Design and Fabrication of An Automated Pesticide Spraying Robot for use in Greenhouse Plants

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Introduction:

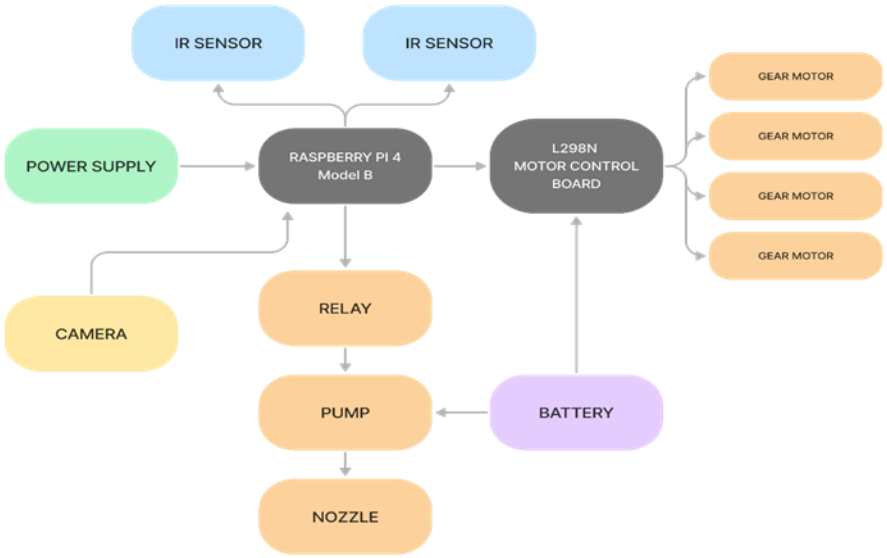
The function of a greenhouse is to create the optimal growing conditions for the full life of the plants. Achievement of these desired conditions often requires the use of pesticides, high temperatures and increased carbon dioxide and humidity levels. Prolonged exposure of greenhouse workers to these conditions leads to an uncomfortable and hazardous work environment. The adverse health effects are repetitive strain injury and heat strokes. Automating tasks within the greenhouse will enable the avoidance of unwanted or hazardous human exposure whilst potentially leading to an increase in overall efficiency and productivity.

The main application of robots in the commercial sector has been concerned with the substitution of manual human labour by robots or mechanised systems to make the work more time efficient, accurate, uniform and less costly. The carbon dioxide levels within a greenhouse are approximately five times the normal atmospheric levels. The optimal temperature and humidity levels of a greenhouse during the normal working hours of the day can be quite high up to 38◦C making it very hot and uncomfortable for someone wearing the heavy protective equipment. This can subject the worker to risks such as heat stroke and other health hazards associated with such conditions. An autonomous pesticide spraying device would be invaluable in the avoidance of human exposure to hazardous chemicals. This is achieved by the design and construction of an autonomous mobile robot for use in pest control and disease prevention applications in commercial greenhouses. The effectiveness of this robot is shown by its ability to successfully navigate itself down rows of a greenhouse using line follower algorithm, while the pesticide spraying system efficiently covers the plants that houses pesticides using object detection and image processing and then sprays in the set dosages

Objectives:

- To design a robot for detection of specific pests and diseases developed in plants of small stature in the greenhouse using image processing.
- To fabricate a working model of a robot that can spray the pesticides automatically.
- To test the working model on the selected specimens in a greenhouse.

Methodology:



- Automatic pesticide sprayer robot movement is based on the principle of a line follower robot, where the robot follows a fixed line around the farm or garden where the robot is deployed.
- The IR Sensors help in sensing the laid out path for the movement of the robot and sends the signal to raspberry pi which in-turn controls the movement of the robot.
- Speed of the robot is maintained with the help of the L293D Motor Control Board which is connected to 4 geared motors to which the wheels are attached.
- While the robot is moving on its given path, the camera collects data and with the help of image processing it compares the image that is stored for image detection.
- If the image matches the stored image the movement is stopped and a certain amount of pesticide is sprayed onto the plant by sending a signal to the pump and the robot moves forward repeating the above process.
- a safety measure an ultrasonic sensor is placed just in case it encounters an obstacle where the movement of the robot is halted

Result:

The robot follows the path laid in the greenhouse and scans the crops for pests and diseases, if detected the pesticide is sprayed. If no pests are detected the robot continues in the path until it reaches the end of the path.

Conclusion:

The use of image processing helped to overcome the wastage of time in pest detection and disease diagnosis. By automating the task of pesticide spraying we can minimize maintenance time of each plant by considerable amount and efficiently spray pesticide. 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. He will stay unaffected by his health condition. Apart from that, it does not require any supervision for operating. It only needs pesticide level refilling, recharging the battery. It can be operated with a rechargeable Mobile Power bank. Solar technology for self-recharge can also be imported in future. This project proposes an efficient use of technology to meet agricultural growth. This is a low-cost, one-time investment project. It reduces labour costs, which reduces total costs for farmers. By removing the disease from the crop, a farmer gains more productive output, resulting in the maximizing profits of the farmer. This can be considered an advanced step in the agricultural sector, as it avoids food crises, attracts young people, and demonstrates the need of agriculture

Scope for future work:

- Automation of simple tasks with the help of technology is just the beginning, building an ecosystem with the help of IoT for collection of data and managing the entire greenhouse seamlessly
- More advanced navigation system can be implemented using LiDAR sensor wherein the robot can perform self-mapping and can lay its own path
- With improvised structural design, it can be used for outdoor crops overcoming challenges like uncertain and uneven terrain mud, rocks, water puddles, undergrowth/weeds, etc.
- Multiple pesticide containers containing different pesticides can be accommodated for different plants and pests at a time, by building a pesticide selection system in the robot for enhanced usability
- Solar panels can be installed for charging of batteries while performing task, increasing battery uptime and eliminating idle time during manual charging