iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 Issue: IV Month of publication: April 2026

DOI: https://doi.org/10.22214/ijraset.2026.80221

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue IV Apr 2026- Available at www.ijraset.com

Development of Solar Powered Multi Functional Agribot

Prof. S.V. Borkar[1], Khushi Pandey[2], Rashi Yelne[3], Kanchan Khonde[4], Sneha More[5]
[1]*Assistant Professor, Department of Computer Science and Engineering, Priyadarshini College of Engineering, Nagpur, India*
[2,3,4,5] *UG Scholar, Department of Mechanical Engineering, Priyadarshini Bhagwati College of Engineering, Nagpur, India*

Abstract: The development of a Solar Powered Multi-AgriBot aims to provide an efficient, low-cost, and eco-friendly solution for small-scale farming operations. This project integrates three essential agricultural functions—soil tilling, seed sowing, and irrigation—into a single robotic system powered by renewable energy. The system consists of a metallic robotic frame equipped with a 12V, 10W solar panel, a 12V, 2Ah battery for energy storage, and multiple DC motors for different operations. A 12V, 60 RPM motor enables movement, while a 12V, 10 RPM motor controls the seed dispensing mechanism, and a 12V, 2 LPM DC pump is used for watering crops. The robot is controlled through a wired remote system, allowing directional movement and operation flexibility. This multifunctional agribot reduces human labor, increases operational efficiency, and promotes sustainable farming practices. The integration of solar energy minimizes dependency on conventional power sources, making it suitable for rural and off-grid areas. Overall, the system demonstrates a practical approach to automation in agriculture, enhancing productivity and resource optimization.
Keywords: Solar Energy, AgriBot, Automation, Seed Sowing, Irrigation etc.

I. INTRODUCTION

Agriculture remains the backbone of many developing economies, particularly in countries like India, where a significant portion of the population depends on farming for livelihood. However, traditional farming methods are labor-intensive, time-consuming, and often inefficient in terms of resource utilization. With increasing population demands and decreasing availability of manual labor, there is a pressing need for technological advancements in agriculture to enhance productivity and sustainability [1].

Modern agriculture is gradually shifting toward automation and smart farming techniques, where machines and robotic systems are used to perform repetitive and physically demanding tasks. Agricultural robots, commonly known as agribots, are designed to assist farmers in performing operations such as ploughing, seed sowing, irrigation, and harvesting with greater precision and efficiency [2]. These systems not only reduce labor dependency but also improve accuracy and consistency in farming practices.

One of the major challenges in implementing automated systems in agriculture is the availability of reliable power sources, especially in rural and remote areas. Conventional energy sources such as diesel and grid electricity contribute to environmental pollution and incur high operational costs. Renewable energy, particularly solar energy, has emerged as a viable alternative due to its abundance, sustainability, and cost-effectiveness [3]. Solar-powered agricultural systems can operate independently of grid power, making them ideal for off-grid farming applications. The proposed Solar Powered Multi-AgriBot is designed to address these challenges by integrating multiple agricultural functions into a single compact system. The robot is equipped with a metallic frame structure that provides durability and stability in field conditions. It uses a 12V, 10W solar panel to harness solar energy, which is stored in a 12V, 2Ah battery to ensure continuous operation even during low sunlight conditions. This energy-efficient design reduces reliance on fossil fuels and promotes environmentally friendly farming practices [4].

The agribot incorporates three primary functionalities: soil tilling, seed sowing, and irrigation. A 12V, 60 RPM DC motor is used for the movement of the robot, allowing it to navigate across the field in multiple directions through a wired remote control system. This provides flexibility and ease of operation for the user. The seed sowing mechanism is driven by a 12V, 10 RPM motor, ensuring controlled and uniform seed distribution, which is crucial for optimal crop growth [5].

In addition to seed sowing, the system includes a water pumping mechanism using a 12V, 2 liters per minute DC pump. This enables precise irrigation, reducing water wastage and ensuring adequate moisture supply to the soil. Efficient water management is particularly important in regions facing water scarcity, making this feature highly beneficial [6].

The integration of multiple functions into a single robotic platform significantly reduces the need for multiple machines, thereby lowering costs and improving operational efficiency. Furthermore, the compact and portable design makes it suitable for small and medium-scale farmers who may not afford large agricultural machinery.

The Solar Powered Multi-AgriBot represents a step toward smart and sustainable agriculture. By combining automation with renewable energy, the system enhances productivity, reduces manual labor, and promotes eco-friendly farming practices. The project demonstrates the potential of low-cost robotic solutions in transforming traditional agriculture into a more efficient and technologically advanced sector [7].

