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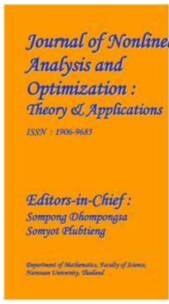

DESIGN AND DEVELOPMENT OF AN AGRIBOT FOR AUTOMATIC SEED SOWING AND MOSITURE MONITORING

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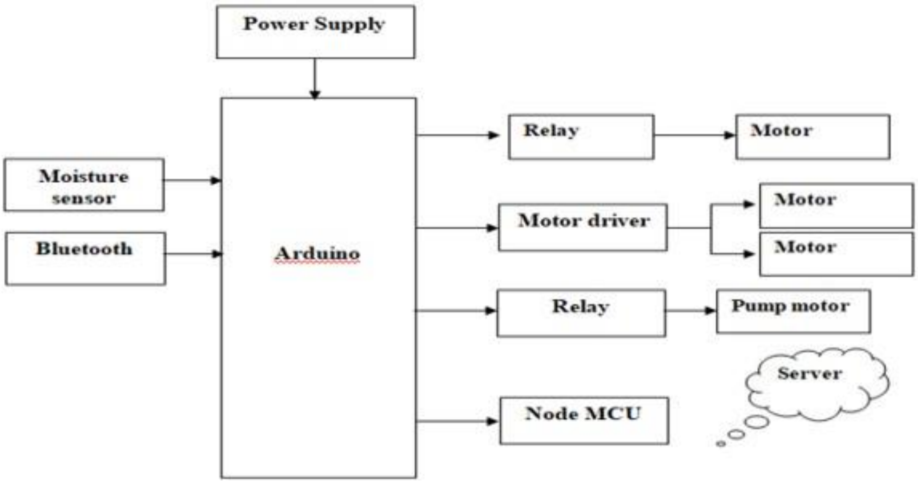
Abstract:
The study, "Design and Development of Agribot for Automatic Seed Sowing Machine," offers a creative way to improve farming methods through the automation of the seed-sowing procedure. This project makes use of cutting-edge technology, integrating Bluetooth connectivity to give commands to the robot, an Arduino controller to operate the robot, and a NodeMCU module to upload soil moisture sensor results to a server. The exact seed sowing mechanism, which is accomplished via a servo motor arrangement, is the focal point of this project. The Agribot is made to roam agricultural fields on its own and plant seeds while continuously measuring the moisture content of the soil. To evaluate soil conditions and make sure seeds are placed under ideal moisture conditions, the soil moisture sensor gives crucial data. Control and navigation in the field are made possible by the use of Bluetooth orders to communicate with the Agribot. With less human labour required, the initiative will modernise agriculture, improve the accuracy of seed sowing, and increase crop output. Including a pump motor that activates when the moisture content is low as an extra feature. In contrast, a high moisture level causes the pump motor to shut off.
Keywords: Arduino, Motor driver, Motor, Seed sowing, Agribot, Moisture sensor, Pump Motor, Node MCU.

1.Introduction

The design and development of an autonomous robot for pesticide spraying in fertigation farms is described in this study [1]. The robot's actions are managed by an Arduino controller, while a servo motor controls the spray nozzle. To keep track of soil conditions, an integrated soil moisture sensor is used. The invention of a smart robot for pesticide spraying is presented in this study [2]. The robot only sprays pesticides on specific locations after using sensors to identify the presence of crops. The concept and development of an agricultural robot intended for pesticide spraying is described in this study [3]. The robot has a control system and a spraying mechanism. The design and application of an agricultural robot for seed planting is the main topic of this paper [4]. The robot plants seeds at predetermined intervals and depths using a mechanism. An agricultural robot that sprays pesticides under the control of an Android application is shown in this research [5]. Through the programme, users can remotely operate the robot's movement and spraying capabilities. The design and development of an automated seed-sowing robot is covered in this study [6]. The robot sows seeds at the proper depth after using sensors to determine the state of the soil. The concept and development of an automatic seed-sowing mechanism is described in full in this publication [7]. Seeds are sown by the machine using a mechanism at prearranged intervals. The design and construction of a combination system for automated grass cutting and seed sowing is presented in this study [8]. For each function, the machine uses a different mechanism. The design and development of an automatic seed-sowing system is covered in this study [9]. To plant seeds at precise depths and spacing, the machine use a mechanism. A smart seed-sowing robot's design and construction are presented in this study [10]. The robot can adapt its actions to the surroundings and utilises sensors to find good spots to plant seeds. The design and construction of an automated seed-sowing robot for agricultural areas is the main topic of this paper [11]. The robot plants seeds at predefined intervals and depths using a mechanism. This paper [12] presents a wireless seed-sowing agricultural robot. The robot can be remotely controlled and observed using a wireless connection system.

