E-ISSN No : 2581-6195 | Volume : 9 | Special Issue | May 2026

MULTI-PURPOSE AGRICULTURAL ROBOTIC VEHICLE

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Access Online

Article DOI:
10.5281/zenodo.21408205

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How to Cite:
Dr Pavan Mankal, G Rakshita, Shradha Patil, Pragati Biradar & Ambika P G (2026), Multi-purpose Agricultural Robotic Vehicle, International Educational Journal of Science & Engineering (IEJSE),Vol: 9, Special Issue, May 2026 188-193

ABSTRACT

This project focuses on the development of a multipurpose agricultural robotic vehicle designed to automate essential farming tasks. The system is capable of performing operations such as seed sowing, irrigation, and pesticide spraying using a microcontroller and sensor-based setup. It can be controlled remotely or operate autonomously, ensuring accurate and efficient field operations. The robot reduces human effort, saves time, and improves resource utilization. Overall, it offers a cost-effective and practical solution to enhance productivity in modern agriculture.

KEYWORDS: Agricultural Robot, Automation, Microcontroller, Seed Sowing, Irrigation System, Pesticide Spraying, Smart Farming, Sensors, Autonomous Vehicle, Precision Agriculture

I. NTRODUCTION

Agriculture remains a fundamental sector supporting food supply and rural economies worldwide. However, farmers face recurring challenges including crop destruction by animals and improper utilization of available water resources. These problems result in reduced yield and financial losses.

The main motive for developing Agricultural Automation Technology is decreasing labor force and increasing the processes of digging and seed sowing of crops and covering the land so that human efforts will get reduce up to 90 percent. Especially when the duties, that needs to be performed, are potentially harmful for the safety or the health of the workers or when more conservative issues the applications of instrumental robotics cover further domains, as the opportunity of replacing human operators..

The proposed model uses basic components like DC motors, relay, relay driver ULN2003, Bluetooth module and Arduino Uno R3 as the main controller. The mechanical design of the robot is also simple. It is programmed to carry out the above functions simultaneously.

II. LITRATURESURVEY

Nair and Joseph proposed an intelligent agriculture framework integrating IoT and machine learning for sustainable farming. The system combined real-time sensing with predictive analytics to optimize irrigation and crop management. As there are no efficient equipment's to aid the farmers. There is a need for new techniques to be implemented. Once the idea was formulated, design options were finalized.

Reference paper [1]: "SaurabhUmarkar and Anil Karwankar, discussed that the process of seed sowing is a key component of agriculture field. For many crop varieties, high-precision pneumatic planting has been developed for a wide range of seed sizes, resulting to uniform seed distribution in seed spacing along the travel path. Wifi is used as receiver. Main disadvantage of the system is robot moves in only one direction. Whenever there is

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obstacle power supply is automatically turned OFF."

Reference paper [2]: "M.D. I. Sujon, R. Nasir and JayasreeBaidya, agricultural researcher determined the effects of various seeding techniques and machines and also different rates of oil seed rape application on establishment of seed emergence plant and final yield of grain. The robot will perform farming using analogy of ultrasonic detection in order to change its position. The main disadvantage of this system is, it does not work well on all types of soil."

Reference paper [3]: "H. Pota R Eaton, J Katupitiya and S D Pathirana, concludes that bullock drawn planting becomes a necessity to sow as skilled sowing workers are almost decreasing. Planting distance and plant population are acute factors in maximizing the yield of crops. In this Microcontroller 8051 is used for communication between the input and output devices. The main drawback of this model is, it consists of only one mechanism.."

Reference paper [4]: "S. Kareemulla, K Shaik, E Prajwal, B Mahesh, V Reddy, the system benefits farmers in the basic operation of seed sowing. This machine's operating mode is simple. It is possible to increase the total yield percentage effectively. Labour problem can be reduced. As compared to the manual and tractor based sowing time and energy required for this robot machine is less. Also wastage of seed is less. The disadvantage of model is, it consists of only one mechanism.."

Reference paper [5]: "S. Ramesh, P. Kumar, A. Naresh, M. Teja, R. Verma, the proposed system focuses on a multipurpose agricultural robot capable of performing operations like seed sowing, irrigation, and pesticide spraying. The system helps farmers by reducing manual effort and improving efficiency in farming activities. It is easy to operate and saves time compared to traditional methods.."

