Agrivision Pesticides Spraying System

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Abstract: The agricultural sector faces significant challenges related to human health and labor intensity during pesticide application. This project proposes the development of an intelligent agricultural pesticide-spraying robot video streaming to address these issues. Controlled via an Android application, the robot integrates components like an Arduino Uno, DC motors, servo motors, and a Bluetooth HC-05 module for efficient and precise navigation and spraying operations. Additionally, temperature and humidity sensors optimize spraying conditions. By automating pesticide application, the robot minimizes direct human contact with harmful chemicals, reduces pesticide use by up to 30%, and promotes sustainable farming practices. This innovation not only enhances agricultural safety but also reduces labor demand, encouraging wider adoption of robotics in farming. such as the inclusion of an ESP32-CAM for real-time monitoring, further highlight the potential of this technology in modernizing agricultural processes

Index Terms - Agricultural sector, Pesticide application, Intelligent agricultural robot, Pesticide-spraying robot, Video streaming, Android application, Arduino Uno, DC motors, Servo motors, Bluetooth HC-05 module, Navigation and spraying operations, Temperature and humidity sensors, Sustainable farming, Automation, Agricultural safety, Robotics in farming, ESP32-CAM, Real-time monitoring, Labor reduction, Chemical exposure reduction, Precision agriculture.

I. INTRODUCTION

- Agriculture serves as the backbone of many economies, particularly in countries like India, where it employs nearly 60% of the population. As global food demand surges, farmers are compelled to increase crop yields, often through the extensive use of pesticides. While essential for protecting crops from pests, manual pesticide application poses significant health risks to farmers, including skin irritation, respiratory issues, and long-term diseases like cancer. Moreover, traditional pesticide application methods are inefficient, often leading to overuse, which contaminates the environment and endangers food safety. These challenges necessitate a shift towards safer, more efficient, and sustainable practices in agriculture.

- Automation in agriculture has emerged as a transformative approach to address these challenges. Robotic systems, such as pesticide-spraying robots, can drastically improve the precision and safety of pesticide application. The Agricultural Pesticide Spraying Robot with video streaming developed in this project integrates modern technologies like IoT, Bluetooth communication, and sensor systems to optimize pesticide usage. The proposed robot operates through a mobile via an Android application, this cost-effective robot offers a user-friendly interface for farmers to navigate the robot remotely, ensuring precise spraying and avoiding human exposure.

- A unique feature of the robot is its integration of temperature and humidity sensors, which play a crucial role in optimizing spraying conditions. These sensors ensure that pesticides are applied under favorable environmental conditions, enhancing their effectiveness while reducing waste. For example, applying pesticides when humidity is too high may lead to runoff, while low humidity can cause excessive evaporation, rendering the pesticide less effective. The inclusion of environmental monitoring capabilities makes this robot a holistic solution for precision agriculture

- The robot's low-cost design, based on components such as the Arduino Uno and HC-05 Bluetooth module, makes it accessible to small-scale farmers. Additionally, the integration of temperature and humidity sensors ensures the robot operates under optimal conditions.
- Future scalability of the project includes integrating advanced features such as an ESP32-CAM module for real-time field monitoring. This addition would enable farmers to remotely observe the robot's operation, assess spraying effectiveness, and identify field conditions such as pest infestations or crop health. These capabilities align with the principles of precision agriculture, which seeks to increase productivity while minimizing resource use and environmental impact.

II. LITERATURE REVIEW

In our literature review, we delved into several articles to inform the development of our project, particularly focusing on the design of Pesticide Spraying Robot with video streaming.

- One standout study in this realm is the research paper titled "Agricultural Pesticide Spraying Robot with video streaming".
- The study suggests new ways to design the parts and reduce the human health risk with direct contact of chemical pesticide.
- The aims of our project is to promote the farmers health and increasing crop efficiency while minimizing complexity and cost.

