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Multipurpose Agriculture Vehicle using Arduino

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Abstract
This project presents the design and development of a cost-effective, multifunctional agricultural vehicle powered by an Arduino microcontroller. In response to the growing need for efficient and adaptable machinery in modern farming, particularly for small-scale operations, this vehicle is engineered to automate key agricultural tasks such as ploughing, sowing, spraying, and harvesting. By integrating interchangeable implements and sensor-based feedback systems, the vehicle optimizes performance based on real-time environmental conditions like soil moisture and temperature. At the core of the system, the Arduino microcontroller processes data from various sensors and controls actuators to ensure precise and adaptive task execution. The paper outlines the conceptualization, mechanical and electronic integration, and functional testing of the prototype. Initial results indicate the vehicle & effectiveness in performing intended operations, demonstrating its potential to significantly reduce manual labour and enhance productivity in resource-constrained agricultural settings. Future enhancements will explore the incorporation of advanced features such as autonomous navigation, precision farming techniques, and a more intuitive user interface. This work represents a promising step toward sustainable, intelligent farming solutions tailored to the needs of smallholder farmers.

Keywords: *Solar panel; Arduino UNO; Bluetooth; DC Motor; Motor Driver; Bluetooth App;*

1. Introduction

Agriculture forms the backbone of the Indian economy and remains the primary source of livelihood for a significant portion of the population. However, traditional farming practices are increasingly becoming unsustainable due to factors such as labor shortages, increased operational costs, and declining soil productivity. As a result, the integration of automation and smart technologies into agricultural operations has become crucial to ensure productivity, precision, and sustainability. Automation not only improves efficiency but also reduces the physical burden on farmers and enhances yield quality through consistent operation. In recent years, the use of embedded systems and low-cost microcontrollers like Arduino has gained popularity in the development of agriculture-related technologies. Arduino offers flexibility, ease of programming, and compatibility with a wide range of sensors and actuators, making it a suitable platform for rural and resource-constrained environments. Combining this technology with mobile communication interfaces such as Bluetooth enables farmers to operate devices remotely, with minimal training. The idea of a **Multipurpose Agriculture Vehicle (MAV)** stems from the need to develop a single, compact system capable of executing multiple essential farming tasks such as plowing, sowing, pesticide spraying, and soil condition monitoring. While there are machines available for individual tasks, they are often large, expensive, and inaccessible to small-scale farmers. Moreover, employing separate tools for each operation increases time, effort, and fuel consumption. [1] This paper aims to present the design methodology, hardware

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and software implementation, and testing of the prototype MAV. The results demonstrate that the MAV can successfully reduce dependency on human labor and serve as an economical solution for precision farming practices. The modular approach ensures that more functionalities can be added in the future without redesigning the entire system.

2. Literature Review

[1] Seed Sowing and Ploughing Systems Patel et al. (2020) developed a robotic seed sowing system using Arduino Uno, which automated seed dropping at uniform intervals. The machine was also equipped with depth-controlling mechanisms. However, the design was limited to a single function and lacked real-time feedback or environmental sensing. Similarly, Pawar and Kadam (2019) proposed a low-cost seed sowing cart using servo motors, but it required continuous manual supervision. [2] Pesticide Spraying Robots S. Kumar and A. Joshi (2018) implemented an Arduino-based pesticide spraying vehicle controlled via Bluetooth. The system allowed the farmer to move the vehicle and control the sprayer remotely, thereby reducing human exposure to harmful chemicals. Although effective in spraying, the model lacked soil sensing or seeding capabilities and could not adapt to multipurpose use. [3] Soil Monitoring and Smart Irrigation Yadav and Patel (2019) presented a system that utilized soil moisture sensors and temperature sensors connected to an Arduino microcontroller to automate irrigation systems. Their focus was on optimizing water usage. While this system could be integrated with irrigation, it was stationary and not capable of performing mobility-based farming operations [4].

3. System Design and Methodology

The system comprises the following components

- Arduino UNO
- Solar Panel
- Bluetooth Module
- Motor Driver
- Relay Module

The **Multipurpose Agriculture Vehicle** uses solar panels to generate electrical energy, which powers the system and reduces the need for fossil fuels. An **Arduino Uno** microcontroller controls all operations, receiving commands via Bluetooth [5]. The vehicle performs three key functions: **grass cutting** using a rotating blade, **spraying** through a pump and nozzle system, and **ploughing** with an attached soil-cutting tool. Each function is powered by motors and relays, allowing efficient and eco-friendly operation in agricultural fields (Figure 1).

