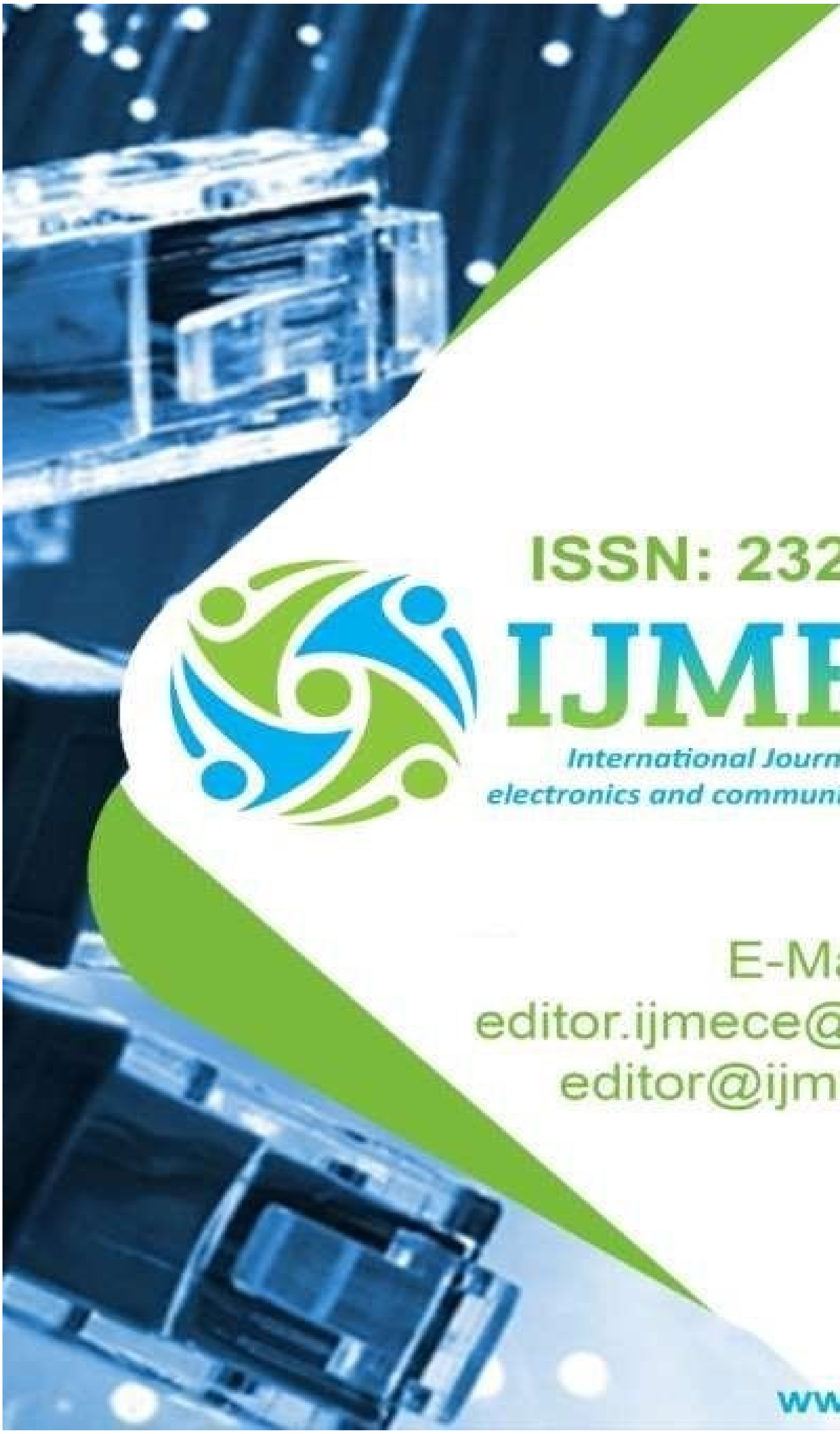

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AGROBOT FOR PEST CONTROL

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ABSTRACT:

Agriculture is a critical sector in India, with a significant portion of the population relaying on it for their livelihood. However, one of the major challenges faced by farmers is the extensive use of chemical pesticides, with usage levels reaching up to 70%. Direct human involvement in pesticide spraying poses health risks, as these chemicals are toxic and can cause serious harm upon exposure. To address this issue, technological solutions are being developed to reduce human contact with these harmful substances, while also improving the efficiency of agricultural operations. One such innovation is the development of an “Agrobot”. This Agrobot is designed specifically for spraying liquid pesticides, allowing farmers to manage pest control without the need for direct involvements. The robot can be controlled by mobile phone, using GSM technology for communication. This control feature ensures that the robot can move in all directions across the field and spray pesticides with precision. The Agrobot is equipped with a small liquid pumping motor that efficiently sprays pesticides and also fitted with sensors and a camera that can detect obstacles and objects within a 180-degree range. The camera and sensors guide the robot’s movements and ensure that the pesticide is sprayed in the right areas, avoiding wastage. The microcontroller receives commands from a mobile, decodes them and executes the corresponding actions. Through the mobile farmers can send instructions to move the robot, change directions, and control the pesticides sprayer. The robot’s movement is powered by two DC motors which are connected to the L293D motor bridge.

Keywords: L293D, Esp32 camera, GSM, IR sensor, Robot, WSN.

I INTRODUCTION

Agriculture is the primary source of revenue for India's population, which accounts for nearly 60% of the country's total. Farmers work in their fields to cultivate various crops based on the environment and resources available. Farmers must use large quantities of pesticides to increase food production in order to meet such high food demand for such a large population. Traditional manual pesticide spraying operations is full of direct exposure to the pesticide liquid work environment, great harm to human body and when

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this pesticide may come into contact with the farmer during spraying, which may trigger skin cancer and asthma illnesses. Increased pesticide spraying can impact consumer health as it enters the food chain. Pesticide spraying and fertilizer scattering are tedious applications. Despite the fact that pesticide spraying is now required, farmers still find it to be a hazardous process. This project is based on the development of an agricultural robot vehicle that navigates between crops using SMS based on the farmer's instructions. This truck has lower-cost components, making it more cost-effective. To move the robot in the field, the farmer can use any phone with SMSoperation. Through the GSM technology, farmers can control pesticide sprinkling devices. This low-cost robotic vehicle would increase efficiency, safety, and meet labour demand in agricultural applications.

Furthermore, the adoption of such technology addresses the pressing labour shortage in the agricultural sector. With the rural-to-urban migration trend, many young people are moving away from traditional farming roles. By integrating technology such as SMS-controlled robots, farming becomes more accessible, manageable, and appealing, even for those with minimal technical training. This innovation not only aids in sustaining agricultural productivity but also empowers farmers to adopt modern farming techniques. In the long term, this shift towards agricultural automation can pave the way for greater sustainability in farming practices, reduced production costs, and improved food security for India's growing population.

II. LITERATURE SUREY

[1] Pvr Chaitanya, Dileep Kotte, A Srinath, KB Kalyan 2020 Development of Smart Pesticide Spraying robot. In this paper, a depth measurement method for detecting pests on leaves is proposed, and it provides pestes position for automatically spraying pesticide on the leaves where the pest model pasted on. This Project is done through taking input images using camera, analyzing them using machine learning process. This displays the disease presented on the leaf, stem or plant. This also displays the exposed area to disease and also predicts the remedies, turn on the pesticide sprayer which sprays the respective pesticide on the exposed area to disease. This is very necessary for effective spraying of the pesticide. The movement of robot is done with L293d motor driver and the processor or embedded system is done through Raspberry pi3. We use python code for machine learning which trains the robot with pre-defined images. Since this can be controlled from anywhere without working in the field and being exposed to pesticides, it will be a profit for the farmer.

[2] Aishwarya.B.V, Archana.G, IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development 2015.This paper deals with the exposition of how robotics can be applied to

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various fields of agriculture. It is very important to improve the efficiency and productivity of agriculture by replacing laborers with intelligent machines like robots using latest technologies. The paper proposes a new strategy to replace humans in various agricultural operations like detection of presence of pests, spraying of pesticides, spraying of fertilizers, etc there by providing safety to the farmers and precision agriculture. The developed system involves designing a prototype which uses simple cost effective equipment's like microprocessors, wireless camera, various motors and terminal equipment's which is an aid to the farmers in various crop field activities.