III. OBJECTIVES:

- Ensure Farmer Safety: Automate pesticide spraying to reduce direct human exposure to harmful chemicals.
- Improve Efficiency: Use precise spraying mechanisms to minimize pesticide wastage and optimize usage.
- Affordable and Easy to Use: Design a cost-effective robot controlled via a simple Android app for small-scale farmers.
- Enable Remote Monitoring: Add features like live video streaming for better field observation and control.

IV. BLOCKDIAGRAM & METHODOLOGY
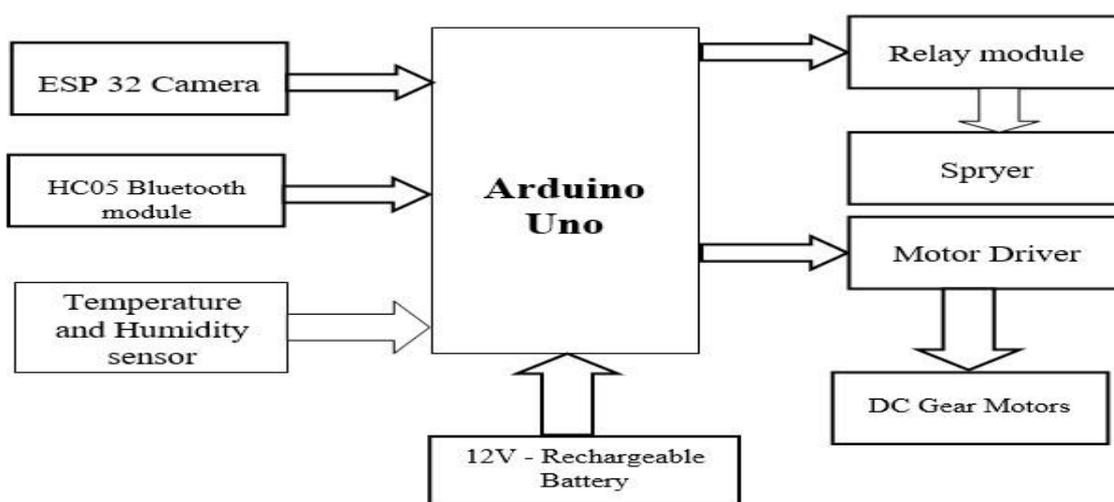
- The block diagram of the Agricultural Pesticide Spraying Robot outlines its key components and their interactions. At the core of the system is the Arduino Uno microcontroller, which serves as the central processing unit, coordinating all operations. The robot is controlled via an Android application that acts as the user interface, enabling farmers to send commands such as movement directions and sprayer activation. These commands are transmitted through the HC-05 Bluetooth module, which communicates with the Arduino Uno.
- Motor drivers (L293D) interface with the Arduino Uno to control the DC motors responsible for the robot's movement. These motors facilitate forward, backward, and directional navigation, ensuring precise mobility through the field. Servo motors are employed to adjust the positioning and angle of the sprayer for

targeted pesticide application. The pesticide pump system, controlled by the Arduino through a relay module, handles the spraying mechanism, ensuring consistent and effective pesticide distribution.

- Environmental monitoring is achieved through temperature and humidity sensors integrated into the system. These sensors provide real-time data, allowing the robot to operate under optimal conditions for pesticide application. An ESP32-CAM module is included to enable live video streaming, giving farmers the ability to monitor the robot's operations remotely and assess field conditions. The entire system is powered by a 12V rechargeable battery, with a buck converter ensuring appropriate voltage levels for low-power components.

- This modular and integrated design ensures the robot is efficient, precise, and adaptable to diverse agricultural settings, addressing the limitations of traditional pesticide application methods while promoting safer and more sustainable farming practices.

Working Flow:

- The farmer inputs commands into the Android app.
- The Bluetooth module receives and relays these commands to the Arduino Uno.
- The Arduino processes the commands and controls the motors for movement and the pump for pesticide spraying.
- The ESP32-CAM streams real-time video, aiding the farmer in monitoring the robot's operation.

