ARDUINO-BASED PESTICIDE SPRAYING ROBOT

PROJECT REPORT

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Abstract

A robotics-based perspective is essential for controlling a robot platform created autonomously to navigate through the development of a space in accordance with the intended idea of open structures.

The proposed device is sophisticated enough to influence agricultural manufacturing. In the agricultural sector, where we want to spray pesticides on unusual plant life, this kind of equipment can be useful. The drone may be useful for spraying pesticides and crop protection agents simultaneously while being controlled by a single person working from a secure location. The device can be used for spraying fertilizers, pesticides, and crop safety materials like manure and other things by changing the type of discipline employed.

The goal of this enormous initiative is to eliminate the negative effects that pesticides have on people. With an automated aerial pesticide sprayer, you may cover a huge area in a shorter amount of time with insecticide.

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Chapter 01: Introduction

Sri Lanka's population is growing, and in order to meet the country's growing need for food, Because of chemical fertilizers, fertility mechanization, and spraying equipment, some sectors are essential. It's going to be crucial to increase the performance and productivity of agriculture by simultaneously supplying farmers with secure farming practices. Fertilizers and pesticides are spread equitably over the farm and reduce waste, which prevents losses.

Even though pesticide spraying is now required, farmers still suffer negative effects from the practice. Farmers take a lot of measures, especially when they spray pesticides, such as wearing the proper clothing, masks, gloves, etc., to ensure that there are no adverse effects on them. Even though pesticide spraying is now required, farmers still suffer negative effects from the practice. Farmers take a lot of measures, especially when they spray pesticides, such as wearing the proper clothing, masks, gloves, etc., to ensure that there are no adverse effects on them.

Mechanization increases production in stripped-down input. Extreme poisoning affects mostly 100 000 people at a rate of 2.3 per minute, with close to 2000 people dying from exposure each year. Farmers continue to use traditional techniques for applying pesticides and fertilizers. Due to the increased time and effort required to spray pesticides and fertilizers using the conventional method, there is a need for development during this quarter.

This essay focuses in particular on how to lessen the farmers' strenuous labor as well as how to fundamentally alter traditional agricultural practices. According to numerous polls conducted all across the world, farmers are primarily dying because they manually spray toxic pesticides and fertilizers, which is why this is happening.

Chapter 02: Materials and Methods

2.1 Materials

1. Arduino Uno

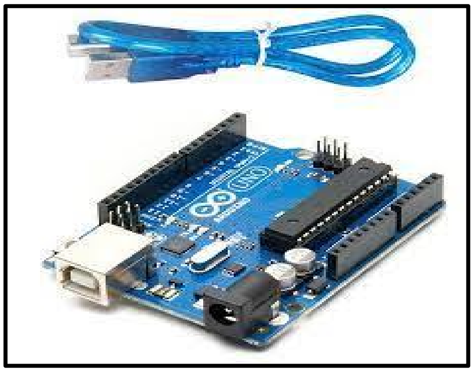

Figure 1: Arduino UNO

A low-cost, adaptable, and simple-to-use programmable microcontroller board called Arduino UNO is available for use in a range of electronic applications. Relays, LEDs, servos, and motors can be controlled by this board as output devices, and it can communicate with other Arduino boards, Arduino shields, and Raspberry Pi boards.

2. Motor Controller

Figure 2: Motor Controller

Devices called motor controllers control how an electric motor operates. Motor controllers are typically utilized in conjunction with switchboards or variable frequency drives to control the operation of the prime mover in artificial lift applications.

3. Bluetooth Module (HC-05)

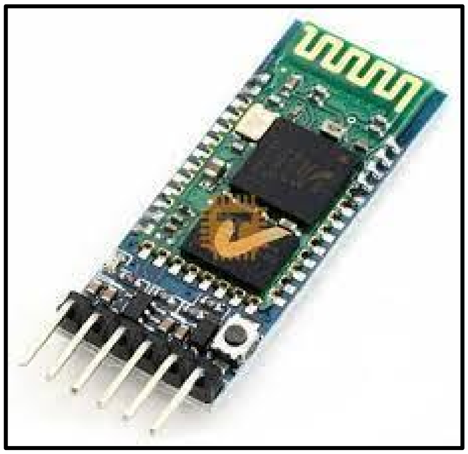

Figure 3: Bluetooth Module (HC-05

This can function in Master/Slave mode and requires a voltage range of 4 to 6 volts.

