



SEED SOWING AGRICULTURAL ROBOT

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ABSTRACT –

A technology that is easier for farmers to understand, apply, and use is needed in agriculture. Success in the agriculture sector greatly depends on having equipment that requires less time, labor, and money to implement. A seed sowing robot is a tool that helps farmers save time and money by aiding with the proper seed sowing position.

One of the primary functions of farming is the sowing of seeds. It takes a long time and a significant quantity of human labor. The goal of this project is to develop and build an intelligent seed-sowing robot for the specified purpose. One robotic arm is used by this clever seed-sowing robot to plant seeds directly from the seed container.

Keywords –seed-sowing,robot,labor

1.INTRODUCTION:

The majority of nations in this generation lack enough qualified labor, particularly in the agricultural sector, which hinders the development of developing nations. Reducing human labor is the primary goal of automation in our nation; mechanical, electrical, and electronic components are commonly used in all industrial enterprises.

Production processes are sped up and a great deal of laborious manual labor is saved via automation. Therefore, automation of the industry is needed to solve this issue. Seventy percent of Indians rely on agriculture. Since prehistoric man developed the first crop plant, seeds have been a vital agricultural product. The automated seed-sowing method in this approach decreases human labor.

Agricultural robots have become a disruptive influence in contemporary farming methods in recent years. Robots that sow seeds are one of the many uses for these technologies, and they are a major development in agricultural production since they increase productivity, accuracy, and sustainability.

Autonomous or semi-autonomous agricultural robots that plant seeds in fields at the ideal depths and spacing are known as seed sowing robots. These robots navigate and function with extreme precision because of the employment of cutting-edge technology including robotics, machine vision, and GPS. They lower the requirement for manual labor, boost planting accuracy, and raise total crop yields by automating the seed planting process.

Navigation Systems: -GPS and RTK-GPS: Accurate navigation is ensured by high-precision GPS systems, which also sow seeds at pre-selected sites. Machine Vision: Sensors and cameras identify impediments, evaluate the environment, and modify the robot's motions accordingly.

Seeding Mechanisms: -Seed Dispensers: Seeds are dispensed at precise intervals by use of mechanically operated mechanisms. Depth Control: To guarantee ideal growing conditions, sensors track and modify the planting depth.

Automation Software Algorithms: Sophisticated algorithms regulate the robot's movements, accounting for changes in the kind of soil, amount of moisture, and other surrounding conditions. Remote Monitoring: Using PCs or mobile devices, farmers can keep an eye on and manage the robot's actions in real time.

LITERATURE REVIEW:

One of the most significant developments in precision farming is the introduction of agricultural robotics, namely seed sowing robots. With the goal of increasing crop yields and sustainability, these robots incorporate cutting-edge technologies to increase planting operations' accuracy and efficiency. This study of the literature looks at the state of research and development for seed-sowing robots today, stressing significant discoveries, approaches, advantages, and difficulties.

The firsts Navigation and Positioning Systems - Study conducted by [Shamshiri et al. (2018)] highlights the use of RTK-GPS and GPS for high-precision navigation in agricultural robots (<https://www.sciencedirect.com/science/article/pii/S1537511017301796>). Precise path tracking and seed distribution are guaranteed by these devices, which are essential for precision farming. The technologies of machine vision, as examined by Perez-Ruiz and colleagues (2015) (<https://link.springer.com/article/10.1007/s11119-015-9395-1>), allowing a robot to traverse fields on their own while instantly identifying impediments and evaluating the state.

Seeding Mechanisms: Research conducted by [Wanget al. (2019)] in order to ensure consistent planting, (<https://www.sciencedirect.com/science/article/pii/S1537511018306288>) describes sophisticated seed dispensing technologies that precisely control seed release. [Johnson et al. (2020)] emphasize depth control systems (<https://ieeexplore.ieee.org/document/9223800>), who created sensors that improve seed germination rates by dynamically adjusting planting depth based on soil conditions.

Automation and Control: - Bechar and Vigneault (2016) (<https://www.sciencedirect.com/science/article/pii/S1537511015002037>) review the integration of complex algorithms. These algorithms control how the robot operates, adjusting to changes in the surrounding environment and streamlining the planting procedure. According to [Ozdogan et al. (2021)] (<https://www.tandfonline.com/doi/abs/10.1080/21693744.2021.1918403>), remote monitoring and control systems enable farmers to watch and modify the actions of the robots from a distance, improving operational flexibility and efficiency.

Prospective Courses (2021) (<https://www.tandfonline.com/doi/abs/10.1080/21693744.2021.1918403>) suggests that future study concentrate on improving the adaptation of seed planting robot to different agricultural environments and crops. As suggested by [Johnson et al. (2020)] (<https://ieeexplore.ieee.org/document/9223800>), cost-cutting and interface simplification are essential for broader adoption. As noted by [Tellaeché et al. (2011)] (<https://www.mdpi.com/1424-8220/11/3/3328>), integration with other smart agricultural technologies, such as drones and the Internet of Things, will expand the capabilities and advantages of these systems.

