e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

SOLAR-POWERED MULTIPURPOSE AGRICULTURE ROBOT

Prof. Dr. M.B. Kadu[*1], Pratiksha S. Shelke[*2], Tejas B. Varpe[*3], Pratiksha B. Bhor[*4], Saurabh D. Landge[*5]

[*1]Assistant Professor, E&TC Dept. AVCOE, Sangamner, India.

[*2,3,4,5]Student, E&TC, Dept. AVCOE, Sangamner, India.

ABSTRACT

The "Solar-Powered Multipurpose Agriculture Robot" is an innovative project designed to address the modern agricultural industry's evolving demands for efficient and sustainable farming practices. This robot integrates various technologies to automate and enhance agricultural tasks, making farming more productive and environmentally friendly. The core components of the project include a solar panel system for battery charging, DC motors for robot movement, a servo motor for seeding, a DC motor pump for pesticide spraying, and a high-torque GC motor for grass cutting. The project employs an ESP8266 microcontroller as its brain to manage and coordinate these components seamlessly. One of the project's standout features is its connectivity through a web-based interface. The robot is controlled via a website accessible through a Wi-Fi connection. This web-based control system offers convenience, accessibility, and real-time monitoring of the robot's activities.

Keywords: Smart Farming, Agriculture Robot, Microcontroller, DC Motor, Solar Panel, Wi-Fi.

I. INTRODUCTION

For a long time, agriculture has been and will continue to be the foundation of the Indian economy. An individual that goes three days without food will dispute, fight, and inevitably perish. Over the past forty years, India's record of agricultural advancement has been fairly spectacular. The agricultural industry has done a good job of keeping up with the growing demand for food. The contribution of expanding the amount of land used for agriculture has decreased over time, and the advances in production over the previous two decades have mostly been attributable to rising productivity. The majority of people in the world-more than 42% have made agriculture their main line of work. The use of autonomous cars in agriculture has drawn more attention in recent years. Numerous researchers have began to create more logical and adaptive vehicles as a result of this advancement [1].

Robotic technology in agriculture is a relatively new concept. The potential for robot- enhanced productivity in agriculture is enormous, and more and more robots of all shapes and sizes are showing up on farms. We can anticipate autonomous agricultural robots undertaking tasks like seed sowing, grass cutting, water spraying, and pesticide application. A Node MCU and Wi-Fi model controls the robot. A user can communicate with the robot using language, which is accessible to the majority of people. These robots have the benefit of quick and hands- free data entry an idea has been created in the field of agricultural autonomous robots to see if several tiny autonomous machines may be more effective than conventional big tractors and human effort.

Agriculture is the foundation of the Indian economy. Farmers are the backbone of the food- 2 producing industry. Traditionally, humans have done farming using bullock carts, tractors, tillers, and other tools. The primary issues facing agriculture in the current period include labour shortages, a lack of understanding of soil testing, rising labour costs, seed and water waste, and increased labour costs. The development of the agricultural robot aims to address all these drawbacks. The application of robotic technology in the agricultural area is the primary goal of agricultural robots. Plowing, sowing, and mud leveling are all expertly handled by the farm robot on an autonomous basis. A robot is a mechanical device that can carry out a variety of duties without the assistance of a person. The controller issues a command to the robot, which follows them. Along the robotic journey, numerous sensors are employed to sense various characteristics. The robotic system's microprocessor, which sits at its core, controls every single movement it makes. Managing the DC motors also regulates the motion of a wheel. The DC motor is driven by a motor driving circuit, which regulates the wheel's velocity [2].

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

II. OBJECTIVES

1. To build a robot that is easy to use and easy to perform agriculture operations.
2. To develop a user-friendly interface for controlling and configuring the agricultural robot functionality.

III. LITERATURE SURVEY

IoT based smart multipurpose agricultural robot was proposed by prof. Dr. S. B. Dhoble, et.al, this robotic system is named as agricultural robot, it is nothing but the machine which assembles with electronic equipment or components & performs specific operation as directed by instructor. This technology provides optimum and efficient solution for wide range of production in agriculture field. The robot is capable of performing operation like automatic ploughing, seed sowing and chemical spraying.

