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Solar Powered Voice Controlled Multipurpose Agriculture Robot using IOT

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ABSTRACT—

Agriculture is the backbone of our nation. However due to shortage of labor and mechanized equipment's, Indian agricultural still follows obsolete methods which heavily affect productivity of agricultural produce. With technological advancements in many other fields, agriculture is still followed by obsolete methods, as majority of the farmers are not literate to operated highly complicated technological devices. Thus, this project simplifies the technology for farmers using voice. This project involves development of completely autonomous agricultural machines which can be used for different applications such as spraying, sowing, irrigation using voice commands over IOT where farmers can operate the machine in the farm form any corner of the world using voice The system uses speech recognition and can detect the voice commands of the farmers and trigger the vehicle in farm remotely using IOT. The machine is capable of performing multiple operations such as sowing, spraying, cutting and more. Since the machine is voice activated, the farmers can easily control the machine as it involves just voice commands. Further the machine operates over IOT and is autonomous, so that farmer can control the machine from any corner of the world. Thus, this project provides a completely economical solution to problems faced by farmers and automating agricultural operations improving productivity. Further the machine is solar powered which not only makes it green but also ecofriendly and cost free for farmers. Further the height adjustment system for spraying and crop cutting is implemented in this project to be able to spray at different heights and also to maintain different cutting heights using lead screw-based mechanisms.

Keywords—voice, IOT, Sowing, Spraying, Tilling, Labor, IOT, Autonomous, cutting, solar, etc.

I. INTRODUCTION

Agriculture is the backbone of economic system of specified country standard techniques of farming rely on Man power and old procedures such as the application of synthetic chemical fertilizers, pesticides, herbicides and genetically changed creatures. To carry out similar tasks with efficiency, we make use of agricultural robotics. Agribots can spot the life of diseases, weeds, insect infestations and different pressure circumstances. Agri robots are lightweight. Agricultural robots that may be managed through Android apps are very beneficial for farmers' livelihoods. This indeed supports the farmer's livelihood. Nevertheless, current methodologies that permit highly mechanized group of primary phenotypic data for compact numbers of plants in the greenhouse fall far short of the requirement to look into and distinguish plenty of plants under real world circumstances. Building structures that can gather multi-modal, multicharacter data in real time in the field needs joining plant biology and crop science with robotic vision and computer engineering. These structures should be precise and dependable, and should supply exceptional facts than the present routine accessible for automated greenhouse or physical field phenotyping. This will assist us to associate plant genotypes in additional to the molecular and Eco physiological responses with the interpretation of particular phenotypes in retaliation to the flourishing surroundings.

The Indian economic system is primarily based totally on agriculture. The backbones for meals manufacturing are farmers. Traditionally farming is carried out through individual with the assist of bullock carts, tractors and tillers etc. In present day era, the primary trouble in agricultural area consists of loss of exertions availability, loss of understanding concerning soil testing, growth in exertions wages, wastage of seeds and extra wastage in water. To conquer a lot of these dangers the robotic for agriculture has been developed.

The proposed project can be controlled from any corner of the world using voice commands by farmers. The proposed project can recognize the command the farmer gives and can start performing that particular operation in the field. Performs the seeding process in the agricultural field [1]. The main idea

behind this development is to perform agricultural tasks without human intervention and to implement a prototype of an effective low cost agribot. The proposed project is to help farmers produce high quality yields to meet the rising demand of food with the increased population, by making use of wireless sensors, UAVs, cloud computing, and communication technologies [4]. The project is solar powered hence it is clean, green and ecofriendly. [7]

Solar panels are used to charge the robot. the ultrasonic sensors detect the hurdles and also helps in digging of holes for sowing seeds at a predefined distance. The system being autonomous reduces the burden on farmers.

Fig 1. Agriculture Robot

II. LITERATURE REVIEW

Before starting with the project, a brief literature review was done regarding the solutions available in the market. Additionally, the number of research papers by different research scholars are also studied to arrive at the scope of the project.