2. Proposed Method

The current study develops an Agribot system that uses an Arduino control and servo motor to automate the sowing of seeds. It uses a sensor to track the moisture content of the soil and sends data via NodeMCU. Bluetooth enables remote monitoring and user control. Furthermore, automatic watering based on soil moisture levels is made possible by a pump motor. By enhancing the accuracy of seed planting, optimising water use, potentially raising agricultural production and sustainability, and decreasing manual labour, the system's output will transform agriculture.



Figiure.1. Block diagram of the Project

2.1 Hardware description

2.1.1 Introduction to Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. It consists of a microcontroller that can be programmed to sense and control objects in the physical world. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. They are used for a variety of purposes, including creating interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino boards come in various shapes and sizes, each with its own set of features and capabilities. Some of the most popular Arduino boards include:

Arduino Uno: The Uno is one of the most popular Arduino boards. It features a microcontroller, digital and analog input/output pins, USB connection, and a power jack.

Arduino Mega: The Mega is similar to the Uno but with more digital and analog input/output pins, making it suitable for larger projects that require more I/O.

Arduino Nano: The Nano is a compact board with similar features to the Uno but in a smaller form factor, making it ideal for projects with space constraints.

Arduino Due: The Due is based on a more powerful microcontroller than the Uno, making it suitable for projects that require more processing power.

Arduino Leonardo: The Leonardo is similar to the Uno but with built-in USB communication, making it easier to interface with computers.

In addition to the hardware, Arduino also provides a software development environment that allows users to write, compile, and upload code to their Arduino boards. The Arduino IDE (Integrated

Development Environment) is a simple yet powerful tool that is used to write code in the Arduino programming language, which is based on Wiring, and upload it to the board.

Overall, Arduino is a versatile platform that is used by hobbyists, students, and professionals alike to create a wide range of projects, from simple blinking LED lights to complex robotics projects. Its ease of use, coupled with its affordability and flexibility, has made it one of the most popular platforms for electronics prototyping and experimentation.

2.1.2 Features of the Arduino

Arduino boards come with a variety of features that make them suitable for a wide range of projects. Some of the key features of Arduino boards include:

Microcontroller: Arduino boards are equipped with a microcontroller, which is the brain of the board. The microcontroller is responsible for executing the program and controlling the inputs and outputs of the board.

Digital Input/Output Pins: Arduino boards come with a number of digital input/output (I/O) pins that can be used to connect the board to external devices such as sensors, LEDs, and motors. These pins can be configured as either inputs or outputs, allowing the board to read data from sensors or control external devices.

Analog Input Pins: In addition to digital I/O pins, Arduino boards also feature analog input pins that can be used to read analog signals from sensors. These pins allow the board to measure variables such as light intensity, temperature, and sound level.

PWM (Pulse Width Modulation) Pins: Some Arduino boards come with PWM pins, which can be used to generate analog-like signals. PWM is often used to control the brightness of LEDs or the speed of motors.

USB Connection: Arduino boards feature a USB connection, which allows them to be connected to a computer for programming and serial communication. The USB connection also provides power to the board, eliminating the need for an external power source.

Power Jack: Arduino boards come with a power jack that can be used to connect an external power source, such as a battery or a wall adapter. This allows the board to be powered independently of the USB connection.

Reset Button: Arduino boards feature a reset button that can be used to restart the board and re-run the program.

Integrated Development Environment (IDE): Arduino boards are programmed using the Arduino IDE, which provides a simple and intuitive interface for writing, compiling, and uploading code to the board.

Open-Source: Arduino is an open-source platform, which means that the hardware designs and software libraries are freely available for anyone to use and modify. This has led to a large community of Arduino users who share their projects and collaborate on new ideas.

Overall, Arduino boards are versatile and easy-to-use platforms that are ideal for beginners and experienced makers alike. Their combination of features, affordability, and flexibility make them a popular choice for a wide range of projects, from simple blinking LED lights to complex robotics applications.