II. PROBLEM IDENTIFICATION

1) An electric Lawn mower There are so many complication Traditional farming methods rely heavily on manual labor, making agricultural operations time-consuming, physically demanding, and less efficient, especially during peak seasons.
2) Shortage of skilled labor in rural areas leads to delays in critical activities such as soil preparation, seed sowing, and irrigation.
3) Use of separate machines for tilling, seeding, and watering increases overall cost, making it unaffordable for small and marginal farmers.
4) Conventional farming equipment depends on fossil fuels, resulting in high operational costs and environmental pollution.
5) Lack of access to reliable electricity in remote areas limits the use of automated agricultural systems.
6) Inefficient seed sowing methods cause uneven distribution, leading to reduced crop yield and wastage of seeds.
7) Excessive or insufficient irrigation due to manual practices results in water wastage and poor crop growth.
8) Existing agricultural robots are often expensive, complex, and not suitable for small-scale farming conditions.
9) There is a need for an integrated, low-cost, solar-powered solution to perform multiple agricultural tasks efficiently.

III. LITERATURE REVIEWS

A. Literature Survey

1. Kumar, R., & Singh, P. (2025), presented a comprehensive study on solar-powered agricultural robots designed for small-scale farming. Their research focused on integrating photovoltaic systems with robotic platforms to perform operations such as ploughing and seeding. The findings revealed that solar-powered agribots significantly reduce dependency on fossil fuels and operational costs. The study also highlighted improved efficiency in field operations due to automation and precise control mechanisms. However, limitations were observed in terms of energy storage and performance under low sunlight conditions. The authors concluded that incorporating efficient battery management systems and hybrid energy solutions could enhance overall system reliability and performance in diverse environmental conditions.

2. Sharma, V., & Patel, M. (2024), investigated the development of a multifunctional agricultural robot capable of seed sowing and irrigation. Their system utilized DC motors and microcontroller-based control for automation. The findings indicated that uniform seed distribution and controlled irrigation significantly improved crop yield and reduced resource wastage. The robot demonstrated high accuracy in seed placement compared to traditional manual methods. Additionally, the study emphasized the importance of integrating sensors for soil moisture detection to further optimize irrigation. The researchers concluded that such automated systems can play a vital role in precision agriculture, especially for small and medium farmers seeking cost-effective technological solutions.

3. Reddy, K., & Rao, S. (2024), developed an IoT-enabled agribot for smart farming applications. Their system incorporated wireless communication and real-time monitoring features to control agricultural operations remotely. The findings showed that IoT integration enhanced decision-making by providing real-time data on soil conditions and crop health. The robot was capable of performing multiple tasks, including watering and monitoring environmental parameters. However, the study identified challenges related to network connectivity in rural areas. The authors suggested that combining IoT with autonomous robotic systems could significantly improve agricultural productivity while minimizing manual intervention and enhancing overall farm management efficiency.

4. Patel, H., & Desai, J. (2023), focused on the design and analysis of a seed sowing robot with an emphasis on precision farming. Their system used a controlled dispensing mechanism driven by low-speed DC motors to ensure accurate seed placement. The findings demonstrated that the robot achieved consistent spacing between seeds, which contributed to better crop growth and reduced seed wastage. The study also highlighted the importance of mechanical design in achieving efficient operation. The authors concluded that precision seed sowing robots can significantly improve agricultural productivity and reduce labor costs, especially in regions where manual sowing is still prevalent.

5. Gupta, A., & Verma, N. (2023), explored the use of solar-powered irrigation systems integrated with robotic platforms. Their research emphasized sustainable water management in agriculture using renewable energy. The findings indicated that solar-powered pumps effectively reduced electricity consumption and ensured reliable irrigation in off-grid areas. The system demonstrated improved water efficiency and reduced operational costs. However, performance variations were observed due to

fluctuations in solar intensity. The authors suggested incorporating energy storage systems and intelligent controllers to maintain consistent operation. The study concluded that solar-powered irrigation robots are a promising solution for sustainable agriculture.

6. Mehta, S., & Joshi, R. (2022), developed a compact agricultural robot designed for multifunctional operations, including tilling and watering. Their research focused on reducing the size and cost of agricultural machinery for small farmers. The findings showed that the robot successfully performed multiple tasks with minimal human intervention, thereby reducing labor requirements. The system was found to be energy-efficient and easy to operate. However, the study identified limitations in handling uneven terrain and heavy soil conditions. The authors concluded that further improvements in mechanical design and traction systems are required to enhance the robot's adaptability to different field conditions.

