Kamala Education Society’s

Pratibha College of Commerce & Computer Studies, Chinchwad, Pune-

Project Title: Iot-Based Smart Seed Sowing Robot

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Certificate

This is to certify that Sakshi Jagtap have satisfactorily completed Project Lab - BCA-368 "Iot-Based Smart Seed Sowing Robot" for TYBCA SCIENCE under the Savitribai Phule Pune University in the academic year 2024-2025.

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1.Introduction

A Smart Seed Sowing Robot is an advanced agricultural automation system designed to efficiently and precisely sow seeds in a field with minimal human intervention. This innovative system integrates technologies such as **Arduino microcontroller**, **IoT (Internet of Things)**, **GPS**, and various **agricultural sensors** to ensure accurate seed placement, depth control, and uniform spacing. The robot uses **soil moisture sensors, distance sensors, and motor-controlled mechanisms** to adapt to field conditions and sow seeds accordingly.

Real-time data such as location coordinates, sowing patterns, and operational status are transmitted to a **cloud-based platform** via IoT technology, allowing farmers to monitor and control the sowing process remotely. The inclusion of **GPS tracking** ensures systematic coverage of the field, reducing overlap and seed wastage. This smart system not only enhances productivity but also supports sustainable farming practices, making it highly beneficial for precision agriculture. It is especially useful in addressing the challenges of labour shortages, time constraints, and increasing demand for efficient farming methods.

2.Abstract

The proposed system is designed automate the seed sowing process using **Arduino**, **IoT technology**, and various sensors. The robot ensures precise seed placement, depth control, and spacing by continuously monitoring soil conditions and field parameters. The collected data is transmitted to an **IoT platform**, allowing users to view real-time updates and monitor the robot's performance remotely. This system can be effectively implemented in **smart agriculture**, **precision farming**, and **sustainable farming practices** to enhance productivity and reduce manual labour. By leveraging IoT technology, the system enables efficient resource utilization, minimizes seed wastage, and ensures uniform crop growth. Additionally, the ability to collect and analyse sowing data supports **predictive analysis**, which can be crucial for improving crop yield, planning agricultural activities, and optimizing farm operations.

3.Components and supplies

 Microcontroller & Communication

- Arduino Uno – Main controller
- HC-05 Bluetooth Module – Wireles communication

 Motors & Motor Driver

- 4 x DC Motors (with Wheels) – For movement
- L298N Motor Driver Module – To control motor direction and speed
- 2 x Servo Motors – For seed dispensing

