Project Report

on

PESTICIDE SPRAYING ROBOT

Submitted to

Shri Ramdeobaba College of Engineering & Management, Nagpur

(An Autonomous Institute Affiliated to Rashtrasant Tukdoji Maharaj Nagpur University)

for partial fulfillment of the degree in

Bachelor of Engineering

(Information Technology)

Sixth Semester

by

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Nagpur-13

2021-22

CERTIFICATE

This is to certify that the Project Report on

"PESTICIDE SPRAYING ROBOT"

is a bonafide work and it is submitted to

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CONTENTS

ABSTRACT

Despite the emphasis on industrialization, agriculture remains the most important sector of the Indian economy, both in terms of GDP contribution and as a source of employment for millions of people across the country. Agriculture is extremely important to the Indian economy. More than 70% of rural households rely on agriculture as their primary source of income. However, pest infestations in crops are one of the key issues limiting agricultural production growth. The diagnosis of crop disease is critical in dealing with this type of problem. So, we'd like to present an engineering solution to address this challenge, in which an automatic pesticide sprayer is used to apply the pesticide to a specific area. This technique is based on a pesticide-filled sprayer. Sprayer movement is controlled by a slider that moves up and down according to plant height. The design includes two processing modules as well as automatic pesticide spraying. The proposed system can be controlled remotely using any electronic device, such as a mobile phone or a wireless solution. We are planning to make it fully automatic. Farmers will be able to solve their human resource difficulties with this clever approach.

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1. INTRODUCTION

Farming is done in India utilizing modern ways. It is even more irregular because most of our farmers lack proper comprehension. The forecasts are based on a significant portion of farming and agricultural operations, which occasionally fail. Farmers are often the victims of tremendous losses and the source of suicide. Given the benefits of optimum soil moisture and consistency, air quality, and irrigation in crop growth, these parameters cannot be overlooked. Agriculture is the primary source of revenue for India's population, which accounts for almost 60% of the country's total. Farmers work in their fields, cultivating various crops based on the environment and available resources. Farmers must use significant quantities of pesticides to increase food production in order to meet such high food demand for such a vast population. Other significant biological parameters such as pests and diseases affect crop yield, and these parameters can be controlled by humans to improve crop production. Farmers, on the other hand, must take numerous precautions when spraying pesticides, including wearing appropriate clothing, gloves, and masks. In such instances, the deployment of robots is a highly imminent technological solution that increases production and efficiency. Controlling pest infestation production is really important. Pest infestation is causing serious problems for farmers. Pests are unwanted insects or diseases that disrupt human activity by biting, destroying food plants, or making farming more difficult. Early detection and avoidance of pests is critical in crop management. Understanding pests and their habitats is necessary for effective pest control. Pesticides are currently being sprayed throughout farmers' fields. The main drawbacks of this practice are that the pesticide may come into contact with the farmer during spraying, potentially causing skin cancer and asthma. As pesticides penetrate the food chain, they may have an impact on consumer health. Pesticides are sometimes sprayed on crops that are not impacted, resulting in the same waste. To address the aforementioned issues, we developed an automated robotic system that can spray pesticides in limited quantities only when pests are detected. This not only protects the farmer from life-threatening illnesses and physical problems, but it also saves him money due to chemical restrictions. As a result, we developed a novel approach for crop monitoring and intelligent farming. We believe our concept will be a landmark in the agriculture because of its dependability and remote monitoring. Our idea is to digitalize agriculture and farming operations so that farmers can watch crop requirements and accurately forecast their development. Surely, this idea will help their company reach new heights and become more profitable. Our approach relies heavily on farmer awareness, which we believe will be easily developed due to its numerous benefits. As a result, it aids the economic development of farmers and, by extension, the nation. Using this type of robot, the time spent spraying pesticide liquid is reduced, and it will also assist farmers in reducing their workload in any season or condition.

1.1 Objective

The primary goals of this project are to design a mechanism for spraying and managing parameters such as spraying pace control, tank status monitoring, and to deliver a pesticide/fertilizer spraying tank on it that can travel across any type of terrain, change the height of spraying using liner traversing mechanisms, which will allow the advanced system to spray at various heights for various plants, and to sprinkle pesticides aerially. The robot aims to capture leaf image and scan it. It will detect where the leaf has disease or not and according to that it will send response to the server. Adding this feature in the robot will help to reduce unnecessary wastage of resources. GPS module will trace the path automatically so that there is no need of managing manually. By upgrading the spraying procedure, this system will save farmers time and money while also lowering labor costs. Our main aim is too reduce labor work and prevent the farmers from health issues.

1.2 Study of Problem Statement

The World Health Organization estimates that 3 million people are poisoned by pesticides each year, resulting in up to 220,000 fatalities, mostly in developing nations. Others may irritate the skin or eyes, while carbonates impair the nerve system. Some pesticides may cause cancer, while others may alter the body's hormone or endocrine system. Children, like other young and developing organisms, are particularly exposed to pesticides' negative effects. Even relatively low amounts of exposure during childhood can have negative health consequences. Memory loss, loss of coordination, reduced speed of response to stimuli, impaired visual capacity, altered or unpredictable mood and general behaviour, and reduced motor abilities are all possible side effects of pesticide exposure. This research aims to reduce the harmful effects of pesticides on humans (as compared to manual pesticide sprayers) and to cover bigger areas of land while spraying pesticides in a shorter amount of time. The workforce in a backpack sprayer must carry the entire weight of the pesticide-filled tank, which produces weariness and hence limits human capability. The engine-driven spraying equipment requires gasoline to run and function properly, which increases its operating costs and causes back pain due to vibration. The fertilizer is squandered in the aerial spraying approach, and it is not ideal for small farms. When fuel-powered cars are used, the exhaust fumes released by the Silencer or muffler cause a detrimental effect on crops, reducing crop productivity and endangering people.