2.1.3 Arduino Pinout

• Arduino Uno is based on an AVR microcontroller called Atmega328. This controller comes with 2KB SRAM, 32KB of flash memory, and 1KB of EEPROM. The Arduino Board comes with 14 digital pins and 6 analog pins. ON-chip ADC is used to sample these pins. A 16 MHz frequency crystal oscillator is equipped on the board. The following figure shows the pinout of the Arduino Uno Board

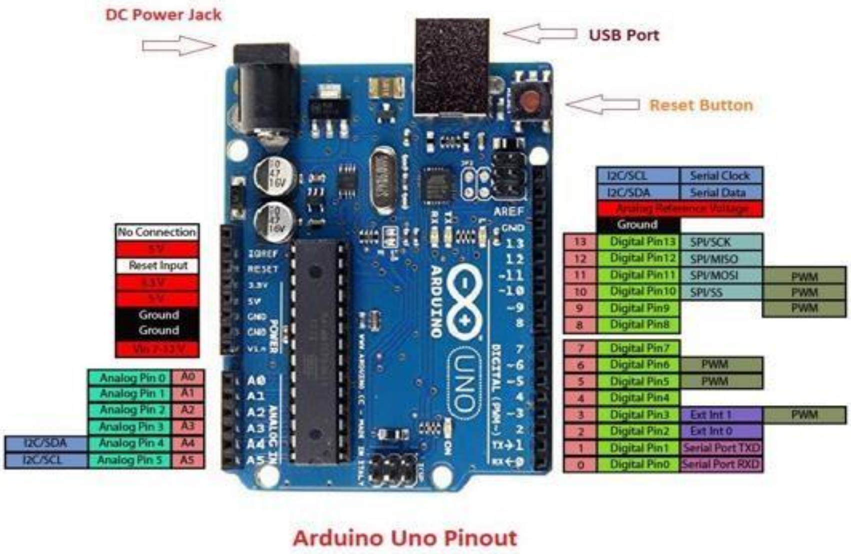


Figure.2. Arduino UNO Pinout diagram

3. Results and Discussion

The specifications of an integrated Thing Speak-enabled soil moisture sensor and agrobacterial communication is used for control. Commands such as "f" for forward, "b" for backward, "r" for right, "l" for left, "s" for stop, "o" for open seeding compartment, and "c" for close seeding compartment are all accepted. Additionally, if the soil is dry, it detects the soil moisture sensor and activates the pump. Every thirty seconds, the Thing Speak software establishes a WiFi connection and sends the soil moisture reading to a Thing Speak channel. In the future, it might be able to transmit control commands to the car using the data it gets from the serial monitor.