7. Singh, D., & Kaur, H. (2022), investigated automation in agriculture using robotic systems for soil preparation and seed sowing. Their study highlighted the benefits of mechanization in reducing time and labor costs. The findings revealed that automated systems improved the uniformity of operations and increased overall productivity. The robot demonstrated efficient performance in controlled environments but faced challenges in large-scale field applications. The authors emphasized the need for scalable designs and robust control systems to enhance field performance. They concluded that agricultural robotics has significant potential to revolutionize farming practices with further technological advancements.

8. Khan, M., & Ali, S. (2021), conducted a study on low-cost agricultural robots for developing countries. Their research focused on affordability and ease of use for small-scale farmers. The findings showed that simple robotic systems with basic functionalities such as seed sowing and watering can significantly improve farming efficiency. The study emphasized the importance of cost-effective design and locally available materials. However, limitations were observed in terms of automation level and precision. The authors suggested integrating advanced control systems and renewable energy sources to enhance performance. The study concluded that low-cost agribots can play a crucial role in modernizing agriculture in developing regions.

9. Verma, S., & Kulkarni, A. (2025), developed an autonomous solar-powered agribot designed for integrated farming operations such as tilling, seeding, and spraying. Their system utilized advanced motor control and energy-efficient circuits to optimize power consumption. The findings indicated that the robot achieved significant reductions in manual labor and operational time. The solar integration enabled continuous operation in remote areas with limited electricity access. However, the system faced efficiency challenges during cloudy conditions. The authors recommended hybrid energy systems and adaptive control algorithms to improve performance. The study concluded that solar-powered multifunctional robots are essential for sustainable and scalable agricultural automation.

10. Iyer, R., & Nair, V. (2024), proposed a smart agricultural robot incorporating sensor-based automation for irrigation and soil analysis. Their system used soil moisture sensors to control water flow automatically. The findings revealed that precise irrigation significantly reduced water consumption while maintaining optimal soil conditions for crop growth. The robot demonstrated improved efficiency compared to traditional irrigation methods. The study also emphasized the importance of integrating real-time feedback systems for better decision-making. The authors concluded that sensor-based agribots can enhance precision agriculture and contribute to resource conservation in water-scarce regions.

11. Choudhary, P., & Mishra, L. (2024), designed a low-cost robotic system for seed sowing and fertilization. Their research focused on improving affordability and accessibility for small farmers. The findings showed that the robot achieved uniform seed placement and efficient fertilizer distribution, leading to improved crop yield. The system was easy to operate and required minimal maintenance. However, challenges were observed in achieving high precision on uneven terrains. The authors suggested incorporating advanced navigation systems and better wheel design to improve performance. The study concluded that cost-effective robotic solutions can significantly enhance agricultural productivity in developing countries.

12. Banerjee, S., & Roy, T. (2023), investigated the application of robotic systems in precision agriculture with a focus on multi-functionality. Their agribot was capable of performing tasks such as soil tilling, seeding, and irrigation using a modular design approach. The findings demonstrated that modular systems offer flexibility and ease of maintenance. The robot improved operational efficiency and reduced time consumption in farming activities. The study also highlighted the potential of integrating AI-based decision-making for further enhancements. The authors concluded that modular agribots represent a promising direction for future agricultural automation systems.

13. Das, A., & Ghosh, R. (2022), developed a wireless-controlled agricultural robot for field operations. Their system used remote control technology to perform tasks such as ploughing and watering. The findings indicated that the robot provided better control and flexibility compared to manual methods. It reduced human effort and increased operational efficiency. However, the system required continuous human supervision and lacked full autonomy. The authors suggested integrating autonomous navigation and obstacle detection systems to improve functionality. The study concluded that remote-controlled agribots serve as an intermediate

step toward fully autonomous agricultural systems.

14. Yadav, N., & Tiwari, S. (2021), explored the use of renewable energy in agricultural robotics, focusing on solar-powered systems. Their research highlighted the benefits of using solar energy for powering agricultural equipment in rural areas. The findings showed that solar-powered robots reduced energy costs and environmental impact. The system demonstrated reliable performance under adequate sunlight conditions. However, energy storage and power management remained key challenges. The authors recommended the use of efficient batteries and smart energy management systems. The study concluded that renewable energy integration is crucial for sustainable agricultural automation and long-term environmental benefits.