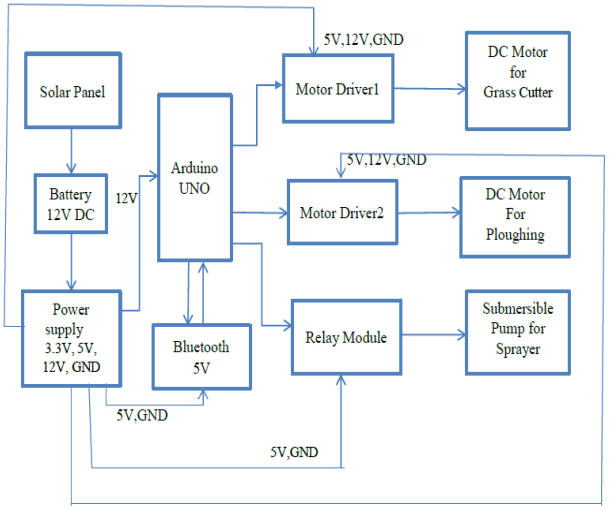

Figure 1 Block Diagram of Multipurpose Agriculture Vehicle

3.1.Arduino UNO

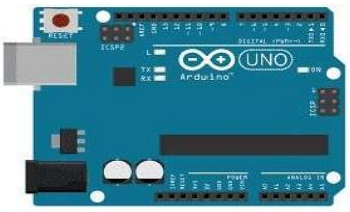

Figure 2 Arduino UNO

The Arduino UNO (Figure 2) is one of the most widely used microcontroller boards, especially among beginners and electronics enthusiasts, due to its user-friendly design, robust community support, and extensive library ecosystem. It features 14 digital input/output pins (including 6 with PWM capability), 6 analog input pins, a 16 MHz quartz crystal, a USB interface, a power jack, an ICSP header, and a reset button. The board is programmed using the Arduino IDE, which supports both C and C++ languages and offers an intuitive development environment. Power

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can be supplied through a USB cable or an external adapter, allowing flexible deployment. Its compatibility with a wide range of sensors, actuators, and modules makes it an ideal choice for building embedded systems and automation-based projects.

3.2.Bluetooth Module (HC-05)

Figure 3 Bluetooth Module

The HC-05 is a versatile Bluetooth module (Figure 3) widely used in embedded systems and IoT applications for enabling wireless serial communication. It supports both master and slave modes, allowing seamless communication between serial-enabled devices over Bluetooth. A built-in status LED provides visual feedback—blinking rapidly when awaiting a connection and slowing to a 2-second interval once paired. Although the HC-05 operates at a 3.3V logic level, it includes an onboard voltage regulator, which permits safe operation with a 5V power supply. Its broad compatibility with various microcontrollers and straightforward integration make it a popular choice for wireless control and monitoring applications.

3.3.Motor Driver

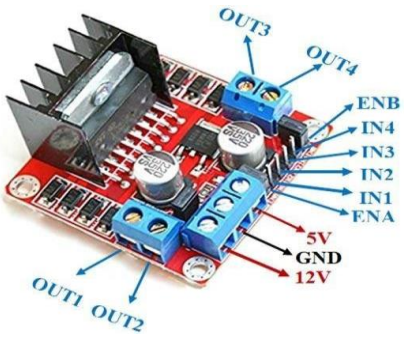

Figure 4 L298N Motor Driver

The L298N Motor Driver Module (Figure 4) is a robust, high-power motor controller commonly used in robotics and automation projects to manage DC and stepper motors. At its core is the L298 dual H-Bridge motor driver IC, which allows for independent control of two DC motors with both speed and direction capabilities. The module also integrates essential components such as a 78M05 voltage regulator, resistors, capacitors, a power indicator LED, and a 5V jumper, all housed within a compact circuit board. It can drive up to four DC motors (without speed control) or two motors with full speed and directional control, making it a reliable and versatile solution for embedded motor control applications.