CHAPTER 2

LITERATURE SURVEY

2. LITERATURE SURVEY

This chapter reviews recent research and developments in the subject of agricultural automation as described in the literature by various authors. The following is a brief summary of the study

2.1 ACCORDING TO [1], IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING

Adjustable Spraying Device(ASD) involves 4 basic steps which are directing the nozzle towards the face of the crop(that is perpendicular to the crop),capture the image of the plant using the ASD's Camera, find the target position of the crop and diameter required to spray the pesticide, for each target move the ASD to the particular location and open the sprayer electric valve for a specific pre-defined duration. It is based on a commercial spraying nozzle(AYHSS 16) using the pressure of near about 20 bar(recommended).The intensity of sprayer is controlled by using an electric nozzle and the spraying diameter can be controlled by rotating the nozzle cap over the nozzle spray which is done with the help of stepper motor. The entire device can rotate horizontally in both directions upto 180 degrees and vertically 31 degrees above and 80 degrees below. An experiment was conducted in order to evaluate the performance of the ASD while implementing the results of the previous experiment. To focus the evaluation on the spraying device only, the robotic sprayer is designed to perform the spraying task in step mode, the robot travels a single step along the vineyard row, stops, captures image from the field, sprays the targets, and moves another step forward. Hence, the spraying operation is performed while the robot is static (the operation of the ASD occurs only when the robotic platform is not moving). One of the secondary goals of this experiment was to provide insights into the overall work procedure of the complete spraying system, which will include the robot equipped with an ASD. The experiment included 12 repetitions of the robot traveling along the baseline and spraying the seven targets attached to the target base. Each target was sprayed for 2 seconds. All the experiments were conducted early morning. The measured wind speed was zero in all the experiments The results of the automatically adjustable spray diameter show a constant increase in the sprayed diameter with increase in target size; however, the ratio between the sprayed diameter and the target size decreases. This ratio can be addressed as the false detection ratio, and this ratio decreases with increase in the target size. The 150 mm diameter target was sprayed with a coverage diameter of ∼250 mm, whereas a 300 mm diameter target was sprayed with a coverage of ∼425 mm. Hence, the amount of material saved increases as the size of the target increases.

2.2 ACCORDING TO [2], IOP CONFERENCE SERIES: EARTH AND ENVIRONMENTAL SCIENCE

The aim of spraying test is to get droplet diameter, effective spraying width (ESW), effective spray debit (ESD), and water pump voltage at each nozzle. Spraying test was done by using a Patternator Electrical pump voltage was tested to determine the voltage needed to obtain a certain spray pressure. The type of nozzle and spray pressure to be used for pesticide spraying are determined based on the results of the knapsack sprayer test. It also used as basis for designing automatic control systems for spraying pesticide precisely on cabbage cultivation. The measurement of the droplet diameter was conducted by mixing the water and ink liquid with a ratio of 30 ml of ink and 1000 ml of water which is sprayed onto concord paper then scanned the paper, the spray drip results are analysed with ImageJ software to determine the diameter of the droplet in VMD (Volume Median Diameter) range.

The operation of the prototype ACS is if the spray button is pressed the pump will automatically work based on the appropriate pressure while the solenoid valve open, then the nozzle will produce a spray in the form of droplet beads. Based on the measurement results, the higher spray pressure will produce a smaller droplet for both nozzles. The spray droplet produced between the two nozzles in the same pressure almost had similar size because both nozzles have the same output hole diameter. Effective Spraying Debit (ESD) of 4-hole nozzle produce a higher debit than the 3-hole nozzle at the same spraying pressure. The 3-hole nozzle has a higher Effective Spraying Width (ESW) at each spray pressure compared to the 4-hole nozzle, because the construction of the 4-hole nozzle has a small funnel at the end of nozzle, so the spraying can be more focused. By using an Automatic Control System (ACS) in spraying cabbage plants allows spraying conducted one-by-one plant with adjustable duration based on the application dosage and the width of the plant to be sprayed. Calibrating pressure sensor was conducted to get the real pressure value on the pressure transducer. Data from the sensor will be converted into voltage value by the microcontroller, the results of this calibration are used as a reference in the microcontroller program. Spraying accuracy was obtained by comparing the spray output volume with the theoretical spray output volume. Spray duration for each cabbage plant will increase along with the application dosage (AD). The tested output volume for each application dosage produced bigger value than theoretical output volume, because the control system difficult to get constant spray pressure in short spray duration. The Effective Spraying Width (ESW) is the maximum width for spraying. Application dosage for spraying pests on annual crops commonly at 200-600 L/Ha or depending on the instructions on the label of the pesticide. Knapsack Electric Sprayer (KES) with Automatic Control System (ACS) has been designed and tested. The 3-hole spraying nozzle used in this research require lower electric pump voltage than 4-hole nozzle to produce 4 bar pressure and medium spray granules.