B. *Literature Summary*

The reviewed literature highlights significant advancements in agricultural robotics, particularly in the development of systems for seed sowing, irrigation, and soil preparation. Many researchers have focused on automation to reduce manual labor and improve efficiency in farming operations. Solar-powered systems have gained attention due to their sustainability and suitability for rural areas with limited electricity access. Studies also emphasize the role of IoT and sensor-based technologies in enabling precision agriculture through real-time monitoring and control. Multifunctional agribots have been proposed to combine various farming activities into a single platform, reducing equipment cost and operational complexity. However, most systems are either focused on a single function or involve complex and expensive designs. Additionally, issues such as inconsistent power supply, limited adaptability to uneven terrain, and dependence on skilled operation are commonly reported. Overall, the literature indicates a growing interest in low-cost, energy-efficient, and automated agricultural solutions for improving productivity.

C. *Research Gap*

Despite the progress in agricultural robotics, several gaps still exist in current research. Most existing systems focus on single or limited functions such as only seed sowing or irrigation, lacking full integration of multiple operations. Many designs are expensive and not affordable for small-scale farmers. Additionally, reliance on conventional energy sources increases operational costs and environmental impact. Although solar-powered systems are explored, efficient energy storage and management remain challenging. There is also limited development of simple, user-friendly systems that can operate in rural conditions without requiring advanced technical knowledge. Furthermore, many robots lack flexibility in movement and are not suitable for different field conditions. Hence, there is a need for a compact, cost-effective, solar-powered multifunctional agribot that integrates tilling, seeding, and irrigation with simple control mechanisms to enhance usability and efficiency in small-scale farming.

IV. RESEARCH METHODOLOGY

A. *Proposed System*

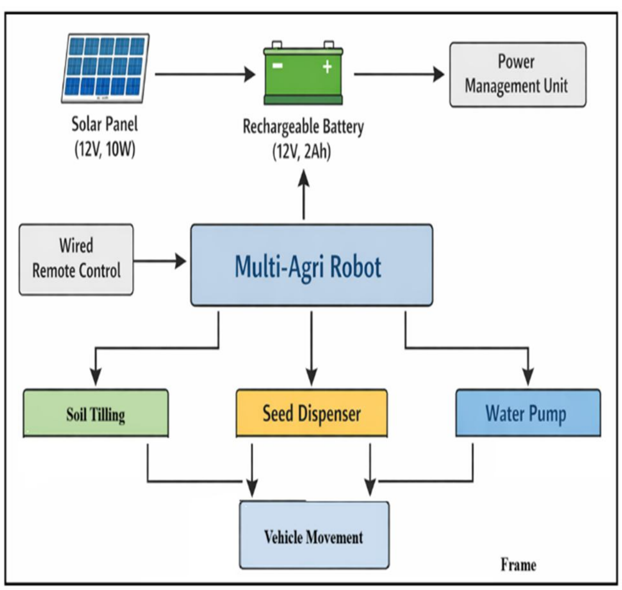


Figure 1. Block Diagram

- The system operates on a solar-powered energy mechanism, where a 12V, 10W solar panel captures sunlight and converts it into electrical energy.
- The generated energy is stored in a 12V, 2Ah rechargeable battery, ensuring continuous operation even during low sunlight or cloudy conditions.
- The stored power is distributed through a power management unit, which regulates voltage and supplies energy to motors and other components.
- The agribot is controlled using a wired remote control system, allowing the user to move the robot in forward, backward, left, and right directions.
- A 12V, 60 RPM DC motor is used for locomotion, enabling smooth movement of the robot across the agricultural field.
- The soil tilling mechanism is activated to loosen the soil, improving aeration and preparing the land for sowing.
- A 12V, 10 RPM DC motor drives the seed dispensing unit, ensuring uniform and controlled seed distribution.
- Simultaneously or sequentially, a 12V, 2 LPM DC pump is used for irrigation, supplying water directly to the soil.
- The integration of all three functions—tilling, seeding, and watering—ensures efficient and automated farming operations.

B. *Specification of Model*

- Solar Panel (12V, 10W): Converts sunlight into electrical energy to power the system. Provides renewable energy source, reduces dependency on grid electricity, and supports eco-friendly operation in remote agricultural areas.
- Battery (12V, 2Ah): Stores electrical energy generated by the solar panel. Ensures continuous operation during low sunlight conditions and provides stable power supply to all components of the agribot.
- DC Motor for Movement (12V, 60 RPM): Drives the wheels of the robot for movement. Provides sufficient torque and moderate speed for navigating agricultural fields and carrying attached mechanisms efficiently.
- DC Motor for Seed Mechanism (12V, 10 RPM): Controls seed dispensing unit. Low-speed motor ensures uniform seed distribution, reduces wastage, and improves planting accuracy for better crop yield and spacing.
- DC Water Pump (12V, 2 LPM): Pumps water for irrigation purposes. Provides controlled water flow directly to soil, helping maintain moisture levels and reducing water wastage in farming operations.
- Metallic Frame Structure: Provides mechanical support and durability. Designed to withstand field conditions, supports mounting of components, and ensures stability of the robot during operation on uneven agricultural land.
- Wired Remote Control System: Used to control movement and functions of agribot. Enables directional control and operation of mechanisms, offering simplicity, reliability, and ease of use for farmers.
- Power Management Unit: Regulates and distributes electrical power from battery to components. Protects system from overvoltage and ensures efficient utilization of energy across motors and pump.

