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Smart Agricultural Robotic System

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Abstract— **Agriculture has seen a transition in recent years, with the incorporation of new technologies to increase production and sustainability. The idea of a "Smart Agricultural Robot" that would transform conventional agricultural methods is presented in this abstract. This robotic device can carry out a variety of agricultural activities by utilizing cutting-edge technology, including IoT connectivity. It can perform autonomous weeding, data-driven decision-making, crop monitoring, and precision planting. This abstract examines the possible advantages, difficulties, and future possibilities of intelligent agricultural robots in meeting the changing demands of contemporary farming, such as increased crop yield prediction, lower labor costs, and better resource efficiency. A potential response to the needs of a world population that is expanding and the requirement for sustainable agriculture is the smart agricultural robot.**

I. Introduction

Agriculture is the backbone of our society, providing food, fiber, and raw materials for various industries. With the global population expected to reach 9.7 billion by 2050, the agriculture sector faces the challenge of producing more food with limited resources, including arable land and labor. Traditional farming methods are increasingly strained and often unsustainable in the face of climate change, resource constraints, and the need for higher yields to meet growing demand.

IoT Based Smart Agricultural Robots offer the potential to revolutionize farming practices by automating labor-intensive tasks, optimizing resource usage, and enhancing overall crop yield and quality. An automated, cutting-edge farming tool created to improve and streamline a range of agricultural operations is called a smart agricultural robot. These advanced robots can precisely and efficiently carry out duties like planting, harvesting, weeding, and crop monitoring since they are outfitted with sensors, and autonomous navigation skills. The ultimate goal of intelligent agricultural robots is to completely transform contemporary farming methods while increasing crop yields, saving labor expenses, and protecting the environment.

II. Literature Review.

In 2020 Said Smith et al. [1] concluded that Emphasizes the potential of data-driven decision-making in agriculture. Highlights the need for integrating diverse sensor data in precision agriculture. Precision agriculture has gained significant attention due to its potential to optimize resource utilization and increase crop yield. Robotic systems are crucial in implementing precision agriculture techniques by leveraging data analytics and sensor technologies.

In the year 2021, Qin et al. [2] conferred that Discussed the integration of robotics and automation to optimize greenhouse conditions. Highlights improved crop quality and resource utilization. Greenhouse agriculture has emerged as a sustainable solution to meet the increasing demand for high-quality produce. Robotics and automation technologies offer promising opportunities to enhance the efficiency and productivity of greenhouse operations.

In 2018, S. Sukkarieh [3] discussed the adoption of robotic systems in various agricultural processes and highlighted their role in enhancing productivity and profitability in farming operations.
Agriculture faces numerous challenges, including labor shortages and the need for increased productivity to meet global food demands. Robotics offers promising solutions to address these challenges by automating labor-intensive tasks and improving the precision of agricultural operations.

In the year 2022 S E. Brown, and M. Johnson [4] suggested the adoption of sustainable agricultural practices enabled by robotics, leading to reduced environmental harm and improved long-term soil health. By automating tasks such as precision spraying and weed management, robotics reduces the reliance on chemical inputs, thereby minimizing pollution and preserving ecosystem integrity. Additionally, robotics facilitates soil monitoring and management practices that promote soil health, contributing to long-term agricultural sustainability.

III. Objective

The goal of smart farming as a management concept is to give the agriculture sector the tools it needs to use cutting-edge technology for tracking, monitoring, automating, and analyzing processes. These tools include big data, the cloud, and the Internet of Things (IoT). Its three primary goals are to increase agricultural incomes and productivity sustainably, adapt to climate change and build resistance to it, and, when feasible, reduce or eliminate greenhouse gas emissions**.**

Smart Agriculture: Sensors that provide data to farmers for crop monitoring, crop optimization, and environmental factor adaptation are utilized in precision agriculture. Modification of DNA and Vertical farming, tissue culture, hydroponics, and aeroponics**.**

