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Multitasker Agri-Bot

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***Abstract*--- Agriculture has been the backbone of the Indian economy and it will continue to remain so. However, timely farming operations such as seed sowing, harrowing, pesticide spraying, and measuring the moisture have become very important to get a good yield. Hence, nowadays, with the advances in robotic technology, it can serve as a very useful tool. With the advantages of robots such as hands-free and fast data input operations, Multitasker Agri-bot is designed in a way so that it can perform all the major agriculture operations, remotely. It is an electromechanical vehicle that is steered by hub motors to drive wheels, the farm is cultivated by an automated system, depending on the crop considering rows and specific columns. The bot is controlled remotely by using a smartphone. There is a plant health monitoring system that uses a web camera to detect any disease of a plant. Sensors present in the system can gather data from its environment, based on which it takes the right decisions, then send commands to other parts to take action. In this, a robot is controlled by Node MCU and Raspberry Pi. Power to the bot is given by 48v LiFepo4 and power to various functions of the bot and electronics component is provided by 12v LiFepo4. 7inch display screen shows data and sends the command to control some actuators. The bot is designed using CATIA software and node-red is used to create GUI (Graphical User Interference). Multitasker Agri-bot has a run time of 6 hours resulting in better efficiency and productivity.**

***Index Terms*— Electromechanical vehicle, LCD display, Plant health monitoring, Remotely operated**

I. INTRODUCTION

Agriculture has been the backbone of the Indian economy and it will continue to remain so for a long time. .A person left without food for three days will quarrel with him, for a week he will fight and for a month or so he will die. India record the progress of agriculture over the past four decades, that's impressive. The agriculture region has been a success in retaining tempo with growing call for for food. The contribution of elevated land vicinity below agricultural manufacturing has declined over the years and will increase in manufacturing withinside the beyond many years were nearly totally because of elevated productivity. More than 42% of the full populace withinside the global has selected agriculture as their number one occupation. Recently, people shows more experience in the development of autonomous vehicle for agriculture. Because of that development, many researchers started to produce vehicles for agriculture.

In agriculture autonomous vehicle, the concept is developed to examine that so many small machines may be more effective than the traditional tractors or human source. These cars have to be able to running 24 hours an afternoon all yr round, in maximum climate situations and feature the intelligence embedded inside them to act sensibly in a semi-herbal surroundings over lengthy intervals of time, unattended, whilst sporting out a beneficial task. There are numerous field operations that may be completed via way of means of self reliant vehicles, giving greater advantages than a unmarried venture traditional machines.

The idea of applying robotics technology in agriculture is very new. In agriculture, the possibilities for robot-greater productiveness are tremendous and the robots are performing on farms in diverse sorts and in growing numbers. Agricultural operations can be performed automatically such as seed sowing, Grass cutting, water spraying or pesticides, plant health monitoring, and soil moisture sensing. The robot is controlled by Node MCU and Wi-Fi model. The language used to interact with bot is familiar to people. The advantage of agriculture robot is hand-free and data input operation is fast. In agriculture autonomous vehicle, the concept is developed to examine that so many small machines may be more effective than the traditional tractors or human source.

II. REVIEW OF LITERATURE

We studied various papers to develop our agriculture robot and idea to implement

Designing, employing, and analyzing an self reliant multipurpose vehicle [1] with safe, reliable, and economical. These agriculture vehicle goes through the crop rows of the agricultural field and does task that are unsafe to the user. Majorly, it is made for spraying purpose but with that other configurations are also designed like seeding system, plug system to reach notable area of a plant to execute different tasks

Automatic robot [2] is designed, developed and fabricated such that it can dig the field, put the seeds, level the ground and use sprayer to water, and whole assembly of automatic robot work together with supply of power through battery.

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Improvement in techniques of agriculture which are automatic seeding on ploughed land with use of automatic robot [3]. A agriculture bot having four tires and DC motor is used to steering. The device of planting seed is fixed to the automobile for carry out seeding in even manner.
By taking the image of the plant and collecting the databases of the cotton plant diseases it will give information of the plant disease.

III. METHDOLOGY

The methodological procedure, block diagram, and flow chart are included in this section. The main aim is to design and develop a system that can be remotely controlled to aid in the agriculture functions such as seed sowing, harrowing and harrowing, pesticide spraying, and soil moisture detection using soil moisture sensor and show the values on an LCD display. The system consists of Node MCU and Raspberry Pi [8] which will act as the heart of the system.
Fig.1 and Fig.2 show the complete block diagram of the Agriculture robot developed for farming operations know as bot. We use a 48v LiFepo4 battery to power the bot. Node MCU ESP8266 [9] has a Wi-Fi module that can be connected to our smartphone by using the Blynk app which is a big IoT platform and it helps to control the bot remotely. Node MCU controls the 4 hub motors. Output is obtained through mechanical parts to perform seeding operation and movement of these parts is controlled using DC motors. LDR circuit is used to check for empty conditions for seed tanks and pesticide tanks. If the tank will be empty, the system signals the farmer through the speaker. The farmer can then refill it up. The soil moisture content can be used to check the moisture level in soil, using a soil moisture sensor. The moisture level is then displayed on the screen. Users can water the soil as per the need. The seed sowing system works as follows:Digging of soil field to specific depth and seed is dropped in that hole and covered with soil. Distances between crop rows and crops are given in table 1.