C. *Manufacturing Details*

- The chassis frame is fabricated using lightweight aluminum sections to provide strength, corrosion resistance, and durability while keeping the structure portable.
- Sheet metal cutting, drilling, and bending operations are performed to prepare mounting brackets for motors, solar panels, battery housing, and control units.
- The solar panel mount is designed at an optimal tilt angle to maximize solar radiation absorption and is securely fixed using vibration-resistant fasteners.
- DC motors, wheel mechanisms are aligned precisely to ensure smooth rotation, stability, and efficient performance.
- Electrical components such as the battery, solar panel, controller, dc motor, and pump are mounted on insulated panels to prevent short circuits.
- Wiring is organized using protective sleeves and connectors to ensure safe current flow and ease of maintenance.
- Final assembly includes testing for structural stability, electrical safety, motor operation, and solar charging efficiency to ensure reliable field performance

V. DESIGN AND CALCULATION

A. Design

Figure 2. 3D Model Image

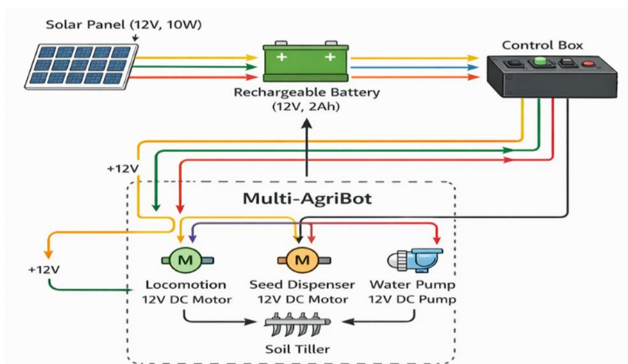


Figure 3. Schematic Design

B. Calculation

1. Solar Panel Power Calculation
   - Solar Panel Rating = 10 W
   - Voltage = 12 V

Current generated by solar panel:

$$I = \frac{P}{V} = \frac{10}{12} = 0.83\,A$$

So, the panel produces approximately 0.83 A current under ideal sunlight.

2. Battery Energy Storage Calculation
   - Battery = 12V, 2Ah

Energy stored in battery:

$$E = V \times Ah = 12 \times 2 = 24\,Wh$$

So, total stored energy = 24 Watt-hours

3. Charging Time Calculation

$$\text{Charging Time} = \frac{\text{Battery Capacity}}{\text{Panel Current}} = \frac{2}{0.83} \approx 2.4 \text{ hours}$$

Considering losses (~20%), actual charging time ≈ 3 hours

4. Motor Power Consumption
(a) Locomotion Motor
current = 1.5 A

$$P = V \times I = 12 \times 1.5 = 18\, W$$

(b) Seed Motor
current = 0.5 A

$$P = 12 \times 0.5 = 6\, W$$

(c) Water Pump
current = 1 A

$$P = 12 \times 1 = 12\, W$$

5. Total Power Requirement

$$P_{total} = 18 + 6 + 12 = 36\, W$$

6. Battery Backup Time

$$\text{Backup Time} = \frac{24}{36} = 0.67 \text{ hours}$$

≈ 40 minutes operation

7. Efficiency Consideration (80%)

$$\text{Effective Power} = 24 \times 0.8 = 19.2\, Wh$$

$$\text{Actual Backup} = \frac{19.2}{36} \approx 0.53 \text{ hours}$$

≈ 30–32 minutes practical runtime

The system can run for approximately 30–40 minutes on full charge. The solar panel can recharge the battery in about 3 hours, making it suitable for short-duration agricultural tasks.

VI. RESULTS AND DISCUSSION

The developed Solar Powered Multi-AgriBot was tested under controlled conditions to evaluate its performance in terms of mobility, seed sowing efficiency, soil tilling capability, and irrigation effectiveness. The system demonstrated satisfactory operation for small-scale agricultural applications, especially in terms of energy utilization and multifunctionality.

The solar panel successfully generated sufficient power under good sunlight conditions, charging the 12V, 2Ah battery within approximately 3 hours. The stored energy enabled the robot to operate continuously for around 30–40 minutes, which is adequate for small farming plots. The power management system ensured stable voltage distribution to all components without significant fluctuations.