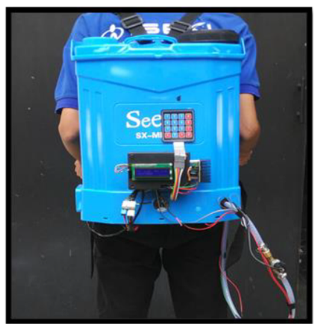

Figure 2.1 Prototype of ACS on KES

2.3 According to [3], ICAR Sonar sensing predicated automatic spraying technology for orchads

A sensor-based, tractor mounted automatic spraying system for small orchard holders was developed for plant canopy detection and spraying of liquid chemical over the detected canopy. The system consists of ultrasonic sensors, microcontroller board, solenoid valves, one-way valves, fixed displacement pump, pressure gauge, relief valve, nozzles, storage tank of 200 litre capacity and 12 V battery. The pump was driven through the tractor PTO. The ultrasonic sensor could detect a set object with a sensing range of 0–3 m. Three turbojet nozzles on each boom divided the spray region into three parts which can be adjusted by their tilt and height according to the average canopy height and width. The system was mounted on a tractor for high field capacity spraying on two rows of the orchard canopy. Ultrasonic sensor works by interpreting the sound waves transmitted and received. As soon as the plant canopy is detected, a voltage signal is transmitted to the microcontroller which turns the relay switch to ON mode for actuation of the solenoid valve and allows the pressurized liquid spray precisely through the nozzle on the plant canopy. In case of no canopy, the sensor will not generate a voltage signal that withholds the system from spraying in the blank region. A code block and algorithm of system functioning was developed in the IDE of the Arduino (Atmega 328P) to switch relays based on sensing of sonic waves. The controller circuit was powered by a 12 V DC battery for system actuation. The microcontroller was programmed so as to neglect the continuous ultrasonic pulses generated for single canopy for a particular pre-set period and again accepts the first ultrasonic pulse after the blank region has passed by. The tractor-mounted ultrasonic sensor-based orchard sprayer was tested at a pomegranate orchard research farm at MPKV Rahuri (Maharashtra, India;). The trees were spaced at 2.4 × 4 m intervals with a density of 1248 plants/ha. They had an average canopy size of 2.52 × 2.36 × 2.24 m (height × width × length). The sprayer was tested once with constant spraying mode and once with sensor-based spraying mode with hollow cone nozzle and turbo nozzle for 24 trees separately. Nozzles on the boom were set at 65, 160 and 255 cm above the ground. The designed sensor-based sprayer was rigorously tested in orchards and compared in different modes with two types of nozzles. The easily adjustable boom for adjusting height and tilt of nozzle improved the efficacy of spraying. The sprayer was observed for its best impact, spray coverage, penetration, minimum fruit infection and savings. Turbo nozzle spraying was observed to be better compared to hollow cone nozzle spraying and no spraying modes. The ultrasonic spraying technology was evidently able to abstain from spraying in blank region without canopy. Minimal spray coverage and impact was observed with sensor based spraying in the blank region and any amount was due to an acceptable impact of wind. Turbo nozzle was minimally affected by wind resulting in the desired efficient spraying. The developed technology thus proves to be of assistance in pesticide saving (26%) and better fruit production especially in small orchard.

CHAPTER 3

PROPOSED WORK

3. PROPOSED WORK

We are aiming to follow some basic assumptions while designing our working model in order to make it more feasible. It includes Bot of height 1.96 ft/60 cm and weight about 50 kgs. The dimensions of wheel includes a width of 3cm and diameter of 14 cm. The following dimensions of the wheel are assumed in handling the weight of the bot in the most efficient way. We are assuming the land to be a plane surface. We have considered that the land is ideal for growth of the crop that we have chosen. The crop that we have opted for is Cotton. The crop is considered to have a height of 1-2 meters. We have assumed that the bot is capable of mounting a slope with inclination of 15 degree. Along with that the area is expected to have a proper network connectivity for establishing uninterrupted and fast communication. The network connectivity will be used to handle and maintain the status of the bot. It will be used for notifying the farmer about the following consequences like liquid drop, system failure, battery drainage, inconveniences caused to the bot and many more. The temperature of the area is expected to lie between a range of 12-25 degrees. The following temperature is taken to avoid excessive heat generation so that bot doesn't heat up and components don't suffer damage. The gap between successive rows of the crop is considered to be 60 cm.

Figure 3.1 Cotton Plant

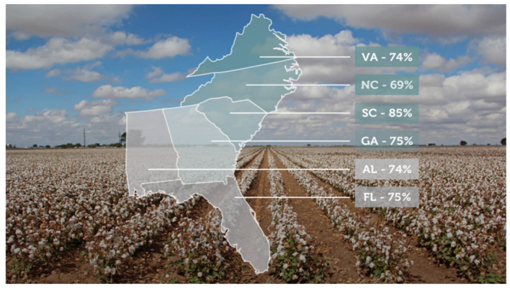

Figure 3.2 Plane Cotton Farm

3.1 Description of Work Flow

The system will follow the mentioned Work Flow. Initially, the system will be switched ON. The next immediate step will include checking the battery status. It will be followed by Liquid check. Further it will be connected to the GSM network. Then the Wi-fi connection will be established. A request to the farmer will be sent in the next step. It will now wait for server response. Then the motors will be set to start mode. Further the step will be bifurcated in two parts. It is because two activities will be taking place simultaneously. The two activities include starting of GSM and waiting for server response if received. The steps following the start of GSM are as follows. Once the GSM is started, it will try to trace a location. Once location has been traced, it will be sent to the server. Once location is sent, then system will wait for server response. Then the set destination will be captured. It will be followed by setting motors to run state. The steps following the second activity i.e. waiting for server request if received are as follows. The image will be captured in the next immediate step. Once image is captured, it will be uploaded to the google drive. Then it will wait for server response. The next step includes making certain adjustments. The adjustments include setting up the sprayer height, angle and amount as per the response receives in earlier step. The bot will start spraying in the next step. Now the motor step has to be set. In backend one particular section will handle errors simultaneously. It will include updating(notifying) the farmers about Battery drainage, system failure and insufficient availability of liquid.

