

# IOT Enabled Multipurpose Agriculture Robot for Crop Monitoring and Field Operation

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**Abstract** - The IoT-enabled multipurpose agriculture robot for crop monitoring and field operation is a smart farming system designed to automate essential agricultural activities such as seed sowing and irrigation using renewable solar energy. The system is built around an Arduino microcontroller, which controls movement and field operations. The robot is mounted on a four-wheel mobile platform driven by DC motors through a motor driver to ensure smooth navigation across agricultural land. A servo motor-controlled funnel mechanism enables precise and uniform seed dispensing, reducing wastage and ensuring proper crop spacing, while a relay- controlled water pump provides efficient irrigation. The system is powered by a 9V solar panel, making it energy-efficient and environmentally sustainable. The robot is integrated with the Adafruit IoT platform for remote monitoring and control via the internet, allowing farmers to manage operations from anywhere. Designed for small- scale farming, this system reduces manual labor, improves efficiency, and promotes sustainable smart agriculture practices.

**Key Words:** Agriculture robot, Ploughing, Seed dispenser, Water Pumping.

## 1. INTRODUCTION

An Embedded System is a combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a specific function. A good example is the microwave oven. Almost every household has one, and tens of millions of them are used everyday, but very few people realize that a processor and software are involved in the preparation of their lunch or dinner.

This is in direct contrast to the personal computer in the family room. It too is comprised of computer hardware and software and mechanical components (disk drives, for example). However, a personal computer is not designed to perform a specific function rather; it is able to do many different things. Many people use the term general-purpose computer to make this distinction clear. As shipped, a general-purpose computer is a blank slate; the manufacturer does not know what the customer will do with it. One customer may use it for a network file server another may use it exclusively for playing games, and a third may use it to write the next great American novel.

Frequently, an embedded system is a component within some larger system. For example, modern cars and trucks contain many embedded systems. One embedded system controls the anti-lock brakes, other monitors and controls the vehicle's emissions, and a third displays information on the dashboard. In some cases, these embedded systems are connected by some sort of a communication network, but that is certainly not a requirement.

## 2. LITERATURE SURVEY

Several researchers have proposed IoT-based and robotic solutions to enhance agricultural productivity and reduce manual labor in farming operations. R. K. Jain, S. Kumar, and P. Singh developed an IoT-based smart agriculture monitoring system that utilizes sensors to monitor environmental parameters such as soil moisture, temperature, and humidity in real time. The system also incorporates automated irrigation control to optimize water usage and improve crop growth efficiency. Similarly, M. V. Reddy and A. Sharma designed a solar-powered agricultural robot capable of performing field operations such as seed sowing and irrigation. Their system uses DC motors for navigation and a servo-based

mechanism for precise seed placement, while solar energy is used as a sustainable power source. In another study, S. R. Nandurkar et al. introduced an IoT-based smart farming approach that integrates wireless sensors and cloud technology to monitor field conditions and automate irrigation systems.

P. Rawal explored the application of wireless sensor networks in agriculture to collect and transmit real-time environmental data to centralized monitoring systems, enabling farmers to make better decisions regarding irrigation and crop management. Furthermore, A. Kumar and T. Patel proposed an Arduino-based automatic irrigation system that uses soil moisture sensors to control water supply, thereby reducing water wastage and improving irrigation efficiency. Additionally, B. Kumar et al. developed an autonomous agricultural robot capable of performing various field operations such as navigation and crop monitoring using embedded systems and motor driver modules. These studies indicate that the integration of IoT, automation, and robotic technologies can significantly improve efficiency, optimize resource utilization, and support sustainable agricultural practices.