3.4.Relay Module

Figure 5 Relay Module

The **Relay Module** (Figure 5) is an electrically operated switch widely used in automation and control systems to manage high-voltage or high-current loads using low-power control signals. It acts as an interface between microcontrollers like Arduino and external devices such as motors, lights, or pumps. The module typically consists of an electromagnetic relay, transistor driver circuitry, optocoupler isolation (in most modules), status indicator LED, and input pins for signal, power (VCC), and ground (GND). When a control signal is applied, the relay coil energizes, triggering an internal mechanical switch that either opens or closes the high-voltage circuit. Relay modules are available in single-channel or multi-channel variants and can handle AC or DC loads, making them ideal for projects involving automation of pumps, actuators, or electrical appliances.

4. Results and Discussions

The Multipurpose Agriculture Vehicle was tested successfully for its three main functions grass cutting, spraying, and ploughing. The grass cutter worked effectively on light vegetation, and the sprayer provided uniform coverage using a mini pump. The ploughing tool could till soft soil but was less effective on hard terrain. The vehicle was controlled

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smoothly via Bluetooth with fast response time, and solar panels could supply most of the required power under sunny conditions. The overall system proved to be cost-effective, eco-friendly, and suitable for small-scale farms, although limited battery life and manual tool adjustments were noted as challenges (Refer Figure 6 &7).

Figure 6 Operation of The Vehicle Controlled by Using Remote control in the Smartphone

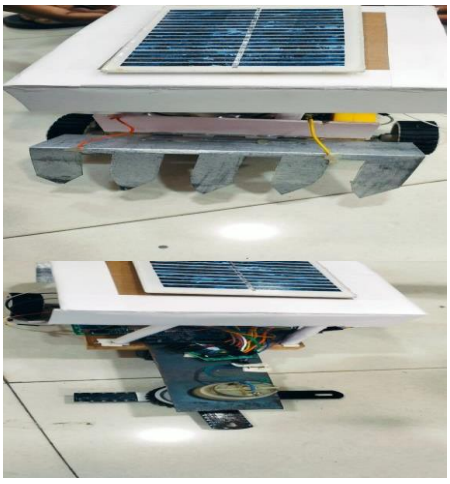

Figure 7 Front and Back View of Project Model

Conclusion

The development of the **Multipurpose Agriculture Vehicle using Arduino** demonstrates a low-cost, eco-friendly, and efficient solution for small and medium-scale farmers. By integrating grass cutting, spraying, and ploughing functionalities into a single solar-powered platform, the system reduces manual labor, saves time, and promotes sustainable farming practices. The use of Arduino and Bluetooth technology enables easy control and operation, making it accessible even to non-technical users. While the vehicle performed effectively in field tests, enhancements like improved soil-handling capacity, automatic tool switching, and higher battery backup can further expand its usability. Overall, the project offers a practical approach to modernizing agriculture with embedded automation.

Future Scope

The multipurpose agriculture vehicle can be further enhanced by adding features such as autonomous navigation using GPS, obstacle detection with sensors, and a mobile app interface for better user control. Upgrading the battery and solar panel capacity can improve operation time. Additionally, integrating soil moisture sensors and crop monitoring systems would make the vehicle more intelligent and suitable for precision farming. These improvements can make the system more scalable and useful for larger agricultural fields

References

[1]. D. Patel and R. Shah, “Arduino Based Smart Seed Sowing Robot,” International Journal of Innovative Research in Science, Engineering and Technology, vol. 9, no. 5, pp. 3211–3216, May 2020.

[2]. S. Kumar and A. Joshi, “Design and Implementation of Bluetooth Controlled Spraying Robot for Agriculture,” International Research Journal of Engineering and Technology (IRJET), vol. 5, no. 3, pp. 1426–1430, Mar. 2018.

[3]. M. Yadav and P. Patel, “Smart Irrigation System Using Arduino and Soil Moisture Sensor,” International Journal of Engineering Research and Technology (IJERT), vol. 8, no. 7, pp. 620–624, Jul. 2019.

[4]. Shivani, K. Rani, and A. K. Singh, “Multi-Function Agricultural Robot for Seeding and Spraying,” International Journal of Scientific Research in Engineering and Management (IJSREM), vol. 5, no. 11, pp. 1–5, Nov. 2021.

[5]. A. Verma and S. Gupta, “Autonomous Agricultural Robot for Smart Farming,” International Journal of Emerging Trends in Engineering Research, *vol. 8, no. 2, pp. 441–*446, Feb. 2020.