[3] According to Shubhangi. B. Londhe, K. Sujata, robotics model provides a facility to control the movement of agriculture vehicle. Plant diseases may decrease the quality and quantity of agricultural products, resulting in a massive post-effect situation. Plantation crops face a number of challenges, including early pest detection. The first step entails keeping a close eye on plants on a regular basis. The diseased plants will then be categorised, and photographs of the affected parts of the plants will be taken with a camera. Pre-processing, transformation, and clustering are then applied to these images. The images are then presented to the processor as input, and the processor compares them. If the image provided is an affected image, an automatic pesticide sprayer is used to apply the pesticide to a specific area of the leaf. If it isn't, the processors will automatically discard it, and the robot will continue on its way.

[4] Denis O. Kiobia et al. integrated AI and IoT technologies to develop a pest detection system focused on cotton pests. The system used GSM modules to notify farmers in real time about pest occurrences, allowing for timely intervention. The study achieved a detection accuracy of 70–98% and highlighted challenges in recognizing immature pests and predatory species. By reducing pesticide use and improving pest targeting, the research demonstrates the benefits of technology-driven solutions in agriculture

[5] B. Vijayalakshmi and collaborators designed a system combining GSM modules, Raspberry Pi, and environmental sensors for pest control. Their approach leveraged real-time data from temperature and humidity sensors to trigger notifications to farmers about potential pest threats. The study emphasized automation and resource optimization, showcasing how early pest detection can minimize pesticide overuse and its environmental impact. The work bridges IoT and precision agriculture to improve farm efficiency.

III. WORKING METHODOLOGY

The agrobot for pest control begins by utilizing an ESP32 camera module for real-time visual monitoring of the agricultural field. The camera captures high-resolution images and streams live video, allowing the system to detect pests and anomalies in the crops. Integrated image processing algorithms or machine learning models running on the ESP32 or an external server analyze the captured data. The system identifies pest types and their locations, ensuring targeted intervention. The data is processed in real time, and key findings are transmitted via a GSM module, which sends alerts to the farmer's mobile device about the detected pest activities

The next step involves the execution of pest control measures. Based on the data received from the ESP32 camera and analysis, the agrobot activates its pesticide spraying mechanisms. Actuators and motorized sprayers precisely apply pesticides to the affected areas, reducing chemical usage and minimizing harm to the environment. The agrobot's navigation is controlled by motor drivers and sensors that allow it to traverse the field effectively. This movement is guided by pre-defined algorithms or GPS, ensuring the robot reaches specific pest-infested areas identified by the ESP32 camera

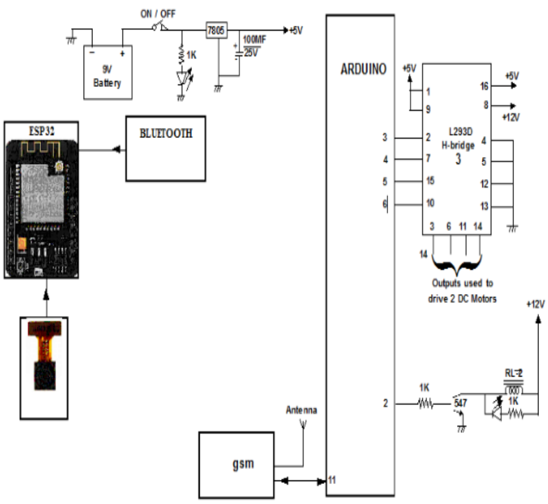

Fig.1. Circuit diagram

The GSM module maintains continuous communication between the robot and the farmer. It sends periodic updates on the robot's operations, such as pest control coverage, pesticide usage, and field conditions. Additionally, the ESP32 camera can transmit snapshots or live feeds to the farmer, enabling remote monitoring and manual overrides when required. This integration of GSM and ESP32 ensures a cost-effective, automated pest control system that enhances farming efficiency, reduces labor dependency, and supports sustainable agricultural practices.

Hardware connections:

The provided image appears to show a basic circuit diagram for a robotic system incorporating multiple components: an Arduino, ESP32, GSM module, L293D motor driver, relay module, and power supply elements.

