Design and Implementation of Multi Seeding Agricultural Robot

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***Abstract*— A Multitasking robot for the field of Agriculture has been studied in this research. Now a day, precision agriculture by agricultural robots is the newly emerging technology in agriculture sector to save the time and energy that is wasted in repetitive farming tasks automation in farming processes is quite helpful. To design these sorts of robots there should be certain considerations and particular approach considering the agriculture environment in which it will be working. The working of an autonomous robot is based on field parameters i.e. length and width. Prototype of an agricultural robot "Agro-Bot" is modeled for multitasking such as seeding, ploughing and harvesting with a separate irrigation system and also soil moisture measuring using sensors and that data is transmitted to our smart mobile with solar power. It is a four wheeled vehicle which is controlled by nodemcu esp-8266 microcontroller (Arduino) as master controller, it is powered with battery so It will also help in decreasing the use of nonrenewable sources of energy and will not pollute the environment. Other accessories are slaves performing specific operations. The approach is now to develop smarter machines that are intelligent enough to work in an unmodified or semi natural environment.**

Keywords*— *Ploughing, seed dropping, survilance, IoT, Robot, Microcontroller

I. INTRODUCTION

Agriculture is important sector in Indian economy. The backbones for food production are farmers. Traditionally farming is done by humans with the help of bullock carts, tractors and tillers etc. In modern era main problem in agricultural field includes lack of labour availability, increase in labour wages, wastage of seeds and more wastage in water. To overcome all these disadvantages the robot for agriculture has been developed.

The main aim of agricultural robot is applying robotic technology in agricultural field. In recent years there are many agricultural robots which can perform only single tasks.We are improving robot by designing an agricultural robot for ploughing, seeding and water sprinkling operations. The agriculture robot efficiently performs ploughing, seeding and water sprinkling automatically.

Robot is a mechanical device which is capable of performing various tasks without human intervention. The robot works based on command given by the controller.Controlling of the robot mainly require some means of communication.One of the communication is the wireless Bluetooth connectivity.

The Bluetooth application is user friendly and data exchanging between robot and smartphones is done systematically. This whole system works on battery charged with help of solar panel

II. BLOCK DIAGRAM

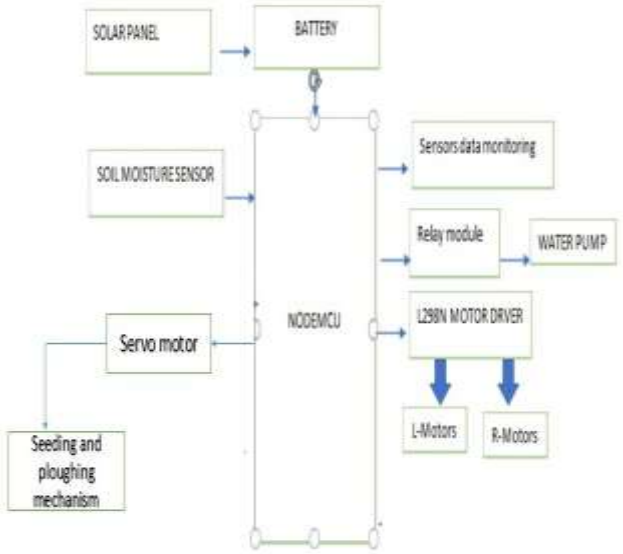

Fig1.Block diagram of Mutli seeding agricultural robot

III. LITERATURE REVIEW

The development of agricultural robots, or Agribots, signifies a significant advancement in farming technology, aimed at reducing the intensive human labor traditionally required in agriculture. These robots, leveraging advanced technology, are poised to revolutionize the sector by enhancing efficiency, productivity, and return on investment. According to Abhay R. Kasetwar and Darshan Moundekar in their 2020 study, Agribots offer numerous advantages over human labor. Unlike humans, robots do not get sick or tired, and they do not require breaks. This capability for continuous operation leads to substantial increases in productivity and efficiency on farms.

Additionally, the integration of robotics in agriculture presents a substantial opportunity to replace human labor with highly effective automated solutions, ensuring consistent performance and reliability.

In a related development, the creation of solar-powered multifunctional agricultural robots marks a notable advancement in agricultural automation technology. As outlined by Mr. Amol A. Suryawanshi and Varsha A. in their 2019 research, the primary aim of this technology is to address the challenges posed by a decreasing labor force while streamlining essential farming processes such as digging, seed sowing, and land covering. By automating these tasks, it is possible to reduce human effort by up to 90%, resulting in considerable savings in time and labor.

The robotics industry presents compelling opportunities for investment in agricultural automation. The implementation of Agribots not only boosts operational efficiency but also offers a high return on investment by minimizing labor costs and maximizing output. As technology continues to evolve, the potential for even more sophisticated and versatile agricultural robots will grow, further enhancing the agricultural landscape. The integration of agricultural robots represents a pivotal step towards the future of farming. By leveraging the benefits of continuous operation, high efficiency, and reduced labor dependency, Agribots are set to transform agricultural practices. The ongoing advancements in solar-powered and multifunctional agricultural robots underscore the immense potential and promising future of agricultural automation technology.

IV. METHODOLOGY

This section details the methodological procedures, circuit diagrams, and block diagrams used in the development of the agricultural robot. The robot's design integrates both hardware techniques and software tools to create a functional and efficient system for agricultural tasks.

Hardware Development

A. Chassis and Mobility:

The robot's chassis is constructed using iron square pipes, providing a robust and durable framework. The chassis is equipped with four wheels, each driven by DC motors, ensuring mobility and stability across various terrains. The placement and drive mechanism of the wheels are crucial for the robot's maneuverability in the field.