3.1 Code for Arduino UNO

```
#include<SoftwareSerial.h>
SoftwareSerial ss(10,11);
#include <Servo.h>
Servo myservo;  // create servo object to control a servo
// twelve servo objects can be created on most boards
int pos = 0;    // variable to store the servo position
String data; int mot1=2; int mot2=3; int mot3=4; int
mot4=5;
int soil=6;
int pump=7;

void setup()
{   // put your setup code here, to run
once:   Serial.begin(9600);
ss.begin(9600);
   myservo.attach(9);  // attaches the servo on pin 9 to the servo object
pinMode(mot1,OUTPUT);   pinMode(mot2,OUTPUT);
pinMode(mot3,OUTPUT);   pinMode(mot4,OUTPUT);
pinMode(pump,OUTPUT);   pinMode(soil,INPUT);
digitalWrite(mot1,LOW);   digitalWrite(mot2,LOW);
digitalWrite(mot3,LOW);   digitalWrite(mot4,LOW);
digitalWrite(pump,HIGH);
}
void loop()
```

```
{   // put your main code here, to run
repeatedly:   while(Serial.available()>0)
  {
data=Serial.readString();
  Serial.println(data);
  delay(500);  if(data=="f")
    {
      digitalWrite(mot1,LOW);
    digitalWrite(mot2,HIGH);
    digitalWrite(mot3,LOW);
    digitalWrite(mot4,HIGH);
      Serial.println("FORWARD");
    } else
    if(data=="b")
    {
      digitalWrite(mot1,HIGH);
digitalWrite(mot2,LOW);
digitalWrite(mot3,HIGH);
digitalWrite(mot4,LOW);
Serial.println("BACKWARD");
    }     else
if(data=="r")
    {
      digitalWrite(mot1,LOW);
digitalWrite(mot2,HIGH);
digitalWrite(mot3,LOW);
digitalWrite(mot4,LOW);
Serial.println("RIGHT");
    }     else
if(data=="l")
    {
      digitalWrite(mot1,LOW);
digitalWrite(mot2,LOW);
digitalWrite(mot3,LOW);
digitalWrite(mot4,HIGH);
      Serial.println("LEFT");
    }     else
if(data=="s")
    {
      digitalWrite(mot1,LOW);
digitalWrite(mot2,LOW);
digitalWrite(mot3,LOW);
digitalWrite(mot4,LOW);
Serial.println("STOP");
    }
    else if(data=="o")
    {
      for (pos = 0; pos <= 90; pos += 1)
```

```
    { // goes from 0 degrees to 180 degrees
   // in steps of 1 degree
     myservo.write(pos);           // tell servo to go to position in variable 'pos'
delay(15);                     // waits 15 ms for the servo to reach the position
if(pos==90)
    {
//     myservo.detach();
    Serial.println("SEEDING OPENED..");
    }
   } }  else
  if(data=="c")
   {    for (pos = 0; pos <= 180; pos +=
   1)
    { // goes from 0 degrees to 180 degrees //
   in steps of 1 degree   myservo.write(pos);
   // tell servo to go to position in variable
   'pos'   delay(15);                 // waits 15
   ms for the servo to reach the position
     if(pos==180)
    {
//     myservo.detach();
    Serial.println("SEEDING CLOSED");
    }
    }
   }
  }
  int moi=digitalRead(soil);
delay(500);   Serial.println(moi);
  if(moi==0)
  {
   Serial.println("PUMP OFF");
   digitalWrite(pump,HIGH);
  }
  else if(moi==1)
  {
   Serial.println("PUMP ON");
digitalWrite(pump,LOW);
   delay(5000);
digitalWrite(pump,HIGH);     delay(2000);
  }
ss.println(moi);
delay(500);
}
```

3.2 Code For Node MCU

```
#include <ESP8266WiFi.h>
#include "ThingSpeak.h" String
String_main;
```

```
const char* ssid = "project";   // your network SSID (name)  const
char*  password  =  "1234567890";     //  your  network  password
WiFiClient  client;
unsigned long myChannelNumber = 1351385; const char *
myWriteAPIKey = "8A5JUJ6XFDQQK2CW";
// Timer variables unsigned long
lastTime = 0; unsigned long
timerDelay = 30000; void setup() {
  Serial.begin(9600);  //Initialize serial
  WiFi.mode(WIFI_STA);
   ThingSpeak.begin(client);  // Initialize ThingSpeak
} void loop()
{
  if ((millis() - lastTime) > timerDelay) {
   // Connect or reconnect to WiFi
   if(WiFi.status() != WL_CONNECTED){
      Serial.print("Attempting to connect");
    while(WiFi.status() != WL_CONNECTED){
        WiFi.begin(ssid, password);
    delay(5000);
      }
      Serial.println("\nConnected.");
    } if
    (Serial.available())
{
  String_main=Serial.readStringUntil('\n');
  Serial.println(String_main);
    int x = ThingSpeak.writeField(myChannelNumber, 1, String_main, myWriteAPIKey);
if(x == 200){
      Serial.println("Channel update successful.");
    }
else{
      Serial.println("Problem updating channel. HTTP error code " + String(x));
    }     lastTime =
millis();
  }
}
}
```