 Sensors

- Moisture Sensor – To detect soil moisture levels

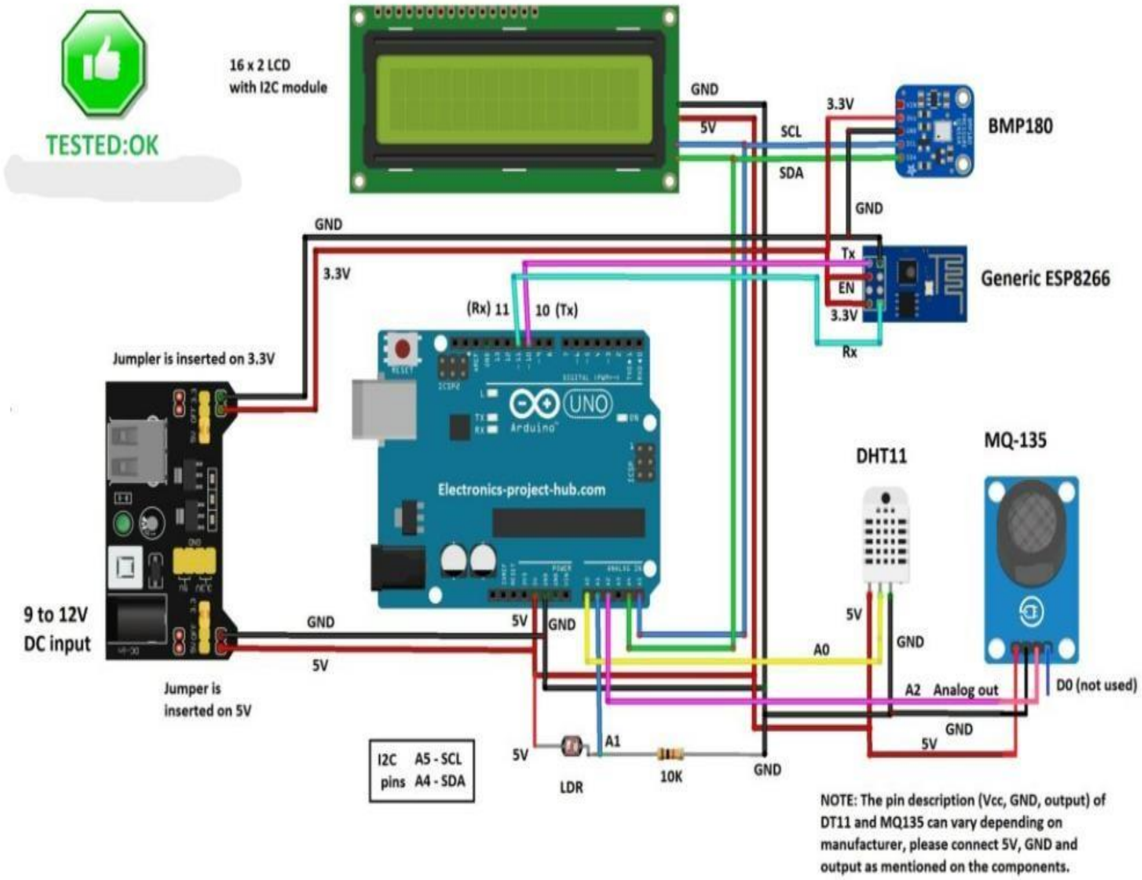
 Power Supply

- 15V External Power Supply – To power the motors
- Arduino Power (USB or 9V Battery)

 Additional Components & Wires

- Jumper Wires – For connections
- Breadboard (if needed) – For testing connections

4.Diagram



IoT based weather monitoring system using Arduino

5.Working of Project

1.Power Supply Connection:

A 9–12V DC power source is provided to power the system.

The power supply module regulates and distributes 5V and 3.3V to various components such as sensors, motors, and the microcontroller.

A jumper switch is used to select the appropriate voltage required for each module.

2.Arduino UNO as the Central Controller:

The Arduino UNO serves as the core controller of the system. It processes input from the sensors, manages the seed sowing mechanism, controls the motors, and communicates data to the cloud using the ESP8266 Wi-Fi module.

3.Sensors Collect Field Data:

Soil Moisture Sensor: Measures the moisture content in the soil to determine suitable conditions for sowing.

Ultrasonic or IR Sensors: Detect obstacles in the path of the robot for safe navigation.

Seed Level Sensor: Monitors the seed hopper to alert when the seed level is low.
These sensors feed data to the Arduino through their

respective input pins, enabling real-time field condition monitoring.

4.Data Transmission via ESP8266 Wi-Fi Module:

The ESP8266 Wi-Fi module is connected to Arduino via Tx (Transmit) and Rx (Receive) pins.

It provides wireless communication capabilities, sending operational and sensor data to an IoT platform such as ThingSpeak or Blynk for real-time monitoring.

5.Display Data on LCD Screen:

A 16x2 I2C LCD Display is used to show real-time data such as soil moisture level, seed level, and robot status.

The I2C communication protocol (SDA and SCL pins) allows efficient data display with minimal wiring.

6.Data Upload to Cloud for Remote Monitoring:

The Arduino regularly sends real-time operational data to the IoT cloud platform via the ESP8266 module.

Farmers or users can access this data remotely through a web dashboard or mobile app, helping them monitor sowing activity and make informed decisions.

7.User Alerts and Sowing Analytics:

The system can trigger alerts if predefined conditions are met, such as dry soil, low seed level, or obstacle detection.

