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A REVIEW ON INTELLIGENT AGRICULTURAL SEED AND FERTILIZER SPREADER ROBOT WITH IOT

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ABSTRACT

India is the farmland with a population of three-fourths in agriculture. In accordance with the climate and other resources accessible to them, farmers will grow multiple plants in their field. But some technical abilities along with technological assistance are required to achieve high output and excellent quality. The management of food crops includes very close surveillance, particularly with regard to the treatment of Illnesses, which will cause severe effects after harvest. Disease is recognized in crops as the shift or deficiency of the plants ordinary functions that will generate certain symptoms. The disease that causes agents in plants is mainly defined as any agent's pathogens Most of these pathogenic agents' signs are seen in the leaves, stems and branches of the crops. Consequently, the diagnosis of disease and the proportion of disease produced in crops is compulsory for effective and successful plant cultivation. This can be 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. He will stay unaffected by his health condition.

Keywords: Solar Photovoltaic; Agricultural Robots; Agri 4.0; Battery-Based Farm Machinery; Mobile Irrigation System; Smart Water Sprinklers; Smart Pesticide Sprayers; Multi-Purpose Farming Robots.

I. INTRODUCTION

Agricultural communities use more than 70% of freshwater extracted from water sources (wells, wells, lakes, rivers, etc.) to produce commodities that meet rapidly growing food needs. On the other hand, due to changes in weather and uneven rainfall, the shortage of fresh water from the above water resources is becoming a serious problem. At the same time, the demand for water is increasing mainly due to industrial activity. Increasing demand for water is proving to be an imminent threat to society and other interdependent sectors such as food and agriculture. There is considerable uncertainty in global estimates and projections for water use, particularly the relationship between water use and crop production. However, food use projections show that food demand will increase by 60% by 2050, and this increase will require more arable land with adequate water resources. Population, urbanization, clean energy and climate change are major concerns for food security in the modern world. Food security is becoming a top concern for governments and health organizations around the world. Therefore, in order to feed a large population, great attention must be paid to the supply of agricultural products.

Many countries, especially South Asia, Africa and Latin America, use more than 90% of their water withdrawals for agriculture. Freshwater withdrawals in Sudan are among the highest. Thus, it is clear that water withdrawals for the agricultural sector are unevenly distributed around the world, creating problems for food security and water supply. At the same time, different technologies are being used to solve food security and versatile water supply issues and ensure ecological balance. Several studies in the literature suggest taking measures to control water demand. Smart irrigation could be a viable solution in terms of efficient water management. Irrigation system upgrades should consider assessing overall water availability, preparing mechanisms to deal with drought, improving irrigation planning tools, and combining technology and management techniques. Smart watering management helps identify when to water, how much water is needed, and how often to water based on monitoring plant evaporation and soil moisture. The cheapest way to irrigate large fields is to run water pipes connected to sprinklers to draw water from nearby sources. Rough terrain can make laying irrigation pipes difficult, and locations with significant elevation changes may require more efficient pumps.

In such situations, there are obvious drawbacks related to energy use and maintenance. In addition to the irrigation system, pest control is also an important issue. Although there has been extensive development in the field of pest control, capital costs, size and complex nature have made them less popular. More advanced machines can perform the task of pest control with great efficiency, but are often expensive. Overall, when controlling pests, chemicals are often sprayed across agricultural fields as long as the chemicals reach all the plants on the farm. Different plant species have different lifespans in some stages. Maximum production requires a certain amount of fertilizer or chemicals

II. LITERATURE SURVEY

Mahapurush et al [1] proposed a solar operated automatic pesticide spraying robot to reduce the manpower and use of electricity. The author implemented the prototype as shown in the Fig 2 with Arduino, ultrasonic sensor,camera, motor drive circuit, relay circuit to pump the sprayer circuit and the battery powered with the help of solar panel. The robot is operated with transmitter and receiver operating at high frequency of 434 Mhz. It is an automated robot that is controlled by Arduino UNO R3. Automation of the robot is achieved by using ultrasonic sensors and Arduino UNO R3. DC motors are used for the operation of cutting of the grass. DC battery is used to power all the components of the system. As a second option, a water pump with a spreading nozzle is used for spraying pesticides.