IoT based mechanized robot: an integrated process involving fulltime multipurpose control, automation and surveillance system proposed by Abdullah all Aamun Anik, et.al, the internet of things (IoT) is the next generation of wireless technology that automates routine tasks and reduces labour. Software, sensors, and actuators are combined into a network of linked devices in the internet of things. The gadgets may exchange data and communicate over a network. Our laboratories have used this technology to make appliances more convenient and automated. One of the key reasons for this increase is its capacity to both secure and facilitate research. The IoT innovation can provide fantastic content for modern automation. This study proposes an internet-based smart laboratory and laboratory machine automation, cloud storage data gathering, and monitoring system to efficiently operate types of machinery, online live data streaming, and monitor mechanical work devices.

A multipurpose agricultural robot for automatic ploughing, seeding and plant health monitoring Chandana R, et.al, this approach is on the designing of agricultural robot for various tasks. Certainly robots are playing an important role in the field of agriculture for farming process autonomously. In agriculture, the opportunity for robot is enhancing the productivity and the robots are appearing in the field in large number. The proposed system focuses on implementing all the farming process especially in the field of ploughing and seeding by using microcontroller, hc- 05 and hc06 bluetooth models, various sensors etc, the robot detects the planning area by using sensors and seeds need to be planted in the corresponding field using gripper arrangement of the robot. In a continuation, the rest of remaining process could be done automatically.

Table No. 1: Comparative Survey

Sr. No.	Paper Title	Publish Year	Method Used	Drawbacks
1	Solar Powered Autonomous Multipurpose Agriculture Robot Using Bluetooth/ Android App	2020	Bluetooth/ Android App	Limited Range of Bluetooth
2	Solar Powered Autonomous Multipurpose Agricultural Robot Using Website and WiFi Connection	2023	Website and WiFi Connection	Requires internet connectivity
3	Solar Powered Autonomous Multipurpose Agricultural Robot Using a GPS System	2022	GPS System	Can be inaccurate in poor weather conditions
4	Solar Powered Autonomous Multipurpose Agricultural Robot Using a Vision System	2021	Vision System	Can be expensive and complex to implement

5	Solar Powered Autonomous Multipurpose Agricultural Robot Using a Combination of Sensors	2020	Combination of Sensors	Requires careful calibration of sensors
6	Solar Powered Autonomous Multipurpose Agricultural Robot Using a Hybrid Control System	2019	Hybrid Control System	Can be complex to design and implement

IV. PROPOSED SYSTEM

The solar-powered autonomous multipurpose agriculture robot employs a comprehensive system of components to facilitate its efficient operation. At the heart of this system is the solar plate, responsible for converting sunlight into electrical energy, which, in turn, charges the battery. This battery serves as an energy reservoir, allowing the robot to continue its tasks even in the absence of sunlight.