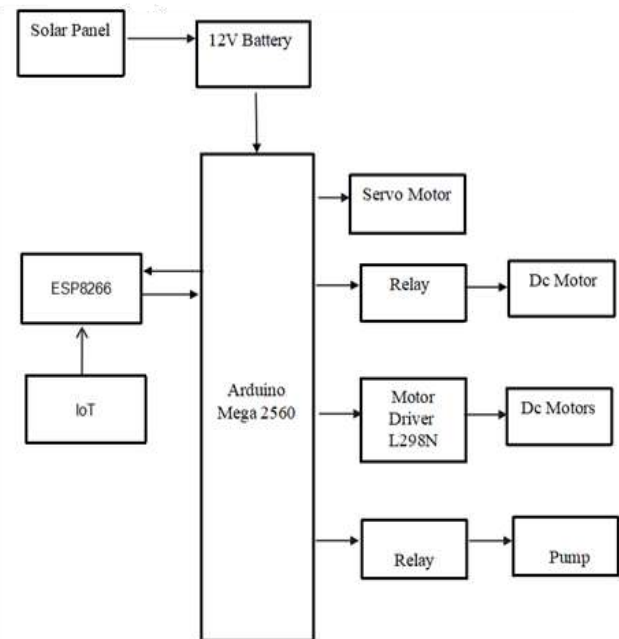
### 3. EXISTING SYSTEM

Traditional agricultural practices still rely on manual labor or fuel-powered machines for tasks like seed sowing and irrigation. These methods are time-consuming, inconsistent, and environmentally unsustainable due to high fuel consumption and human dependency. Manual processes often lead to uneven seed distribution, overuse or under use of water, and delayed operations, especially in large or remote farms. Moreover, rising labor costs and the lack of automation reduce the overall efficiency and scalability of farming operations.

### 4. PROPOSED SYSTEM

The proposed model is an IoT-enabled multipurpose agriculture robot designed to automate crop monitoring and essential field operations such as seed sowing and irrigation using solar energy. An Arduino microcontroller acts as the central control unit, interfacing with DC motors through a motor driver to enable smooth navigation of the robot across agricultural fields. A servo-controlled funnel mechanism is employed for accurate seed dispensing, while a relay-operated water pump supports controlled irrigation. The system is integrated with the Adafruit IoT platform, allowing remote monitoring and control of robot movements and

agricultural operations through the internet. Power is supplied primarily by a 9V solar panel, ensuring energy efficiency and eco-friendly operation. All hardware components are enclosed in a protective plastic casing to withstand outdoor conditions. This proposed model reduces manual labor, improves operational efficiency, and supports smart and sustainable agricultural practices for small-scale farming.



**Fig 4.1:**Block Diagram of Proposed System

Initially, the user controls the robot through the Adafruit remote interface available on a mobile application or web dashboard. The interface contains different control buttons that allow the user to send commands for robot movement and other farming operations. When the user presses any button on the remote interface, the command is transmitted through the internet to the Adafruit cloud server.

The ESP8266 then sends the command to the Arduino Mega 2560, which activates the motor driver module. The motor driver controls the DC motors connected to the robot wheels, allowing the robot to move in the required direction. If the stop or mode button is pressed on the remote interface, the Arduino Mega 2560 stops the motor driver signals and the robot movement is immediately stopped.



**Fig 4.2:** Working Model of the Proposed System

For the ploughing operation, a servo motor is connected to the ploughing mechanism of the robot. When the user presses the Enter button on the remote interface, the command is transmitted to the ESP8266 and then forwarded to the Arduino Mega 2560. The Arduino Mega 2560 activates the servo motor, which rotates and lowers the ploughing tool into the soil. This allows the robot to perform soil loosening while moving through the field. When the Back button is pressed on the remote interface, the servo motor stops and the ploughing operation is turned off.

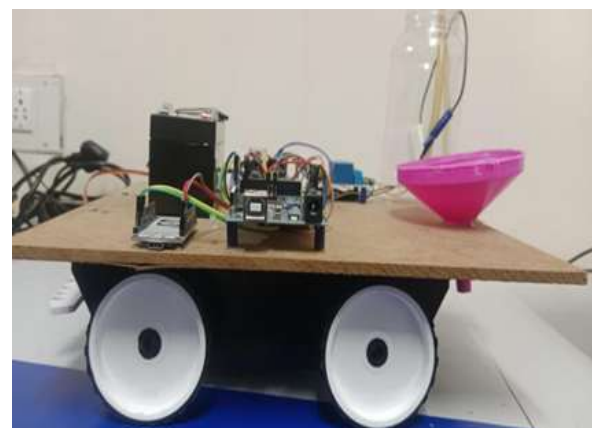
For the seed sowing process, a DC motor is connected to the seed dispensing mechanism of the robot. When the user presses Button 1 on the remote interface, the ESP8266 receives the command and sends it to the Arduino Mega 2560. The Arduino Mega 2560 then activates the DC motor, which rotates the seed dispensing unit and releases seeds into the soil. When Button 3 is pressed, the Arduino Mega 2560 stops the DC motor and the seed sowing operation is turned off.

For irrigation, the robot uses a water pump controlled by a relay module. When the user presses Button 2 on the remote interface, the command is received by the ESP8266 and transmitted to the Arduino Mega 2560. The Arduino Mega 2560 activates the relay module, which switches on the water pump to supply water to the crops. When Button 4 is pressed, the relay module deactivates the pump and the irrigation process stops.

Through this working mechanism, the proposed system enables efficient agricultural operations using IoT technology. The integration of the Adafruit platform, ESP8266 communication module, and Arduino Mega 2560 controller allows the robot to perform multiple farming tasks remotely and efficiently.

