SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR.

Mini Project/Electronic Design Workshop Report

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“CropJet-RC Spraying Bot”

Submitted By

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1. Introduction

CropJet is an advanced solution poised to transform the way farmers approach crop spraying. It is a shift towards efficiency, safety, and sustainability.

The core innovation includes an RC (Remote-Controlled) spraying bot designed to liberate farmers from the cumbersome task of manually carrying pesticide and fertiliser bags on their backs. With CropJet, farmers can bid farewell to the risks associated with harmful gases and physical strain, all while enhancing productivity in their fields. It has a sturdy framework stand resembling a trolley, providing a stable platform for mounting containers holding sprayables like fertilisers, pesticides and herbicides. It is engineered to carry a payload of up to five kilograms.

Cropjet is also integrated with modern technology. Farmers can control the RC spraying bot remotely using their mobile devices, allowing them to execute precision spraying from a specified distance. Its another compelling feature lies in its location-specific precision. This localization capability ensures that only designated areas receive treatment, reducing environmental impact and maximizing resource efficiency.

Through easy to understand mobile control interfaces, farmers can precisely target specific areas requiring treatment, thus minimizing pesticide drift and optimizing resource utilization. This wireless capability not only enhances operational efficiency but also minimizes human exposure to potentially hazardous spraying environments, fostering a safer working environment for agricultural workers.

Its has location-specific functionality, allowing for targeted spraying that optimizes pesticide utilization while minimizing wastage. Another noteworthy feature of CropJet is its height-adjustable settings, facilitating customizable spraying heights to accommodate varying crop types and growth stages. Thus by implementing this, farmers can have better control over their pesticide, herbicides or fertiliser spraying.

2. Impact of Project on society and the environment

How it will solve the problems of society/individuals and the environment:

CropJet has significant benefits to both society and the environment. It addresses key challenges faced by farmers and reduces environmental risks associated with traditional spraying methods.

1. Enhanced Safety: By eliminating the need for farmers to carry conventional pesticide bags, CropJet significantly reduces their exposure to harmful gases and chemicals during spraying operations. This promotes a safer working environment and reduces the risk of health hazards associated with pesticide exposure.

2. Resource Efficiency: CropJet's targeted spraying capability ensures precise application of pesticides, fertilizers, and herbicides, minimizing wastage and optimizing resource utilization. This not only improves cost-effectiveness for farmers but also reduces the environmental impact of chemical runoff and over-application.

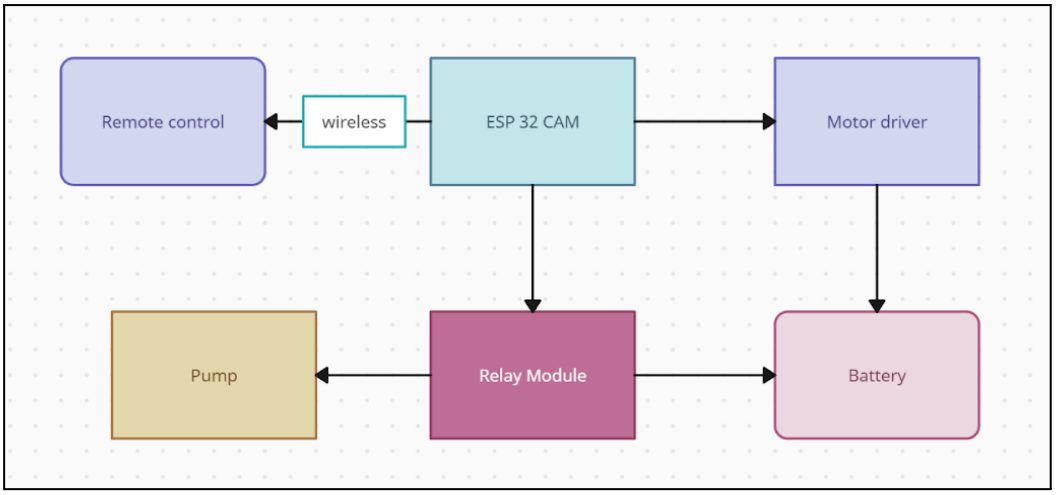
3. Improved Accessibility: With its mobile-controlled functionality, CropJet enables farmers to remotely operate the spraying bot from a specified distance by using video streaming. This enhances accessibility, particularly for individuals with limited mobility or those working on large agricultural plots, making spraying operations more efficient and manageable.

4. Sustainable Practices: By offering height-adjustable settings and the ability to spray into the central areas of plants, CropJet promotes sustainable farming practices. This ensures thorough coverage of crops while minimizing the need for excessive chemical application, thereby reducing environmental pollution and promoting ecological balance.

5. Empowerment of Farmers: CropJet empowers farmers by providing them with a cutting-edge tool that enhances their productivity and is available with easy rechargeable battery.

