



Agriculture Smart Pesticide Spraying Robot

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ABSTRACT: This paper proposes the development of a smart robotic system for pesticide application, aimed at reducing the amount of pesticides used and minimizing harm to human health. This robotic system is designed to lessen the labor intensity for farmers by incorporating comprehensive route planning, navigation, and driving control systems.

The robot will be equipped with a spraying mechanism and a construction system that can avoid obstacles, thanks to the integration of a multi-sensor module. The design process of the spray robot will include simulations and analyses for obstacle avoidance, spraying, and sensor integration.

The robot's functionality extends beyond tracking movement and monitoring orientation. It also compensates for path errors to ensure high stability and reliability. The spraying system will be enhanced to prevent leaks and avoid repeated spraying. The system will automatically adjust the spray according to the target, thereby eliminating waste.

In conclusion, this project introduces a novel pesticide application system that could revolutionize agricultural practices by providing farmers with a more efficient and safer alternative to traditional methods.

KEYWORDS: Route planning, Navigation System, Intelligent Spraying, Multi sensor, Monitor orientation

INTRODUCTION

Agriculture is the backbone of India's economy, contributing to the livelihood of nearly 60% of the country's population. Farmers cultivate a variety of crops, depending on the local environment and available resources. To meet the high food demand of such a populous country, farmers often resort to using large amounts of pesticides. However, traditional manual pesticide spraying exposes farmers to harmful chemicals, posing significant health risks, including skin cancer and asthma. Moreover, excessive pesticide use can also affect consumer health as it enters the food chain.

To address these challenges, we have developed an automated robotic system that sprays pesticides in limited quantities, only when pests are detected. This approach not only protects farmers from health hazards but also reduces costs due to limited pesticide use. The robot also lessens the time spent on spraying pesticides and reduces the farmers' workload in all seasons and conditions. We believe that the numerous benefits of this system will readily generate awareness among farmers, thereby contributing to the nation's economic development.[6]

The proposed project aims to enhance farmer safety during crop activities such as spraying chemicals, fertilizers, and pesticides. It finds relevance in various fields including Agricultural Engineering, Electrical Engineering, Electronics Engineering, Telecommunication Engineering, Mechatronics Engineering, Environmental Engineering, Biomedical Engineering, Mechanical Engineering, etc. The project also

involves the detection and tracking of moving objects, a common task in computer vision applications like video surveillance, robotics, authentication systems, gesture-based user interfaces, and MPEG4 image compression.[11]

The rest of the paper is structured as follows: Section II provides a literature review, Section III describes the proposed system and the robot's operation, Section IV presents the results, advantages, and applications of the robot in different fields. Finally, Sections V and VI conclude the paper and discuss future scope, outlining the outcomes of the proposed system.

PROBLEM STATEMENT

Farmers often face significant financial losses due to factors such as improper irrigation methods, pest infestations, plant diseases, unmeasured use of pesticides and insecticides, and inaccurate weather predictions. The introduction of wireless crop monitoring can help reduce labor costs and provide real-time tracking of field changes.

When it comes to pesticide application, farmers need to take several precautions, including wearing appropriate protective clothing, gloves, and masks. In this context, the advent of robotics offers a promising technological solution that can enhance productivity and efficiency.

Globally, about 42% of the population relies on agriculture for their livelihood. This often involves strenuous work and heavy loads. One such task is pesticide spraying, which is not only challenging but also risky due to the hazardous nature of the chemicals involved. These chemicals can cause respiratory issues and other health problems.

To address these issues, we have developed an agricultural robot that aids farmers in applying pesticides, thereby reducing their workload. This innovative solution not only protects farmers from potential health risks but also contributes to increased efficiency in agricultural practices.

A) OBJECTIVES

The objectives of this project are as follows:

1. **Eliminate Manual Spraying:** The aim is to replace manual pesticide application on farms, which will help reduce the overuse of pesticides on plants.
2. **Versatile Machine Design:** The machine is to be constructed in a way that allows it to navigate through various terrains.
3. **Weather Considerations:** The system will take into account weather conditions such as temperature and humidity before initiating the pesticide spraying process.
4. **Spraying Mechanism:** The project involves designing a mechanism for spraying and managing parameters like the area of spraying. It will deliver a pesticide/fertilizer spraying tank and traverse the fields.
5. **Remote Control:** The pump and rover will be remotely controlled via a mobile application.