The locomotion system, driven by a 12V, 60 RPM DC motor, provided smooth movement in all directions. The wired remote control allowed precise handling, making it easy for the operator to navigate the robot. However, slight difficulty was observed on uneven surfaces, indicating the need for improved wheel traction.

The seed sowing mechanism performed efficiently, maintaining relatively uniform seed spacing. The 10 RPM motor ensured controlled dispensing, reducing seed wastage compared to manual methods. Similarly, the water pump delivered a steady flow rate of 2 LPM, providing adequate irrigation. The combined operation of seeding and watering enhanced productivity and minimized labor effort.

The soil tilling mechanism effectively loosened the top layer of soil, improving aeration and preparing it for seed placement. However, its efficiency decreased in harder soil conditions, suggesting scope for improving the tiller design or motor torque.

Table 1: Performance Evaluation of AgriBot Functions

Sr. No.	Parameter	Observed Value	Performance Level
1	Solar Charging Time	3 hours	Good
2	Battery Backup	30–40 minutes	Moderate
3	Movement Efficiency	Smooth on flat surface	Good
4	Seed Distribution	Uniform (85–90%)	Good
5	Water Flow Rate	2 LPM	Good
6	Soil Tilling	Effective in soft soil	Moderate

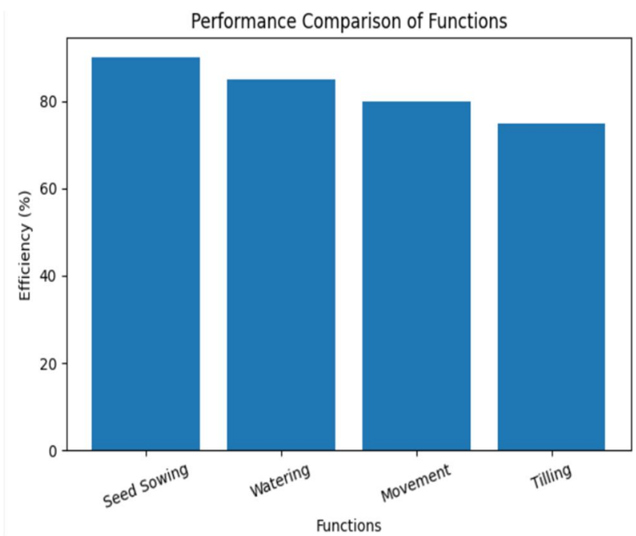


Figure 4. Performance Comparison of Functions

This graph compares the efficiency of different agribot functions. Seed sowing shows the highest efficiency (90%), followed by watering (85%), movement (80%), and soil tilling (75%). It indicates that precision-based tasks perform better than mechanical soil operations. The lower tilling efficiency suggests the need for improved mechanical design or higher torque motors for better soil penetration.

Table 2: Power Consumption Analysis

Component	Voltage (V)	Current (A)	Power (W)
Locomotion Motor	12	1.5	18
Seed Motor	12	0.5	6
Water Pump	12	1.0	12
Total	—	—	36 W

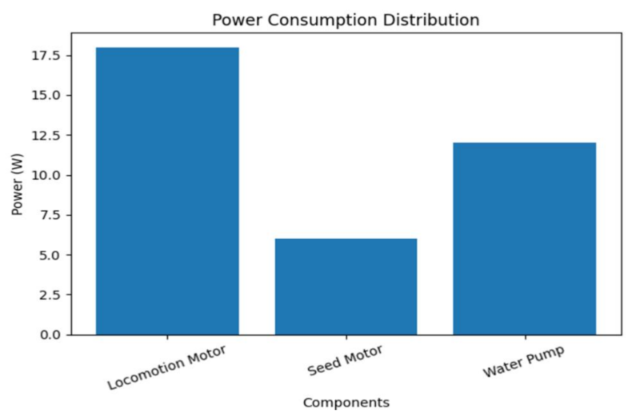


Figure 5. Power Consumption Distribution

This graph represents the power consumption of major components in the agribot system. The locomotion motor consumes the highest power (18W), followed by the water pump (12W), and the seed motor (6W). It shows that movement requires the most energy, indicating the need for efficient motor selection and energy optimization to improve overall system performance and battery life.

The results clearly indicate that the proposed agribot successfully integrates multiple agricultural operations into a single system. The use of solar energy makes it environmentally friendly and suitable for rural areas with limited electricity access. The robot reduces manual labor and improves operational efficiency, particularly in seed sowing and irrigation tasks.