In study [1], The objective of this project is to develop a system capable of autonomously performing the seeding process in agricultural fields. The primary aim is to achieve agricultural tasks without the need for human intervention, resulting in the creation of an efficient and cost-effective agribot prototype. The agriculture-bot is equipped with a range of sensors, including soil moisture sensors, temperature sensors, and humidity sensors. These sensors gather data from the farm, which is subsequently analyzed to assess the crop's growth rate and determine the optimal timing for irrigation and fertilization. To facilitate wireless communication, the project utilizes Arduino and Bluetooth technology.

In study [5], intelligent robotic system that assists in agricultural crop management. The system consists of a robot equipped with a camera that captures images of the crops. The images are then processed using image processing techniques to extract features such as leaf area, leaf count, and leaf color. The extracted features are then used to analyze the crop's health and growth status. The system is designed to be intelligent and adaptive, meaning that it can learn and improve its performance over time. The system can be trained to recognize different crop types and adjust its analysis and irrigation strategies accordingly.

In study [7], proposes a solution to improve the efficiency of solar-powered agricultural robots. high demands. The agriculture-bot is also equipped with an automatic sun tracking system that enables it to track the sun's movement and adjust its solar panel's position accordingly. This ensures that the robot's solar panels receive maximum sunlight, increasing the robot's efficiency and reducing the need for manual repositioning. The paper proposes a microcontroller- based control system for the agriculture-robot. The control system processes the data collected by the sensors and controls the robot's movements and actions. The control system also monitors the battery level and automatically switches to a power-saving mode when the battery is low.

In study [9], - Our proposed solution aims to automate the process of sowing and irrigating crops by introducing a specialized machine. This machine, known as the AGROBOT, has been designed and implemented to carry out both sowing seeds and irrigating crops in a single operation. Equipped with a seed hopper, a seed metering mechanism, and an irrigation system, the AGROBOT is a mobile machine that offers convenience and efficiency. It can be operated remotely, either manually or through a dedicated mobile application. The machine's control system plays a crucial role, allowing for adjustments in the amount of water and seeds dispensed based on factors such as the crop's growth rate and soil conditions.

III. METHODOLOGY

Prior to commencing the actual fabrication of the project, it is crucial to conduct a material survey in order to carefully select the suitable materials for the entire undertaking. The subsequent step involves devising a well- structured plan for the project, ensuring that it can be executed in stages. Based on the project's concept and requirements, the following materials are necessary for its successful completion.

Choosing the optimum drive system: A proper drive system is needed for transmitting the power from motors to the spinning disc. Thus it is necessary to select the drive system in such a way that it is most efficient to with minimum maintenance. Also the selected drive system for the machine should have a proper transfer of energy and have least maintenance.

Hopper Fabrication: The hopper is used for storing the seeds to be sowed. The hopper is proposed to be made using 1.6 mm sheet metal using welding and cutting.

Chassis Fabrication: With the selected frame the next step is fabrication of the chassis. The chassis should be so fabricated that is is light weight , withstand all the forces and should have sufficient space for mounting all the components. The chassis also should sustain the forces which are induced as a result of tilling mechanism as tilling attachment is a part of chassis and is fabricated during the chassis fabrication itself.

The Spraying systemme development: In this phase the spraying system of the project is developed. The spraying system is responsible for performing the spraying operation in the farm once the farmer commands the spraying operation from Robo assistant.

The cutting attachment: The cutting attachment is responsible for cutting. Once the command for cutting is received the same will be performed by the Agrobot across the field.

The Voice control system: In this phase the voice and speech recognition system is developed which is linked to the Agrobot over internet. This involves development of voice recognition application to connect the machine to the internet. The farmers can give voice commands to the machine using speech recognition system developed which can detect the control commands and send it to the cloud server to operate the robot in the field using Internet of things.

Constant pitch seed sowing mechanism: In this phase the constant pitch seed sowing mechanism is fabricated. This mechanism is responsible for dropping the seeds exactly at one feet as the machine is operated across the farm.