6) Code

```
#include <SoftwareSerial.h>
#include <Servo.h>

SoftwareSerial BT(10, 11); // RX | TX for Bluetooth (HC-05)
Servo seedServo;  // Servo for seed dispensing

#define MOISTURE_SENSOR A0  // Moisture Sensor Analog Pin
#define MOTOR_IN1 6
#define MOTOR_IN2 7
#define MOTOR_IN3 8
#define MOTOR_IN4 9

void setup() {
  Serial.begin(9600);  // Serial Monitor for debugging
  BT.begin(9600);  // Bluetooth module communication

  // Servo motor for seed dispensing
  seedServo.attach(3);  // Servo on Pin D3
  seedServo.write(0);  // Ensure it's closed at start

  // Motor driver pins setup
```

```
  pinMode(MOTOR_IN1, OUTPUT);
  pinMode(MOTOR_IN2, OUTPUT);
  pinMode(MOTOR_IN3, OUTPUT);
  pinMode(MOTOR_IN4, OUTPUT);

  // Moisture sensor setup
  pinMode(MOISTURE_SENSOR, INPUT);

  // Stop motors initially
  stopMotors();
}

void loop() {
  // Read moisture sensor data
  int moistureValue = analogRead(MOISTURE_SENSOR);
  Serial.print("Moisture Level: ");
  Serial.println(moistureValue);

  // Bluetooth control
  if (BT.available()) {
    char command = BT.read();
    Serial.print("Received Command: ");
    Serial.println(command);  // Debugging print
```

```
    executeCommand(command);
  }

  delay(500);  // Delay for moisture sensor reading
}

void executeCommand(char command) {
  switch (command) {
    case 'F':  // Move Forward
      Serial.println("Moving Forward");
      moveForward();
      break;
    case 'B':  // Move Backward
      Serial.println("Moving Backward");
      moveBackward();
      break;
    case 'L':  // Turn Left
      Serial.println("Turning Left");
      turnLeft();
      break;
    case 'R':  // Turn Right
      Serial.println("Turning Right");
```

```
    turnRight();
    break;
   case 'S':  // Stop
    Serial.println("Stopping");
    stopMotors();
    break;
   case 'O':  // Open Seed Dispenser
    Serial.println("Opening Seed Dispenser");
    seedServo.write(90);
    break;
   case 'C':  // Close Seed Dispenser
    Serial.println("Closing Seed Dispenser");
    seedServo.write(0);
    break;
   default:
    Serial.println("Unknown Command");
    stopMotors();
    break;
  }
}

void moveForward() {
  digitalWrite(MOTOR_IN1, HIGH);
```

```
  digitalWrite(MOTOR_IN2, LOW);
  digitalWrite(MOTOR_IN3, HIGH);
  digitalWrite(MOTOR_IN4, LOW);
}

void moveBackward() {
  digitalWrite(MOTOR_IN1, LOW);
  digitalWrite(MOTOR_IN2, HIGH);
  digitalWrite(MOTOR_IN3, LOW);
  digitalWrite(MOTOR_IN4, HIGH);
}

void turnLeft() {
  digitalWrite(MOTOR_IN1, LOW);
  digitalWrite(MOTOR_IN2, HIGH);
  digitalWrite(MOTOR_IN3, HIGH);
  digitalWrite(MOTOR_IN4, LOW);
}

void turnRight() {
  digitalWrite(MOTOR_IN1, HIGH);
  digitalWrite(MOTOR_IN2, LOW);
  digitalWrite(MOTOR_IN3, LOW);
```

```
  digitalWrite(MOTOR_IN4, HIGH);
}

void stopMotors() {
  digitalWrite(MOTOR_IN1, LOW);
  digitalWrite(MOTOR_IN2, LOW);
  digitalWrite(MOTOR_IN3, LOW);
  digitalWrite(MOTOR_IN4, LOW);
}
```

7. Application

1. Precision Agriculture

- Smart seed sowing systems ensure **accurate and consistent seed placement**, improving crop yield and reducing seed wastage.
- By automating the sowing process, farmers can achieve **uniform spacing and depth**, leading to better germination rates.

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2. Reduced Labor Dependency

- Automation reduces the need for manual labor in the sowing process.
- This is especially beneficial for **large-scale farming**, where manual sowing can be time-consuming and costly.