Working Flow:

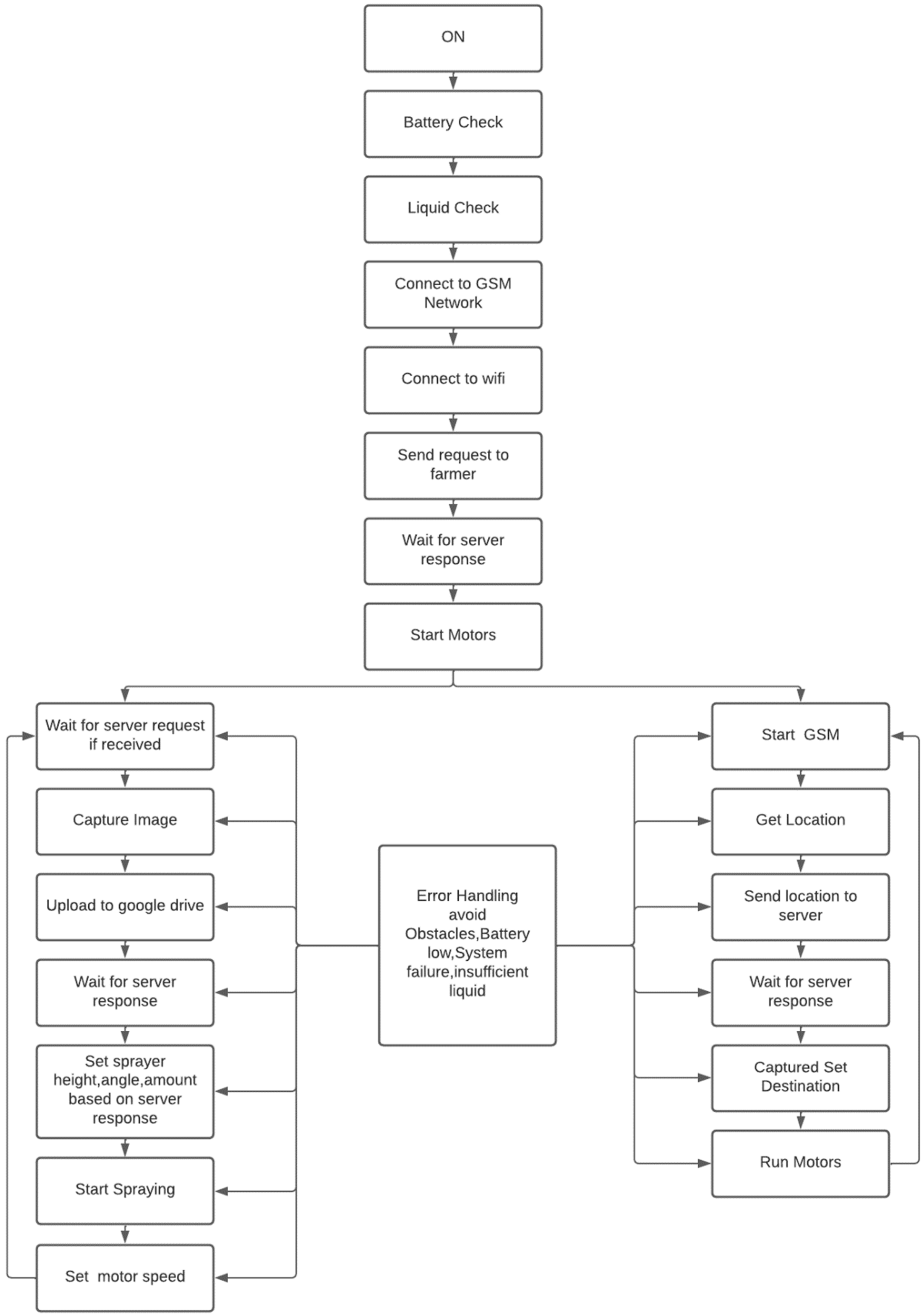

Figure 3.3 WorkFlow

Agricultural automation with robots is an attempt to lessen the strain of managing a farm on a small and big scale by automating typical tasks such as pesticide spraying. A robot with four stepper motors is part of the system. Stepper motor drivers, Arduino UNO, and spraying tool. The broad concept that will be used to address the issue of automated pesticide spraying.

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. This project is basically divided into two components

A. Robot Movement:

DC motors are used for the robot's motion that is governed electronically by ESP 32. 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 ESP32 to have a specific pin. An adequate velocity is provided by DC motors.

B. Image Processing

Firstly it will camera will capture the image and upload it on google drive. Then the image will be processed and detect the disease if it contains disease then it will send response to the server . After receiving response it will set the sprayer according to the height, angle and amount of pesticide to be sprinkled. Then it will start spraying the pesticide.

C. Pesticide Spraying Mechanism:

Bluetooth module connects to the digital key of ESP32, which receives the signal installed on the operator's Smartphone from the Android app. Sprayer spray the pesticide only when the leaves has disease. According to leaf requirement that particular amount of pesticide will be sprinkle.

CHAPTER 4

COMPONENT SPECIFICATION

4. COMPONENT SPECIFICATION

1.Motor

Figure 4.1 Motor

Geared motor is a simple DC motor with gear box attached to the shaft of the motor which is mechanically commutated electric motor powered from direct current. 60 RPM 12v DC geared motors for robotics applications. It gives a massive torque of 7kgcm. Power Source is DC. As the torque requirement for the bot comes out to be 7kgcm, we have decided to go with this motor which gives 7 kg of rated torque.

2. Motor Shaft

When considering the best device for the device and its shaft, you should consider primarily the cost. The material used for a typical car shaft is a soft metal, but when high strength is required, alloys such as chromium-vanadium, nickel, and nickel-chromium are used.

3. Bearings and mount

Figure 4.2 Bearing

Installed solutions include rolling bearings, housing, signs, and other elements, and can be attached to any surrounding machine structure. You can design a machine structure with strips and frames, welded, stitched or stitched together without the need for high precision. Your surrounding building does not need to be a casing, which provides precision machined seats. Mounted bear solutions are easy to install. Houses are attached to their support area. The connection to the shaft can be made with fixed screws lock collar , SKF ConCentra lock technology (fig. 4.2), or with an adapter or retractable sleeve . Apart from the adapter and retractable sleeves, the other three locking methods do not require the knowledge and tools you normally need to mount a bearing. SKF information on ring bearings, housing design, sealing, and lubrication in the case of mounted units, has been compiled to provide the products that deliver the desired performance.