Development of spraying and cutting system height adjustment: In this phase the spraying and cutting system height adjustment is devised. This phase consists of development of lead screw based motorized mechanism which can be used to vary the height of the spraying system to spray at different heights. The Lead screw based mechanism is also implemented to the cutting system which can be used to vary the height of the cutting

The Internet Control system: The voice commands given by farmers using are sent to internet. In this phase the internet control system is developed to make the machine solar powered and automated.

Assembly: The components fabricated in the above phases are assembled to form a complete machine in this phase

Testing: The testing is carried out in this phase and optimizations if any are done.

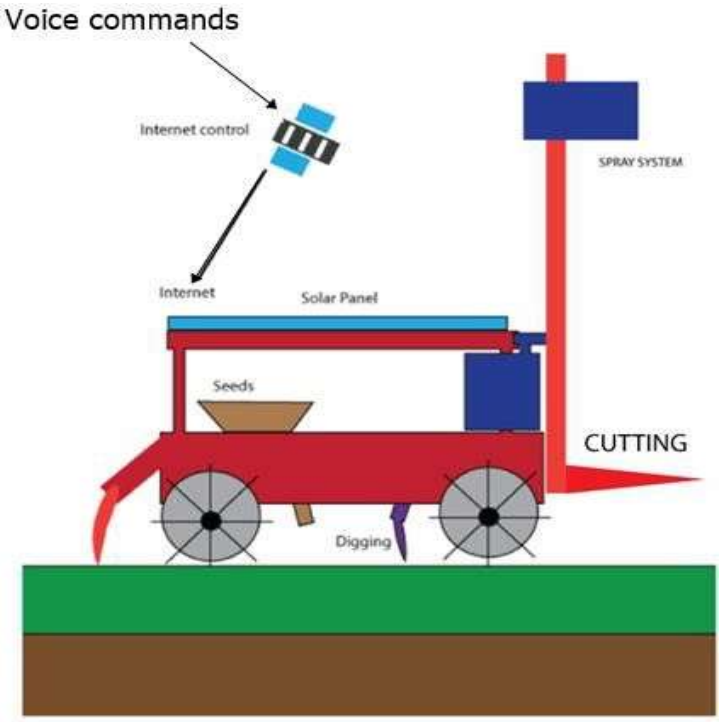

Fig 2. Expected model

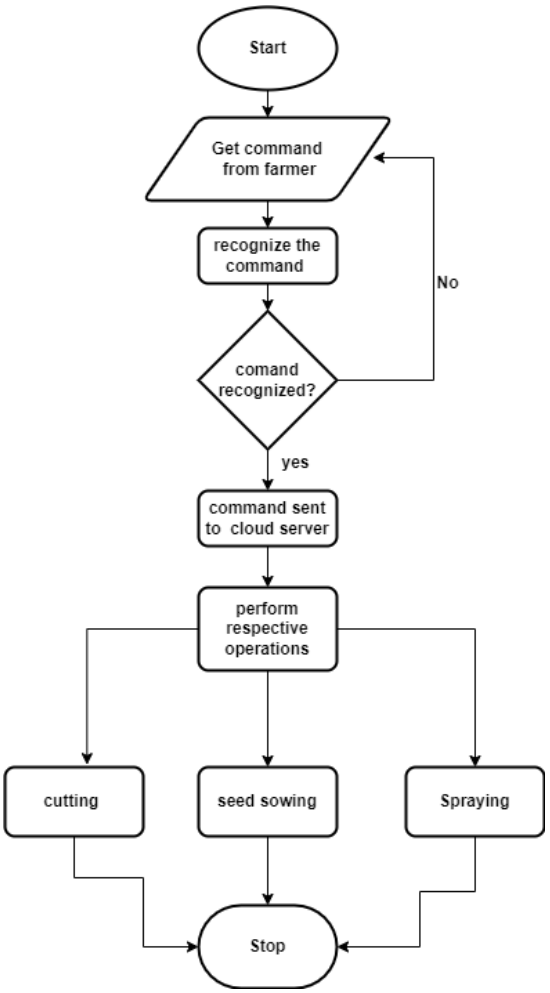

Fig 3. Block diagram of Agriculture Robot

The illustrative diagram below shows the working principle of the project. As shown in the illustrative diagram, the system consists of voice-controlled agriculture Robot. The Robot will reside in the farm waiting for farmers commands. When the farmer gives voice commands using the device which is present with the farmers, the system starts working. The farmer's voice is detected and speech recognition system finds out which particular command farmer has given. The command is recognized and sent to the cloud server which will then command the machine to perform those operations. The machine is also totally autonomous and does not require any manual intervention. The solar energy provides all the energy to the machine to operate. The farmer can sit in home and control all the agricultural operations in the field using voice commands over IOT.

IV. HARDWARE AND SOFTWARE

Drive train:

The seed sowing robotic vehicle's drive train comprises a prime mover and reduction gear boxes. The drivetrain is responsible for transmitting power to the vehicle's driving wheels, enabling it to navigate through the field. It should be noted that the engine or motor that generates the power is not included in the drivetrain. In contrast, the powertrain encompasses both the engine or motor and the drivetrain. The primary function of the drivetrain is to connect the power- producing motor to the power-consuming driving wheels. This connection involves physically linking the two

components, which may be positioned at opposite ends of the vehicle, necessitating a long propeller shaft or drive shaft. It's important to consider that the engine's operating speed and the wheels' rotational speed differ, requiring the correct gear ratio to ensure proper matching. As the vehicle's speed changes, maintaining an approximately constant engine speed is crucial for efficient operation. Therefore, the gearbox ratio must be adjusted accordingly, either manually, automatically, or through automatic continuous variation.