Table 1: Dimensions for Two Crops

Type	Distance between two crops	Distance between two crop rows
Cotton	15cm	60cm
Soybean	7cm	30cm
Maize	7cm	60cm
Gram	7cm	30cm

The bot also has some smart functions. A plant health monitoring system is one of them. Image of the plant is captured by the camera, then by using a CNN, disease detection would be carried out and the result will be displayed on the screen. The LCD screen [10] is used to show data on the dashboard which is designed using Node-Red. There are two head-light so that the bot can be used at night.

IV. WORKING OF THE AGRIBOT

A. BLOCK DIAGRAM AND DESCRIPTION

The working of the bot is divided into two parts as shown in Fig.1. It consists of a battery, Node MCU ESP8266 controller, hub motors, relay module, dc-dc converter. The bot is controlling remotely by establishing a Wi-Fi connection between node MCU and smartphone using the Blynk app. The bot is powered by a 48V Lifepo4 battery having a capacity of 110 Ah. Four 48V hub motors are having the power of 500 watts which allows for the moment of the bot. It provides a maximum of 3Hp power to the wheel. The relay module is connected in between the Node MCU ESP8266 and the hub motors. Using that module we either provide power or cut the power to the motors. The operating voltage of the Node MCU is 5V, and hence a dc to dc converter is used to convert 48v to 5V.

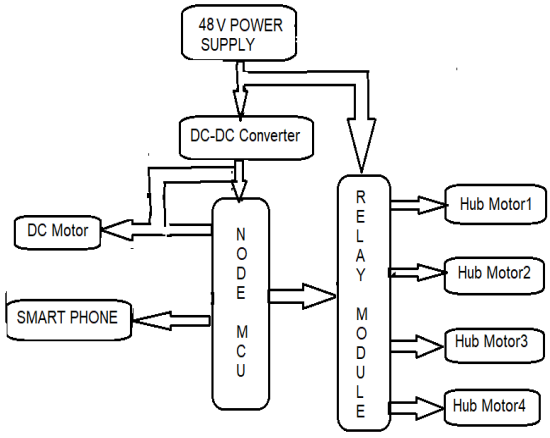

Fig.1 Block Diagram for Moving of the Bot.

The Raspberry Pi is the heart of the system which controls all the functioning of the bot. It consists of sensors, motors, relay module, 12V LiFepo4 battery, headlights, speaker, and LCD display. Motors are also used in various systems of the bot such as automatic seed sowing, pesticide, and fertilizer spraying, etc. These systems are controlled by the Raspberry Pi with the help of the relay module. Soil moisture sensor, ultrasonic sensor, LDR circuit will give information to Raspberry Pi and this information is shown on the LCD display. The camera is interfaced with Raspberry Pi using an HDMI cable. Headlights are used to light the way during the dark hours of the day or night. These electronic components are powered by a 12V LiFepo4 battery, having a capacity of 60 Ah. Therefore, it can run for at least 5 hours. For wiring

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together hardware devices, APIs and online services Node-Red programming tool is used. The graphical user interface on LCD is created using node-red. There is a different attachment for different functions like seed sowing, plouging. At a time we can do 3 or 4 tasks. SPST switches 1 and 2 are used to on-off function of headlights. The data of soil moisture, plant health monitoring are displayed on the display.

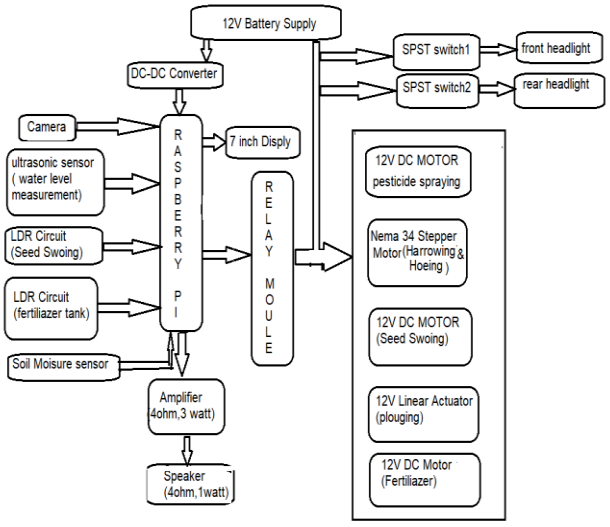

Fig.2 Block Diagram for Function of Bot

Mechanical Design

We tried to make the basic design for our reference purpose only. With all dimensions that are 2 x 4 feet.