In conclusion, CropJet's innovative features and societal and environmental benefits position it as a transformative solution for modern agriculture. By addressing key challenges faced by farmers while promoting sustainable practices, CropJet not only enhances agricultural productivity but also contributes to the well-being of both society and the environment.

3. Block diagram and Functional description



Block diagram

Functional Description of Components in CropJet:

1. ESP32-CAM:
   - Functional Description: The ESP32-CAM is a versatile microcontroller module with integrated Wi-Fi and camera functionality. It features an ESP32 chip and a camera module, allowing for wireless communication and image/video capture. In CropJet, the ESP32-CAM serves as the central control unit responsible for coordinating various functions of the spraying bot. It communicates wirelessly with the user's mobile device to receive commands and stream live video feed for remote monitoring of spraying operations.

2. Relay Module:
   - Functional Description: A relay module is an electromechanical switch used to control high-power devices by toggling a low-power signal. It typically consists of a control circuit and one or more relay switches. The relay module in CropJet is utilized to control the activation and deactivation of the 12V pump, which is responsible for dispensing pesticides or fertilisers. When triggered by the microcontroller, the relay switches allow the pump to turn on/off, enabling precise control over spraying operations.

3. Gear Motor:
   - Functional Description: A gear motor is a type of electric motor paired with a gearbox to provide torque multiplication and speed reduction. CropJet employs gear motors to drive the wheels of the spraying bot. These motors enable precise movement and navigation across agricultural fields, allowing CropJet to traverse various terrains while maintaining stability and control during spraying tasks.

4. Battery 18650:

- Functional Description: The 18650 battery is a type of rechargeable lithium-ion cell commonly used in portable electronic devices. It offers high energy density and long cycle life. In our project, the 18650 battery serves as the power source , supplying electrical energy to drive the microcontroller, motor drivers, pumps, and other electronic components. Its compact size and high capacity make it ideal for powering the spraying bot while ensuring extended operation between recharges.

5. Motor Driver:

- Functional Description: It is a motor driver IC capable of controlling two DC motors bidirectionally. It provides a simple and efficient solution for driving motors with higher current requirements. In CropJet, the motor driver interfaces between the microcontroller and the gear motors, regulating the direction and speed of motor rotation based on control signals from the ESP32-CAM. This allows for precise control over the movement and positioning of the spraying bot during operation.

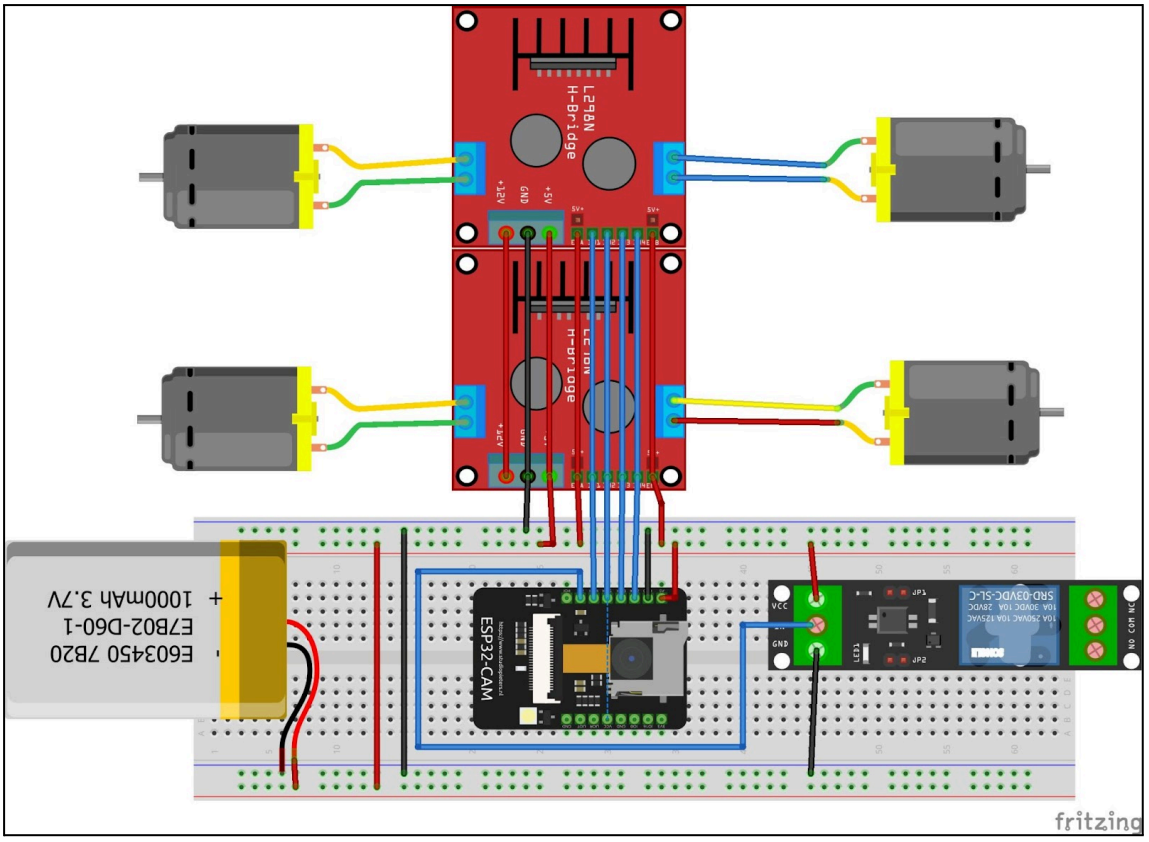
6. 12V Pump:

- Functional Description: The 12V pump is a type of electric pump designed to operate using a 12-volt DC power supply. It is commonly used for fluid transfer and circulation applications. The 12V pump is a critical component of CropJet's spraying mechanism, responsible for dispensing pesticides or other fluids onto crops. It is activated and controlled by the microcontroller via the relay module, allowing for precise and controlled application of spraying substances to targeted areas of the crop.

By integrating these components into CropJet's design, the spraying bot achieves precise, efficient, and controlled pesticide application, enhancing agricultural productivity while minimizing environmental impact and ensuring user safety.

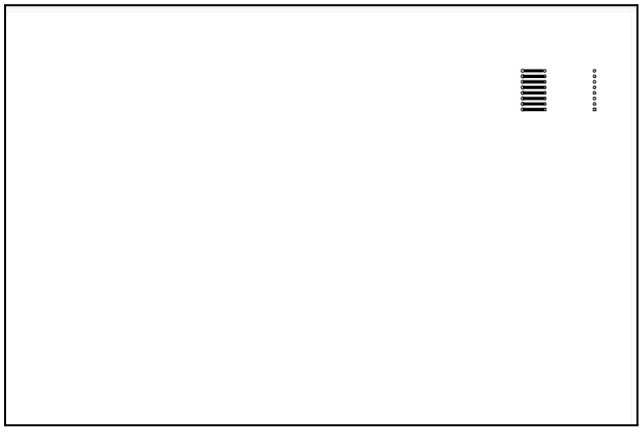
4. Circuit diagram and its description

Following is the circuit diagram for our project:



Circuit diagram

5. PCB layout and Artwork



PCB layout

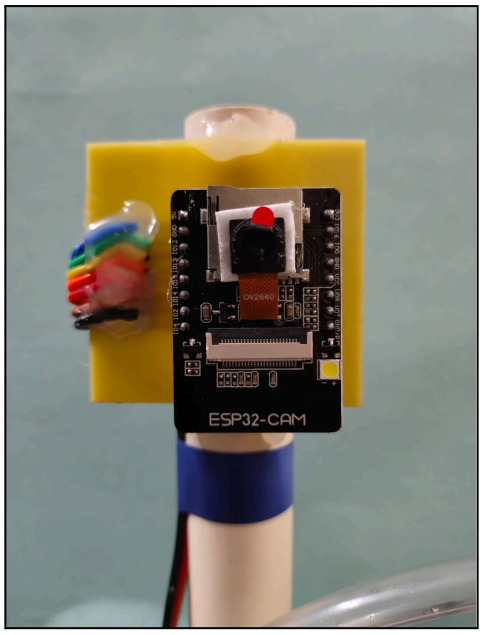


Image 1

Image 2

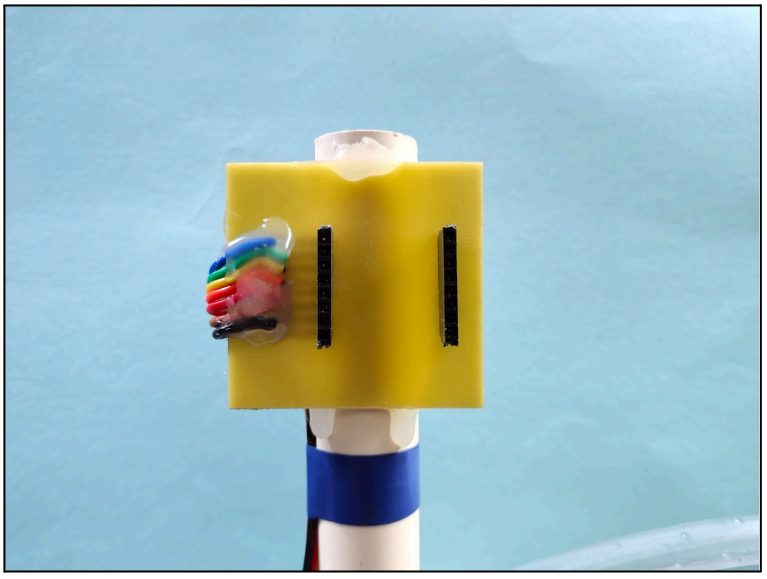


Image 3

PCB artwork (different view)