Ranjitha et al [2] developed a robot that can sow seeds, mow lawns, and spray insecticides. Using a solar panel, all of the system's components are powered by solar energy. The robot is operated manually using a Bluetooth/Android App that provides signals to the robot for various mechanics and movement. As a result, it improves the efficiency of seed sowing, pesticide spraying, and grass cutting, as well as reducing the problem that farmers face when manually planting.

Ege Ozgul et al [3] created the "X-Bot," a low-cost semi-autonomous robot that uses current technical breakthroughs to do agricultural jobs with high efficiency and precision. The Arduino Mega 2560 microcontroller was utilized to automate the control of all the components. The motor driver is responsible for controlling the DC motor's speeds as well as the water pump that is attached to the nozzle. For path detection, three ultrasonic sensors are utilized buzzer is used for repelling insects.

Umayal et al [4] implemented a prototype that matches with our aim of implementing reduced cost pesticide spraying robot equipment that were implemented with motherboard consisting of, transmitter, receiver, PIC16F87X microcontroller optocoupler, driving circuit and the stepper motor. The transmitter board is implemented with IC (12E), carrier signal generator with frequency of 434 MHZ that modulates the signal and produces a modulated signal in accordance with command issued by the user. The information after passing through the mixer and the amplifier will be transmitted by wireless transmitter. The receiver device consisting of antenna is tuned to receive the transmitted 434 MHZ carrier signal followed by RF amplifier for the amplification that generates the appropriate command to the robot. The PIC microcontroller serves as the heart of the prototype that will drive the entire circuit by issuing command signal to the driver circuit to run the stepper motor which in activates the robot. Optocouplers ensure data is transmitted in one direction as it is optically coupled and also acts as a protection circuit because of the isolation characteristics with the driver circuit. This prevents the damage that may be caused to microcontroller because of the backward electromotive force.

Alireza Rafiq et al [5] used an algorithm to implement an autonomous robot a robot with an AVR microcontroller for controlling all the inputs and outputs of the system. Hot water pipeline tracks were placed along the rows to assist the robot navigate. A gearbox and shaft setup distributed power from two DC motors to two driving wheels. BASCOM-AVR version 1.11.9.8 is used to programme the microcontroller, whereas PROTEUS 7 professional is used to simulate the circuit.

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Bernstein et al [6] modified the conventional robot to an ASD (Adjustable spraying device) for precise spraying of the pesticide on the leaf invariant of the shape and the size of the target leaf. The goal of this research was to build a spraying unit that could be put on a robot, as shown in Figure 3. It features a single spray nozzle with an automatically adjustable spraying angle, as well as a color camera and distance sensors, all of which are mounted on a pan-tilt unit. The spraying diameter will change depending on the target's form and size. The description and the application of the parts are

- Color Camera – To capture an target image in the crop
- Spraying Nozzle – The nozzle will be directed to face perpendicular to the leaf or the target of the crop such that the nozzle diameter is equal to the target diameter. It consists of two parts nozzle cup and an adjustable pesticide hose attached to the Nozzle base that will spray pesticide at defined intervals.

Yan Li et al [7] concentrated on developing an automated technique for detecting and locating pests in order to obtain pest location and information for plants in a greenhouse. Binocular stereo was utilized to place the pest. The difference in color characteristic between the bug and plant leaves retrieved by picture segmentation is used to identify the infestation. The position of the pest has been determined using picture segmentation and binocular stereo vision methods. The pest's job is to direct the robot to spray pesticides for a greenhouse autonomously. The DSP board controls the spray nozzle, and data is transmitted between the chip and the computer at the robot through RS-232-C.