V. ADVANTAGES

- The Agricultural Pesticide Spraying Robot offers several advantages and diverse applications, making it a valuable innovation for modern farming.
- One of its primary benefits is enhanced safety, as it automates pesticide application, significantly reducing direct human exposure to harmful chemicals.
- This minimizes health risks for farmers and promotes safer working conditions.
- Additionally, the robot improves efficiency by delivering precise and even pesticide distribution, reducing wastage and ensuring
- effective pest control.
- The integration of temperature and humidity sensors ensures that spraying occurs under optimal environmental conditions, maximizing pesticide efficacy and minimizing environmental impact.
- The low-cost design of the robot, using widely available components, makes it accessible to small-scale farmers, addressing the affordability challenge often associated with advanced agricultural technologies.

VI. APPLICATIONS

- Terms of applications, the robot is ideal for use in crop protection, particularly in fields requiring frequent and precise pesticide spraying.
- It is well-suited for small and medium-sized farms, where labor shortages or high labor costs pose challenges.
- The system's real-time monitoring capabilities, enabled by the ESP32-CAM module, make it useful for remote field observation, allowing farmers to assess crop conditions and spraying effectiveness without being physically present.
- Beyond pesticide application, the robot can be adapted for other agricultural tasks, such as nutrient spraying or irrigation, further broadening its utility.

VII RESULTS AND CONCLUSION:

- This agriculture vehicle proves to be an effective and efficient machine which can be easily navigated and controlled. The robot can traverse a variety of terrains and soils. The android application is used to control the robot's movement as well as spray pesticides.

- Every connection made is to ensure the continuity of the circuit is maintained for all the operating modes in one sequence hence eliminating the need for multiple wires or connection for individual modes. Each sensor terminal is distinguished with distinct positive, negative, and Signal connection to make troubleshooting easy and quick. In case of any distress signal from the Arduino or the Motor Driver Shield, the connection terminals can be quickly checked to eliminate the issue.

- Mounting of motors are measured setup to provide tight maneuvering control and agile movement of the vehicle in varied environments. Ground clearance and width of the vehicle has been considered as a essential part of the design to make the package as compact as possible. For varied condition and requirements the dimension, load carrying capacity, speed and other such factors can be modified and adjusted for the necessary application.
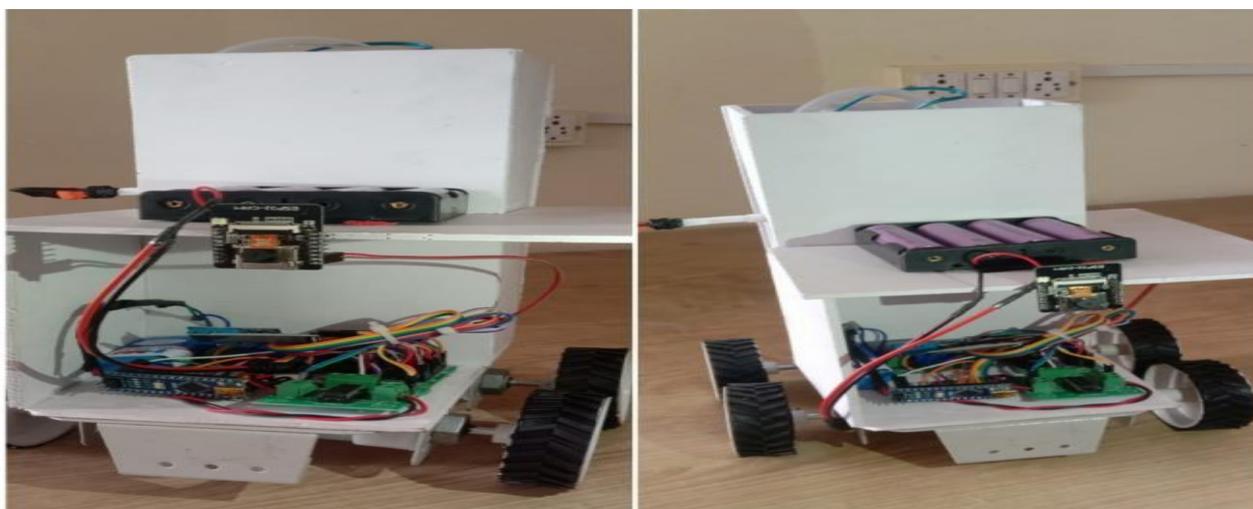