- Arduino is the central microcontroller controlling the overall operation, including motor control, communication with GSM, ESP32, and Bluetooth modules.
- L293D Motor Driver Controls two DC motors connected to the outputs of the L293D (pins 3, 6, 11, 14). The motor drive is powered with +12V for the motors and +5V for its logic.
- ESP32 camera has built-in Wi-Fi/Bluetooth. It could be used for live video streaming or wireless communication (through Bluetooth or Wi-Fi).
- GSM Module Used for communication over mobile networks. It’s connected to the

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Arduino via pin 11. The antenna is shown for communication with the GSM network, likely to send/receive messages.

- Relay Module Controlled by the Arduino via pin 2. This activates a connected pump or actuator. Powered with +12V through the relay switch, controlled by a transistor (likely 547) to drive the relay.

Power Supply A 9V battery is the primary power source. A 7805 voltage regulator is used to step down the 9V battery to 5V for powering the Arduino and ESP32. A 100μF capacitor is placed to stabilize the output from the 7805.

IV. RESULTS AND EXPLANATION

The implementation of the agrobot equipped with GSM and an ESP32 camera has shown promising results in improving pest management practices. The ESP32 camera's real-time visual capabilities enable precise pest detection, which reduces the need for manual field inspections. Image processing algorithms applied to the captured data ensure accurate identification of pests, even in early stages of infestation. This proactive approach has led to significant reductions in crop damage and pesticide waste, enhancing the overall efficiency of pest control operations

The integration of the GSM module further amplifies the system's utility by providing seamless communication between the farmer and the robot. Farmers receive real-time alerts about pest activity, field conditions, and pesticide application progress. This connectivity enables timely decision-making and allows remote monitoring, which is particularly advantageous for large farms or inaccessible areas. Reports from trials indicate that the system's ability to selectively spray affected areas minimizes pesticide use by up to 30%, contributing to cost savings and environmental sustainability.

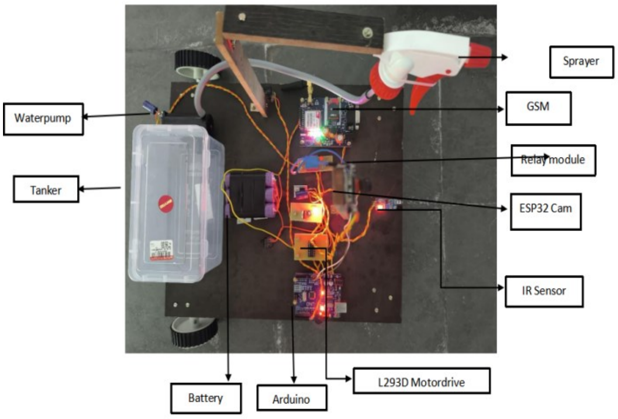

Fig.2. Hardware model.

Moreover, the agrobot's ability to operate autonomously has reduced labor dependency and improved operational precision. Field trials demonstrate that its navigation system, guided by sensors and GPS, ensures thorough coverage of targeted areas without damaging crops. The combined functionality of the ESP32 camera and GSM module has resulted in enhanced crop yield, better resource management, and scalable solutions for precision farming. These results underline the agrobot's potential to revolutionize pest control in agriculture by merging automation and connectivity.

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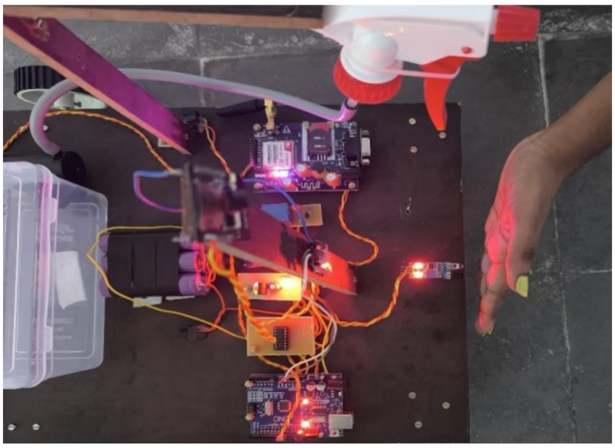

Fig.3. IR detected image.

