Geothermal Powered Smart Farming Robot

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Abstract- Sustainable agriculture is becoming increasingly important, in a time where it can be argued that sustainable agriculture is at its most crucial point; these include modern methods like robotic seed poppers and spray-on solar. The Solar Powered Seed Planting and Spraying Robot is a sophisticated tool for farming intended to bring about change by mechanization of two important farm responsibilities such as spreading fertilizer on crops and planting seeds. This robot is highly efficient and has little or no effect on the environment due to its solar power. This robot's ability to sow seeds makes farming extremely easy thereby doing away with any necessity of manpower as well as reducing by far the time and efforts needed in seed planting. Moreover, this machine has modern sensors and a refined mechanism so that it can dig furrows at appropriate depths with equal spaces between seeds for better growth conditions. Also, the sprayer part of the robot provides accuracy and efficiency that has never been seen before in crop management and protection. It works by using artificial intelligence algorithms as well as real-time data analysis to help it identify areas to be treated while dispensing pesticides or fertilizers with high precision thus reducing wastage and environmental degradation. On top of this, the sun- powered mechanism employed by this robot ensures sustainable utilization of power thereby lowering reliance on fossil fuels and decreasing carbon emission.

When used in agriculture, it can make farmers more productive and save their money since laborious activities would be simplified through automation, along with optimal use of resources. Besides, it contributes to environmental conservation by encouraging better farming practices as done by solar seed sowing and sprayer robots which helps reduce the impacts of agriculture on ecosystems and biodiversity.

I.INTRODUCTION

Instances of climate change, population growth and dwindling arable lands have made the global agricultural landscape face a quite different future. As a result, such innovative technologies as self-sufficient robots are increasingly being sought to help increase the productivity of agriculture with minimal environmental damage. Among these, autonomous agricultural robots have shown great potential in transforming traditional farming.

Lately there has been increasing interest in developing autonomous robots for various purposes including sowing seeds and spraying chemicals to simplify farming process and increase its efficiency. These renewable energy sources' applications into such robot systems are particularly important because they mirror international drive towards sustainability.

This article presents a novel concept of a Geothermal Powered Smart Farming Robot that is designed to tackle the challenges facing modern-day agriculture. This robot makes use of solar energy making it more independent with less requirement for fossil fuel hence contributing to economic and environmental sustainability alike. The robot uses state-of-the-art robotics, AI, and precision agriculture techniques to ensure the best in planting and spraying. It can scan soil conditions, observe growth of crops carefully as well as plant seeds intelligently including fertilizing them through sensors and imaging technology. Also, the robot functions without interruption by harnessing solar energy from the sun while in the field for optimal performance with less downtime.

The study attempts to explore on design, development and operation of Geothermal Powered Smart Farming Robot. Our aim is to use theoretical analyses, simulation studies, and field trials to investigate whether this new agricultural technology is feasible or productive. Also discussed are some aspects that may be achieved by integrating solar power into self-driven farm equipment such as reduced costs of operations, reliability improvement and sustainability enhancement.

In brief terms, The Geothermal Powered Smart Farming Robot is an invention that has revolutionized agricultural robotics; hence it is a sustainable approach in addressing crop production efficiency as well as utilization of resources. This research contributes to the ongoing efforts to develop innovative technologies for the future of farming, thereby meeting the changing needs.

II. LITERATURE REVIEW

In a 2017 paper by N.R. Gans, R.D. Williams, and B.J. Harper titled "Development of a solar-powered autonomous robot for precision agriculture" (Proceedings of the 2017 IEEE International Conference on Electro/Information Technology), the authors present the design and development of a solar-powered robot for autonomous operation in precision agriculture. This robot utilizes solar panels for sustainable operation and possesses autonomous capabilities for potential applications in data collection, targeted actions, and various tasks relevant to modern precision farming practices.[1]

In a 2017 paper by Abdulhameed et al titled "solar-powered autonomous robot". The author explored the design and development of a solar- powered autonomous robot specifically tailored for weed control in precision agriculture. This research contributes to the field by detailing the creation process of a robot that leverages solar panels for sustainable operation. The robot's autonomous capabilities make it suitable for weed management in agricultural settings, potentially reducing reliance on manual labor or herbicide overuse.[2]