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3. Water and Resource Optimization

- Integration with **soil moisture sensors** allows precise sowing only in areas with optimal moisture levels.
- This reduces water wastage and ensures **efficient resource utilization**.

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4. Cost-Effectiveness and Efficiency

- Automated sowing reduces the cost of labor and minimizes seed wastage.

- The **accurate placement of seeds** prevents overcrowding, leading to healthier crops and better yield.

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5. Data-Driven Decision Making

- By integrating **IoT sensors** and data collection modules, farmers can monitor and analyze soil conditions, weather patterns, and seed performance.
- This enables **data-driven decisions** for optimal planting strategies.

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6. Suitable for Various Crops

- Smart sowing machines can be customized for different seed types and planting patterns.
- Suitable for **cereals, pulses, oilseeds, and horticultural crops**.

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7. Sustainability and Eco-friendliness

- Reduces the **use of fertilizers and pesticides** through precise planting techniques.
- Supports **eco-friendly farming practices** by minimizing soil disturbance and improving overall efficiency.

8.Future Scope

- **Integration with Artificial Intelligence (AI):**

Implement **machine learning algorithms** to analyse soil data, optimize seed placement strategies, and predict crop yield for enhanced farming outcomes.

- **Advanced Sensor Integration:**

Incorporate additional sensors such as **pH sensors, nutrient sensors**, and **crop growth monitoring sensors** to further improve sowing precision and crop management.

- **Mobile App Development:**

Develop a **dedicated mobile application** to allow farmers to monitor robot operations, receive **real-time notifications**, and control sowing functions remotely.

- **Automated Multi-Tasking in Agriculture:**

Extend functionality by integrating **automated irrigation**, **fertilizer spraying**, and **weeding mechanisms** into the robot, making it a complete smart farming solution.

- **Energy Efficiency Enhancements:**

Introduce **solar-powered models** for sustainable operation, especially in remote or off-grid agricultural fields, reducing dependence on conventional power sources.

- **GPS and GIS-Based Sowing:**

Implement **GPS and Geographic Information System (GIS)** technology for accurate field mapping and **automated path planning**, ensuring zero overlap and maximum efficiency.

- **Swarm Robotics for Large-Scale Farming:**

Deploy **multiple interconnected seed sowing robots** (swarm robots) working collaboratively across large fields, improving scalability and reducing sowing time significantly.

- **Data Analytics and Cloud-Based Insights:**

Utilize historical sowing data for **data-driven decision-making**, yield prediction, and **smart farm planning**, contributing to more productive and profitable agriculture.

9.Conclusion

The **Smart Seed Sowing Robot** represents a significant step forward in the automation of agricultural practices. By integrating **Arduino, IoT, sensors, and smart control mechanisms**, the system ensures precise, efficient, and uniform seed sowing, thereby enhancing productivity and reducing manual labour. The robot not only streamlines the sowing process but also contributes to **sustainable and precision farming** by optimizing resource utilization and minimizing seed wastage.

Its ability to **collect and transmit real-time data**, coupled with the potential for **future integration of AI and advanced analytics**, makes it a valuable tool in transforming traditional agriculture into a **technology-driven sector**. The implementation of such intelligent systems can greatly benefit farmers by improving yield, reducing costs, and paving the way for a **smarter and more efficient agricultural ecosystem**.

10.Reference links :

⍰ **Research Paper:**
"Precision Agriculture and IoT: Smart Seed Sowing Machines"
Journal of Agricultural Engineering, 2024.
📌 Available at: ResearchGate

⍰ **Article:**
"How IoT is Transforming Precision Agriculture"
AgriTech Today, 2023.
📌 Available at: AgriTech Today

⍰ **Technical Blog:**
"Smart Farming: Automated Seed Sowing with IoT and Robotics"
TechFarmer Blog, 2024.
📌 Available at: TechFarmer

⍰ **IoT in Agriculture Report:**
"Smart Agriculture Market – Trends and Forecast (2025)"
Research and Markets, 2024.
📌 Available at: Research and Markets