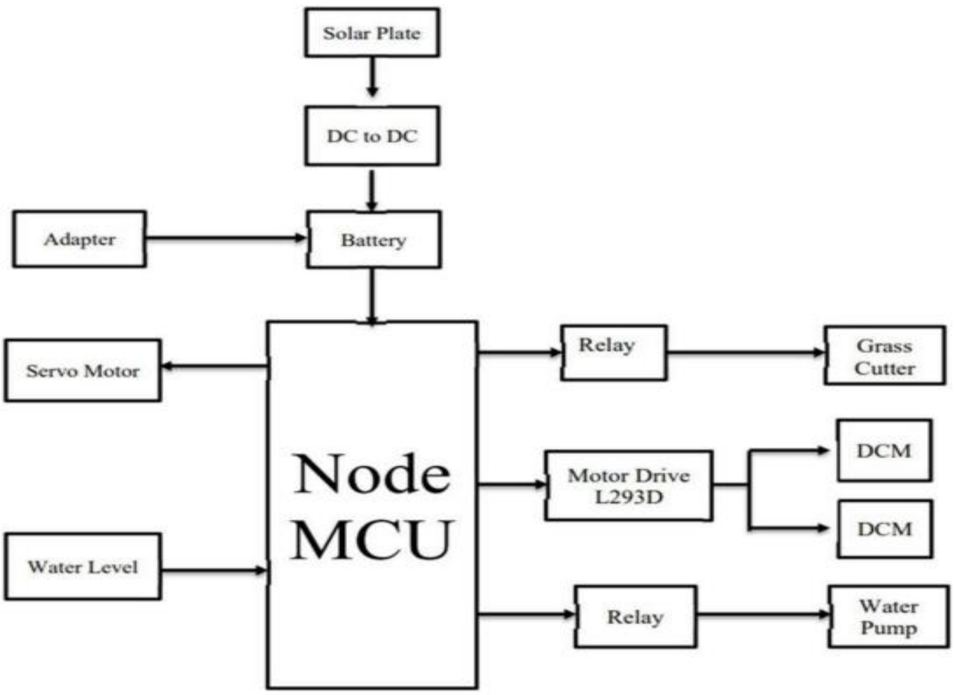

Figure no. 1: Block Diagram of Proposed System

To ensure the safe and efficient charging of the battery, a DC to DC adapter is employed to regulate the voltage from the solar plate.

The robot's mobility is powered by a DC motor, which propels it around agricultural fields. Additionally, a servo motor is responsible for controlling the seeding mechanism, while a high-torque motor (GC) drives the grass cutter. To manage and coordinate these various components, the ESP8266 microcontroller acts as the central command center, connecting to a dedicated website through a WiFi connection. This website serves as a user interface, enabling individuals to remotely control the robot by sending commands like "move forward," "sow seeds," or "spray pesticides."

The operational flow of the system is as follows:

- The solar plate harnesses sunlight, converting it into electrical energy to charge the battery.
- The battery powers the ESP8266 microcontroller, DC motor, servo motor, DC motor pump, and GC high-torque motor.
- Through the website, users send commands, which the ESP8266 interprets and translates into signals for

the relevant components.

- For instance, a "move forward" command activates the DC motor to propel the robot in the specified direction.
- A crucial component, the relay, is employed to control the DC motor pump and grass cutter motor.
- When commands are issued for tasks such as spraying pesticides or cutting grass, the ESP8266 microcontroller engages the relay, thereby activating the corresponding motor.

This innovative system offers several noteworthy advantages, including its reliance on renewable energy, making it both environmentally friendly and cost-effective. Furthermore, its versatility allows for automation of various agricultural tasks, enabling farmers to allocate their time and efforts elsewhere. The remote controllability via the website ensures that the robot can be operated from virtually anywhere worldwide, as long as an internet connection is available. Overall, the solar- powered autonomous multipurpose agriculture robot represents a significant advancement in sustainable and efficient farming practices.

V. ALGORITHM STEPS

A. Algorithm of Parameter Measurement System

- Start the software.
- Initialize the robot's hardware components, including the DC motors, servo motor, and pump, as well as the NodeMCU microcontroller.
- Establish a Wi-Fi connection using the NodeMCU to enable communication with the Android app.
- Wait for user input from the Android app.
- Upon receiving user input:

a. If the user selects "Planting" as the desired action:

➢ Perform the seeding operation using the servo motor.

➢ End the planting operation.

b. If the user selects "Spraying" as the desired action:

➢ Activate the pesticide sprayer using the DC motor pump.

➢ End the spraying operation.

c. If the user selects "Cutting" as the desired action: i. Start the grass cutter using the high-torque DC motor. ii. End the cutting operation.

- Continuously monitor the robot's status: a. Check if the battery level is low. b. If the battery is low: i. Initiate the solar panel charging to recharge the battery. ii. Continue robot operations while monitoring the battery level.
- If the user requests to stop the robot's operation: a. Halt all ongoing operations and power down the robot.
- End the software program