III. EXISTING SYSTEM

Traditional agricultural practices mainly depend on manual labor and basic machinery such as tractors for tasks like seed sowing, irrigation, and spraying. These methods often require more time, physical effort, and human involvement. Some semi-automated machines are available, but they usually perform only a single function and are not flexible for multiple farming operations. Additionally, the high cost of advanced machinery makes it less accessible for small and medium-scale farmers.

IV. PROPOSED SYSTEM

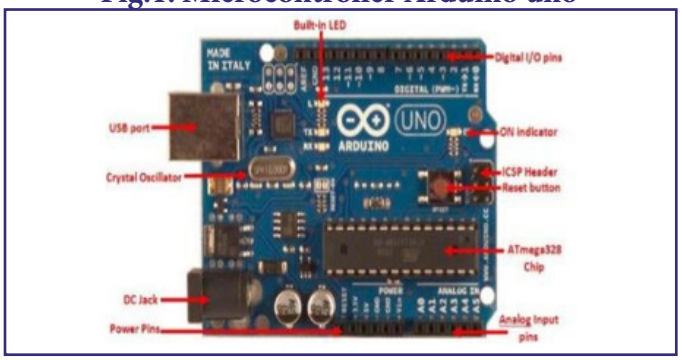
The proposed system deals with a multipurpose agricultural robotic vehicle designed to perform operations such as seed sowing, irrigation, and pesticide spraying using an automated control system. The device includes the following components:

- Microcontroller –Arduino uno
- Relay Module
- Rechargeable Battery
- Bluetooth model (HC-05)
- Motor Driver (L293D)
- DC Motors
- Solar Panel

LET US SEE ABOUT THE COMPONENTS IN BRIEF

A. MICROCONTROLLER –Arduino uno:

Fig.1: Microcontroller Arduino uno



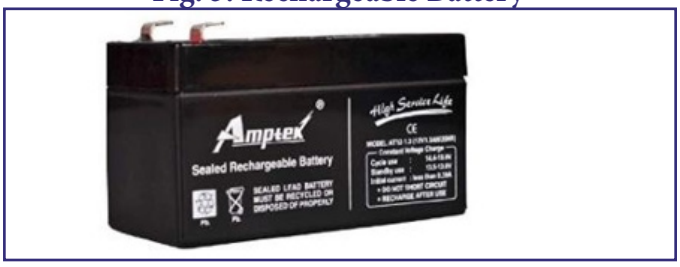
The Arduino Uno functions as the main controller of the system. It receives inputs from different modules and manages the overall operation by sending appropriate signals to motors, relay, and other components for proper functioning. It processes this data and automatically controls irrigation systems or sends alerts to farmers. Its low power consumption, real-time processing, and built-in communication features make it ideal for smart agriculture applications.

B. RELAY MODULE:

The relay module acts as a switching device that allows low-power signals from the controller to operate higher power equipment like pumps and sprayers safely.

C. RECHARGEABLE BATTERY:

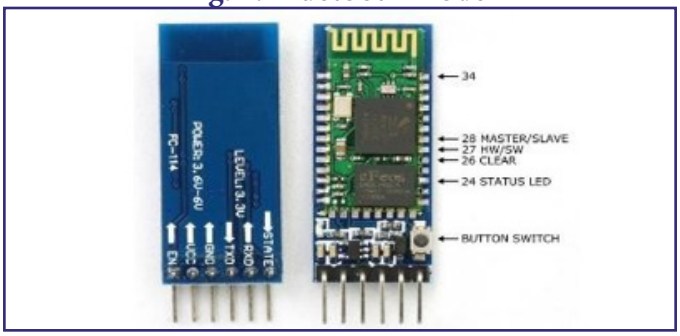
Fig. 3: Rechargeable Battery



The rechargeable battery serves as the primary power source for the robotic vehicle. It enables the system to operate continuously in agricultural fields without relying on external electricity..

D. BLUETOOTH MODEL:

Fig. 4: Bluetooth Model



This module provides wireless communication between the robot and a mobile device. It allows the user to control and monitor the system remotely with ease.

E. MOTOR DRIVER (L293D):

Fig. 5: Motor Driver (L293D)

The motor driver is responsible for controlling the motion of DC motors. It helps in adjusting the direction and speed of the motors based on the commands from the microcontroller.