Chun-Mu Wu et al[8] proposed an intelligent spraying robot with a driver module, spray module, obstacle avoidance module, path planning module, and control module. Sprayer luffing mechanism is used for the sprayer to vary with spray target. The obstacle avoidance is done by using a camera lens, electronic compass, and ultrasonic sensors. For path planning GPS located the range of spray. Sonal Sharma et al [9] suggested a prototype of the robot with parts labeled as shown in Fig 4 consisting of sensor unit comprising of temperature sensor , Humidity sensor and a soil moisture sensor, the heart of control unit ARM7 microcontroller, ZigBee module, spraying module, driver modules and a camera unit.

The robot was proposed by Tao Li, Bin Zhan, and Jixing Jia [12] can be utilized only in the greenhouse. This robot features a navigation system that incorporates controllers, electromagnetic sensors, an angle transducer, an induced wire, and a signal generator, as well as a real-time measurement of magnetic field strength. The IPC/104 bus is used by the control system. It is powered by a four-wheel independent drive system. The steering may be adjusted by adjusting the speed of the wheel motors to the left or right. It can make small bends at less than 0.5 m/s.

Victor J. Rincónaand and Paolo Balsari [13] planned to develop a remote controlled prototype for spraying pesticide for tomato crops. It is often used manually or automatically. It uses two electric motors of 1kW and two pumps. The sprayer has an air-assisted system, and the nozzle is often adjusted as a full cone or hollow cone nozzle. For hand spraying the nozzle have a 1.5 mm hole and 30° jet angle.

Tingkai Chen et al [14] enforced a pesticide spraying robot that can adapt to the height of the plant. It has a Microsoft camera which has a sensor. It can calculate height and change according to it. Arduino is used as a controller. It uses RGB and depth camera to calculate the actual height of the plant accurately. Three nozzles were kept on the side of machines. The command from the controller helps in the opening of the nozzle accordingly. Extreme spraying height is 900 mm with three nozzles open.

Peng Jain-sheng et al [15] designed a robot with trolley module, system control module, driver module, spray module, video capture module, WIFI module, infrared obstacle avoidance module. In STC11F32XE as core controller. It has anti-interference ability and low prices. The robot can move in variety of roads. Webcam video capture can cover the range 0-180 degrees. Maintenance and handling of a robot is easy. The robot movement is controlled by the mobile applications with the help of Wi-Fi.

A robot combining Robot Movement, Video Streaming, and Pesticide Spraying Mechanism was proposed by Chaitanya et al[16]. It makes use of a disease detection algorithm and to identify and classify the plant disease. Machine learning and image processing were used to aid in the identification of plant diseases. Solar-powered robots are also being developed to maximize the use of electricity [17].

Londhe et al. [18] suggested a remote operated robot with microcontroller, motor driver, DC motors, camera. The robot is used to spray pesticides to the localized area of the pest affected plants. DC motors used to control the movement of the robot. There three stages in the robot, image capturing, image processing, and automatic pesticide spraying. The image processing is done by signal processing.

The research papers listed above aided in understanding the many systems and approaches used to construct an agricultural robot. Processors, transmitters/receivers, and spraying nozzles all fail to meet the required specifications in the design of the robots by the researchers. The above survey is effectively presented as the table in the next section for quick reference[24].

III. METHODOLOGY

This agricultural robot can display 3 processes, i.e. (a) movement of machine, (b) uploading of video and (c) spraying process for pesticides[23]. For the operation of the robot and the spray unit, the operator uses the Android application. The Raspberry pi is connected to an ordinary USB web cam, which is mounted on the robot to stream live video to the operator-connected PC. We use Raspberry Pi programmed with Python's programming code to identify and classify the disease in crops[22].