IV. Block Diagram

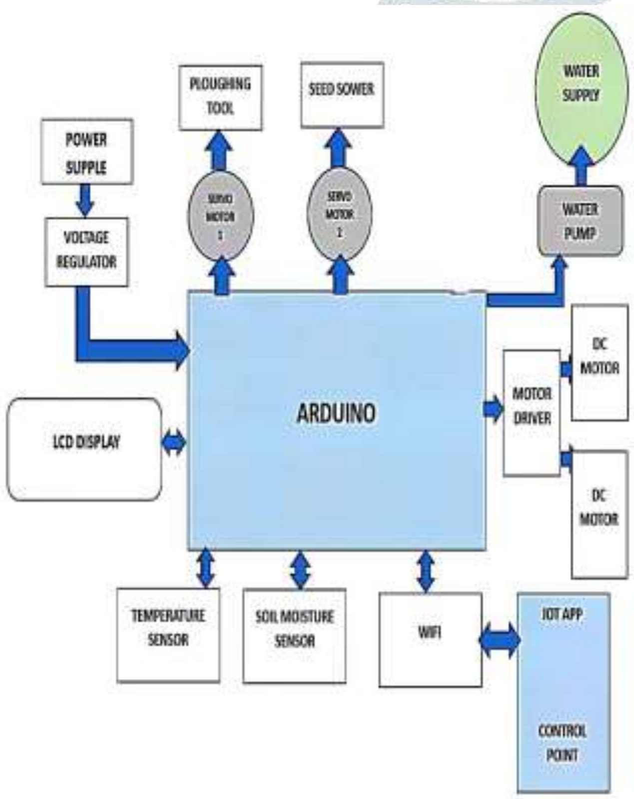


Figure 4.1: Block Diagram of Smart Agriculture Robot

V. METHODOLOGY

1. Ploughing:

   - Equipped with Ploughing implements such as plow blades or tillers. Autonomous navigation to predefined Ploughing areas. Depth control algorithms to regulate Ploughing depth.
   - The robot navigates to the designated Ploughing area. Create a straight, grained, structural, and moist sowing layer Remove horizontal clods from the soil Bring fresh nutrients to the surface while burying weeds and crop remains to decay.

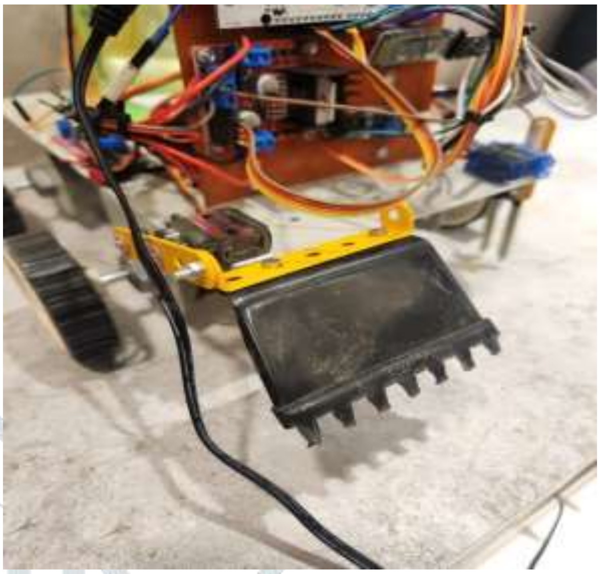


Figure 5.1: Ploughing

2. Seeding:

   - The robot carries seeds in storage containers. Real-time GPS for accurate seed placement. Soil analysis data to determine optimal seeding locations. Precision seed dispensing mechanisms.
   - It can take various forms, such as planting seeds for crop cultivation, initializing databases with initial data, encouraging precipitation through cloud seeding, sharing complete files in peer-to-peer networks, or intentionally distributing information to reach a broader audience