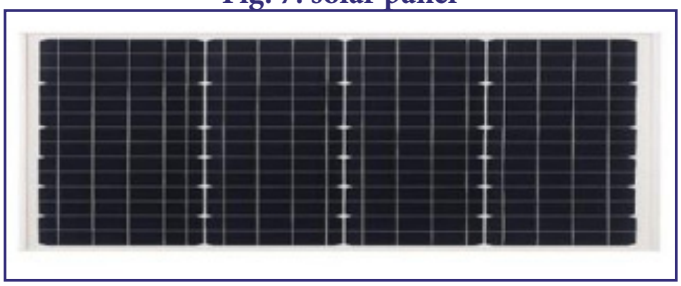
F. DC MOTORS:

Fig. 6: DC Motors

The motor driver is responsible for controlling the motion of DC motors. It helps in adjusting the direction and speed of the motors based on the commands from the microcontroller.

G. SOLAR PANEL:

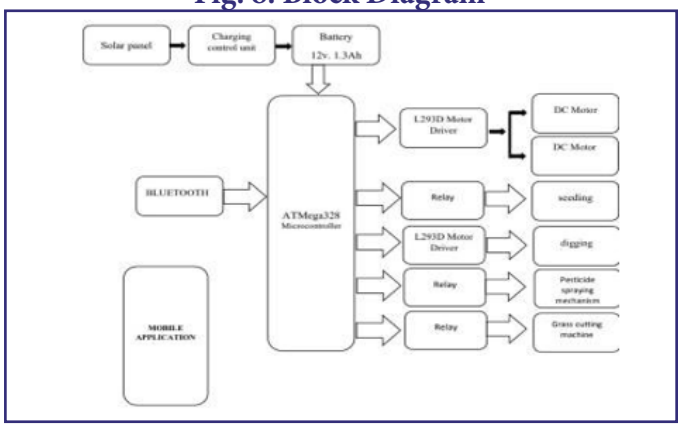
Fig. 7: solar panel



The solar panel is used to convert sunlight into electrical energy through photovoltaic cells. It serves as the primary power source for the proposed system, supplying energy to the microcontroller, sensors, and other components. By utilizing renewable solar energy, the system becomes energy-efficient and suitable for remote agricultural areas where conventional power supply may be limited. This ensures continuous operation while reducing dependency on non-renewable energy sources.

V. METHODOLOGY

Fig. 8: Block Diagram



The working of the multipurpose agricultural robotic vehicle is based on a central control unit using the ATmega328 microcontroller. Electrical power is supplied through a solar panel, which charges a 12V battery with the help of a charge controller. This setup allows the system to operate efficiently in outdoor conditions without depending on external power sources.

User commands are given through a mobile application and transmitted wirelessly via a Bluetooth module. These signals are received by the microcontroller, which processes them and controls different operations of the robot accordingly. For locomotion, the controller sends control signals to the L293D motor driver, which drives the DC motors to move the vehicle in different directions.

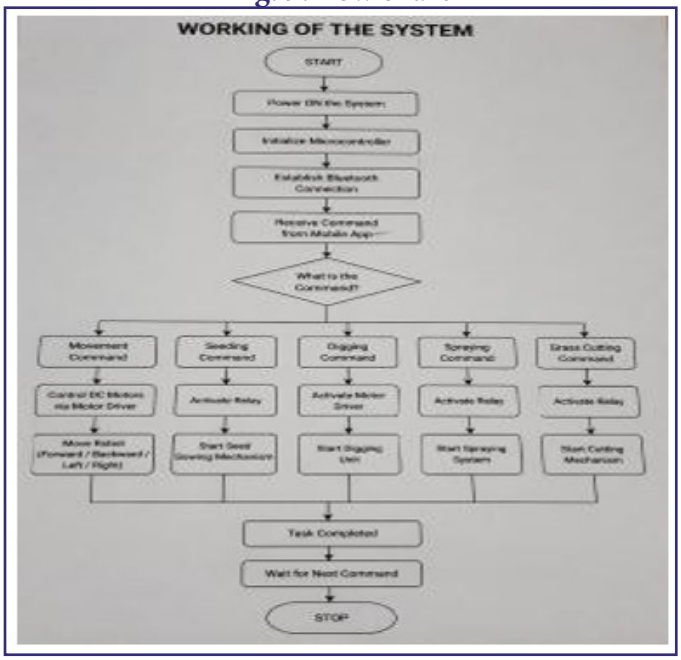
Various agricultural functions are carried out using separate control units. The seed sowing mechanism is activated through a relay to ensure controlled seed distribution. The digging unit is driven using a motor driver to prepare the soil. In addition, relays are used to operate the pesticide spraying system and grass cutting mechanism as required.