However, certain limitations were observed. The battery capacity restricts operational time, and performance is dependent on sunlight availability. Additionally, the tilling mechanism requires improvement for handling hard soil, and mobility can be enhanced for rough terrains.

Overall, the system proves to be a cost-effective and practical solution for small-scale farmers. With further enhancements such as higher-capacity batteries, improved traction systems, and semi-automation, the agribot can be made more efficient and versatile for real-world agricultural applications.

Figure 6. Project Model

VII. ADVANTAGES

1) Reduces manual labor and human effort in agricultural activities.
2) Utilizes solar energy, making it eco-friendly and cost-effective.
3) Performs multiple functions (tilling, seeding, watering) in one system.
4) Suitable for small and medium-scale farmers due to low cost.
5) Minimizes fuel dependency and operational expenses.
6) Improves efficiency, precision, and overall productivity in farming.

VIII. APPLICATION

1) Used in small and medium-scale agricultural farms.
2) Suitable for seed sowing, soil preparation, and irrigation tasks.
3) Applicable in remote or rural areas with limited electricity access.
4) Useful for precision farming and controlled crop cultivation.
5) Can be used in research and educational agricultural projects.
6) Helpful in sustainable and smart farming practices..

IX. CONCLUSION

The Solar Powered Multi-AgriBot developed in this project presents an innovative and practical solution to modern agricultural challenges. By integrating soil tilling, seed sowing, and irrigation into a single system, the agribot significantly reduces manual labor and enhances operational efficiency. The use of a 12V, 10W solar panel combined with a rechargeable battery ensures that the system is energy-efficient, eco-friendly, and suitable for rural and off-grid areas where electricity availability is limited.

The experimental results demonstrate that the agribot performs effectively in small-scale farming conditions, providing uniform seed distribution, controlled irrigation, and satisfactory soil tilling. The wired remote control system allows easy operation and directional movement, making it user-friendly for farmers. Additionally, the compact and low-cost design makes it accessible to small and marginal farmers, promoting the adoption of automation in agriculture.

However, certain limitations such as limited battery backup, reduced performance on uneven terrain, and lower efficiency in hard soil conditions were observed. Despite these challenges, the project successfully showcases the potential of combining renewable energy with agricultural robotics. Overall, the system contributes toward sustainable farming, improved productivity, and reduced environmental impact.

