



IoT Applications in Seeding Machinery

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Seed sowing is a crucial agricultural step as it marks the beginning of the plant's life cycle and establishes the foundation for healthy growth and successful cultivation. This paper presents an IoT-based automated system for seed sowing aimed at addressing key challenges faced in modern agriculture, including labour shortages, inefficient resource usage, and excessive reliance on chemicals. The proposed system integrates various components such as soil moisture sensors, temperature and humidity sensors, ultrasonic obstacle detectors, actuators, and a microcontroller (ESP32) with Wi-Fi connectivity. These components work together to assess environmental conditions in real time, enabling precise seed placement and timely pesticide application only when necessary. By using real-time data and automation, the system significantly reduces human effort while increasing operational efficiency and accuracy. It ensures optimal use of agricultural inputs, helping to minimize waste and environmental impact. The machine also features cloud connectivity, allowing farmers to monitor and control operations remotely through a mobile application or web interface. Powered by solar energy, the system is energy-efficient and well-suited for remote or off-grid farming locations. The design promotes sustainable and smart farming practices, making it especially valuable for small and medium-scale farmers. Overall, the implementation of this IoT-based agricultural solution can play a vital role in enhancing crop productivity, conserving resources, and supporting the transition toward precision agriculture.

Keywords: Internet of Things (IoT), Precision Agriculture, Smart Farming, Automated Seed Sowing, Wireless Monitoring System.

Introduction

IoT-based agricultural systems are designed to bring intelligence and automation to farming practices, addressing the limitations of conventional manual methods. Traditional farming often relies on labour-intensive processes for seed sowing and pesticide application, leading to inefficiencies such as uneven seed placement, excessive chemical use, and increased operational costs. The integration of the Internet of Things (IoT) enables the development of smart farming machinery that performs these tasks based on real-time environmental data. The proposed system utilizes a combination of soil moisture sensors, temperature and humidity sensors, and ultrasonic obstacle detectors to automate decision-making in seed sowing and pesticide spraying. A microcontroller (such as ESP32) processes sensor input and controls actuators, while wireless communication via Wi-Fi allows real-time monitoring and remote control through cloud platforms. This facilitates precision farming by ensuring optimal seed placement and targeted spraying, improving both crop yield and resource management. Designed with small and medium-scale farmers in mind, the machine is solar-powered for off-grid usability, and structured to be cost-effective, modular, and scalable. As final-year students in electronics and telecommunication, we recognize the significance of this innovation in transforming traditional agriculture into a sustainable, data-driven industry. The increasing need for smart farming solutions positions this project as a step forward in addressing global food security challenges.

Table No.1 Essential IoT Applications in seeding Machinery

IoT Application	Function
Real-time machinery tracking	Continuous monitoring of equipment location and usage
Predictive maintenance	Early detection and prevention of breakdowns
Precision farming	Optimal resource management based on sensor data

IoT in seeding machinery: IoT (Internet of Things) applications in seeding machinery focus on transforming traditional planting into a precision-driven, automated process. By integrating sensors, actuators, and connectivity, these systems allow farmers to monitor and control seeding in real-time, improving accuracy, reducing labor, and optimizing seed usage.

Precision Seeding: Sensors measure soil moisture, temperature, and texture in real-time. The IoT system then automatically adjusts the seeding depth and seeding rate (the number of seeds per acre) on-the-fly to match the specific conditions of a micro-patch of soil.

Variable Rate Technology (VRT): Connected machines use GPS and historical field maps to vary the amount of seed or fertilizer applied. For instance, if a specific area of a field is historically less fertile, the machine can be programmed to sow more seeds or apply more fertilizer automatically as it passes over that zone.

Real-time Monitoring & Blockage Detection: Seed drills are fitted with optical sensors that count seeds as they drop. If a tube gets blocked or a hopper runs empty, the IoT system sends an instant alert to the farmer's smartphone or the tractor's dashboard, preventing large patches of "missed" crop.

Remote Management & Telematics: Farmers can track the machine's location, fuel consumption, and performance metrics from a central dashboard. This allows for better fleet management and logistics planning.

Predictive Maintenance: IoT sensors monitor mechanical vibrations, motor temperature, and part wear. The system can predict a failure before it happens, allowing for repairs during the off-season and avoiding costly downtime during the narrow "planting window."

Examples of IoT Based Seeding Machinery

Solar-Powered Agribot with Seed Sowing: An autonomous robot utilizing an ESP8266 or Arduino Uno that integrates ploughing, sowing, and fertilizing. It features a motor-driven mechanism for seed release, a 12V battery charged by solar panels, and a Wi-Fi module for live monitoring of soil moisture, temperature, and humidity, allowing for remote operation through a web-based dashboard.



Fig 1: Solar powered Agribot with Seed sowing
<https://www.youtube.com/watch?v=tru3Fo5FTGQ>

Smart Seed Sower Rover: A small-scale robotic rover that uses an ESP8266 Node MCU to act as an automatic seed dropper and waterer. It is designed to navigate rows, drill holes with a servo motor, drop seeds at precise intervals, and cover them, using data from moisture sensors to trigger automatic irrigation after seeding.



Fig 2: Smart Seed sower rover
<https://nevonprojects.com>

Automatic Seed Sowing Robot with Blynk App: A prototype device controlled via a smartphone app. Using Bluetooth or Wi-Fi, the operator can move the robot forward, backward, left, or right, and trigger a servo motor to dispense seeds at specific intervals, automating the planting process.



Fig 3: Automatic Seed Sowing Robot with Blynk App

IoT-Enabled Semi-Automated Sowing Machine: A walk-behind tractor attachment that combines physical seeding mechanisms with sensors to monitor seed levels in the hopper. It connects to the internet to report the coverage area, sowing density, and speed to a cloud-based dashboard.

Multipurpose Agricultural Robotic Vehicle: An advanced bot using Arduino, featuring a, digging unit, a, seed dropper, and a, weed cutter. It uses a, soil moisture sensor to make real-time decisions about when and where to plant, maximizing, water efficiency and, labor, savings.



Fig 4: Smart phone operated multipurpose robotic vehicle
(<https://matlabprojects.org>)

Conclusion

The future scope of seed sowing machines looks promising, particularly in the context of sustainable farming practices and increased demand for automation in agriculture. As global agricultural practices evolve, the need for efficient, environmentally friendly, and cost-effective solutions becomes more apparent. Innovative seed-planting tools have a significant impact on agriculture. We may save a lot of labor costs and the amount of time needed for the sowing procedure by utilizing this creative project of seed sowing equipment. solar-powered seedplanting machine can maintain row spacing and regulate seed rate after comparing various seed-planting techniques and the shortcomings of the current machine.

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