IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 14, Issue 12, December 2025

DOI: 10.17148/IJARCCE.2025.141225

ECOCLIMB SPRAYER

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Abstract: The tree-climbing robot for spraying pesticides automates the spraying process and reduces the need for manual, risky work. It safely climbs trees and applies pesticides with better accuracy, minimizing chemical exposure to farmers. The system ensures targeted spraying to reduce chemical wastage and environmental pollution. It can also carry sensors to detect pest-affected areas for focused spraying. Overall, the robot improves safety, saves time, and supports efficient and sustainable farming.

Keywords: Robot, pesticide spraying, automation, precision agriculture, sensor- based monitoring, sustainable farming, crop protection

I. INTRODUCTION

Spraying pesticides on coconut and areca nut trees is one of the toughest and most dangerous tasks for farmers because these trees are very tall and difficult to climb. Workers often depend on ladders or manual climbers, which increases the risk of falls and exposes them to harmful chemicals. To overcome these challenges, an automated tree- climbing robot offers a safer and more efficient solution. This robot is designed to climb tall coconut or areca nut trees smoothly and spray pesticides without the need for human climbing. It helps reduce physical effort, improves safety, and prevents farmers from coming into direct contact with chemicals. The robot can reach the top portions of the tree where pests commonly attack and ensures that the spray is applied only where needed, reducing wastage. With the help of sensors or simple control systems

Overall, this technology supports farmers by saving time, improving crop protection, and create the spraying process much safer for tall plantation crops like coconut and areca nut

II. LITERATURE SURVEY

“Research in 2019 that investigated the challenges associated with spraying coconut and areca nut trees by R. Sharma et al. demonstrated that automated especially safe methods are needed for pesticide and herbicide application. In 2020, Noshir K. Prasad and Harish B. Naik constructed and tested a basic tree climbing robot which proved that a mechanical grip on a tree trunk significantly increases the amount of mechanical grip the robot has on the tree and thus increases the stability of the robot when spraying on a smooth tree trunk.

“Kumar and Joseph's (2021) study described a surrogate model for precision application tools used to apply pesticides and herbicides, allowing accurate targeting by farmers and less chemical waste.

“Shetty and Rao (2022) presented research that confirmed that using sensors allows for precision application of pesticides/herbicides and automation providing not only safer application for farmers, but a more optimized application process. All these researchers have established an evidence base for our project”.

“In 2021, Sathishkumar et al. showed that mechanical climbing machines can lessen farmer's work and increase the safety level of farmers. Prasad and Naik documented the safety issues of manual spraying tall coconut trees due to the risks involved in their work as well as the need for automation.

“In 2020, Sharma et al. proved that automated spray systems have increased the precision of applying pesticides and decreased the volume of chemicals erroneously expelled, which validates our need to develop our own pesticide robot for tree climbing”.

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"Research conducted in 2020 by Pandey eta l, focused on creating a robust climbing design specifically for certain upright species of plants, including coconut and areca nut, while the preceding year (2019) in their research Pallavi and others established a motorized spraying system to enhance the degree of mechanization of chemical application via robotic means to promote safety and accuracy for the application of pesticides on trees which were greater than normal human reach.

"In a paper published in 2017 by Megalingam Gupta, Singh, and Belagali, researchers described issues with the challenges and dangers associated with climbing coconut trees; they evaluated a number of mechanical/robotic climbing devices to demonstrate that an automated climbing system would be a safer option for coconut farmers. The outcomes of their study also demonstrate that our project could replace human labour and provide a more effective method for applying pesticides to coconuts.

III. METHODOLOGY

The methodology of tree-climbing robot utilizes components such as motors and sensors to ensure a safe and controlled method for climbing trees and accurately applying insecticides. The robot movement is enabled by 3 DC motors connected to wheels on each side of the motor frame. The speed, direction and motion for climbing will be programmed with Python and controlled by Bluetooth

To assist in the spraying function, a servo motor is connected to the pesticide sprayer and it will activate when the robot has reached its intended application height. An IR (infrared) sensor will ensure that the robot does not fall from the edge of a tree or that it collides with any branches while climbing. An ultrasonic sensor is also included to measure the length of time it will take for the robot to reach the top of the tree and that it maintains stability while climbing.

