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AGRICULTURAL PESTICIDE SPRAYING ROBOTIC SYSTEM CONTROLLED USING ANDROID APPLICATION

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ABSTRACT
This system deals with the exposition of how robotics is applied to varied fields of agriculture. One amongst the foremost important professions in a developing country like India is agriculture. It's important to boost the efficiency and productive capacity of agriculture by replacing labourers with intelligent solar-powered machines like robots using the newest technologies. The system proposes a brand new attempt to substitute humans in diverse agricultural operations like detection of the presence of pests, spraying of pesticides, spraying of fertilizers, etc. thereby providing safety to the farmers and accurate agriculture. The evolved system includes plotting a prototype that uses simple cost-effective equipment like microprocessors, solar panels, wireless, different motors and terminal equipment which helps the farmers in numerous crop field activities. The most feature of this method is Electrostatic spraying. This application is adopted in crop defence to stop pest infestation, to increase product quality and to expand yield. It includes a superposition of charges to pesticide spray droplets to draw in substrate ions at unseen surfaces. The droplets wraparound effect decreases off-course deposition, expands on-course spray and invariably improves spray productivity. Electrostatic spraying system works productively at the best suitable parameters in union with charging voltages, spraying height arrangement, application pressures, flow rate, travel speed, electrode material, and nozzle orientation.

INDEX TERMS - Pesticide Sprayer, Agriculture Vehicle, Robot, Stepper Motor, Solar, Electrostatic Spraying, Charged Droplet.

INTRODUCTION

Agriculture in India constitutes over 60% of the occupation. It serves to be the backbone of the Indian economy. It's vital to enhance the efficiency and productive capacity of agriculture by simultaneously providing safe cultivation of the farmers. Actions like the spraying of pesticides, scattering fertilizers are very tedious. Though spraying of pesticides has become mandatory it also proves to be a dangerous process for the farmers. Farmers, especially once they spray pesticides, take too many precautions like wearing appropriate outfits, masks, gloves, etc. So, it doesn't cause any harmful consequences on them. Avoiding pesticides is additionally not completely possible because the required outcome must be met. So, the employment of robots in such cases gives the most effective of the outcomes for these problems, together with the desired production capacity and efficiency. Cost-effective technology using components such as ESP32 Microcontroller for the control of agriculture robot, geared motors that facilitate the robot wheels to move and mobile application to guide the robotic movement are incorporated in this agriculture robotic vehicle to make all of the above practical.

The advancement within the area of robotics has widened and also the fields of its application, extend from home automation to the military. Application of Robotics within the field of machinery design and accomplishments of tasks using agricultural vehicles had resulted in increased investment and research. Continuous administration of the agricultural field is feasible with the automated performance of such agricultural vehicles. Abilities of the agricultural vehicles can be classified as guidance, detection, action, and mapping. The way of map-reading by the vehicle is termed as guidance, extraction of environmental features is termed as detection and execution of the assigned task is termed as action and plotting the area with its features is mapping. All four categories are self-reliant. This system is based on developing a robotic vehicle employed in agriculture for spraying dangerous pesticides. This project involves the usage of ESP32 microcontroller to control the movement of the robot with the aid of a mobile application. This cost-effective robotic vehicle can improve productive capacity, safety in agricultural applications and meet the demand for labour.

PROBLEM DEFINITION

To develop a Solar Powered Semi-Automatic Pesticide Spraying Robotic system controlled using an Android Application with Electrostatic Charged Droplets Technique to reduce off-target deposition.

SIGNIFICANCE OF THE SYSTEM

Farmers are moving to technology to label several pressing problems, such as the rising global shortage of food and labour. Wireless communication, field sensors, and data analytics are few of the advanced systems used in that venture, but the one area in which these technologies meet is robotics. Agricultural robots, sometimes known as Agri-bots, are seen as one of the key trends that will largely influence agriculture. For example, they will aid farmers address the issue of reducing workforce and allow them to work more precisely while saving money on labour. Advanced robotic systems will also help for harvesting plants, besides carry out on-farm data collection, increasing crop yields. But these robots are not cost-effective for the Indian market. So, we introduced an agriculture spraying robot that is cost-effective and easy to use for a farmer.