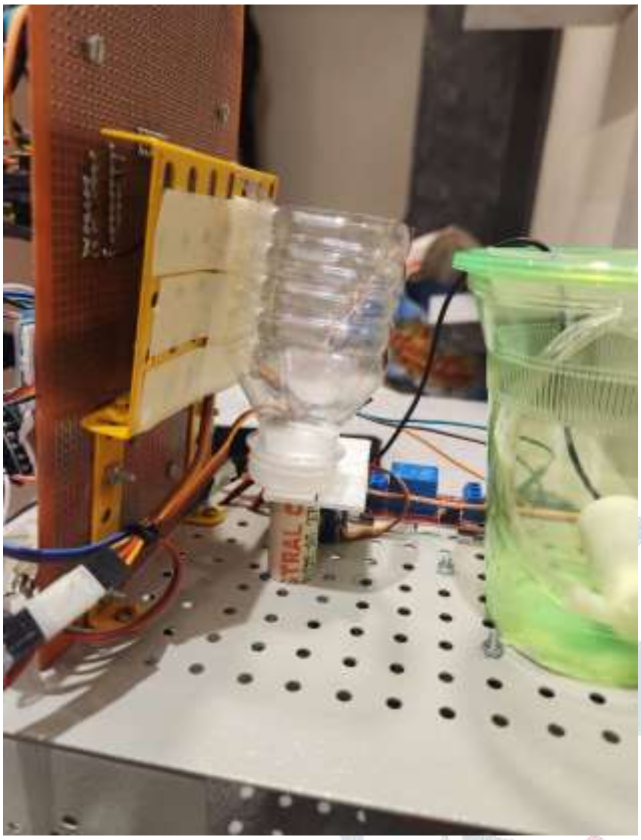


Figure 4.3:.Seed sowing

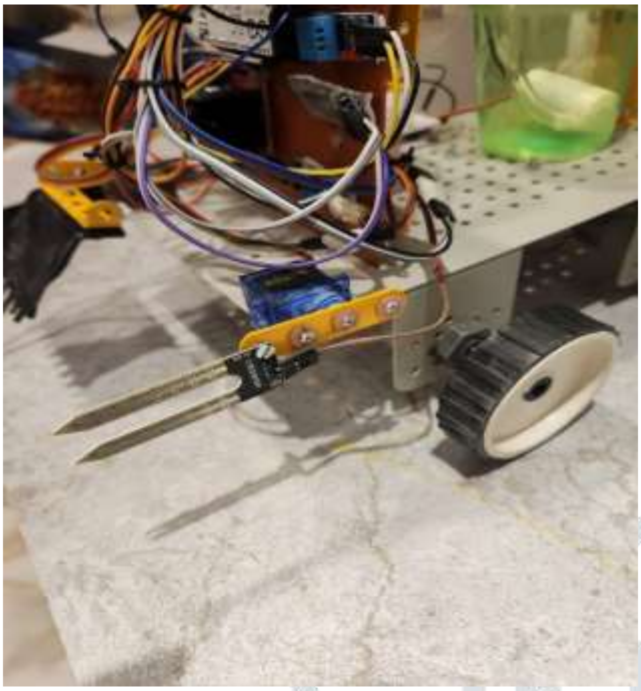
Figure 4.4: Watering

3. Watering:

- Water storage and pumping systems. Soil moisture sensors for data collection. Integration with weather forecasts for irrigation scheduling- Control algorithms to regulate water flow. Plant watering in smart agricultural robots is a vital component of modern precision agriculture, where technology plays a crucial role in optimizing crop growth and resource management.
- These robots are often equipped with advanced sensors and automation systems. Smart agricultural robots use various sensors, including soil moisture sensors and weather prediction systems, to continuously monitor environmental conditions.

4. Moisture Detection:

- Soil moisture sensors (e.g., capacitance or TDR sensors). Autonomous navigation for data collection. Data transmission to the central control system for analysis. Moisture detection in agricultural robotics is a critical component of precision agriculture, enabling the efficient management of water resources, optimized crop growth, and increased yields.
- Agricultural robots with moisture detection systems use various technologies to assess soil moisture levels and make data-driven decisions.



VI. Experimentations and Results

The sensors and hardware are successfully interfaced with the Arduino. Test results show that various field activities like Ploughing, sowing seeds, irrigation, and moisture detection are performed and controlled with the help of the Bluetooth HC-05 module. The Robotic System performed all the tasks with no errors. All the sensors and other components were tested and the desired results were found.

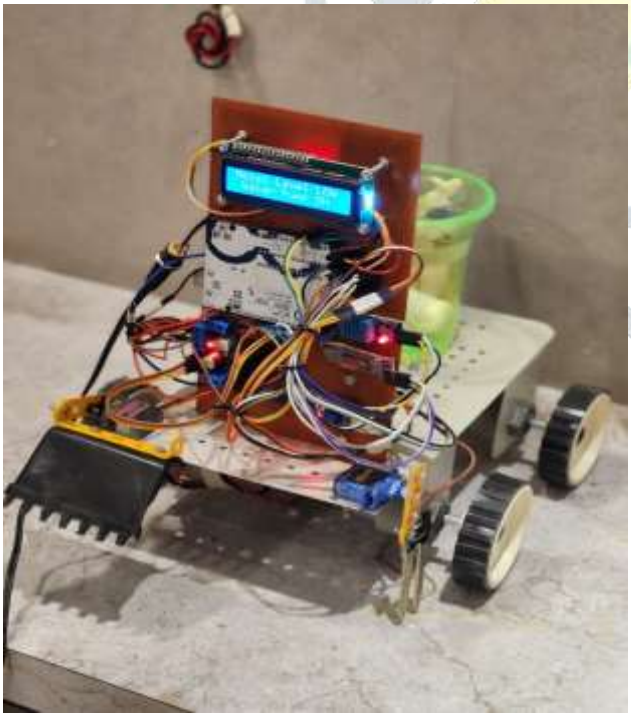


Figure 6.1: Results

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Conclusion

A special robot and monitoring system has been created to help farmers with their crops. It uses special devices like Arduino and Wi-fi to collect information about the temperature and moisture in the soil. This information helps farmers take better care of their plants and produce more food. The system also helps save water by only watering the plants when they need it. It can be used in different places like farms, parks, and golf courses. This system is cheaper and more efficient than other systems. Overall, it helps farmers grow more food and saves water at the same time.

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