All motors and sensors are integrated and programmed with the use of Python. The programming integrates all sensors and motors and ensures that each step is taken prior to proceeding to the next when the robot has reached the height of its intended application of insecticides, the robot will stop and spray accurately and avoid any obstacles (i.e., branches, obstacles). This completes the process of testing the system on coconut and areca nut trees to confirm successful climbs and sprays, as well as safe functioning.

IV. BLOCK DIAGRAM

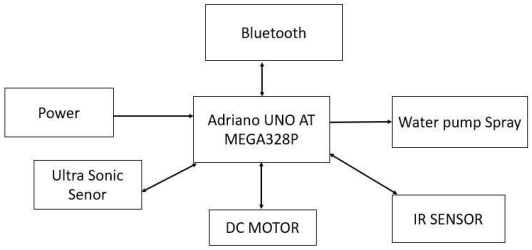

Fig1: Block Diagram of ECOCLIMB SPRAYER

V. WORKING FLOW CHART

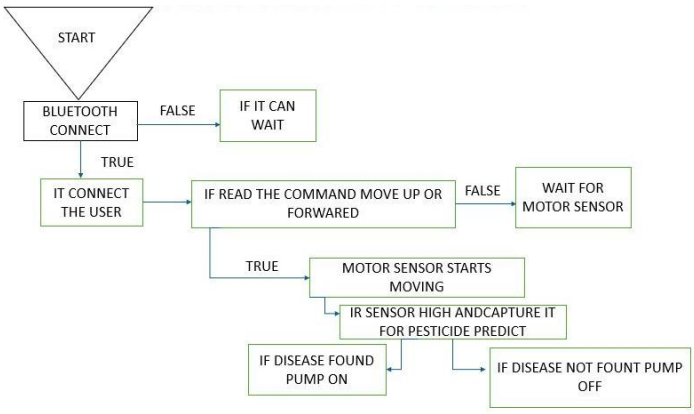

Fig2: flow chart of ECOCLIMB SPRAYER

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VI. COMPONENTS

Hardware Components;

- Arduino Uno ATmega328p
- Bluetooth sensor
- DC Motor
- Ultrasonic Sensor
- Sprayer
- Mini Submersible water pump
- L293D Motor driver
- IR Sensor
- Power supply

Software Requirement; We use Python programming in our project to control the tree- climbing robot and manage automated pesticide spraying. Python helps in processing sensor data, sending commands to the motors, and ensuring smooth operation of the spraying system

VII. EXPERIMENTAL RESULT

The testing of this tree climbing robot on an areca nut tree demonstrated the effectiveness of the design throughout testing while both climbing and spraying. The use of the Arduino Uno (ATmega328P) enabled seamless communication between all sensors and actuators used in the robot, while the L293D motor driver allowed for smooth movement of the DC motors during ascent without any slipping. The robot used ultrasonic and infrared sensors to accurately detect both the surface of the tree and any obstacles it encountered, which allowed for excellent alignment of the robot to the areca nut trunk. A Bluetooth module was incorporated into the robot to permit easy wireless operation during testing. The sprayer was operated using a small submersible pump, which allowed for uniform application of pesticide around the circumference of the tree while the robot climbed.

The successful completion of all the tests demonstrated that the robot has the capacity to properly climb an areca nut tree and accurately apply pesticide while minimizing the amount of effort required of the user.

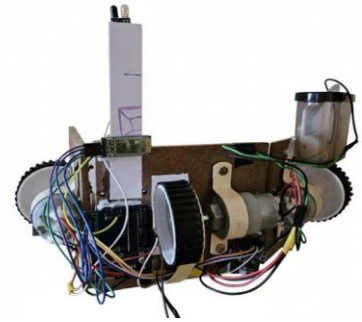

Fig3: ECOCLIMB SPEAYER Model

VIII. CONCLUSION

The tree-climbing robot was able to safely complete climbing and spraying tasks. Using a combination of an Arduino Uno, Sensor's, and DC motor's allowed submersible pump as its spraying mechanism and was able to evenly spray pesticide while ascending up the tree. Bluetooth Control made the robot easy to use and operate safely from a distance. In general, this robot reduces the amount of labor required by human beings, and lessen's the risk associated with manual pesticide spraying. The successes achieved during testing indicate this System can help increase productivity and improve Safety in Areca nut Farming, and with further development and refinement this robot can become more effective and better fit for use in the real agricultural field.

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