Fig 4. Drive Train

Solar Panel: Solar panels are devices that convert light into electricity. They are called "solar" panels because most of the time, the most powerful source of light available is the Sun. Some scientists call them photovoltaics which means, basically, "light-electricity." A solar panel is a collection of solar cells. Lots of small solar cells spread over a large area can work together to provide enough power to be useful. The more light that hits a cell, the more electricity it produces, so the machine is usually designed with solar panels that can always be pointed at the Sun even as the rest of the body of the machine moves around.

Fig 5. Solar Panel

Servo Motor: In this project, the servo motor is employed to regulate the angle of the hopper.

Fig 6. Servo Motor

1-inch square ERW pipes: The chosen pipes for fabricating the frame are Electric Resistance Welded (ERW) pipes. ERW pipe manufacturing involves rolling metal and welding it along its length. These pipes offer both durability in challenging machine conditions and cost-effectiveness. To construct the frame, ERW steel pipes with a square cross section measuring 1 inch were selected.

Fig 7. Square ERW Pipe

Hopper material:

The following options were available for the hopper material Plastic:

The hopper can be made in plastic. The hopper made in plastic is not only durable but also light weight as well as economical. However, making the hopper in plastic requires costly molding equipment and thus not economical for the project purpose.

Sheet metal:

The sheet metal forms perfect choice for hopper material as it is not only locally available but also the hopper can be easily fabricated using the sheet metal. The hopper is fabricated using 1.6 mm sheet metal as it permits welding easily.

Fig 8. Hopper Material

Water Pump: To facilitate the spraying process, a water pump was utilized. Here are the specifications of the water pump.

Fig 9. Water Pump

Arduino IDE: The project is centered around a range of microcontroller board designs that are primarily manufactured by Smart Projects in Italy, as well as other vendors. These boards utilize either 8-bit Atmel AVR microcontrollers or 32-bit Atmel ARM processors. They offer a collection of digital and analog input/output pins, allowing for easy interfacing with various extension boards and circuits. Some models feature serial communication interfaces, including USB, enabling the loading of programs from personal computers.