LITERATURE REVIEW

Robotics is playing an increasingly significant role in agriculture, enhancing productivity and addressing key challenges such as rising input costs, scarcity of skilled labor, water resource management, and crop monitoring. Automation technologies, including robotics, are being employed to tackle these issues. Here's a summary of some relevant studies:

1. Shubhangi B. Londhe and K. Sujata [1] developed a robotic model that controls the movement of an agricultural vehicle. Their system uses image processing to identify diseased plants, categorize them, and apply pesticides to the affected areas automatically.
2. Wasswa Fahad Malende, K. Lokesh Krishna, Omayo Silver, and K. Anuradha [2] designed a wireless robot that can be remotely controlled. The robot can navigate its path, detect unusual movements, spray pesticides, and activate an electric motor based on moisture content in the crop fields.

3. Jaggumantry Swapna Kumari, Kazi Khalid Abdul Karim, Mankari Hemant Tanaji, Bodhgire Yogesh Uttamrao, and Momin Md. Arbi Md. Husain [3] created an agricultural robot that navigates between crops based on joystick instructions from the farmer. The robot can spray pesticides by detecting pests using image processing.
4. Aishwarya B. V, Archana G, and C. Umayal [4] developed a cost-effective agricultural robot that navigates between crops using a joystick and motion switches. The robot uses a wireless camera to view the crops or its path, enabling easy identification of pest-affected crops.
5. Amrita Sneha A, Abirami E, Ankita A, Mrs. R. Praveena, and Mrs. R. Srimeena [5] proposed an agricultural robot for ploughing and seeding. The robot is divided into two sections - one for automated ploughing and seed dispensing, and the other for field operations.

Robotics in agriculture is enhancing productivity by addressing key challenges such as labor costs, precision farming, and safety. Here's a summary of some relevant studies:

1. Pvr Chaitanya, Dileep Kotte, A. Srinath, and K. B. Kalyan [6] developed an agricultural robot that reduces farmers' efforts while increasing the speed and accuracy of their work. The robot uses a Raspberry Pi as a microcontroller to control live video motion, spraying impact, and robot movement. The robot displays three processes: movement of the machine, uploading of video, and the spraying process for pesticides.
2. Peng Jian-sheng [7] designed an intelligent robot for spraying pesticides using a WiFi module, mobile devices, video capture module, car module, driver module, spray module, and an infrared obstacle avoidance module.
3. Ege Ozgul and Ugur Celik [8] proposed a semi-autonomous mobile robot that sprays plants and repels insects from the field, enhancing sustainable farming conditions by protecting plant and soil health.
4. Pranali S. Bhoite, Nisha U. Gurav, Onkar K. Nagarkar, and Reshama R. Chaudhari [9] proposed an automated sprinkling bot that reduces the workload of farmers by sprinkling pesticides on the crops, scanning and capturing the images of the plants, detecting the infected plants, and sprinkling the pesticides only on the infected plants.
5. K Durga Sowjanya, R Sindhu, M Parijatham, K Srikanth, and P Bhargav [10] focused on the design, development, and fabrication of a multipurpose agricultural robot with an irrigation system in addition to ploughing and seeding. The robot performs three functions: soil digging, seed sowing, and levelling the ground to avoid mud and water spraying.

I. PROPOSED SYSTEM

Applications such as pesticide spraying and fertiliser scattering are often laborious tasks. Even though pesticide spraying is necessary, it poses significant risks to farmers. This project focuses on the creation of an agricultural robot that can navigate through crops. The robot is controlled using an Android application based on instructions provided by the farmer.

This robot is designed with cost-effective components, making it an affordable solution. Farmers can operate the robot in the field using any Android smartphone equipped with the corresponding application. Additionally, an IoT application allows farmers to manage the pesticide sprinkling devices remotely.