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

B. Flowchart

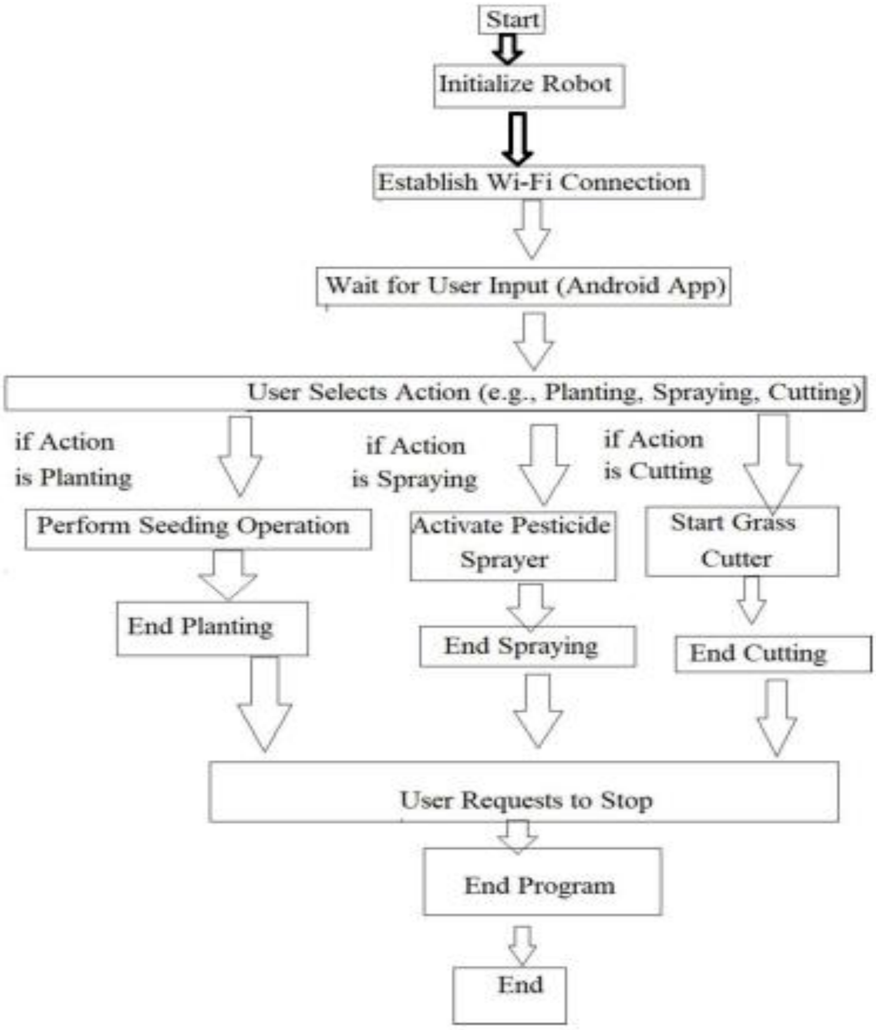

Figure No.2: Flowchart

VI. ADVANTAGES

- Solar power is a clean and renewable energy source, reducing the reliance on fossil fuels and contributing to environmental sustainability.
- Operating on solar power can lead to significant cost savings over time by eliminating the need for fuel or electricity from conventional sources.
- Many solar-powered agriculture robots can operate autonomously, performing tasks without constant human supervision, increasing efficiency and reducing labor requirements.
- These robots can be equipped with advanced sensors and technology for precision agriculture, allowing for precise and targeted actions, such as planting, weeding, and harvesting.
- By employing cleaner energy sources, these robots contribute to reducing greenhouse gas emissions and minimizing the environmental impact associated with traditional farming practices.

VII. DISADVANTAGES

- The initial cost of acquiring and implementing solar-powered agricultural robots can be high, potentially limiting accessibility for small-scale farmers.
- Energy storage technology (e.g., batteries) may still have limitations in terms of capacity and lifespan, impacting the robot's ability to operate during periods of low or no sunlight.

- Solar panels can add weight to the robot, potentially affecting its mobility and ability to navigate challenging terrains.

VIII. APPLICATIONS

1. Autonomous Plowing and Cultivation:

Enable the robot to autonomously plow fields and cultivate soil, reducing the need for traditional tractors and minimizing soil compaction.

2. Data Collection and Analysis:

Gather data on weather conditions, temperature, humidity, and other relevant environmental factors to help farmers make data-driven decisions.

3. Remote Monitoring and Control:

Provide farmers with a remote control interface to monitor and control the robot's operations, ensuring flexibility and convenience.

4. Education and Training:

Use the robot as an educational tool to demonstrate sustainable farming practices and new agricultural technologies, fostering awareness and knowledge transfer within the farming community.

5. Mobile Charging Station:

Include the ability to charge other electronic devices or equipment in the field, acting as a mobile charging station for tools or sensors used by farmers.