When the robot is moving, a live video feed is transmitted to a mobile device via the Arduino Bluetooth controller, allowing real-time monitoring of pests and obstacles. If an obstacle is detected, the robot stops and waits for further commands from the mobile app.

Fig.4. Output results

When the robot is moving forward, sending a message with the notation "@B"to the SIM card installed in the robot will trigger it to move in the backward direction. The robot will interpret this message as a command and execute the corresponding movement.

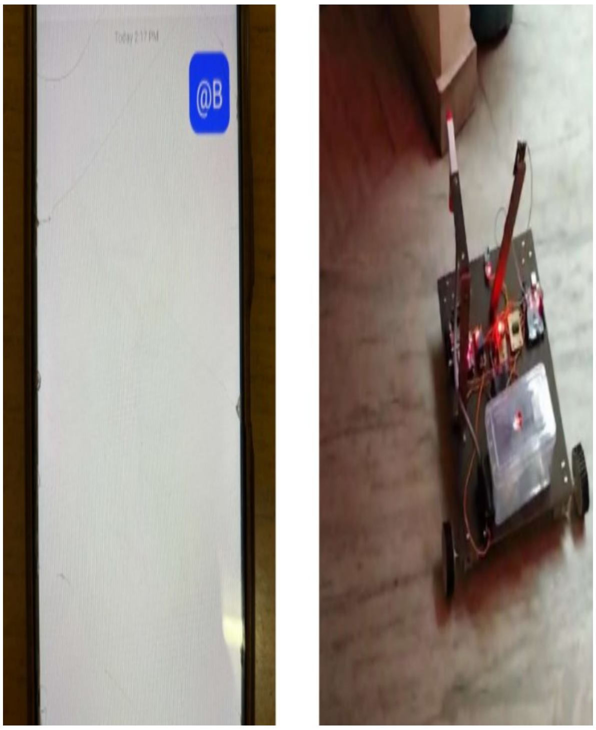

Fig.5. Output from GSM module

S.NO	TEST CASES	DC MOTOR 1 (pin1)	DC MOTOR 1(pin2)	DC MOTOR 2(pin1)	DC MOTOR 2(pin2)	BUZZER	RELAY	SMS ALERT
1	IR Sensor detection	OFF	OFF	OFF	OFF	ON	OFF/ON	ON
2	Backward direction	OFF	ON	OFF	ON	OFF	ON	ON
3	Forward direction	ON	OFF	ON	OFF	OFF	ON	ON
4	Pump ON	OFF/ON	OFF/ON	OFF/ON	OFF/ON	OFF	ON	ON
5	Right direction	ON	OFF	OFF	ON	OFF	ON	ON
6	Left direction	OFF	ON	ON	OFF	OFF	ON	ON
7	Pump OFF	OFF/ON	OFF/ON	OFF/ON	OFF/ON	OFF	OFF	ON
8	Stopping robot	OFF	OFF	OFF	OFF	OFF	ON	ON

CONCLUSION

The project outlines the development of an autonomous robot capable of navigating fields, detecting obstacles, and spraying pesticides based on pest detection. It uses an L293D motor driver to control two DC motors for movement, IR sensors for obstacle detection, and an ESP camera for streaming video or identifying pests. A relay module activates a water pump to spray pesticide, while a GSM module sends alerts to the user regarding the robot's movements and spraying actions. The system ensures proper power management to support the motors, pump, and other components during operation.This autonomous robot presents a comprehensive solution for sustainable agriculture by reducing pesticide use, limiting human exposure to chemicals, and ensuring effective pest control.

FUTURE SCOPE

The future scope for agrobots for pest control is vast and promising. In the short term (2025-2030), advancements in sensors, autonomous navigation, and swarm robotics will enhance efficiency and accuracy. Mid-term (2030-2040), artificial intelligence and machine learning will drive predictive analytics and adaptive pest control. Biodegradable robots, advanced propulsion systems, and human-robot collaboration will emerge. Long-term (2040-2050), fully autonomous farms, nanorobotics, bio-inspired robots, and space-based farming will revolutionize agriculture.

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