3.2 Result

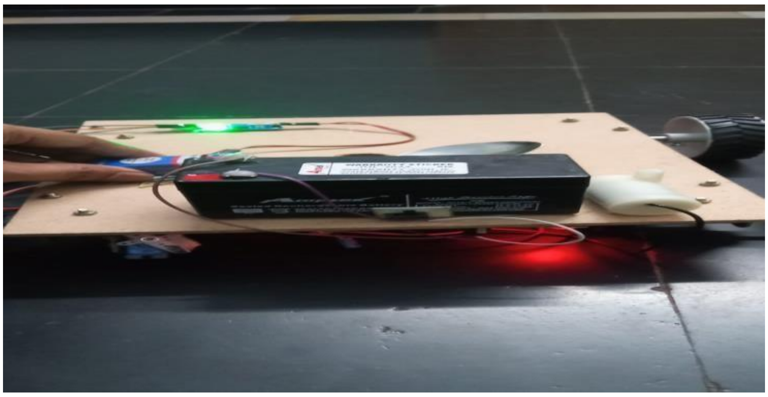


Figure.3. Working model of an Agribot

The picture shows the embedded integration of components include Arduino Uno, Bluetooth module, moisture sensor, Node MCU, Relay ,DC motor and pump.these components work together to create an agribot that can automate various farming tasks. The moisture sensor monitors soil conditions, the microcontroller makes decisions based on the sensor data, and the relay, DC motor, and pump execute actions like irrigation or potentially other tasks depending on the specific design. The Bluetooth module allows for remote monitoring and control, enhancing the functionality and user experience of the agribot.

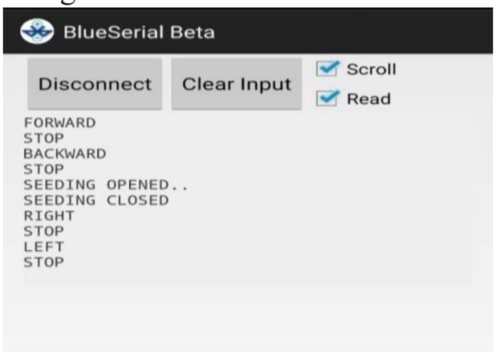


Figure.4. Different types of commands

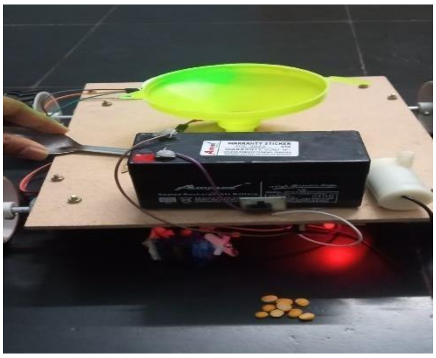


Figure.5. Output for given commands

The figure 4 depicts a remote-controlled agribot designed to assist with farming tasks. The system utilizes a smartphone app called BlueSerial Beta on a mobile phone as the transmitter. This app transmits Bluetooth commands to the agribot, which acts as the receiver. The commands are similar to remote control instructions, including "f" for forward, "r" for right, and likely others for backward, left, stop, and potentially additional functionalities. Upon receiving a valid command, the agribot executes the corresponding action, as illustrated in Figure 5 In essence, the Bluetooth app on the smartphone acts as a remote control for the agribot, enabling farmers to wirelessly guide the machine during farm operations.

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Figure.6. Shows wet condition