6. Working of Project

The functionality of CropJet relies significantly on the ESP32-CAM module, which serves as both an access point and a controller interface. Acting as a hotspot, the ESP32-CAM provides Wi-Fi connectivity, enabling farmers to connect their mobile devices to the spraying bot's network. Through a simple web interface accessible via a browser, farmers gain control over the movement of the bot and the operation of the spraying mechanism.

Upon connecting to the ESP32-CAM's network and accessing the designated IP address (192.168.4.1), users are presented with a webpage displaying intuitive

buttons for various directional movements (forward, backward, left, right) and for toggling the pump on and off. This interface facilitates seamless interaction, allowing farmers to remotely guide the spraying bot through their crops and initiate spraying operations with ease.

The control process is initiated when users interact with the buttons on the web page, triggering HTTP requests that are sent to the ESP32-CAM's server. The ESP32-CAM's server handles these requests, interpreting the user's commands and translating them into actions for the spraying bot. For instance, pressing the "Forward" button prompts the ESP32-CAM to send corresponding signals to the motor drivers, instructing them to move the bot forward.

In the backend, the ESP32-CAM processes the received commands and communicates with the motor drivers to execute the desired movements. The motor drivers, powered by a 12V supply from the battery, receive instructions from the ESP32-CAM and control the gear motors responsible for propelling the bot in the specified direction. Simultaneously, the relay module, also powered by the 12V supply, manages the operation of the pump, controlling the dispensing of pesticides or fluids onto the crops. When it receives an input of 0, it starts spraying the required fluids accordingly incorporated with the commands received by the motor to the wheels.

7. Result and Future Scope

The future scope of CropJet is quite promising, with potential advancements and applications that can bring significant benefits to farmers.

Findings and Achievements:

CropJet has potential in addressing key challenges faced by farmers, such as reducing exposure to harmful chemicals, optimizing resource utilization, and improving crop health and yield.

Circuit Advantages:

- CropJet's circuit design offers several advantages, including precise control over spraying operations, wireless communication capabilities, and compatibility with a wide range of crop spraying applications.
- The use of advanced components such as the ESP32-CAM and L298N motor driver enhances functionality and reliability, enabling seamless integration and operation of the spraying bot.

Applications in Other Areas: - The technology in CropJet's design can be applied to various other fields beyond agriculture, such as automated industrial spraying, environmental monitoring, and urban gardening. By adapting the circuit design and functionality, CropJet can be repurposed for different applications, thereby expanding its utility and market potential.

- Economical Optimization: By optimizing component sourcing and manufacturing processes, CropJet can be made more cost-effective, increasing accessibility for farmers across different socioeconomic backgrounds.

- Seasonal Adaptability: Enhancements in CropJet's design, such as increased sturdiness and weatherproofing, will make it better suited for operation in various seasons and environmental conditions.
- Crop Generalization: By developing customizable spraying parameters and attachments, CropJet can be adapted to accommodate different crop types and growth stages, maximizing its versatility and utility.

- Battery detection: In future, some advancements can be made to monitor the battery level in the bot. This will also enable the farmers to get an rough estimate of how much the pesticide or herbicide is potentially used on a specific crop, and in which season. It will also thus let the farmer know if there is a need of refilling.

Result:

Image 4
(Side view of CropJET)

Image 5
(Side view of CropJET)

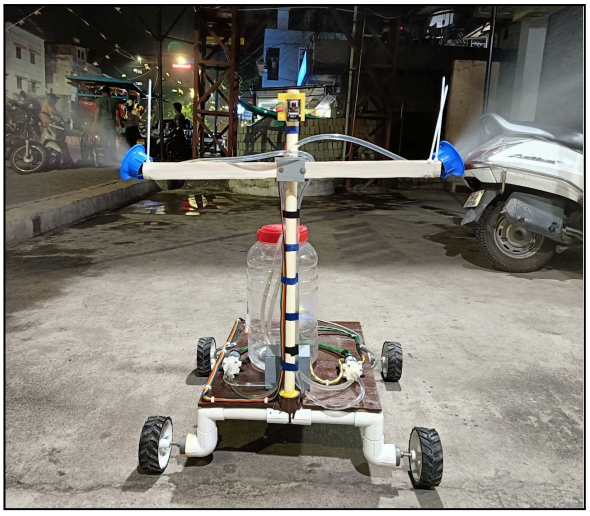


Image 6
(Front view of CropJET)

8. References/ Citations

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