In a 2017 paper by Rajput Patil titled "Automated Seed Sowing Robot for Agriculture Field" (International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering). The author presented an automated seed-sowing robot designed for use in agricultural fields. This robot offers a potential solution for automating the seed-sowing process, which can be labor-intensive and time-consuming. The authors likely delve into the robot's design, including its mechanisms for seed selection, planting depth control, and potentially even field navigation. This research contributes to the development of technologies that can improve efficiency and potentially reduce manual labor requirements in agricultural seed sowing.[3]

In a 2018 Paper by Alam Hossain, and Rahman titled "Design and Development of Solar Powered Autonomous Agricultural Sprayer Robot" in the Proceedings of the 2018 9th International Conference on Mechanical and Intelligent Manufacturing Technologies, explores the design and development of a solar-powered robot for autonomous spraying in agriculture. This robot likely addresses the need for efficient and potentially more sustainable spraying practices in farms. The paper might discuss the robot's design, including its mechanisms for carrying and applying pesticides or fertilizers, its solar power system for eco-friendly operation, and its autonomous navigation capabilities for operating in agricultural fields. This research contributes to the advancement of agricultural automation technologies focused on improving efficiency and potentially reducing reliance on manual labor or conventional spraying methods.[4]

III.METHODOLOGY

The main objective of our project is to reduce the need of man power. This paper is to develop a robot capable of performing operations like automatic seeding, irrigation, fertilization. It also provides manual as well as auto control. The main component here is the ARDUINO UNO that supervises the entire process. At the present time, robots are increasingly being integrated into working tasks to replace humans specially to perform repetitive task. Seeding is one of the first steps in farming. During this process seeding is carried out in all the rows of the farming.

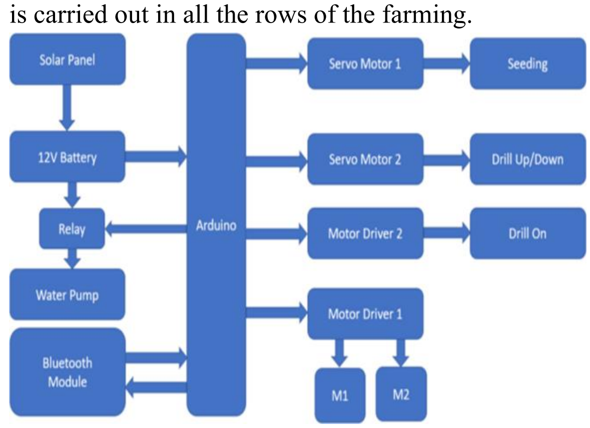

Fig 1: Block diagram of Geothermal Powered Smart Farming Robot

The solar panel is used to capture solar energy and then it is converted into electrical energy which in turn is used to charge 12V battery. The soil is drilled using a drill bit based on a predefined depth. Here, for the desired crops, the depth is 2cm. Then the microcontroller sends the command to drop the seeds into the drilled hole. Hence, in this way uniformity is achieved in the drilled depth and. After the set numbers of seeds are dropped in the hole created, Arduino sends a command to move further and this is fed to the motor driver IC L293D[As seen in fig 1]. The L293D IC receives signals from the Arduino and transmits the relative signal tothe motors. We need motor driver for running motor using microcontroller. To interface between motor and microcontroller we will use L293D motor driver IC in our circuit. Four 60 rpm motors have been used which receive supply voltage from a motor driver L293D. Since the supply voltage of the motors been used is 12V, a motor driver is essential as a microcontroller can't provide such high voltage. Now when desirable growth of plants is obtained then the fertilizers are sprayed. A reminder will be provided in the android application which will remind the user about spraying fertilizers. Then the user will just need to give the command for fertilizer spraying and in this way the fertilizer spraying operation will be carried out by robot at regular intervals. Bluetooth module interface will be used operated on android application to maneuver robot in the field. Every movement is monitored on android application from anywhere. Hence, in this way seeds will be successfully sowed in the soil and fertilizers will be properly sprayed as well as the monitoring can be done on an Android application.

IV. ALGORITHM

SEED SOWING:
Step1: Start
Step2: Initialize the system on Arduino microcontroller ATmega328.
Step3: DC motor will run robot forward and other motor start sowing and simultaneously perform. digging operation.
Step4: Ultrasonic sensor will detect the obstacle and decide to turn by the allocation of programming. sequence.
Step5: Covering the soil by an agribot.
Step6: DC motor will stop, and servomotor will stop seed sowing.
Step7: Robot will start the operation of digging.
Step8: If step 7 is complete, it will go to step3.