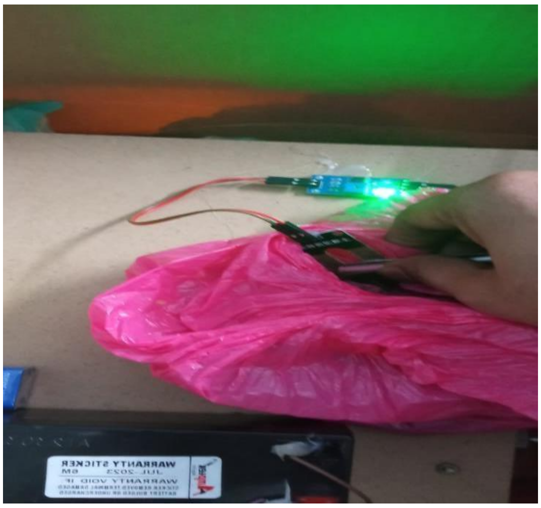


Figure.7. Shows dry condition

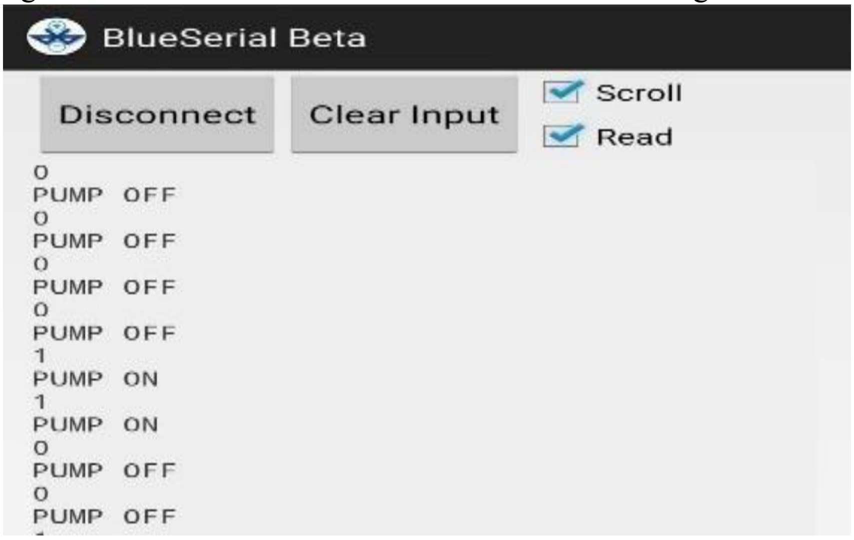
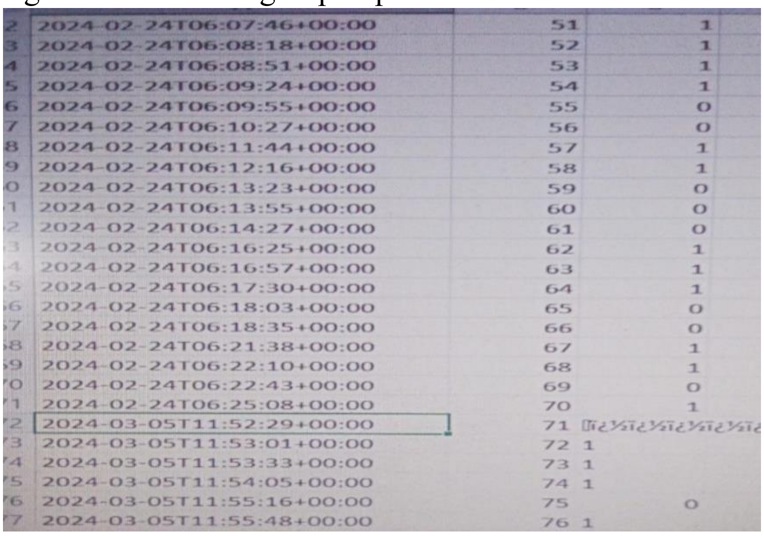


Figure.8. Functioning of pump



2	2024-02-24T06:07:46+00:00	51	1
3	2024-02-24T06:08:18+00:00	52	1
4	2024-02-24T06:08:51+00:00	53	1
5	2024-02-24T06:09:24+00:00	54	1
6	2024-02-24T06:09:55+00:00	55	0
7	2024-02-24T06:10:27+00:00	56	0
8	2024-02-24T06:11:44+00:00	57	1
9	2024-02-24T06:12:16+00:00	58	1
0	2024-02-24T06:13:23+00:00	59	0
1	2024-02-24T06:13:55+00:00	60	0
2	2024-02-24T06:14:27+00:00	61	0
3	2024-02-24T06:16:25+00:00	62	1
4	2024-02-24T06:16:57+00:00	63	1
5	2024-02-24T06:17:30+00:00	64	1
6	2024-02-24T06:18:03+00:00	65	0
7	2024-02-24T06:18:35+00:00	66	0
8	2024-02-24T06:21:38+00:00	67	1
9	2024-02-24T06:22:10+00:00	68	1
0	2024-02-24T06:22:43+00:00	69	0
1	2024-02-24T06:25:08+00:00	70	1
2	2024-03-05T11:52:29+00:00	71 ï¿½ï¿½ï¿½ï¿½ï¿½	
3	2024-03-05T11:53:01+00:00	72 1	
4	2024-03-05T11:53:33+00:00	73 1	
5	2024-03-05T11:54:05+00:00	74 1	
6	2024-03-05T11:55:16+00:00	75	0
7	2024-03-05T11:55:48+00:00	76 1	

Figure.9. Pump On Off Mechanism and Real Time Data Visualization

After completing the seed sowing process, the agribot automatically switches to soil moisture level assessment. It uses a sensor to determine if the soil is in one of two conditions: wet or dry. Based on this information, the agribot then proceeds to the watering stage. If the soil is dry, the agribot will activate its watering mechanism, ensuring optimal moisture levels for seed germination and growth. Conversely, if the sensor detects sufficient moisture (wet condition), the watering system remains inactive, preventing overwatering and potential harm to the seeds. This automated soil moisture check and watering function contribute to efficient water management and potentially increased crop yields.