Fig.3 Mechanical Frame of Bot

B. ALGORITHM FOR MULTITASKER BOT

Once you power on the bot the steps followed by the agriculture bot are as follows. The flow chart in Fig.3 shows the movement of the bot and Fig.4 shows the mechanism of the bot.

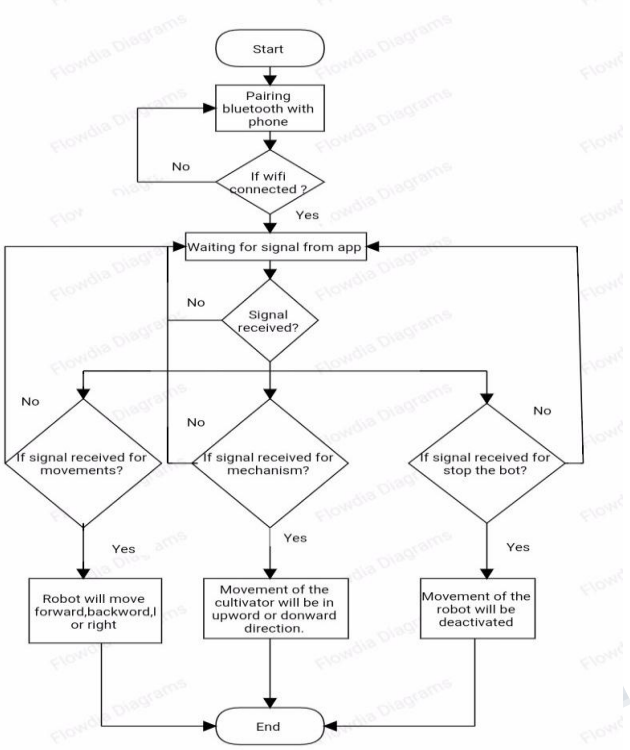

Fig.4 Flowchart for Movement of the Bot.

The algorithm for the robot is as follows:-

Step 1: Start

Step 2: Switch on the robot

Step 3: Initializes node MCU WiFi connection with the mobile phone

Step 4: The robot should wait until it receives the signal from the app

Step 5: If it receives the signal, the robot works accordingly

Step 6: If the signal is not received go to step 4

Step 7: Universal OFF signal is used to deactivate

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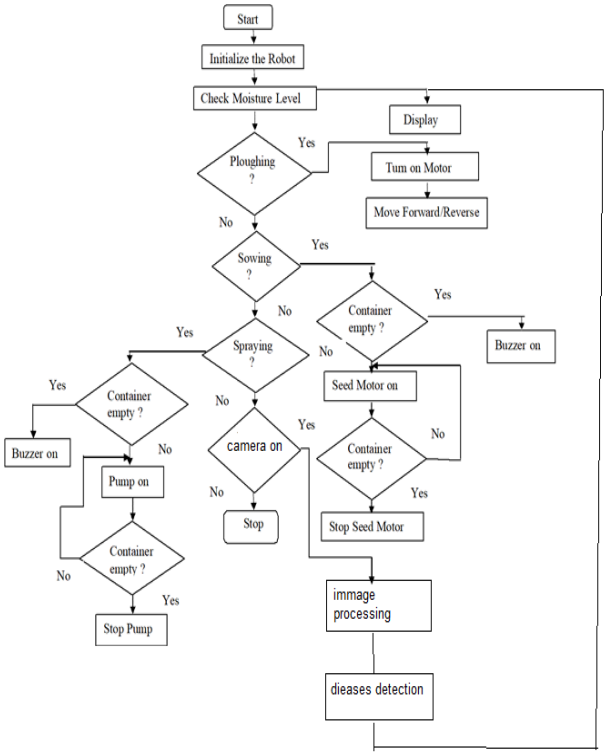

Fig.5 Flowchart for the Mechanism of the Bot

The flow chart in Fig.4 explains the algorithm of automated
seed sowing, fertilizer and pesticide sprayer robot, and plant disease detection.
The Algorithm for the robot is as follows:-
Step 1: Start
Step 2: Initialize the robot
Step 3: Shows received data on LCD
Step 4: The robot should wait until it receives the signal from a farmer about which function to carry out
Step 5: If it receives the signal, the robot works accordingly
Step 6: If the signal is not received go to step 4
Step 7: Stop the functioning of the bot

V. FUNCTIONS OF THE AGRIBOT

We decided to design a system that can remotely control various operations. This project has huge scope in agriculture operations like automatic seed sowing, grass cutting, water, and pesticides spraying. It reduces human effort as well as saves time. We can further add several operations to reduce human efforts even more.