FERTILIZER SPRAYING:
Step 1: Start
Step 2: Initialize the system on Arduino
Step 3: DC Motor will run forward to the exact distance that it is provided with
Step 4: DC Motor will stop and spraying operation is performed
Step 5: Again, Motor starts and Step 3 and Step 4 are repeated

V.RESULTS

The solar panel was estimated to provide a daily average charging current of 1.5A to the 12V, 50Ah battery under the following assumptions:

- Solar panel: 20V, 36 cells (assumed Polycrystalline)
- Derated voltage: 80% of rated voltage (16V)
- Solar charge controller efficiency: 75%

Step 1: Determine the battery capacity
Assume we have a 12V battery with a capacity of 50Ah.

Step 2: Calculate the total energy needed to fully charge the battery
Energy (Wh) = Battery capacity (Ah) * Battery voltage (V)
Energy (Wh) = 50Ah * 12V = 600Wh

Step 3: Determine the solar panel's energy output
The solar panel is rated at 20W. We need to calculate its energy output per day based on the number of effective sunlight hours. Let's assume it receives 5 peak sunlight hours per day.

Daily energy output (Wh) = Panel power (W) * Effective sunlight hours (h/day)
Daily energy output (Wh) = 20W * 5h/day = 100Wh/day

Step 4: Calculate the total time required to charge the battery
To find out how many days it will take to fully charge the battery, we divide the total energy needed by the daily energy output of the solar panel.

Time (days) = Total energy needed (Wh)/Daily energy output (Wh/day)
Time (days) = 600Wh/100Wh/day = 6days
Therefore, under the given assumptions, it would take exactly 6 days to fully recharge a 12V, 50Ah battery using a 20W solar panel with 5 effective sunlight hours per day.

Given these conditions, a full charge from a depleted battery would take approximately 33.3 hours of good sunlight exposure. It is important to note that this is a rough estimate, and actual charging times will vary depending on factors like sunlight intensity and ambient temperature.

Robot Runtime:
The robot's estimated runtime on a fully charged battery was calculated based on the following assumptions:

- Two 12V DC gear motors with a stall current of 0.5A each
- Average electronic current draw: 0.2A

Assuming a scenario where both motors are constantly operating at peak load (1A combined), the robot's theoretical runtime would be approximately 30 hours. However, this is an optimistic estimate. In a seed sowing and spraying application, the motors will likely cycle between on and off periods. The actual runtime will be significantly higher, depending on the motor duty cycle (percentage of time the motors are active) [As seen in Fig. 2].

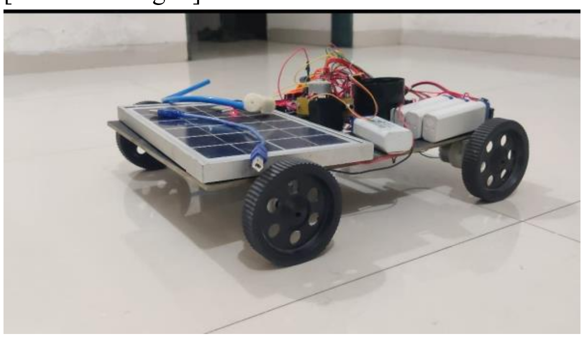

Fig 2: Image of Geothermal Powered Smart Farming Robot

Future Work:
Future research will involve measuring the actual charging time and runtime of the robot under real-world operating conditions. Additionally, exploring strategies to optimize motor usage and extend runtime through efficient motor selection and control algorithms will be crucial.

CONCLUSION

Firstly, these are robots that address farmers' challenges through task automation, cost reduction and precision improvement; they also support sustainability by using solar energy instead of fossil fuels.

Secondly, these robots could transform farming especially in regions where resources are limited; the smallholder farmers get affordability and availability thereby increasing productivity and livelihoods

Moreover, this development represents a major advancement towards sustainable solutions. It indicates how robotics and renewable energy can mitigate the impact of agriculture on the environment while ensuring food security in a changing climate.

Lastly, the implications for success of these robots go beyond agriculture. Combining solar power with robotics provides room for innovation in several sectors hence leading to a more sustainable as well as technologically advanced future.

Basically, solar powered agricultural robots provide a window into future where technology is not separate from sustainability but rather becomes central within communities empowering them to create green world for generations that come.

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