This economical robotic vehicle aims to enhance efficiency and safety, and cater to the labour needs in agricultural applications. It represents a significant step towards modernising traditional farming practices and promoting safer working conditions for farmers.

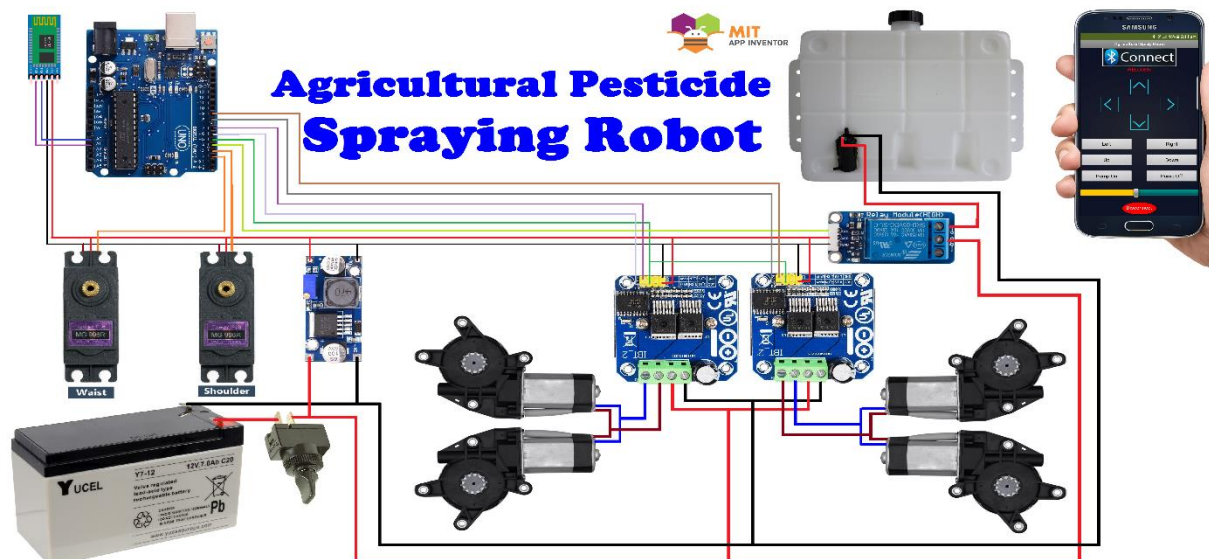


Fig 1: System Architecture

Equipment:-

Arduino:- The Arduino is an open-source electronics platform based on easy-to-use hardware and software. It consists of a physical programmable circuit board (often referred to as a microcontroller) and a development environment for writing, testing, and uploading code to the board. Arduino boards are able to read inputs from various sensors, switches, and other devices, and then based on the code written by the user, they can perform actions like controlling lights, motors, or other actuators. The platform is widely used by hobbyists, artists, students, and professionals to create interactive projects and prototypes in a variety of domains including robotics, home automation, wearable technology, and more.

Step-up motor- If you're referring to a motor that steps up or increases its speed or torque through a gearbox or transmission, it's usually called a "garmotor" or "geared motor."

On the other hand, if you're looking for a motor driver or controller that steps up the voltage to drive a motor, it's called a "step-up motor driver" or simply a "step-up driver."

12V DC MOTER- A 12V DC motor converts electrical energy into mechanical motion using electromagnetism. It consists of a stationary stator with coils and a rotating rotor with magnets or electromagnets. When current flows through the coils, a magnetic field is created, causing the rotor to rotate due to the Lorentz force. Brushes and a commutator ensure continuous rotation by reversing the current periodically. By controlling parameters like voltage and current, the motor's speed and direction can be managed.

Bluetooth Sensor:-

A Bluetooth sensor is a device that combines sensor capabilities with Bluetooth communication. It measures physical parameters like temperature or motion and wirelessly transmits data to other Bluetooth-enabled devices. These sensors use Bluetooth Low Energy (BLE) for efficient communication and have short-range capabilities, typically up to 10 meters. Bluetooth sensors find applications in various fields such as environmental monitoring, healthcare, and industrial monitoring, enabling remote data collection and analysis. They are integrated into IoT networks and can be configured and controlled via Bluetooth commands or mobile apps.