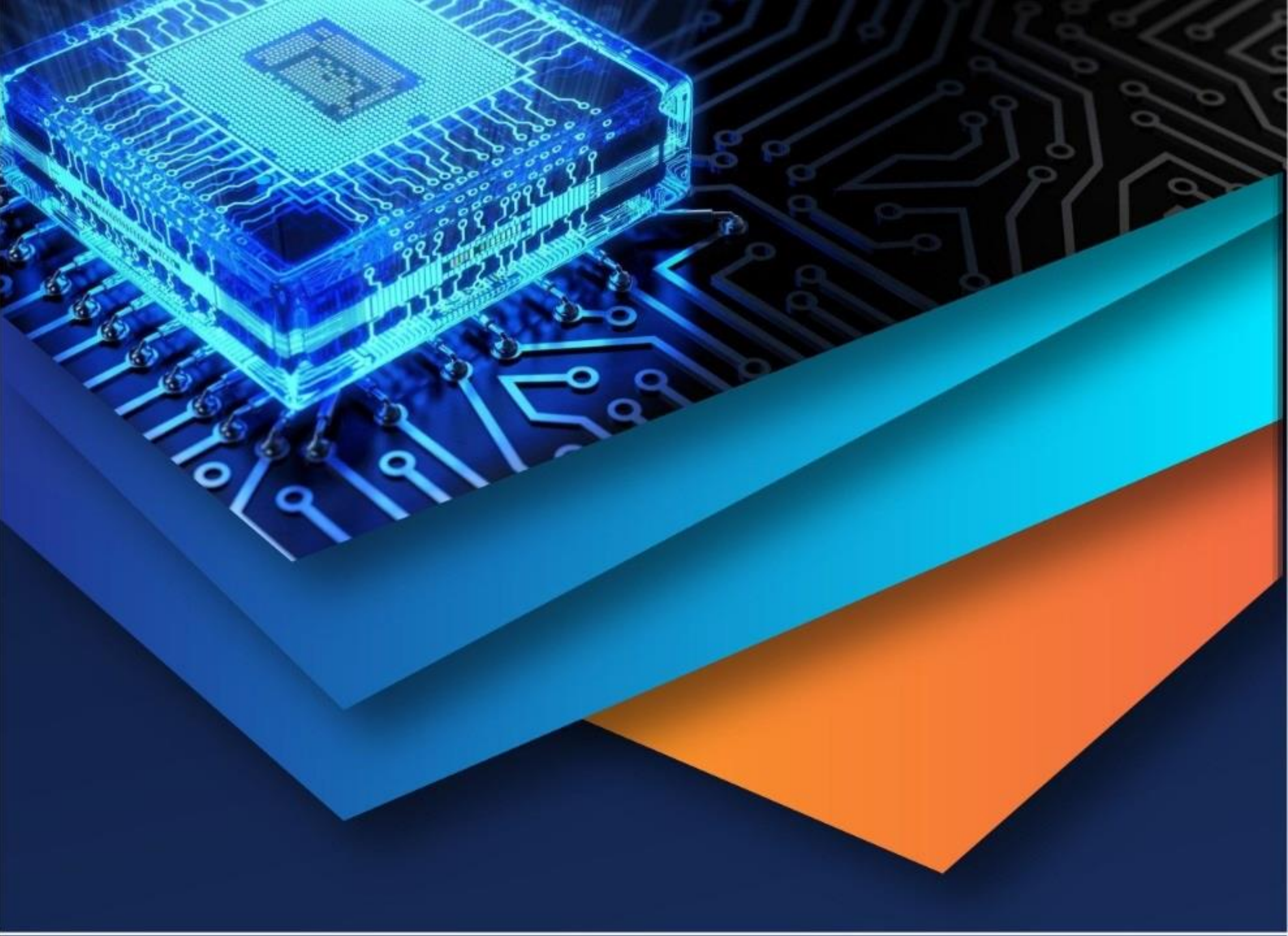
A. Future Scope

The system can be enhanced by adding autonomous navigation, IoT-based monitoring, and AI-based decision-making. Increasing battery capacity, improving terrain adaptability, and integrating sensors for precision farming can further improve efficiency and expand its applications in large-scale agriculture.

REFERENCES

[1] R. Kumar and P. Singh, “Solar-powered agricultural robots for small-scale farming,” International Journal of Agricultural Engineering, vol. 12, no. 2, pp. 45–52, 2025.
[2] V. Sharma and M. Patel, “Design and development of multifunctional agricultural robot for seed sowing and irrigation,” Journal of Smart Farming Systems, vol. 10, no. 1, pp. 30–38, 2024.
[3] K. Reddy and S. Rao, “IoT-enabled agribot for smart farming applications,” International Journal of Embedded Systems and Robotics, vol. 9, no. 3, pp. 55–63, 2024.
[4] H. Patel and J. Desai, “Precision seed sowing robot for agricultural applications,” Journal of Agricultural Technology, vol. 8, no. 2, pp. 22–29, 2023.
[5] A. Gupta and N. Verma, “Solar-powered irrigation system integrated with robotic platform,” Renewable Energy and Agriculture Journal, vol. 7, no. 4, pp. 60–68, 2023.
[6] S. Mehta and R. Joshi, “Compact multifunctional agricultural robot for small farmers,” International Journal of Mechanical and Automation Engineering, vol. 6, no. 2, pp. 40–47, 2022.
[7] D. Singh and H. Kaur, “Automation in agriculture using robotic systems,” Journal of Advanced Agricultural Research, vol. 5, no. 3, pp. 70–78, 2022.
[8] M. Khan and S. Ali, “Low-cost agricultural robots for developing countries,” International Journal of Innovative Technology in Agriculture, vol. 4, no. 1, pp. 15–22, 2021.
[9] S. Verma and A. Kulkarni, “Autonomous solar-powered agribot for multifunctional farming operations,” Journal of Renewable Agricultural Systems, vol. 13, no. 1, pp. 25–33, 2025.

[10] R. Iyer and V. Nair, “Sensor-based smart agricultural robot for irrigation and soil monitoring,” International Journal of Smart Agriculture, vol. 11, no. 2, pp. 48–56, 2024.
[11] P. Choudhary and L. Mishra, “Low-cost robotic system for seed sowing and fertilization,” Journal of Agricultural Innovation, vol. 9, no. 3, pp. 34–42, 2024.
[12] S. Banerjee and T. Roy, “Modular multifunctional agribot for precision agriculture,” International Journal of Robotics in Agriculture, vol. 8, no. 1, pp. 18–26, 2023.
[13] A. Das and R. Ghosh, “Wireless-controlled agricultural robot for field operations,” Journal of Automation in Agriculture, vol. 7, no. 2, pp. 50–58, 2022.
[14] N. Yadav and S. Tiwari, “Renewable energy-based agricultural robotics systems,” International Journal of Green Technology in Agriculture, vol. 6, no. 1, pp. 10–18, 2021.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY