

# Solar Powered Seed Sprayer

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**Abstract**—Agriculture is key to the economy, and using efficient and sustainable farming equipment is crucial for boosting productivity. This project focuses on designing and developing a solar-powered seed sprayer to lessen manual work and reduce reliance on traditional energy sources. The system runs on solar energy, which is stored in a rechargeable battery to power the spraying mechanism. An ESP32 microcontroller controls the system's operation, enhancing reliability and allowing for future automation. A centrifugal fan helps achieve even and controlled seed distribution. The tested model showed efficient performance under various conditions, with reduced seed wastage and minimal human effort. The proposed system provides a cost-effective, eco-friendly, and practical solution for small- and medium-scale agricultural use.

**Index Terms**—Solar Energy, Solar Powered Seed Sprayer, ESP32 Microcontroller, Centrifugal Fan, Sustainable Agriculture, Renewable Energy, Seed Distribution, Agricultural Equipment

## I. INTRODUCTION

Agriculture supports many economies and plays a crucial role in providing food security. With the growing demand for higher agricultural output and the climbing costs of fuel and labor, there is an increasing need for efficient, affordable, and sustainable farming equipment. Traditional methods of seed sowing and spraying often require a lot of manual work and rely heavily on non-renewable energy sources, which can raise operational costs and harm the environment.

Recently, renewable energy, especially solar energy, has become more important in farming. Solar-powered tools provide an environmentally friendly option by cutting down on fuel use and lowering carbon emissions. Among different farming tasks,

seed spraying is essential as it directly impacts crop yield and even growth. Uneven seed distribution and manual sowing can cause seed waste and irregular crop development.

This project focuses on creating a solar-powered seed sprayer that aims to boost efficiency and lessen manual labor. The system uses solar energy stored in a rechargeable battery to run the spraying mechanism. An ESP32 microcontroller is included to manage system operations and allow for future automation. A centrifugal fan is also used to ensure even and controlled seed distribution. The proposed system is designed to be affordable, user-friendly, and suitable for small to medium-sized farms, promoting sustainable and modern farming practices.

## II. LITERATURE REVIEW

Several research studies have focused on improving agricultural practices by introducing mechanized and renewable energy-based equipment. Traditional seed sowing and spraying methods are widely used, but they often require significant manual labor and lead to uneven seed placement. To address these challenges, researchers have looked into alternative approaches that lessen human effort while improving efficiency and consistency in agricultural operations. Solar energy has been identified as a reliable and eco-friendly power source for agricultural machinery. Many studies have reported successful uses of solar-powered sprayers and seed sowing machines to replace fuel-based systems. These systems help lower operating costs and reduce environmental impact, making them suitable for small and medium farmers. However, earlier models mainly relied on simple control mechanisms and needed frequent manual adjustments. Further research introduced electronic control units to boost system performance. The use of

microcontrollers allowed better regulation of motor speed and spraying rate, which improved accuracy and cut down on seed wastage. Despite these improvements, some designs still faced issues like uneven seed distribution and clogging due to inefficient spraying mechanisms. Recent literature highlights the need for better seed dispersion methods and effective airflow systems to ensure uniform spraying. Studies suggest that combining solar power with smart control systems and advanced spraying mechanisms can significantly improve agricultural productivity. Based on these findings, the current project aims to develop a more efficient and practical solar-powered seed sprayer that addresses the shortcomings of earlier models.

### III. METHODOLOGY

The development of the Solar Powered Seed Sprayer follows a clear process to ensure it is efficient, portable, and environmentally friendly. The process can be divided into following stages

1. **Design and Planning:** The design and planning phase started with understanding the basic needs of a solar-powered seed sprayer for agriculture. We focused on simplicity, low cost, and ease of use. We aimed to create a renewable energy system to lessen reliance on fuel and electricity. The overall layout was made compact and lightweight so that it could be handled easily in the field.
2. **Selection of Components:** We selected appropriate components based on the design needs. A solar panel and rechargeable battery were chosen to power the system. An ESP32 microcontroller was chosen to efficiently control the operation and allow for future upgrades. A DC motor and centrifugal fan helped create better air pressure and even seed spraying. We considered availability, efficiency, and reliability when selecting all components.
3. **Assembly:** After selecting the components, we assembled the mechanical and electrical parts on a suitable frame. We mounted the seed container, motor, centrifugal fan, and solar panel properly. We made the electrical connections carefully to ensure safe and smooth power flow. We maintained proper alignment to prevent vibration, seed blockage, and power loss during operation.
4. **Testing:** Once assembly was finished, we tested the system under various working conditions. We observed the charging performance of the solar panel, battery backup, ESP32 control operation, and seed spraying mechanism. We made minor adjustments to improve seed flow and spraying uniformity. We tested the system multiple times to ensure reliable performance.
5. **Calculations:** We conducted basic calculations to estimate the power generation from the solar panel, battery capacity, and motor power needs. These calculations helped us select appropriate components and ensured that the system operates efficiently without power failures.
6. **Field Improvements:** After testing, we made improvements based on field observations. Using a centrifugal fan improved seed dispersion and reduced clogging. The control system with ESP32 improved operational stability. These enhancements increased overall efficiency and made the system more practical for agricultural use.