Another factor that supports reliable operation is the ability of bear bearings to compensate for the inconvenience. When using mounted bearings solutions, you can usually not align the two shaft bases around the shaft accurately. Many of the solutions included compensate for errors by adjusting the bearings on the housing or by using the bearing bearings.

3. Motor Driver

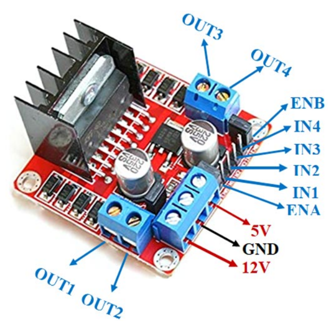

Figure 4.3 Motor Driver

Motor drivers acts as an interface between the motors and the control circuits. Motor require high amount of current whereas the controller circuit works on low current signals. So the function of motor drivers is to take a low-current control signal and then turn it into a higher-current signal that can drive a motor. The motor driver that we have selected is of model L298N 2A. It has a driver chip which is double H bridge L298N. Maximum voltage and current supply that motor can handle is of 46 V and 2A respectively. Driver Voltage is 5-35 V. Logic Voltage is 5V. Driver Current is 2A. Logical Current 0-36mA. Maximum Power it can handle is 25 W. It also has current

4. Servo Motor

Figure 4.4 Servo Motor

Servos are known to always be frequent and work at the same pace. So, if a heavy load is placed on the motor, the driver will increase the current to the motor coil as it rotates the motor. This basically means that servo motors are expected to always be mechanically on point. And because of its precision, it allows companies to operate it at a high-speed pace. MG995 servo is a simple, commonly used standard servo for your mechanical needs such as robotic head, robotic arm. It comes with a stardard 3-pin power and control cable for easy using and metal gears for high torque. As the basic requirements of bot are well satisfied by MG995, it's the best fit for the bot.

5. ESP 32 Cam

Figure 4.5 ESP32 CAM

The ESP32-CAM is a small size, low power consumption camera module based on ESP32. It comes with an OV2640 camera and provides onboard TF card slot. The ESP32-CAM can be widely used in intelligent IOT applications such as wireless video monitoring, Wi-Fi image upload, QR identification, and so on. Consist of features like onboard ESP32-S module, supports Wi-Fi + Bluetooth, OV2640 camera with flash, onboard TF card slot, supports up to 4G TF card for data storage, supports Wi-Fi video monitoring and Wi-Fi image upload, supports multi sleep modes, deep sleep current as low as 6mA and control interface is accessible via pin header, easy to be integrated and embedded into user products.

6. GSM Module

Figure 4.6 GSM Module

A GSM modem or GSM module is a device that uses GSM mobile telephone technology to provide a wireless data link to a network. GSM modems are used in mobile telephones and other equipment that communicates with mobile telephone networks. They use SIMs to identify their device to the network. The GSM module has SRAM of 520 kB, working voltage of 2.7V-3.6V and working current of 70 mA.

7. Logical Level Convertor

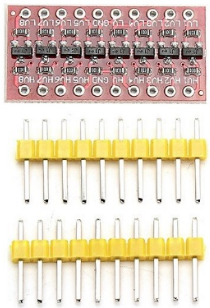

Figure 4.7 Logic Level Convertor

The Logic Level Converter presented here supports bidirectional level shifting by using one MOSFET per bus line and it also protects the low voltage side from spikes at the high voltage side.8 Channel Bi-Directional Logic Level Converter Module is a Bi-directional logic level converter is a small device that safely steps down 5V signals to 3.3V and steps up 3.3V to 5V at the same time. This level converter also works with 2.8V and 1.8V devices

8. Buck Convertor

Figure 4.8 Buck Convertor

A buck converter is a DC-to-DC power converter which steps down voltage from its input to its output .It is a class of switched-mode power supply typically containing at least two semiconductors and at least one energy storage element, a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors are normally added to such a converter's output and input. It is called a buck converter because the voltage across the inductor "bucks" or opposes the supply voltage. It provides input voltage of 5-12V, output voltage of 3.3V, maximum output current of 3A and maximum conversion efficiency of 97.5%.

9. Charger

Figure 4.9 Charger

DC Charger Charge & Maintain all type of 12V Lead acid, VRLA, SMF Batteries & suitable to charge Batteries up to 40AH. Auto cut off when Batteries fully charged. Protection against short circuit, over load, over temperature and battery reverse polarity. Output short-circuits protection with auto restart. LED Indication for Battery Reverse polarity.

10. Pesticide Sprayer (Dual Motor)

Figure 4.10 Pesticide Sprayer

The sprayer is of Kristal Company, made of PVC material and capable to provide 16L Agricultural Battery Sprayer Pump. Moreover, the presented series of products is properly checked on varied industry standards to make sure the longer life with work efficiency of 90%.Also, discharge pressure is 0.2-0.45 Mpa and maximum discharge flow is 3 LPM.

11. Battery

A lead–acid battery characterized by a limited amount of electrolyte absorbed in a plate separator or formed into a gel; proportioning of the negative and positive plates so that oxygen recombination is facilitated within the cell; and the presence of a relief valve that retains the battery contents independent of the position of the cells. The battery has 12v 8Ah, which satisfies the requirement for proper functioning of bot

CHAPTER 5

SYSTEM DESIGN

5. SYSTEM DESIGN

We have thought of the design in such a way that the sprayer won’t topple down from bot as you can see in fig 5.4. We have design the rectangle iron body to handle the placement of sprayer and electronic components. Wheels are attached on the Motors. Nozzle of sprayer will be on either side of the bot. Bot has two half the upper half and the lower half. All the electronics component will be on lower half. The sprayer will be placed on the upper half of the bot.

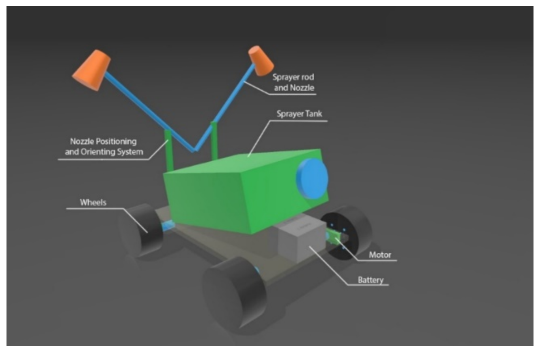

Figure 5.1 Basic Design of bot

Figure 5.2 Front View of the bot

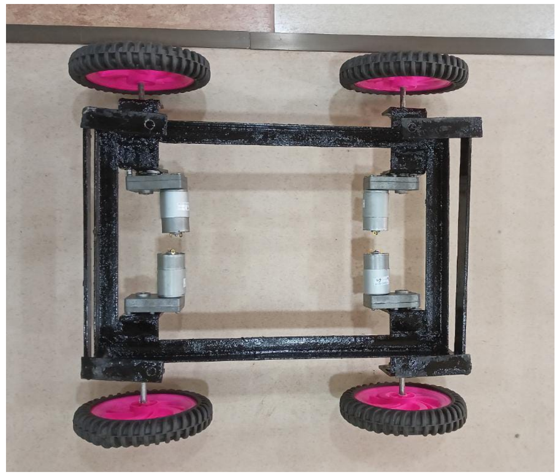

Figure 5.3 Top View of Bot

Figure 5.4 Side View of bot

Below is the code for uploading captured images in google drive

Client Side Code:

```
#include <WiFi.h>
#include <WiFiClientSecure.h>
#include "soc/soc.h"
#include "soc/rtc_cntl_reg.h"
#include "Base64.h"
#include "esp_camera.h"
const char* ssid     = "*******";
const char* password = "**********";
String script = "*************************************************";
String lineNotifyToken = "token=**********";
String folderName = "&folderName=ESP32cam_images";
String fileName = "&fileName=ESP32-CAM.jpg";
String image = "&file=";
//CAMERA_MODEL_AI_THINKER
#define PWDN_GPIO_NUM     32
```

```
#define RESET_GPIO_NUM    -1
#define XCLK_GPIO_NUM      0
#define SIOD_GPIO_NUM     26
#define SIOC_GPIO_NUM     27
#define Y9_GPIO_NUM       35
#define Y8_GPIO_NUM       34
#define Y7_GPIO_NUM       39
#define Y6_GPIO_NUM       36
#define Y5_GPIO_NUM       21
#define Y4_GPIO_NUM       19
#define Y3_GPIO_NUM       18
#define Y2_GPIO_NUM        5
#define VSYNC_GPIO_NUM    25
#define HREF_GPIO_NUM     23
#define PCLK_GPIO_NUM     22
void connectWiFi()
{
  WiFi.begin(ssid, password);
  //Serial.println("Connecting");
  long tim ;
  tim = millis();
  while (WiFi.status() != WL_CONNECTED)
  {
    //    delay(50);
    //    digitalWrite(12, HIGH);
    //    delay(50);
    //    digitalWrite(12, LOW);
    Serial.print(".");
    if (millis() - tim > 3000)
      ESP.restart();
  }
  Serial.println("");
  Serial.print("Connected to WiFi network in " + String(((millis() - tim) / 1000.0)) + " 
seconds with IP Address: ");
  Serial.println(WiFi.localIP());
}
void configCam()
{
  camera_config_t config;
  config.ledc_channel = LEDC_CHANNEL_0;
  config.ledc_timer = LEDC_TIMER_0;
  config.pin_d0 = Y2_GPIO_NUM;
  config.pin_d1 = Y3_GPIO_NUM;
  config.pin_d2 = Y4_GPIO_NUM;
  config.pin_d3 = Y5_GPIO_NUM;
  config.pin_d4 = Y6_GPIO_NUM;
  config.pin_d5 = Y7_GPIO_NUM;
  config.pin_d6 = Y8_GPIO_NUM;
  config.pin_d7 = Y9_GPIO_NUM;
```

```
  config.pin_xclk = XCLK_GPIO_NUM;
  config.pin_pclk = PCLK_GPIO_NUM;
  config.pin_vsync = VSYNC_GPIO_NUM;
  config.pin_href = HREF_GPIO_NUM;
  config.pin_sscb_sda = SIOD_GPIO_NUM;
  config.pin_sscb_scl = SIOC_GPIO_NUM;
  config.pin_pwdn = PWDN_GPIO_NUM;
  config.pin_reset = RESET_GPIO_NUM;
  config.xclk_freq_hz = 20000000;
  config.pixel_format = PIXFORMAT_JPEG;
  // init with high specs to pre-allocate larger buffers
  if (psramFound())
  {config.frame_size = FRAMESIZE_XGA;
    config.jpeg_quality = 10;
    config.fb_count = 2;  }
  else
  {config.frame_size = FRAMESIZE_SVGA;
    config.jpeg_quality = 12;
    config.fb_count = 1;  }
  esp_err_t err = esp_camera_init(&config);
  if (err != ESP_OK) {
    Serial.printf("Camera init failed with error 0x%x", err);
    delay(100);
    ESP.restart();
  }}
void setup()
{
 pinMode(12, OUTPUT);
  //  digitalWrite(12, HIGH);
  //  delay(100);
  //  digitalWrite(12, LOW);
  pinMode(4, OUTPUT);
  WRITE_PERI_REG(RTC_CNTL_BROWN_OUT_REG, 0);
  Serial.begin(115200);
  //  delay(10);
  connectWiFi();
  configCam();}
void loop()
{SendCapturedImage();
  delay(1000);}
String SendCapturedImage() {
  const char* myDomain = "script.google.com";
  String getAll = "", getBody = "";
camera_fb_t * fb = NULL;
  digitalWrite(4, HIGH);
  delay(10);
  sensor_t *s = esp_camera_sensor_get();
  s->set_brightness(s, 2);
  s->set_contrast(s, 0);
```

```
fb = esp_camera_fb_get();
delay(20);
digitalWrite(4, LOW);
if (!fb) {
  Serial.println("Camera capture failed");
  //delay(1000);
  ESP.restart();
  return "Camera capture failed"; }
Serial.println("Connect to " + String(myDomain));
WiFiClientSecure client_tcp;
client_tcp.setInsecure();   //run version 1.0.5 or above
if (client_tcp.connect(myDomain, 443)) {
  Serial.println("Connection successful");
  char *input = (char *)fb->buf;
  char output[base64_enc_len(3)];
  String imageFile = "data:image/jpeg;base64,";
  for (int i = 0; i < fb->len; i++) {
    base64_encode(output, (input++), 3);
    if (i % 3 == 0) imageFile += urlencode(String(output));}
 String Data = lineNotifyToken + folderName + fileName + image;
  client_tcp.println("POST " + script + " HTTP/1.1");
  client_tcp.println("Host: " + String(myDomain));
  client_tcp.println("Content-Length: " + String(Data.length() + imageFile.length()));
  client_tcp.println("Content-Type: application/x-www-form-urlencoded");
  client_tcp.println("Connection: keep-alive");
  client_tcp.println();
  client_tcp.print(Data);
  int Index;
  for (Index = 0; Index < imageFile.length(); Index = Index + 1000) {
    client_tcp.print(imageFile.substring(Index, Index + 1000)); }
  esp_camera_fb_return(fb);
  int waitTime = 500;   // timeout 10 seconds
  long startTime = millis();
  boolean state = false;
  while ((startTime + waitTime) > millis())
  {Serial.print(".");
    delay(10);
    while (client_tcp.available())
    { char c = client_tcp.read();
      if (state == true) getBody += String(c);
      if (c == '\n')
      { if (getAll.length() == 0) state = true;
        getAll = "";
      }else if (c != '\r')
        getAll += String(c);
      startTime = millis();
    }
    if (getBody.length() > 0) break;
  }
```

```
    client_tcp.stop();
    Serial.println(getBody);
  }
  else {
    getBody = "Connected to " + String(myDomain) + " failed.";
    Serial.println("Connected to " + String(myDomain) + " failed.");
  }
  return getBody;
}
String urlencode(String str)
{
  String encodedString = "";
  char c;
  char code0;
  char code1;
  char code2;
  for (int i = 0; i < str.length(); i++) {
    c = str.charAt(i);
    if (c == ' ') {
      encodedString += '+';
    } else if (isalnum(c)) {
      encodedString += c;
    } else {
      code1 = (c & 0xf) + '0';
      if ((c & 0xf) > 9) {
        code1 = (c & 0xf) - 10 + 'A';
      }
      c = (c >> 4) & 0xf;
      code0 = c + '0';
      if (c > 9) {
        code0 = c - 10 + 'A';
      }
      code2 = '\0';
      encodedString += '%';
      encodedString += code0;
      encodedString += code1;
      //encodedString+=code2;
    }
    yield();
  }
  return encodedString;
}
```