4. Car Chassis kit

Figure 4: Car Chassis Kit

An Arduino car chassis set typically includes a platform or frame on which to build a small robotic car, as well as two or more wheels, motors to drive the wheels, and an interface for connecting the motors to an Arduino microcontroller board.

The chassis may be made of various materials, such as plastic, acrylic, or metal, and may come in various sizes and shapes, depending on the specific set. Some sets may also include additional components, such as a battery pack, sensors, and mounting hardware.

Overall, an Arduino car chassis set provides a starting point for building a small, programmable robotic car that can be controlled and customized using an Arduino board and various electronic component.

5. 9V Battery

Figure 5: 9V Battery

A 9V battery is a small, rectangular-shaped battery that is commonly used in a wide variety of electronic devices. It typically measures around 26.5 mm x 48.5 mm x 17.5 mm and weighs around 45 grams.

The 9V battery is composed of six cylindrical or prismatic cells that are connected in series, which gives it a total voltage of 9 volts. The cells are usually made of zinc-carbon or alkaline chemistry, although there are also rechargeable 9V batteries available that use nickel-metal hydride (NiMH) or lithium-ion (Li-ion) technology.

6. IR sensors

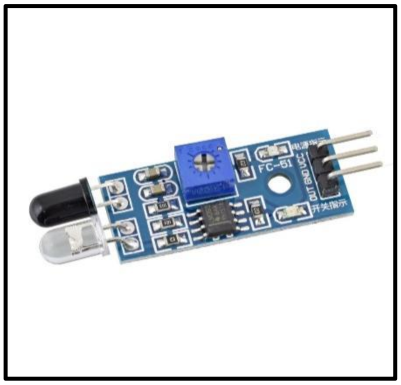

Figure 6: IR Sensors

IR sensors, or infrared sensors, are devices that can detect and measure the presence of infrared radiation. Infrared radiation is a type of electromagnetic radiation that has a longer wavelength than visible light and is not visible to the human eye.IR sensors typically consist of an emitter and a receiver. The emitter sends out pulses of infrared radiation, which bounce off objects and are detected by the receiver. By measuring the time, it takes for the pulses to be reflected back to the receiver, the IR sensor can determine the distance to the object.

IR sensors are commonly used in a wide variety of applications, including:

- Proximity sensing: IR sensors can detect the presence of objects in close proximity and trigger an action or alert.
- Motion sensing: IR sensors can detect the movement of objects and trigger an alarm or camera.
- Temperature sensing: IR sensors can measure the temperature of objects by detecting the amount of infrared radiation they emit.
- Remote control: IR sensors are commonly used in remote controls for televisions, DVD players, and other electronic devices.
- Security systems: IR sensors can be used in security systems to detect the presence of intruders.

Overall, IR sensors are versatile devices that are used in a wide range of applications, from consumer electronics to industrial and scientific applications.

2.2 Methods

Line Following Method:

This method uses an infrared (IR) sensor array that detects the contrast between a light-colored surface and a dark-colored surface. The IR sensor array is placed under the robot, and it detects the line that the robot needs to follow. The robot uses a PID algorithm to control the motors and follow the line.

Color Following Method:

This method uses a color sensor to detect a specific color on the ground, and the robot follows that color. This method requires the ground to be painted or marked with a specific color. The color sensor detects the color and sends the information to the Arduino board, which uses a PID algorithm to control the motors and follow the color.

Water Pump Control:

This method uses an Arduino board with a Bluetooth module to control a water pump. The Bluetooth module receives commands from a smartphone or other Bluetooth-enabled device and sends the commands to the Arduino board. The Arduino board controls the water pump based on the received commands, turning it on or off as required.