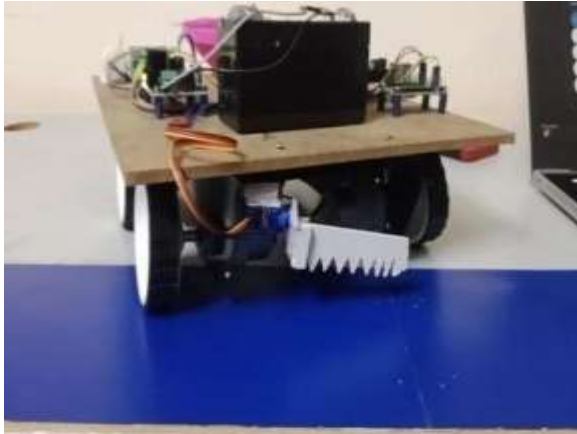
## 5. RESULTS AND DISCUSSIONS

The proposed agriculture robot was successfully controlled using the Adafruit IoT platform. The robot receives remote commands through the internet and performs different agricultural operations such as movement, ploughing, seed sowing, and water pumping. Direction commands such as left, right, up, and down are sent from the Adafruit remote interface. These commands are received by the ESP8266 module through Wi-Fi communication. The ESP8266 forwards the commands to the Arduino Mega 2560 controller. The Arduino Mega 2560 processes these commands and sends appropriate signals to the motor driver module, which controls the DC motors and changes the direction of the robot accordingly. When the stop mode button is pressed, the robot movement stops immediately.



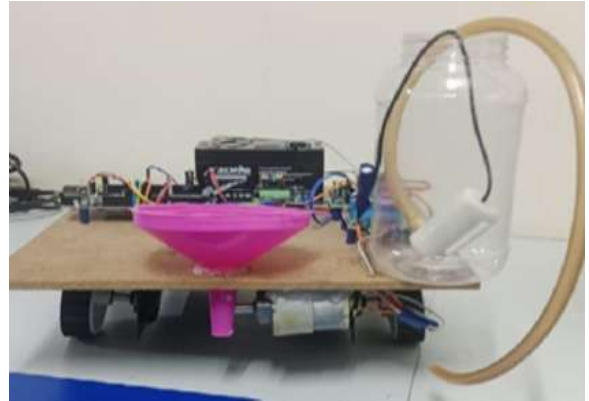
**Fig. 5.1:** Robot direction control using Adafruit Platform

When the enter/save button on the remote interface is pressed, the ploughing mechanism is activated as shown in Fig.5.2. The ploughing tool attached to the robot begins loosening the soil while the robot moves across the agricultural field. When the back button is pressed, the ploughing operation stops.



**Fig. 5.2:** Ploughing Operation

When the 1 button on the remote interface is pressed, the DC motor responsible for seed sowing is activated as shown in Fig.5.3. The seed dispensing mechanism releases seeds into the soil while the robot moves forward. When the 3 button is pressed, the seed sowing process stops.



**Fig. 5.4:** Water Pumping

The experimental results demonstrate that the proposed agriculture robot can successfully perform multiple farming operations through remote commands using the Adafruit IoT platform. This system helps in reducing manual labor, improving irrigation management, and supporting efficient smart farming practices.

## 6. CONCLUSION AND FUTURESCOPE

The IoT-enabled multipurpose agriculture robot presents an innovative and sustainable solution for modern farming challenges. By automating critical agricultural tasks such as seed sowing and irrigation, the system minimizes manual labor, enhances operational precision, and improves overall farming efficiency. The integration of the Arduino microcontroller with DC motors, a servo-controlled seed dispensing mechanism, and a relay-operated water pump ensures smooth and reliable field operations. The use of solar energy as the primary power source makes the system environmentally friendly and cost-effective. Furthermore, integration with the Adafruit IoT platform enables remote monitoring and control, offering flexibility and convenience to farmers. This proposed system is especially beneficial for small-scale farmers seeking affordable automation solutions. Overall, the model supports sustainable agriculture, promotes energy efficiency, and contributes to the advancement of smart farming technologies.



**Fig. 5.3:** Seed Sowing

Similarly, when the 2 button on the remote interface is pressed, the water pump is activated through the relay module and water is supplied to the crops. When the 4 button is pressed, the water pump is turned off as shown in Fig.5.4.

## FUTURE SCOPE

A solar-based multipurpose agriculture robot offers numerous possibilities for enhancing efficiency, productivity, and sustainability in farming practices. In future, by adding few sensors like soil moisture & ultrasonic sensors for extreme minimizing the human supervision. By using soil moisture sensor we can detect the soil type. By Using the ultrasonic sensor the robot can change the direction when the obstacle ahead.

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