LITERATURE SURVEY

1. **"Agriculture robotic vehicle based pesticide sprayer with efficiency optimization"**[1]

This paper deals with explanation of how robotics are often applied to different fields of agriculture. The foremost important occupations in a developing country like India is agriculture. It's important to boost the effectiveness and productivity of agriculture by swapping laborers with intelligent machines like robots using new technologies. The paper proposes a brand new strategy to interchange 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 developing a prototype which uses simple cost effective elements like microprocessors, wireless camera, different motors and terminal elements which helps the farmers in different crop field activities.

2. **"Agricultural robotics, unmanned robotic service units in agricultural tasks"**[2]

The usage of agricultural appliances into precision agriculture has accomplished a rise in investment and exploration because of the utilization of robotics applications within the machinery development and task executions. Precision autonomous farming is that the functioning, counselling, and control of autonomous machines to hold out agricultural tasks. It inspires agricultural robotics. It's expected that, within the near future, autonomous vehicles are at the guts of all precision agriculture applications. The goal of agricultural robotics is over just the appliance of robotics technologies to agriculture. Nowadays, most of the automated agricultural appliances used for weed spotting, agrochemical dispersal, terrain levelling, irrigation, etc. are human controlled. An autonomous execution of such vehicles can give the continual supervision of the farm, because information related to the environment is autonomously acquired, and therefore the vehicle can then perform its task accordingly.

3. **"An advance air-induced-assisted electrostatic nozzle with enhanced performance"**[3]

There is an important need of latest chemical implementation sprayer for tiny scale farmlands in Indian agricultural pesticides spraying. A replacement air-assisted electrostatic nozzle has been designed and developed for tiny scale farms with a selected specialise in Indian agricultural and rural developing economies. Air-assisted based electrostatic nozzle combines of an induction depend electrostatic charging system and air-assisted nozzle. Spray particles are electrified to over 10 mC/kg charge-by-mass proportion by charging voltage minimum to 2.5 kV at liquid flow of 150 ml/min and power consumption minimum to 75 mW. Greater charge-to-mass ratio guaranteed the long range spraying distance to beat the charge neutralization process by recombination of naturally occurring ions present within the environment and charged liquid droplets. The outcomes of applied induction electrification process were identified by a charge-to-mass ratio and also the outcomes are in nice accordance with the theoretical matters. There is 2–3 times rise of liquid discharge with better equivalence on the hidden along with front target. This nozzle is low weight, extremely efficient, decreases pesticide usage and human health risks, and is eco-friendly.

4. **"Review of electrostatic system parameters, charged droplets characteristics and substrate impact behaviour from pesticides spraying"**[4]

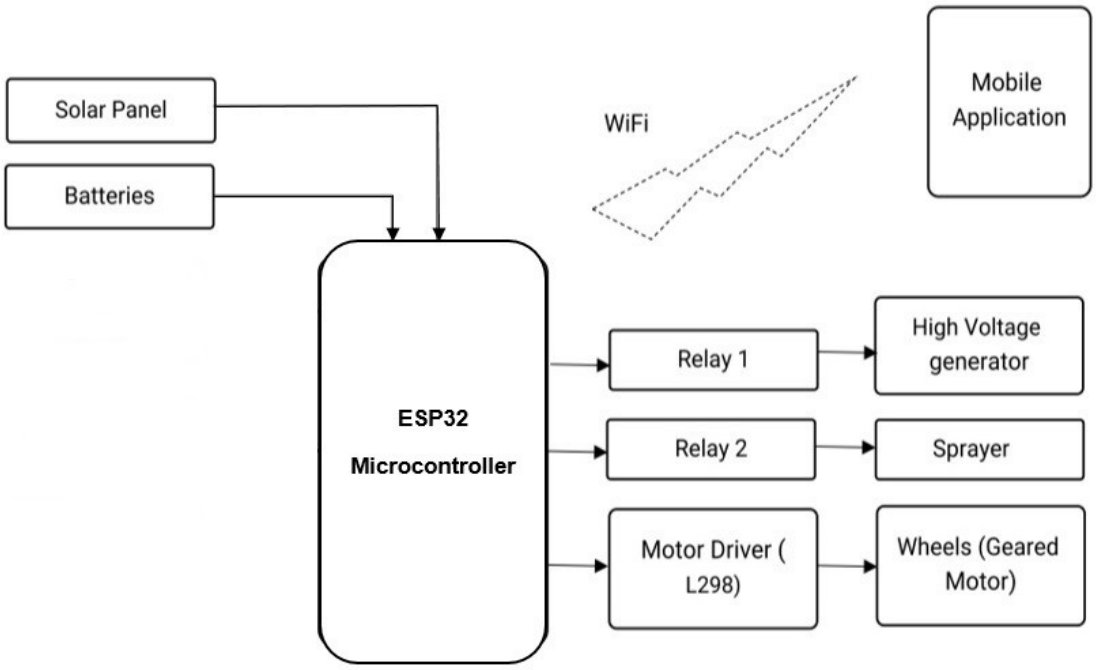
Electrostatic spraying application is adopted in crop protection to forestall pest infestation, to boost product quality and to maximise yield. It involves a superposition of charges to pesticide spray droplets to draw in substrate ions at obscured surfaces. The droplets wraparound effect decreases off-course deposition, enhances on-course spray and invariably improves spray efficiency. Electrostatic spraying system functions productively at ideal parameters together with charging voltages, application pressures, spraying height regimes, flow rate, travel speed, electrode material, and nozzle orientation. Many groups of system parameter settings are systematically utilized by scientists for electrostatic application, yet there are unsure specific optimum parameters groups for pesticide spraying. Since droplets chargeability effects the efficacy of the electrostatic spraying process, the specifications that generate optimum charge by mass ratio decide the functionality of spraying deposition, retention and surface coverage. This paper, hence, examines electrostatic system parameters which generate suitably charged droplets attributes for successful impacting behaviour of pesticides on the substrates. Increasing applied voltages accordingly increases charge-by-mass ratio to ideal and starts decreasing beyond more increase in voltages beyond a juncture. This paper further proposes the choice of an ideal electrostatic parameters combination which gives best droplets chargeability in the pesticide application. Also, it's necessary to research the charge characteristics of the substrates before pesticide application so as to superpose the proper opposite charge on the spray droplets at burst time during electrostatic spraying system.