V. RESULT AND DISCUSSION

Before commencing the actual fabrication of the project, it is essential to conduct a material survey to select the suitable materials for the entire undertaking. The subsequent step involves devising a comprehensive plan for the project, enabling its execution in stages. Considering the project's concept, the following materials are required for its successful completion. Agriculture forms the foundation of the Indian economy, with farmers serving as the backbone of food production. Traditionally, farming has relied on human labor aided by bullock carts, tractors, and tillers. However, in the modern era, the agricultural sector faces several challenges, including a scarcity of labor, inadequate knowledge about soil testing, escalating labor costs, seed wastage, and excessive water usage. To overcome these drawbacks, an agricultural robot has been developed for the proposed project. This robot can be controlled remotely using voice commands from any location worldwide, facilitating seamless interaction with farmers. It possesses the ability to comprehend the commands given by the farmer and execute the corresponding operations in the field. Moreover, the project utilizes solar power, making it environmentally friendly, clean, and sustainable. The autonomous nature of the system alleviates the burden on farmers.

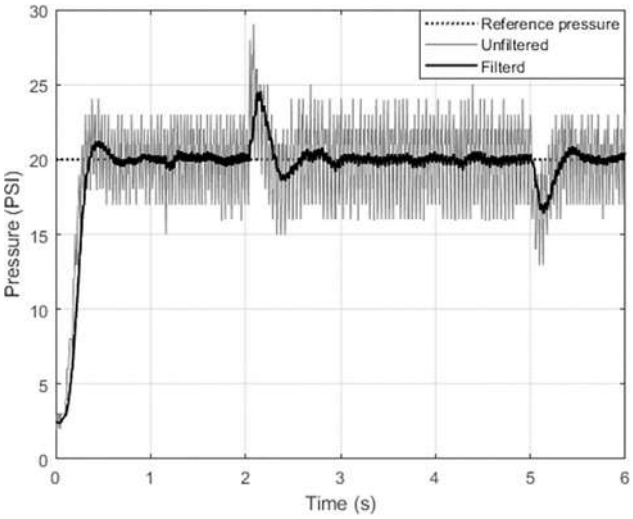

Fig 10: Graphical representation of sprayer

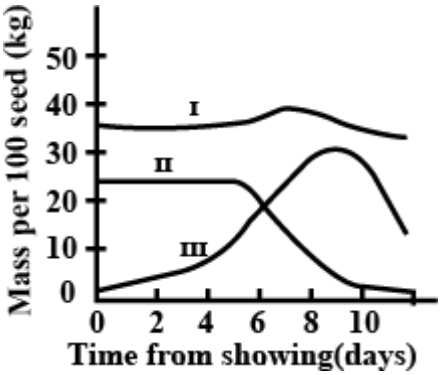

Fig 11: Graphical Representation of cutting

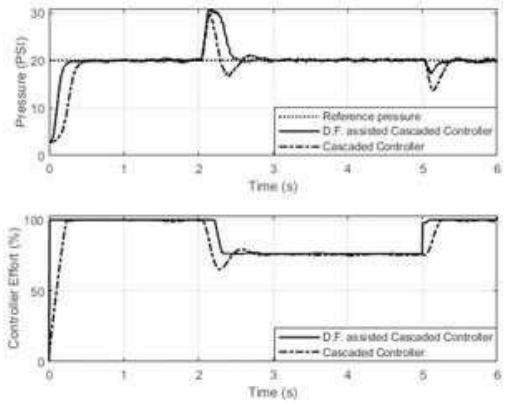

Fig 12: Graphical representation of seed sowing

VI. CONCLUSION

The proposed project introduces an innovative concept: an IoT voice-controlled agricultural robot. This autonomous robot operates on solar power and can be controlled remotely via IoT using a speech recognition system. The primary objective is to provide farmers with a versatile autonomous robot capable of performing various daily agricultural tasks.

VII. FUTURE SCOPE

Robots are poised to replace human labor in various aspects, leading to increased efficiency in the agricultural sector compared to the present time. These advancements will seamlessly integrate with the utilization of big data in smart farming. Additionally, the combination of satellite imaging, unmanned aerial vehicles (UAVs), and ground robots will enable more comprehensive and diverse data collection, enhancing the overall effectiveness of agricultural operations.

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