B. Ploughing Mechanism:

Mounted at the front of the chassis is the ploughing mechanism, which is designed to prepare the soil for planting. This mechanism includes components that dig into the soil, turning it over to create a suitable bed for seeds.

C. Seed Cultivation System:

In the center of the chassis, a seed cultivation arrangement is assembled. This system is responsible for dispensing seeds into the ploughed soil. The precise placement of seeds is critical for optimal plant growth and uniform crop distribution.

D. Water Spraying Feature:

Additionally, a water spraying feature is integrated into the robot. This system ensures that the planted seeds receive adequate water, promoting germination and growth. The water spraying mechanism is designed to cover a wide area efficiently, reducing the need for manual irrigation.

E. Power Supply:

The robot is powered by a 12V battery, which is recharged using a solar panel. This sustainable energy solution ensures that the robot can operate for extended periods without requiring frequent battery replacements or external power sources.

Software and Control

F. Master Controller:

The Arduino Uno microcontroller serves as the master controller of the robot. It is the central unit that coordinates all operations, including movement, ploughing, seed dispensing, and water spraying. The microcontroller is programmed to execute predefined tasks based on the inputs received from various sensors and control commands.

G. Wifi Connectivity:

All operations of the robot are controlled through Wifi connectivity. This wireless communication system allows for remote control and monitoring of the robot's activities. Operators can send commands and receive feedback, enabling precise and efficient management of the robot's functions in real-time.

V. RESULT AND DISCUSSION

Fig 2. Multi seeding agricultural robot

Multipurpose Agricultural Robot with Integrated Seeding, Watering, and Surveillance

The Multipurpose Agricultural Robot represents a groundbreaking innovation in agricultural technology by integrating essential farming functions into a single automated system. This advanced robot, equipped with a multi-seed dropping mechanism, an auto-rechargeable battery with solar panels, ploughing and watering

capabilities, and a CCTV camera for online surveillance, is poised to revolutionize modern farming practices. Additionally, its ability to test soil moisture and release water accordingly enhances its utility.

By automating the seeding and watering processes, the robot significantly reduces the time and labor required for planting crops. This increased efficiency allows farmers to manage larger fields more effectively, optimizing resource use and boosting productivity. The robot's capability to plant seeds at precise depths and intervals ensures uniform crop growth, leading to higher yields. The targeted irrigation system also conserves water, making the farming process more sustainable and eco-friendly.

Fig 3. Multi seeding agricultural robot front view

The integrated camera and mobile control system provide farmers with real-time data on field conditions. This enables early detection of issues and swift corrective actions, minimizing crop loss and enhancing overall crop health. By automating labor-intensive tasks, the robot reduces the need for manual labor, which is particularly beneficial in regions facing labor shortages or where labor costs are high, resulting in significant cost savings and increased operational efficiency.

The robot's efficient use of resources contributes to sustainable farming practices. By conserving water and ensuring the precise application of seeds and nutrients, it supports environmental conservation and reduces waste. By increasing crop yields and reducing losses, the robot enhances food security, ensuring a reliable and abundant food supply crucial for meeting the demands of a growing global population. The reduction in labor costs, combined with increased efficiency and productivity, translates into substantial economic benefits for farmers, leading to lower production costs and higher profit margins.

The integration of advanced technologies, such as real-time monitoring, automated water pumping, and mobile control systems, signifies a significant leap forward in agricultural innovation. This paves the way for further technological advancements in the sector. By enabling more efficient and resilient farming practices, the robot helps farmers adapt to the challenges posed by climate change, supporting the adoption of practices that are less dependent on unpredictable weather patterns and more resilient to climate variability.

As technology plays an increasingly vital role in agriculture, innovations like this crop seeding robot will be crucial in ensuring that we can sustainably and efficiently meet the food demands of a growing global population. This multipurpose agricultural robot exemplifies the potential of technology to transform traditional farming practices, leading to a more sustainable, efficient, and prosperous agricultural sector.

VI. CONCLUSION

Agriculture serves as the primary source of income for the majority of people in India. Currently, the agricultural sector faces several significant challenges, including a lack of awareness regarding soil testing, a scarcity of labor, rising labor wages, and wastage of seeds. To address these issues, the "Smart Multipurpose Agricultural Robot" has been developed. This innovative robot is controlled through the Internet of Things (IoT) and is designed to measure soil parameters, sow seeds at the required depth with proper spacing, and spray pesticides precisely on plant leaves, avoiding wastage in free space.

The project was rigorously tested in the field, and the robot demonstrated its ability to move in all directions effectively. It continuously monitors soil parameters such as humidity and luminosity, and it can adjust sensors to monitor temperature and moisture content. These updates are transmitted to the Blynk App in real-time, allowing for continuous monitoring. Additionally, the user can control a camera wirelessly through IoT for live video streaming of the field, providing a comprehensive view of the agricultural environment.

The seed sowing unit of the robot allows the user to measure the volume of seeds in all bins and select the appropriate seed size for sowing. It is capable of sowing seeds to a desired depth of 4 cm for seeds with a diameter of less than 4 mm, with a spacing of 5 inches between seeds. For seeds with a diameter greater than 6 mm, it can sow to a depth of 5 cm with a spacing of 6 inches. The pesticide spraying unit is designed to spray pesticides directly on the plants, reaching a maximum height of 4 feet, thereby avoiding unnecessary spraying in free space.

Overall, the Smart Multipurpose Agricultural Robot offers a sophisticated and efficient solution to several pressing issues in the agricultural sector, utilizing advanced IoT technology to enhance productivity and precision in farming practices.

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