PROPOSED SYSTEM

Applications like spraying of pesticides, scattering fertilizers are very difficult. Though spraying of pesticides has become compulsory, it also proves to be a dangerous process for the farmers. This project involves usage of ESP32 microcontroller to manoeuvre robot with the aid of mobile Application. This cost effective robotic vehicle can improve productivity, safety in agricultural applications and meet the demand for labour.

SYSTEM ARCHITECTURE

In our System, We are using cost-effective components such as ESP32 Microcontroller for the control of agriculture robot, geared motors which facilitate the robot wheels to move and mobile application to guide the robotic movement, motor driver – L298 and relays to operate wheels and sprayer. The complete system is monitored and controlled by the android application from a remote place with or without the internet using wireless network i.e. Wi-Fi or Bluetooth. The last and main feature of our system is electrostatic charged spraying nozzles which generates high voltage.



ADVANTAGES OF PROPOSED SYSTEM

- Decrease the wastage of pesticides.
- Avoid poisoning due to pesticides.
- Saves time and reduces manpower.

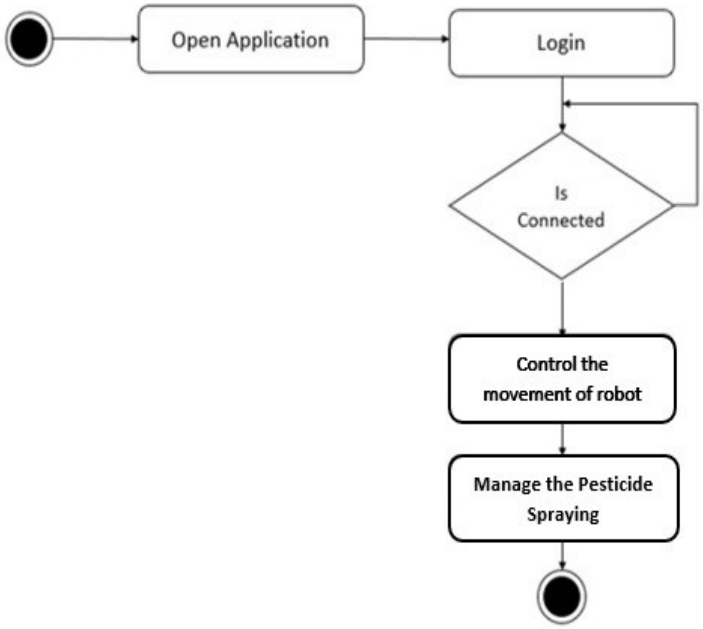


Fig: Activity Diagram

MATHEMATICAL MODELLING

S = {I, O, F, Success, Failure}

I = {i1, i2, i3}
i1= Soil Moisture Data
i2= Temperature Data
i3= Humidity Data

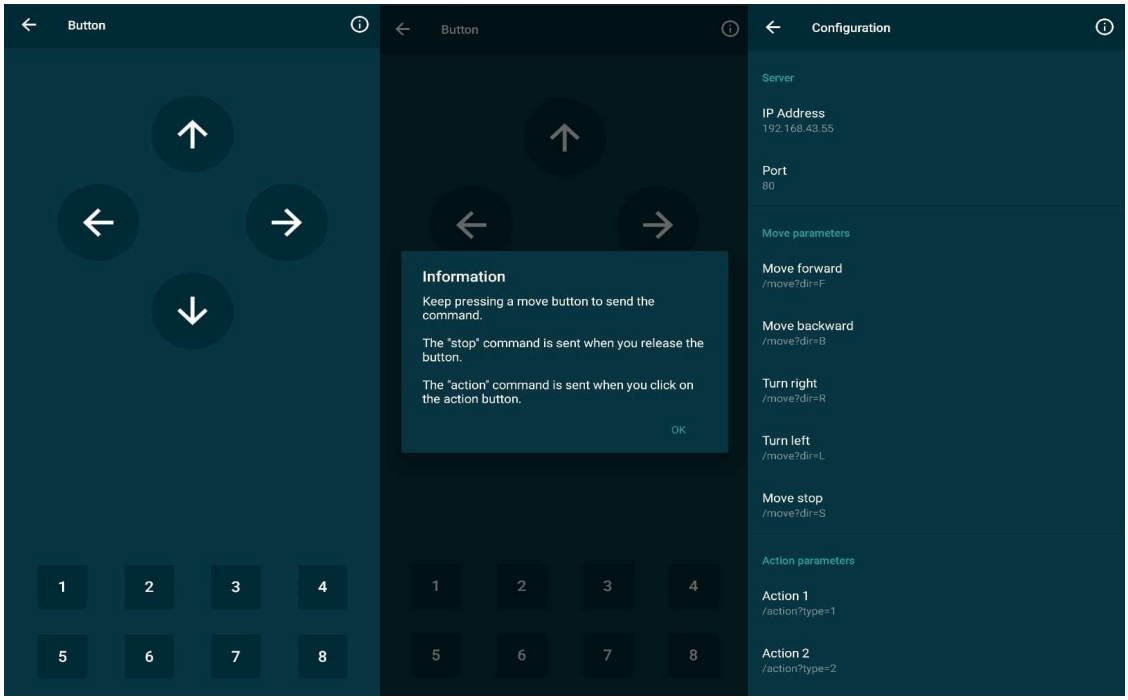
O = {o1, o2, o3}
o1= Pesticide Spraying
o2= Robot Movement
o3= High Voltage Generation

F = {f1, f2, f3}
f1 = Controlling Robot
f2 = Turn On/Off Sprayer
f3 = Send Data Wirelessly

Success = Robot works as per requirements
Failure = Robot does not work as per requirements

SYSTEM IMPLEMENTATION