By combining wireless control, efficient power management, and multiple functional modules, the system is capable of performing several farming tasks with reduced manual effort and improved efficiency.

WORKING

The basic aim of our project is to develop a multipurpose agriculture robot, The 12V battery is used which is charged by solar panel. Then supply is given to Arduino Uno R3 board which is interfaced with relay driver ULN2003. Seven relays for seven DC motors are used in the robot. The operation of these relays is controlled through programming in Arduino by relay driver. Four DC motors are used for four wheels to perform forward, reverse, left and right operation of the robot.., as illustrated in the flowchart.

Fig. 9: flow chart



Two DC motors are coupled in parallel and two relays are used for the operation of forward, stop and reverse operation as a single relay performs only two actions of motor run and stop.

A manual operation of DC spraying motor is contrived on the robot. All the operations are programmed in the Arduino and are operated through the Bluetooth module (HC-05) by android application.

The operation performed by the agribot are described as below:

The elementary purpose of ploughing is to turn over the top layer of the soil, taking fresh nutrients outward to surface, while embalming weeds and the remnants of earlier crops. In the prototype model designed, two DC motor are used for ploughing the farm. The rotor is lowered down manually and the soil is dug up to 1 inch. The operation of the rotor blades can be controlled by the Bluetooth app in the smart phone.

A plastic canister is used for seed storage. We have

provided a hole to canister. The canister is placed above the funnel. The canister is powered by DC motor which is monitored by two relays and is controlled by mobile application remotely via Bluetooth. As the motor is switched on, the canister tends to rotate and rotation makes the seeds fall in the funnel. The speed of the motor can be controlled in programming developed in Arduino. An iron nozzle is provided which trench the seeds in ploughed land. The nozzle can be adjusted up and down manually as required.

A water container is placed on robot for water storage. A DC water pump is used for pumping water to the water sprayer. The water flows to the aerosol through hose. The power for pump is coordinated by a toggle switch.

VI. RESULT

The developed multipurpose agricultural robotic vehicle was successfully designed and tested for basic farming operations. The system was able to perform functions such as movement, seed sowing, digging, spraying, and grass cutting through wireless control using a mobile application. The integration of the microcontroller with motor drivers and relay modules ensured smooth and accurate operation of each unit. The use of a solar-powered battery provided continuous energy support, making the system suitable for field conditions.

The results demonstrate that the robot reduces manual effort, saves time, and performs multiple agricultural tasks effectively within a single platform. Overall, the system proved to be reliable, cost-efficient, and useful for modern farming applications.

VII. CONCLUSION

In agricultural filed, the contingency for robots, augmented yield is colossal. Hence robots are emerging on farms in various guises and are increasing in numbers. The alternative dilemmas combined with autonomous farm equipment's can apparently be overcome with automation. The robot can be with accessible source system rather than a normal robotic car. Affability of automation system is high than traditional system. The advantage of this system is it diminish the labor cost, and time. .

At present in our country all agricultural machines are working manually or by petrol engine or tractor. Humans can't work for long time manually. To avert this condition, we need some kind of power source system to operate the

digging, sowing, leveling and sprinkling at a time. This can be achieved by our solar powered multifunctional agricultural robot.

VIII. FUTURE SCOPE

The multipurpose agricultural robotic vehicle can be further improved by integrating advanced technologies to increase its efficiency and usability. In the future, the system can be enhanced with IoT connectivity to allow real-time monitoring and control from remote locations. The addition of sensors and cameras can help in crop health analysis, obstacle detection, and better navigation. Artificial intelligence and machine learning techniques can be applied to enable decision-making based on soil conditions and environmental factors.

The robot can also be upgraded to operate fully autonomously using GPS-based navigation, reducing the need for manual control. Improving battery capacity and optimizing solar charging can increase working time in the field. Furthermore, the design can be made more compact and cost-effective so that it is easily affordable for small-scale farmers. These enhancements can make the system more intelligent, reliable, and suitable for modern precision agriculture.

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