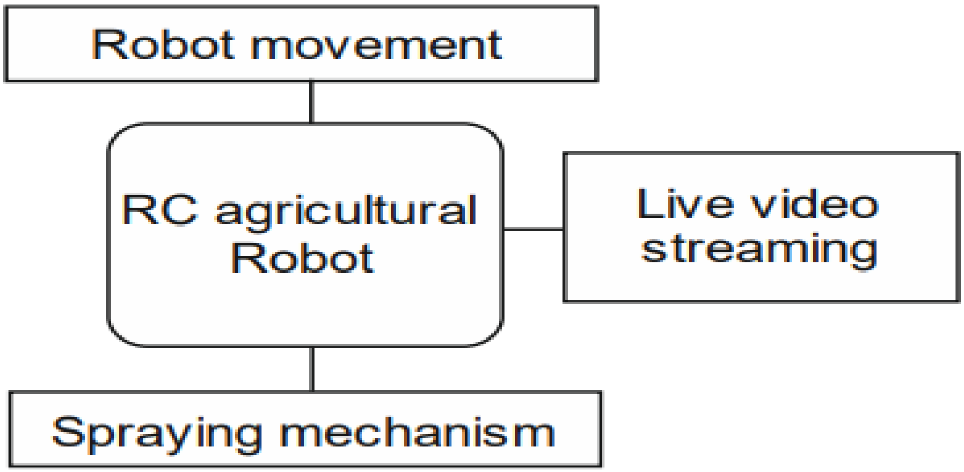

Fig.1 RC Agricultural Robot

A. Robot Movement

DC motors are used for the robot's motion that are governed electronically by Arduino UNO with the assistance of L293D. The HC-05 Bluetooth module receives signals from the input and sends them to the controller, which in turn spins the engine. By obtaining the signal, DC motors are switched ON and OFF by allowing Arduino to have a specific pin. An adequate velocity is provided by 300rpm DC motors[21].

B. Video Streaming

With the aid of the USB webcam and Raspberry pi we stream the video to the operator PC. Video streaming can be achieved in many ways, i.e. by installing gstreamer software on both the raspberry pi and the operator PC or by installing VLC player on both the transmitter side and the receiver side [2]. We prefer to use VLC player to stream the video with https:// followed by raspberry pi's IP address, so it seems simple for operators to take snapshots from the streaming video to detect further disease.

C. Pesticide Spraying Mechanism

Bluetooth module connects to the digital key of Arduino UNO, which receives the signal installed on the operator's Smartphone from the Android app. The floating sensor and submersible pump were mounted inside the pesticide tank. The submersible pump is linked to one end of the tiny diameter pipe and the other end is linked to the sprayer nozzle. The operator can use the Android app to spray particular pesticide if the algorithm says the plant is affected by some disease.

The future work that can be explored for implementation are as follows

- control of a robot manually by the user via IOT through any mobile device.

- By expanding the capacity of the tank, the amount of pesticide carried by the robot can be increased. Pesticides can be sprayed over a bigger area without having to reload.
- For efficient pesticide spraying in vast fields, many robots can be linked together.
- Modernization and Optimization of energy required to power the sensors to be handled by the Solar panels and gel batteries.

IV. CONCLUSION

The survey summarizes the implementation aspect, the technologies employed, and the drawbacks in each study. The problem of spraying pesticides is addressed in the study article, which proposes solutions through the design and development of an autonomous and semi-autonomous agricultural robot. This paper robustly survey the design aspects in the construction of an autonomous pesticide spraying robots that will augment the growth of the plant by incorporating various approaches for monitoring and an enhanced mechanism for spraying fertilizer, pesticide, and water that can be applied to different domains in agriculture. The above proposed work focuses on designing a low cost robot. According to the requirement, the spraying pipe can be selected, i.e., a spraying nozzle or a sprinkler, to enhance the spraying mechanism with high accuracy and efficiency. It's an automated robot; it's programmed to work on its own. As a result, after entering the values, it sprays insecticides across the field automatically. A mobile application can also be used to control it manually. As a result, the notion of robotic automation is used to create a pesticide spraying robot.

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