1. Automatic seed sowing

The automatic seed sowing module consists of a dc motor, a seed tank, a circular disk, and an LDR Circuit. The robot consists of a container to store seeds. The circular disk is connected to the dc motor. The teeth present on the disk allow it to pick up a limited quantity of seeds and pour them on the ground in a steady manner in adequate quantity. We can control the speed of the disk by controlling the speed of the dc motor. LDR circuit consists of a laser and a photo-resistor sensor which signals the farmer, with a buzzer when the tank gets empty.
Dimensions of the tank (in feet):1.96 x 0.65 x 1.64.

Fig.6 Seed Tank

2. Pesticide and fertilizer spraying

It consists of a tank, dc motor, dc gear motor, sprayer, LDR Circuit, ultrasonic sensor [12].
Dimensions for tank are (in feet): 1.96 x 1.14 x 1.96.

Fig 6 describe the CATIA design of the bot.

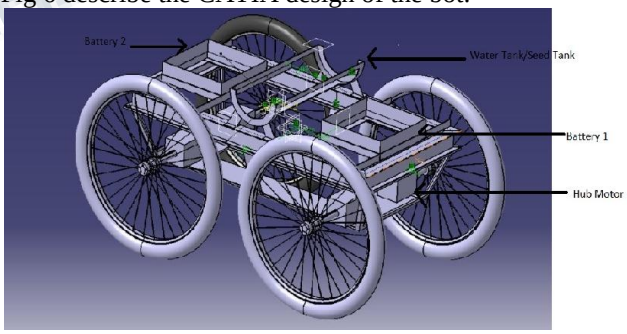

Fig.7 Mechanical Design

3. Harrowing

It is an implementation for breaking up and smoothing out the surface of the soil and removal unwanted grass. It also makes the soil rich in humus. Its weight is about 10 to 15kg.
Fig 7 is the CATIA design of the harrowing machine and simulation is carried out.

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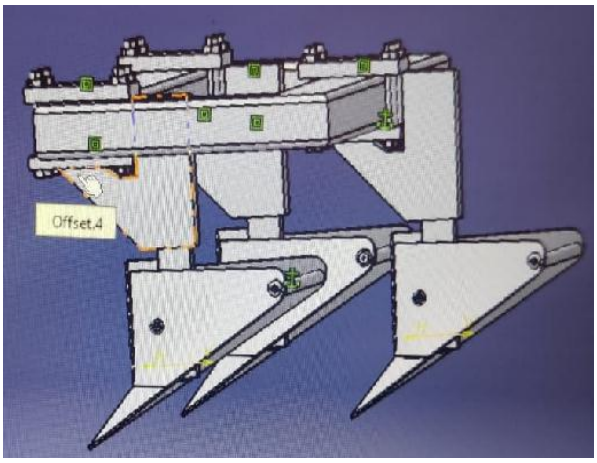

Fig.8 Design of Cultivator

4. Soil moisture sensing

Soil moisture sensor measures the moisture content of the soil. The result will be shown on the LCD screen so that the farmer can easily decide to provide water to the farm. The soil moisture sensor [11] consists of two probes that measure the volume of water in the soil. The two probes allow the electric current to pass through the soil and, according to its resistance, measure the moisture level of the soil. When there is more water, the soil conducts more electricity, which means that the resistance will be less. Hence, the moisture level will be detected as higher. Dry soil reduces conductivity. So, when there is less water, the soil conducts less electricity, which means it has more resistance. So, the moisture level will be lower.

Fig.9 Implementation of Soil Moisture Sensor

5. Plant disease detection

Neural networks have recently been successfully applied in many diverse domains as examples of end-to-end learning. Neural networks provide a mapping between an input such as an image of a diseased plant to an output such as crop disease. For that, we needed a large, verified data set of images of diseased and healthy plants. Until very recently, such a data set did not exist, and even smaller datasets were not freely available so we worked only on the cotton plant. We placed the camera on the front side of the bot. The camera is connected to the Raspberry Pi, which takes photos of the plant, processes it, and shows the result on the LCD screen.

Fig.10 Interfacing of Camera to Raspberry Pi

VI. CONCLUSION

The smart agri-bot has improved productivity in agriculture functions. Multitasker Agri Bot is successfully developed and all attachments are implemented. It helped to reduce human effort by doing automatic functions like automatic seed sowing, automatic pesticides and fertilizers sprayer, plant disease detection, etc.

More innovation can be done on the charging system of battery, such as Solar energy can be used for the charging purpose which would significantly reduce maintenance as well as the cost of an electric bill. We can also identify how to increase the productivity of certain plants based upon the amount and type of fertilizer to be used. The plant disease detection can be done as per the requirement of the farmer. Precision in seed sowing and spraying can be improved by developing different nozzles as per size and requirements.

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