3.3 Advantages and Applications

3.3.1 ADVANTAGE

1. Efficient Soil Moisture Management
2. Reduced Manual Labor
3. Watering
4. Increased Efficiency

3.3.2 APPLICATIONS

Precision Seed Sowing: The Agribot enables precise seed sowing by autonomously navigating agricultural fields and planting seeds at optimal depths and locations. This functionality ensures even crop distribution, reduces seed wastage, and enhances crop yields and resource utilization. Farmers can tailor seeding patterns based on crop types, soil conditions, and desired planting densities, thereby boosting overall farm productivity.

Moisture-Based Irrigation Management: Equipped with an integrated moisture monitoring system, the Agribot delivers real-time soil moisture data across the field. This information empowers farmers to implement accurate irrigation schedules, ensuring crops receive appropriate water amounts at critical stages. By optimizing irrigation practices, the Agribot aids in water conservation, mitigates risks of waterlogging or drought stress, and fosters robust plant growth and development.

Crop Health Monitoring: Leveraging multispectral imaging and remote sensing techniques, the Agribot continuously monitors crucial crop health indicators like chlorophyll content, leaf area index, and canopy temperature. By swiftly identifying early signs of stress, disease, or nutrient deficiencies, the Agribot facilitates prompt intervention strategies such as targeted pest control, foliar nutrient application, or irrigation adjustments. This proactive approach aids farmers in preventing yield losses, optimizing input utilization, and preserving crop quality throughout the growing season.

Data-Driven Decision Making: The Agribot gathers extensive data on soil and crop parameters, weather conditions, and field operations. Through harnessing data analytics and predictive modeling, farmers can extract valuable insights into crop performance, yield potential, and resource allocation. This empowers them to make informed decisions regarding planting strategies, input management, and agronomic practices, thereby enhancing productivity, profitability, and sustainability.

Labor Savings and Efficiency: Through automating labor-intensive tasks such as seed sowing, weed control, and soil monitoring, the Agribot diminishes the dependency on manual labor while streamlining farm operations. This liberates farmers' time and resources, enabling them to concentrate on strategic farm management, innovation, and value-added activities. Furthermore, the Agribot operates efficiently round-the-clock, maximizing productivity and minimizing downtime, particularly during critical farming seasons.

Enhanced Food Security: Ultimately, the Agribot significantly contributes to bolstering food security by elevating agricultural productivity, bolstering crop resilience, and ensuring consistent food supplies. By equipping farmers with cutting-edge technologies and decision support tools, the Agribot assists in surmounting challenges such as climate variability, resource limitations, and market fluctuations. This fosters the production of safe, nutritious, and affordable food, thereby fortifying food security and livelihoods for farming communities worldwide.

4.Conclusion

Our Agribot project showcases the vast potential of cutting-edge agricultural technologies in transforming farming practices. By integrating robotics, sensing capabilities, and data analytics, our goal is to provide farmers with smarter, more efficient, and sustainable solutions. The Agribot delivers unparalleled precision and control in crop management, autonomously handling tasks such as seed sowing, moisture monitoring, and resource optimization. This approach not only maximizes yields but also contributes significantly to food security and economic sustainability. Equipped with advanced sensors like moisture sensors and imaging systems, the Agribot continuously gathers real-time data on various environmental conditions, empowering farmers to make informed decisions and optimize crop health. Its scalability and modular design ensure compatibility with farms of varying sizes, facilitating widespread adoption and ease of integration. Moreover, the Agribot streamlines labour-intensive tasks, easing the workload for farmers and agricultural workers, particularly in areas grappling with labour scarcities. This liberation of time and resources enables farmers to concentrate on strategic decisionmaking and value-added endeavours, thereby enhancing overall farm efficiency and profitability. In summary, the Agribot marks a pivotal advancement toward fostering more sustainable, efficient, and resilient agricultural frameworks. Through the utilization of state-of-the-art technologies, we have the potential to instigate positive transformations, spur innovation, and pave the way for a more foodsecure and sustainable future.

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