Server Side Code:

```
function doPost(e) {
  var folderName = e.parameter.folderName;
  var file = e.parameter.file;
  var fileName = e.parameter.fileName;
```

```
  //var fileName = Utilities.formatDate(new Date(), "GMT", "yyyyMMddHHmmss")+"-
"+e.parameter.fileName;
  var token = e.parameter.token;
  var contentType = file.substring(file.indexOf(":")+1, file.indexOf(";"));
  var data = file.substring(file.indexOf(",")+1);
  data = Utilities.base64Decode(data);
  var blob = Utilities.newBlob(data, contentType, fileName);

  // Save a captured image to Google Drive.
  var folder, folders = DriveApp.getFoldersByName(folderName);
  if (folders.hasNext()) {
    folder = folders.next();
  } else {
    folder = DriveApp.createFolder(folderName);
  }
  var file = folder.createFile(blob);
  file.setDescription("Uploaded by " + fileName);

  var imageID =
file.getUrl().substring(file.getUrl().indexOf("/d/")+3,file.getUrl().indexOf("view")-1);
  var imageUrl = "https://drive.google.com/uc?authuser=0&id="+imageID;

  // Send a link message to Line Notify.
  var res = "Line Notify: ";
  try {
    var url = 'https://notify-api.line.me/api/notify';
    var response = UrlFetchApp.fetch(url, {
      'headers': {
        'Authorization': 'Bearer ' + token,
      },
      'method': 'post',
      'payload': {
          'message': imageUrl
      }
    });
    res += response.getContentText();
  } catch(error) {
    res += error;
  }
  return
ContentService.createTextOutput(folderName+"/"+fileName+"\n"+imageUrl+"\n"+res);
```

CHAPTER 6

COMPARISON AND RESULT

6. COMPARISON

We have 4 models with us to compare, One is by VK Tewari, second is by M. A. Mustafid, third is by Ron Berenstein and the other one is in development stage by us.
In the first model spraying technique is based on ultrasonic sensors while in the second model electric nozzle is being used to change intensity of sprayer and in the third model the image is first captured then its proccesed and then spraying is done. Here the image processing part is done on MATLAB. While in our model we have used CNN Algorithm to process and detect the image. We are using an electric sprayer whose nozzle will be fixed but it will have 2-3 nozzles depending upon the required intensity while talking about the second model it uses a knapsack electric sprayer with 3 & 4 holes in each nozzle.
The second model is specific to cabbage plant while the third model is generalised which can be used for any crop and talking about our model, it is also crop specific (We are initially taking cotton plant for our prototype making). In the second model the duration of the spraying pesticide is already predefined since the crop they have chosen is cabbage. Our model will first detect the disease on the crop (if any) then after sensing it will decide the amount of pesticide required for the particular crop.
All the three models have made use of ARDUINO while in our model we are using ESP32 because of its features that we need.
The size of the third model is very bug which makes it difficult to move around the farm which becomes the disadvantage of that model. Also the components used in that model are much costly which makes it practically difficult for a farmer to purchase. While our model is moderate in size which makes it easier to move easily in between the line of the crops.

