IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, April 2026
Impact Factor: 8.2

Smart Pesticide Spraying Robot for Sustainable Agriculture

Prof. S. A. Sonone[1], Chetak V. Chavhan[2], Kshitij P. Gedam[3], Sujit P. Borkar[4], Vishal J. Hade[5], Dhiraj J. Tantarpate[6], Pranay V. Raut[7]

[1]Lecturer, Students[2-7]

Dr. Rajendra Gode Institute of Technology and Research (Polytechnic), Amravati, Maharashtra, India

Abstract: *Agriculture is the backbone of global food security, but it faces unprecedented challenges due to increasing population, diminishing labor availability, and the urgent need for sustainable practices. Traditional farming techniques are often labor-intensive, time-consuming, and prone to inconsistencies in resource application, leading to wastage and environmental degradation. This paper presents the design and development of a smart pesticide spraying robot that integrates automation, wireless connectivity, and renewable energy. The robot operates autonomously and is controlled via a Wi-Fi-enabled mobile application, allowing real-time monitoring and operation. It features an adjustable spraying mechanism to cater to different crop heights and ensures uniform distribution of pesticides and nutrients. Powered by solar energy, the system promotes sustainable farming practices while reducing operational costs. The proposed system enhances precision agriculture, improves efficiency, and minimizes environmental impact*

Keywords: *Agriculture*

I. INTRODUCTION

Agriculture plays a crucial role in sustaining the global population. However, modern farming faces challenges such as labor shortages, inefficient resource utilization, and environmental concerns. Traditional pesticide spraying methods often result in uneven distribution, excessive chemical use, and increased health risks for farmers.

With advancements in robotics, IoT, and renewable energy, smart farming solutions have gained importance. This research focuses on developing a smart pesticide spraying robot that automates spraying operations, ensures precision, and promotes eco-friendly farming practices.

II. OBJECTIVES

- To design an autonomous pesticide spraying robot
- To reduce manual labor and human exposure to chemicals
- To ensure uniform spraying and efficient resource utilization
- To integrate wireless control using a mobile application
- To utilize solar energy for sustainable operation

III. LITERATURE REVIEW

Recent studies in precision agriculture highlight the importance of automation and robotics in improving crop productivity. Existing systems include:

- Manual sprayers (labor-intensive and inefficient)
- Tractor-mounted sprayers (costly and unsuitable for small farms)
- Drone-based sprayers (expensive and require technical expertise)

Copyright to IJARSCT
www.ijarsct.co.in

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 6, Issue 4, April 2026 Impact Factor: 8.2

The proposed system aims to overcome these limitations by offering a cost-effective, adaptable, and sustainable solution.

IV. SYSTEM ARCHITECTURE

4.1 Components

- Microcontroller (Arduino/ESP32)
- Wi-Fi module for communication
- Water/pesticide pump
- Adjustable spraying mechanism
- Motors and wheels for movement
- Solar panel and battery system
- Mobile application interface

4.2 Working Principle

The robot operates using a microcontroller that controls movement and spraying mechanisms. It connects to a mobile application via Wi-Fi, allowing remote operation. The robot navigates through the field, spraying pesticides evenly based on predefined or manual commands.

V. KEY FEATURES

5.1 Autonomous Operation

The robot performs spraying tasks independently, reducing human effort and improving efficiency.

5.2 Mobile App Control

Farmers can:

- Start/stop the robot
- Adjust spraying parameters
- Monitor operations in real-time

5.3 Adjustable Spraying Height

The height-adjustable nozzle ensures:

- Uniform spray coverage
- Adaptability to different crop types
- Reduced wastage of pesticides

5.4 Solar-Powered System

- Uses renewable energy
- Suitable for remote/off-grid areas
- Reduces electricity costs

6. METHODOLOGY

- Design of mechanical structure
- Integration of electronic components
- Development of mobile application
- Programming of control algorithms
- Testing under field conditions

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, April 2026
Impact Factor: 8.2

VII. ADVANTAGES

- Reduces labor dependency
- Minimizes pesticide wastage
- Improves crop yield
- Environmentally friendly
- Cost-effective for farmers

VIII. APPLICATIONS

- Crop spraying in farms
- Greenhouse irrigation
- Precision agriculture systems
- Organic farming practices

IX. LIMITATIONS

- Initial setup cost
- Dependence on weather for solar power
- Requires basic technical knowledge

X. FUTURE SCOPE

- Integration with AI for crop disease detection
- GPS-based navigation for fully autonomous movement
- Sensor-based smart spraying (only where needed)
- IoT-based data analytics for farm monitoring

X. CONCLUSION

The smart pesticide spraying robot represents a significant advancement in agricultural technology. By combining automation, wireless communication, and solar energy, the system addresses major challenges faced by modern farming. It enhances efficiency, reduces environmental impact, and promotes sustainable agricultural practices. With further improvements, this technology can play a vital role in the future of precision farming.

REFERENCES

[1]. Precision Agriculture Technologies – Research Journals
[2]. IoT in Smart Farming – IEEE Papers
[3]. Renewable Energy in Agriculture – Elsevier Publications
[4]. Robotics in Agriculture – Springer Journals