6. Livestock Monitoring:

Integrate sensors to monitor and manage livestock, ensuring their well-being and providing real-time data on animal health and behavior.

7. Emergency Response:

Utilize the robot for quick response in emergencies, such as firefighting in agricultural areas or delivering critical supplies to remote locations.

8. Collaborative Farming:

Design robots to work collaboratively, enhancing their efficiency and effectiveness in performing various tasks simultaneously across a large agricultural area

IX. CONCLUSION

The development and implementation of a solar-powered multipurpose agriculture robot represent a significant leap forward in sustainable farming practices. By harnessing the power of renewable energy sources, this innovative robotic solution not only addresses the challenges of increasing agricultural productivity but also promotes environmental conservation. The integration of solar technology not only reduces operational costs but also minimizes the carbon footprint associated with traditional farming methods. The multi-functionality of the robot, capable of tasks such as planting, harvesting, and monitoring crop health, further enhances efficiency and precision in agricultural operations. As we strive to meet the growing demands of a burgeoning global population, the solar-powered multipurpose agriculture robot emerges as a promising solution that aligns with the principles of eco-friendly and resource-efficient farming, paving the way for a more sustainable and resilient agricultural future.

X. FUTURE WORK

The future work on Solar-Powered Multipurpose Agriculture Robots holds significant promise for advancing sustainable and efficient farming practices. One avenue for development involves enhancing the robot's autonomy and intelligence through advanced sensors and machine learning algorithms. Integrating real-time data analytics and predictive modeling can enable the robot to make informed decisions about crop management, pest control, and irrigation, optimizing resource utilization. Additionally, researchers can explore the integration of robotic arms or specialized modules for tasks like precision planting, weeding, and harvesting, expanding the robot's versatility. Improving the robot's mobility and adaptability to diverse terrains will also be crucial, allowing it to navigate challenging agricultural landscapes with ease. Collaborative

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

efforts with the agricultural community will be essential to fine-tune the robot's capabilities according to the specific needs of different crops and farming practices. Furthermore, advancements in energy storage technologies can contribute to prolonged operation during periods of low sunlight. Continuous research into lightweight and durable materials for the robot's construction can enhance durability and minimize environmental impact

ACKNOWLEDGMENT

I would like to express my heartfelt gratitude to all those who have played a significant role in the development and success of the Solar-Powered Multipurpose Agriculture Robot project.

First and foremost, I extend my deepest appreciation to [Your Organization/Institution] for providing the resources, support, and conducive environment essential for the realization of this innovative agricultural solution.

Special thanks go to the dedicated team of engineers and researchers who worked tirelessly to design and develop the Solar-Powered Multipurpose Agriculture Robot. Your expertise, creativity, and commitment have been invaluable throughout this journey.

XI. REFERENCES

[1] Amrita Sneha. A, Ankita. A, Abirami.E, “Agricultural Robot for Automatic Ploughing and Seeding”, 2015 IEEE (TIAR2015)[20].

[2] P.Usha, Dr. V. Nandagopal, “Design and Implementation of Seeding Agricultural Robot”, (JIRAS)[8].

[3] Abdullah Tanveer, Abhish Choudhary, DivyaPal, “Automated Farming Using Microcontroller and Sensors”, International Journal of Scientific Research and Management Studies (IJSRMS), 2015[5].

[4] Nikesh Gondchawar, Prof. Dr. R.S. Kawitkar, “Communication Engineering”,2016[12].

[5] Renuka Dhavale, Shweta Kalshetty, Bhushan Patil, Prachi Choudhari, AjayPal Singh ,“Digging and Seed Sowing AGRIBOT”, 2021[30].

[6] Pratiksha K.Deshmukh, Prafull S. Mehetre, Suyash C.Kokane, Paan E.Joshi, “Solar Powered Automated Multi-Tasking Agricultural Robot”, 2020[23].

[7] Prof. Chandrakant D.Bhos, Shrutika M. Deshmukh, Prajakta A. Bhise, ShwetaB.Avhad “Solar Powered Multi-Function Agri-Robot”, 2020[19].

[8] Abdulrahman, Mangesh Koli, Umesh Kori, Ahmadakbar, “Seed Sowing Robot”,2017[27]