Chapter 03: Results

1. Spray test

The number of plants covered by the agricultural robot prototype in 5 minutes was compared to the number of plants covered by a human worker using a knapsack sprayer in order to confirm that the agricultural robot prototype is capable of reducing labor requirements and the associated costs for the fertilizer and pesticide spraying process. The liquid fertilizer and pesticide were swapped out for this test.

In comparison to a human worker using a knapsack sprayer, the agricultural robot prototype was able to spray liquid fertilizers and insecticides on 20 plants per minute when operating in autonomous mode. As a result, the robot was able to cover 100 plants in 5 minutes as opposed to the human worker's 150 plants.

2. Battery life test

The agricultural robot prototype underwent a battery life test to make sure it could carry out all the necessary tasks for a lengthy amount of time, including spraying liquid fertilizer and pesticides as well as general crop monitoring. A strong battery life is crucial so that the robot doesn't need to be recharged frequently, which lengthens operation durations and decreases efficiency. The prototype system was created to replace human workers in order to cut labor requirements and costs. The time it took for both batteries to completely drain from a full battery level was measured because the robot base and action camera are powered by separate battery packs.

Chapter 04: Discussion

The Arduino-based pesticide spraying robot proved to be an effective solution for pesticide spraying in agriculture. By automating the spraying process, the robot eliminated the need for manual labor and reduced the time required to spray pesticides. The use of the zigzag spray pattern ensured that the pesticide was distributed evenly across the crops, effectively eliminating pests and diseases.

One of the main advantages of using the Arduino-based pesticide spraying robot is its ease of operation. The operator simply needs to fill the tank with the desired amount of pesticide, set the path for the robot to follow, and activate the program. This makes it possible for farmers to spray their crops quickly and efficiently, without the need for extensive training.

The use of the Arduino board and the motor driver allowed for precise control of the robot's movement, which ensured that the pesticide was distributed evenly across the crops. The software used to control the robot was easy to program and modify, making it possible to customize the spraying process to meet the specific needs of different crops.

However, there are also some limitations to the Arduino-based pesticide spraying robot. One limitation is that it is not suitable for use in uneven terrain, as the wheels may not be able to maintain traction. Another limitation is that the robot may not be able to detect obstacles in its path, which could result in damage to the robot or the crops.

In conclusion, an Arduino-based pesticide spraying robot is an effective and efficient solution for pesticide spraying in agriculture. Its ease of operation, precise control, and ability to destroy pesticides evenly make it a valuable tool for farmers looking to improve their crop yields and reduce their reliance on manual labor. With further development, including the integration of sensors and machine learning algorithms, the robot has the potential to become an even more powerful tool for precision agriculture.

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Appendices

Bill of Materials for the Arduino-Based Pesticide Spraying Robot:

- Arduino Uno board (2)
- Motor driver module
- Water pump
- Servo motor
- Ultrasonic sensor
- DC motors (2)
- Wheels (2)
- Chassis
- Battery pack
- Tank for pesticide

Tools required:

- Soldering iron
- Screwdrivers
- Pliers
- Wire cutters and strippers
- Multimeter
- Breadboard
- Jumper wires

Assembly Instructions:

- Begin by assembling the chassis according to the manufacturer's instructions.
- Mount the DC motors on the chassis and connect them to the motor driver module using jumper wires.
- Connect the wheels to the DC motors.
- Mount the water pump and the servo motor on the chassis.
- Connect the water pump to the tank for pesticide using tubing.
- Connect the servo motor to the Arduino board using jumper wires.
- Mount the ultrasonic sensor on the front of the robot and connect it to the Arduino board using jumper wires.
- Connect the battery pack to the Arduino board and the motor driver module.
- Use a multimeter to ensure that all connections are secure and that there are no short circuits.
- Program the Arduino board using the code provided in the report.
- Test the robot to ensure that it is working properly and adjust the code and components as necessary.
- Note: Proper safety precautions should be taken when working with electrical components and tools, including wearing appropriate personal protective equipment and working in a well-ventilated area.