### IV. DESIGN

The design of the solar-powered seed sprayer began by recognizing the challenges farmers face with traditional seed sowing. Manual methods need more effort and time, often leading to uneven seed placement. With this in mind, the system was created to be simple, user-friendly, and effective in real field conditions. The basic design relies on solar energy as the primary power source. A solar panel is attached to the structure to capture sunlight during operation. The electricity produced by the panel is stored in a rechargeable battery, allowing the system to run smoothly even when sunlight is inconsistent. This reliability makes the machine suitable for outdoor agriculture. An ESP32 microcontroller controls the operation of the model. The ESP32 manages the motor operation and improves the overall stability of the system. Using this controller also means the

system can be easily upgraded in the future for automation or remote control, without needing to change its basic structure. For seed spraying, a centrifugal fan is used instead of a regular fan. This choice was made because the centrifugal fan offers better air pressure, helping to spread the seeds more evenly on the soil. The seed container is designed simply to let seeds flow easily without getting blocked during use. The machine's structure is lightweight, making it easy to handle in the field. At the same time, it maintains enough strength to ensure durability with regular use. Electrical components are securely fixed and protected against dust and moisture. Overall, the design prioritizes practicality, ease of use, and performance over complexity, making the system ideal for small and medium farmers.

#### V. RESULT AND DISCUSSION

The solar-powered seed sprayer was tested under real operating conditions and performed well. The system ran smoothly on solar energy, and the rechargeable battery provided dependable backup when sunlight was inconsistent. This allowed for continuous operation in the field.

The ESP32-based control system kept the motor running steadily and improved overall reliability. The centrifugal fan ensured even and controlled seed distribution across the field. Compared to manual seeding, this model cut down on seed waste and required less physical effort from the operator.

The lightweight design made the machine easy to handle, while the robust construction ensured it would last through use. Overall, the results show that the solar-powered seed sprayer is efficient, user-friendly, and suitable for small to medium-sized farming operations.

#### VI. DISCUSSION

The performance of the solar-powered seed sprayer during testing showed that the system is suitable for practical agricultural use. The solar panel and battery setup provided a reliable power supply, allowing the machine to operate smoothly even when sunlight was inconsistent. This makes the system dependable for outdoor field conditions.

The ESP32 microcontroller improved control over the motor operation and increased overall system stability. The centrifugal fan played an important role in achieving better seed distribution by generating enough air pressure, which helped spread seeds more evenly and reduced blockage. While the system's performance relies on solar energy, the results indicate that it effectively cuts down on manual labor and boosts efficiency, making it a practical and eco-friendly solution for farmers.

#### VII. ADVANTAGES

1. Uses solar energy, which reduces reliance on fuel and electricity. Low operating cost since sunlight is free.
2. Reduces manual effort and physical strain on farmers.
3. Delivers uniform seed distribution for better crop growth.
4. Minimizes seed waste through controlled spraying.
5. Easy to operate and suitable for small and medium-scale farmers.
6. Requires little maintenance due to simple design and parts.
7. Can work in remote areas without electricity.

#### VIII. FUTURE SCOPE

The solar-powered seed sprayer has great potential for future improvement and development. The system can be improved by using more efficient solar panels and batteries with higher storage capacity. This would enhance performance in low sunlight conditions. Adding automation features, like adjustable seed rate control and sensor-based operation, can increase accuracy and lessen the need for human involvement. The design could also be changed to support multi-crop seed spraying and to integrate with fertilizer or pesticide spraying systems. With technological progress and wider adoption, the solar-powered seed sprayer can significantly promote smart, sustainable, and energy-saving farming practices.

## IX. CONCLUSION

The solar-powered seed sprayer was successfully designed and tested. It provides an efficient and eco-friendly solution for sowing seeds in agriculture. The system uses solar energy to lessen reliance on traditional fuels while reducing manual labor. Its uniform seed distribution, low operating cost, and easy operation make it suitable for small and medium-sized farmers. The results show that the project is practical, reliable, and environmentally sustainable. Overall, the solar-powered seed sprayer positively impacts modern farming by encouraging renewable energy use and improving farming efficiency.

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