Convolutional neural networks

We are using CNN algorithm in our project for image processing. CNN is a strong image processing technique. These algorithms are currently the best we have for automated image processing. Many businesses utilise these algorithms to do tasks such as detecting items in images. RGB data is contained within images. Matplotlib can be used to load an image from a file into memory. The computer only sees an array of numbers and not an image. 3-dimensional arrays are used to store colour images. The image's height and width are represented by the first two dimensions (the number of pixels). Each pixel's red, green, and blue hues are represented by the last dimension. Image processing has advanced significantly thanks to deep learning techniques, particularly Convolutional Neural Networks (CNNs). Many applications for automatic crop disease identification have been developed since 2016. These applications could be used as a foundation for developing expert assistance or automated screening systems. Such tools could help farmers pursue more sustainable farming techniques and increase food security. CNNs is used to automatically diagnose crop diseases to assess their potential for such applications. In image classification, CNNs outperform traditional image processing methods in several applications. This general trend is also observed in the automatic identification of crop diseases. Some of the selected studies compared the performance obtained with CNNs to that of other methods. In all of these studies, the CNN results are better than the others. The convolutional neural network (CNN), sometimes known as CNN, is a type of deep learning neural network. In a nutshell, consider CNN to be a machine learning system that can take an input image, assign relevance (learnable weights and biases) to various aspects/objects in the image, and distinguish between them. CNN works by extracting features from the images.

It is critical to note that Artificial Neural Networks (ANNs), which are made up of numerous neurons, are incapable of extracting characteristics from images. This is when a convolutional and pooling layer combo comes into play. Likewise, the convolution and pooling layers are incapable of classification, necessitating the use of a fully linked Neural Network.

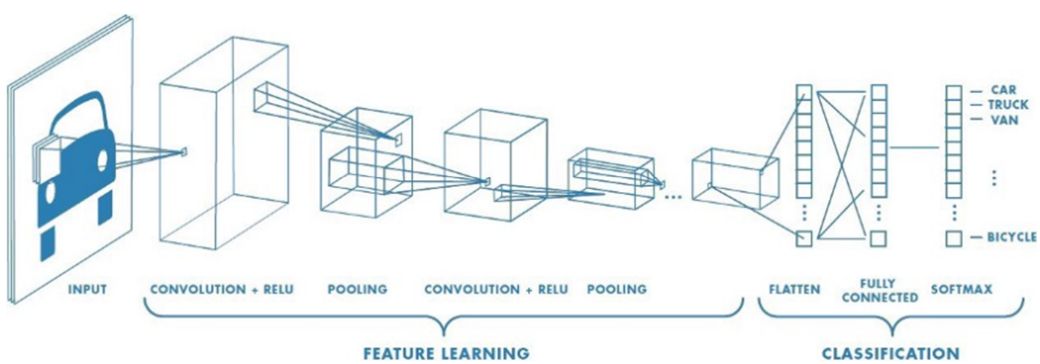

Figure 6.1 CNN Process from input to output data

Here in our project CNN is used to detect the leaf diseases. We are using this algorithm because of its efficiency and features. Below we have listed the comparison of CNN with other machine learning algorithm. With little dependence on pre-processing, this algorithm requires less human effort. It is actually a self-learner, which makes the pre-processing phase, easier. For example, given many pictures of cats and dogs, it can learn the key features for each class by itself. CNN has features parameter sharing and dimensionality reduction. Because of parameter sharing in CNN, the number of parameters is reduced thus the computations also decreased.

CNN over ANN

Since digital images are a bunch of pixels with high values, makes sense use CNN to analyze them. CNN decrease their values, which is better for training phase with less computational power and less information loss.

CNN over MLP

Both MLP and CNN can be used for Image classification however MLP takes vector as input and CNN takes tensor as input so CNN can understand spatial relation (relation between nearby pixels of image) between pixels of images better thus for complicated images CNN will perform better than MLP.

CNN over KNN

KNN and CNN perform competitively with their respective algorithm on the dataset, while CNN produces high accuracy than KNN and hence chosen as a better approach.

RESULT

As the above comparisons showed CNN is better. That's the reason we choose CNN over other.

CHAPTER 7

CONCLUSION

7. CONCLUSION

The potential for robot-enhanced productivity in agriculture is enormous, and robots are increasingly appearing on farms in various forms and in increasing numbers. The other issues with autonomous farm equipment can most likely be solved with technology. Although this technology may be in our future, there are compelling reasons to believe that it will not simply replace human drivers with computers. It may necessitate a reassessment of crop production methods. A swarm of little machines can produce crops more efficiently and cheaply than a few large machines. One advantage of the smaller machines is that they may be more acceptable to non-farmers. Because agricultural tasks are dangerous, demand intelligence, and need quick, but extremely repetitive decisions, robots can effectively replace human operators. Robots can help us live better lives, but they also have drawbacks. In our country, all agricultural machines are operated manually because using a petrol engine or tractor is expensive, and farmers cannot work for long periods of time manually, which is harmful to their health. To solve this problem, we need a system that is both efficient and user-friendly, as well as environmentally friendly because it does not produce pollution.

In comparison to the other types of solutions offered, the remotely operated pest sprayer is more superior. Furthermore, the various materials chosen for the complete mechanism will be readily available at a low cost. The farmer's major concern was carrying the entire load of bugs on his shoulder, and pesticides are toxic to farmers, causing several health problems. This problem can be overcome by using this method. In addition, it requires far fewer resources to operate in real-world situations. Furthermore, the farmer (operator) does not need any specific skills or training to run it, and it uses less manpower than traditional spraying methods.

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REFERENCES

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