Fig 1: Output result
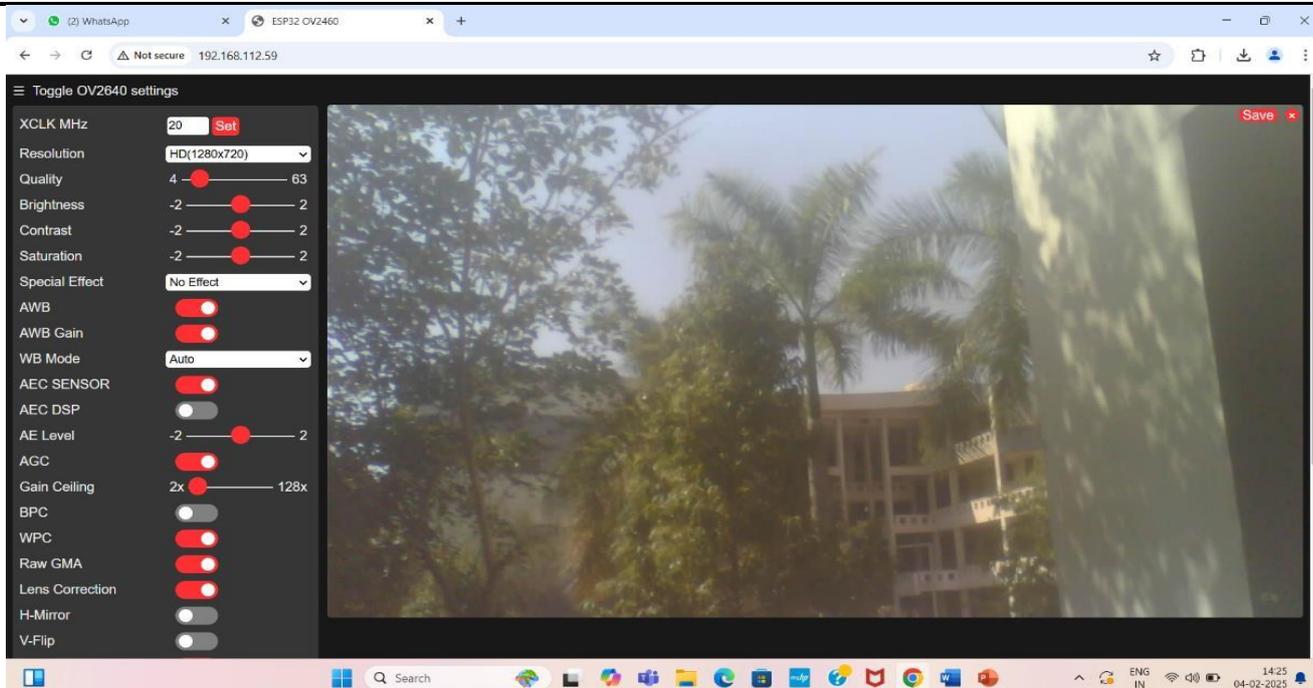

Fig 2: Output result

Fig 3: video streaming

• As a result, the robot's control is simple, and farmers can easily operate this intelligent vehicle. The application was built by using MIT app Inventor. This robot focuses on farmers spraying pesticides from a distance without coming into direct contact with them. Because the task's complexity is reduced and the manned task is converted to an unmanned task, this feature would encourage more people to take up agriculture

• Safer Pesticide Application: The robot reduces direct human contact with harmful pesticides, improving farmer safety.

• Improved Efficiency: Automated and precise spraying minimizes pesticide wastage and ensures even coverage.

• Cost-Effective Solution: A low-cost design makes it affordable and accessible for small-scale farmers.

• Remote Control and Monitoring: Farmers can control the robot using a simple Android app and monitor operations via a live video feed.

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