The robot consists of cost-effective elements such as ESP32 Microcontroller for the control of the entire system, geared motors which enable the robot wheels to move, mobile application to control and guide the robotic movement, motor driver – L298 and relays to function wheels and sprayer. The complete system is monitored and controlled by the android application from a remote place with or without the internet using wireless network technology i.e. Wi-Fi or Bluetooth. The main feature of our system is electrostatic charged droplet spraying which generates high voltage to do effective deposition of pesticide and avoid wastage of it.



CONCLUSION AND FUTURE WORK

This agriculture-based vehicle proves to be a productive and efficient machine that can be easily navigated and controlled. The robot can move through different types of terrains and soil. Precise navigation is possible using Johnson's geared motor as it moves exactly according to the pulses received and it is inertia free, unlike a normal DC motor. Remote control of the robot is possible through wireless technologies (BLE, Wi-Fi). The command for controlling the robot movement and spraying of pesticides is done by using a mobile app. Hence control of the robot is user-friendly and is not very complicated; hence farmers can easily control this intelligent vehicle. Pesticide spraying is a tedious job in agriculture as it requires various protection equipment to protect the farmer. This robot mainly emphasizes on pesticide spraying by farmers from a remote location without directly meeting it. This feature will encourage more people to take up agriculture as the complexity of the task is reduced and the manned task is converted to an unmanned task.

In Future, we will add Artificial intelligence and the machine learning technology to automatically control the robot. This will make the robot fully autonomous.

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