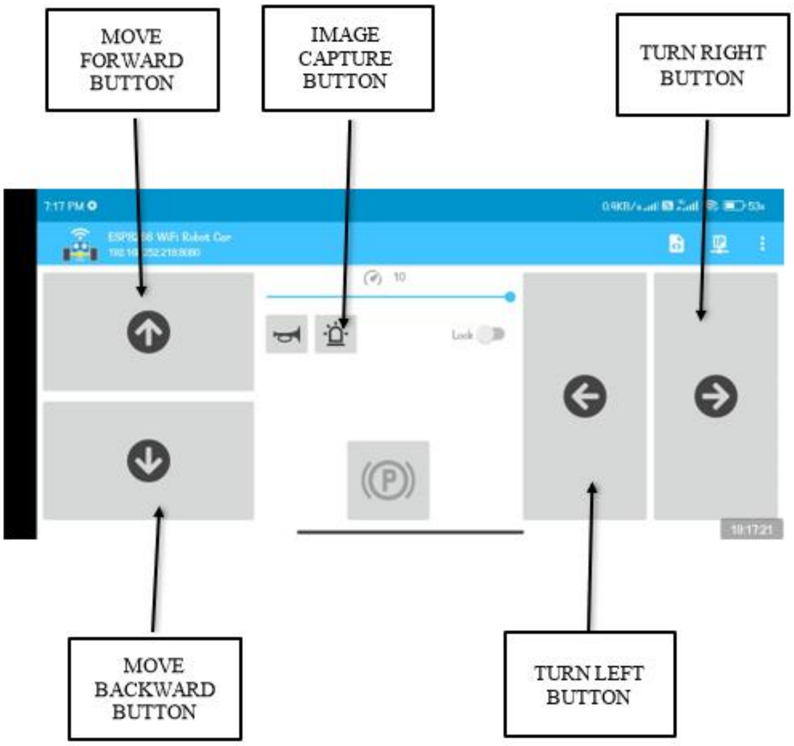
15.1 FEATURES OF AUTOMATED LEAF DISEASE DETECTION AND SPRAYING ROBOT:

- This robot simple and easy to use agricultural machine which can help farmers in long term vision.
- It is portable and easy to run in farms.
- It operates on mobile phones and form remote distance.
- It is small and easy to run in difficult parts of yields.
- Cost effect and affordable with compare of heavy machineries.
- Easy to learn and can be repaired in damaged.

15.2 APPLICATION INTERFACE



IP ADDRESS SETTING



MOBILE APPLICATION INTERFACE

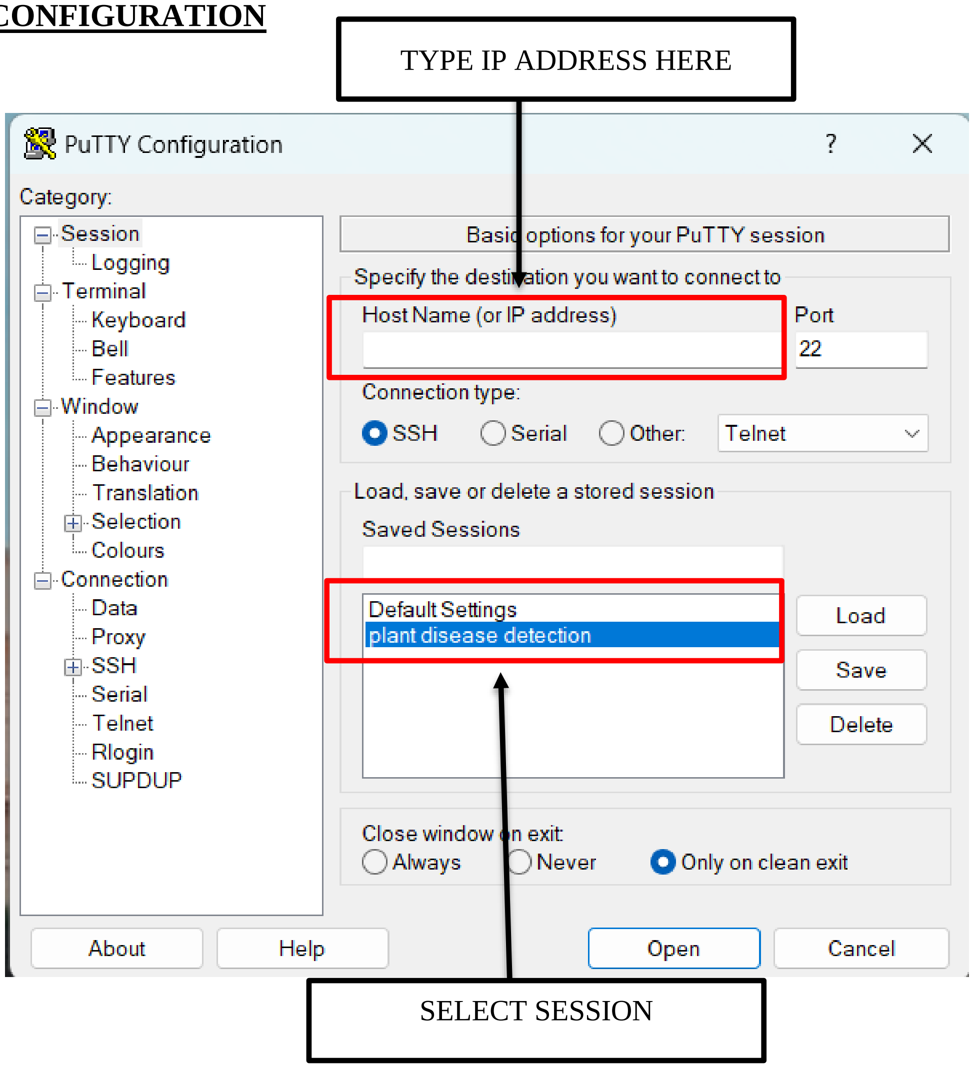
15.3 OPERATING PROCEDURE

- **Step 1:** Turn on the robot also activate the mobile hotspot and connect the PC to the hotspot.
- **Step2:** Open the application for movement of robot. Enter the mobile IP address into the setting.
- **Step 3:** On PC open the software named puTTY and Xming. These shows the command given by machine and, also processed images.
- **Step 4:** Make a movement of robot forward and backward as per requirement.

- **Step 5:** Take a image of plant leaves.

- **Step 6:** Software will process that image and command for the spraying or not spraying

SOFTWARE CONFIGURATION



COMMAND INTERFACE

GROUP PHOTO WITH GUIDE

16 GROUP PHOTO WITH GUIDE