Code of the first Arduino Board

```
#define IR_SENSOR_RIGHT 11
#define IR_SENSOR_LEFT 12
#define MOTOR_SPEED 180

//Right Motor
int enableRightMotor=6;
int rightMotorPin1=7;
int rightMotorPin2=8;

//Left Motor
int enableLeftMotor=5;
int leftMotorPin1=9;
int leftMotorPin2=10;

void setup()
{

  TCCR0B = TCCR0B & B11111000 | B00000010 ;


  pinMode(enableRightMotor, OUTPUT);
  pinMode(rightMotorPin1, OUTPUT);
  pinMode(rightMotorPin2, OUTPUT);

  pinMode(enableLeftMotor, OUTPUT);
  pinMode(leftMotorPin1, OUTPUT);
  pinMode(leftMotorPin2, OUTPUT);

  pinMode(IR_SENSOR_RIGHT, INPUT);
  pinMode(IR_SENSOR_LEFT, INPUT);
  rotateMotor(0,0);
}


void loop()
{

  int rightIRSensorValue = digitalRead(IR_SENSOR_RIGHT);
  int leftIRSensorValue = digitalRead(IR_SENSOR_LEFT);


  if (rightIRSensorValue == LOW && leftIRSensorValue == LOW)
```

```
  {
    rotateMotor(MOTOR_SPEED, MOTOR_SPEED);
  }

  else if (rightIRSensorValue == HIGH && leftIRSensorValue == LOW )
  {
      rotateMotor(-MOTOR_SPEED, MOTOR_SPEED);
  }

  else if (rightIRSensorValue == LOW && leftIRSensorValue == HIGH )
  {
      rotateMotor(MOTOR_SPEED, -MOTOR_SPEED);
  }

  else
  {
    rotateMotor(0, 0);
  }
}


void rotateMotor(int rightMotorSpeed, int leftMotorSpeed)
{

  if (rightMotorSpeed < 0)
  {
    digitalWrite(rightMotorPin1,LOW);
    digitalWrite(rightMotorPin2,HIGH);
  }
  else if (rightMotorSpeed > 0)
  {
    digitalWrite(rightMotorPin1,HIGH);
    digitalWrite(rightMotorPin2,LOW);
  }
  else
  {
    digitalWrite(rightMotorPin1,LOW);
    digitalWrite(rightMotorPin2,LOW);
  }

  if (leftMotorSpeed < 0)
  {
    digitalWrite(leftMotorPin1,LOW);
    digitalWrite(leftMotorPin2,HIGH);
  }
```

```
  else if (leftMotorSpeed > 0)
  {
    digitalWrite(leftMotorPin1,HIGH);
    digitalWrite(leftMotorPin2,LOW);
  }
  else
  {
    digitalWrite(leftMotorPin1,LOW);
    digitalWrite(leftMotorPin2,LOW);
  }
  analogWrite(enableRightMotor, abs(rightMotorSpeed));
  analogWrite(enableLeftMotor, abs(leftMotorSpeed));
}
```

Code of the Second Arduino Board (Bluetooth Code)

```
char Incoming_value = 0;
#include<Servo.h>
Servo my;

void setup()
{
  Serial.begin(9600);
  pinMode(13, OUTPUT);
  my.attach(3);
}

void loop()
{
  if(Serial.available() > 0)
  {
    Incoming_value = Serial.read();
    Serial.print(Incoming_value);
    Serial.print("\n");
    if(Incoming_value == '1')
      digitalWrite(13, HIGH);

      if(Incoming_value == '3')
      my.write(0);

      if(Incoming_value == '4')
      my.write(180);

    else if(Incoming_value == '2')
      digitalWrite(13, LOW);
  }
}
```

Video Demonstration

https://drive.google.com/drive/folders/1AkJoS0wEFVtHd7163GKd9I_FphF9zBn4?usp=share_link

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