ADVANTAGES The benefits of using robots in agriculture include:

1. **Minimizing Pesticide Exposure:** Robots can help reduce the direct exposure of pesticides to the human body, thereby improving production efficiency.
2. **Precision Operation:** Robots can operate with closer tolerances, ensuring precise application of pesticides and fertilisers.

3. **Efficiency and Quality:** Robots can work at higher speeds with fewer errors. They can also reliably identify and select higher-quality produce.
4. **Pesticide Reduction:** Robots can potentially reduce a farm's pesticide usage by up to 30%, contributing to a more sustainable farming practice.
5. **Job Creation:** The introduction of robots in agriculture opens up new job opportunities, particularly for those involved in building and repairing these machines. This can contribute to economic growth and development in the agricultural sector.

CONCLUSION

In this project, we have developed a robot designed for pesticide spraying in agricultural settings. This Agrobot, once optimized, aims to enhance the efficiency and cost-effectiveness of agricultural spraying operations. The implementation of this robot not only reduces the workload of farmers but also mitigates health risks associated with manual pesticide spraying.

The robot is engineered to navigate rough terrains and carry a substantial load of equipment, including a compressor. It boasts a robust structure capable of withstanding the challenges posed by field conditions.

Once this concept is tailored to suit the Indian market, it holds the potential to significantly reduce the mortality rate associated with agricultural spraying operations, currently estimated at 15% among Indian farmers.

Projects of this nature can inspire individuals to consider agriculture as a viable full-time or part-time profession. This is particularly crucial in developing countries like India, where agriculture forms the backbone of the economy.

REFERENCES

- [1] Shubhangi B. Londhe, K. Sujata, "Remotely Operated Pesticide Sprayer Robot in Agricultural Field," International Journal of Computer Applications (0975–8887), Vol 167, No. 3, June 2017.
- [2] K.Lokesh Krishna, K. Anuradha, "Internet of Things Application for Smart Agriculture System Implementation," I-SMAC (Internet of Things in Social, Mobile, Analytics, and Cloud) International Conference (I-SMAC2017).
- [3] Kazi Khalid Abdul Karim, Mankari Hemant Tanaji, Bodhgire Yogesh Uttamrao, Md. Momin, Md. Arbi, Md. Husain, "Agriculture Robotic Vehicles based Pesticide Sprayer," IJSRD - International Journal for Scientific Research and Development, Vol. 6, Issue 03, 2018. Aishwarya. B. V, Archana G., C. Umayal, 2015 IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development, "Agriculture Robotic Vehicle Based Pesticide Sprayer" (TIAR 2015).
- [4] Amrita Sneha. A, Abirami. E, Ankita. A, Mrs.R.Praveena, Mrs. R. Srimeena, 2015 IEEE International Conference on Technological Innovations in ICT for Agriculture and Rural Development, "Agricultural Robot for Automatic Ploughing and Seeding" (TIAR 2015).
- [5] Pvr Chaitanya, Dileep Kotte, A. Srinath, K. B. Kalyan, "Development of a Smart Pesticide Spraying Robot," Volume 8, Issue 5, January 2020, ISSN: 2277-3878, International Journal of Recent Technology and Engineering (IJRTE).
- [6] Peng Jian-sheng, "Intelligent Robot System for Spraying Pesticides", The Open Electrical & Electronic Engineering Journal, 2014, 8, 435-444.
- [7] Ege Ozgul, Ugur Celik, "Design and implementation of Semi-Autonomous Anti-Pesticide Spraying and Insect Repellent Mobile Robot for Agricultural Applications", 2018 5th International Conference on Electrical and Electronics Engineering.
- [8] Pranali .S. Bhoite, Nisha .U. Gurav, Onkar .K. Nagarkar, Reshama .R. Chaudhari, "Smart Automated Pesticide Sprinkling Bot", Proceedings of the Third International Conference on Trends in Electronics and Informatics (ICOEI 2019) IEEE Xplore Part Number: CFP19J32-ART; ISBN: 978-1-5386-9439-8.