METHODOLOGY:

ARCHITECTURE:

The Design of the Research

In order to assess the effectiveness, efficiency, and usability of agricultural robots for seed sowing, a multifaceted research strategy incorporating experimental sets, field trials, and simulation models is used in this work. The approach is broken down into multiple crucial stages:

1. Literature Review: - Perform an extensive analysis of the body of knowledge about robotic systems, precision farming, and seed sowing technologies. This entails examining earlier research, patents, and technical papers to determine current developments, gaps, and potential future study areas.
2. System Development and Integration : - Design and Prototyping: Work on the robot's electrical and mechanical components. This includes choosing the right sensors and actuators, creating a prototype, and modeling in CAD.
Software Engineering: Apply navigation and control algorithms.
3. Experimental Setup: - Lab Testing: To calibrate sensors and actuators, conduct preliminary testing in controlled conditions. Check the precision of the depth control and seed placement systems.
- Field Trials: Place the robot in real agricultural fields to evaluate its functionality in practical settings. Choosing test plots, getting the soil ready, and planting are all part of this process.

Information Gathering In order to assess the robot's performance, the following data points will be gathered throughout lab and field experiments:

1. Accuracy of Seed Placement: - Use high-precision GPS and ground truth measurements to determine how much the seed positions deviate from the planned planting coordinates.
2. Planting Depth : - Evaluate the accuracy and consistency of seed planting depth using manual verification and depth sensors

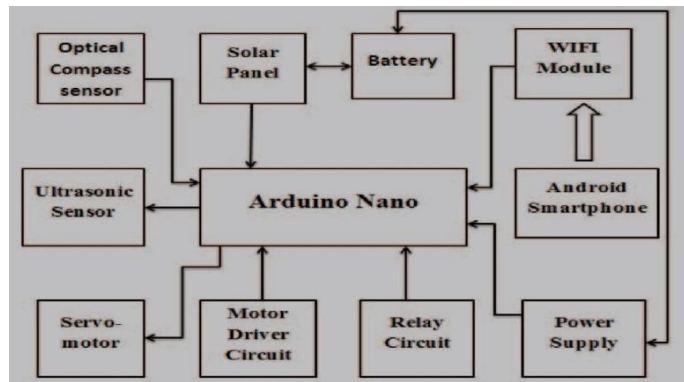


Fig1.SchematicDiagram

The system is comprised of various components and phases that combine modules to create the primary system. Our strategy involves utilizing microcontroller-enabled sensors, actuators, and a Wi-Fi transceiver module for collecting data and measuring the environmental conditions in the vicinity. This

data aids in monitoring smart cities and managing disasters. The Wi-Fi module, ESP8266, serves as a comprehensive and self-sufficient Wi-Fi networking solution, enabling it to host applications or delegate all Wi-Fi networking tasks to another application processor. The modules operate on an addressing system where each node possesses a unique ID within the network. These nodes are interconnected in a star topology, capable of functioning as either a master or slave depending on the circumstances. The proposed hardware design is versatile and can be fitted with sensors or actuators tailored to the specific requirements of the location where they are deployed. An internal power supply is included to ensure uninterrupted operation in the event of a power failure. Additionally, a solar cell power supply is integrated for prolonged power outages. The ATmega328P microcontroller serves as the core for programming and interfacing with various sensors, actuators, and communication using the Arduino firmware. The Arduino programming environment streamlines the developer's ability to manage, compile, and upload data.

The ESP8266 Wi-Fi Module is a self-contained SOC that includes an integrated TCP/IP protocol stack. This module enables any microcontroller to connect to a Wi-Fi network [9]. It supports 802.11 b/g/n and offers Wi-Fi direct functionality, as well as the ability to function as a software-enabled access point. Designed specifically for mobile devices, wearable electronics, and networking applications, this module is a low power device with a built-in antenna. Communication with the module is achieved using communication standards such as SPI and UART. Additionally, the ESP8266 Wi-Fi module is cost-effective, making it an ideal choice for large-scale implementation.

To utilize the Wi-Fi capabilities of the ESP8266, it is used as a Wi-Fi adapter for our microcontroller. The module is communicated with using the AT command set defined by them

The Internet of Things (IoT) has revolutionized computing and communication by making them omnipresent, mobile, and wearable. This is made possible through the use of numerous microcontrollers and microcontroller platforms. One such platform is Arduino, which consists of a programming environment and Arduino boards. At the core of the module, the ATmega328P microcontroller is used. This microcontroller, developed by Atmel, is a high-performance, general-purpose 8-bit AVR RISC-based microcontroller. It supports various communication protocols such as UART, SPI, and 2-wire serial interface. Additionally, it has built-in analog to digital conversion capabilities, making it an ideal choice for central data acquisition in our system.

The ATmega328 microcontroller is used in conjunction with the Arduino bootloader. Arduino is an open-source prototyping platform that offers user-friendly hardware and software. The code written on the Arduino IDE is easy to write and edit, providing a higher level of robustness. Arduino libraries further enhance its capabilities by allowing easy attachment and interfacing of a wide range of sensors and modules to our system.

The main features of the Arduino platform, including its low cost, cross-platform compatibility, simple programming environment, open-source nature, and extensible software

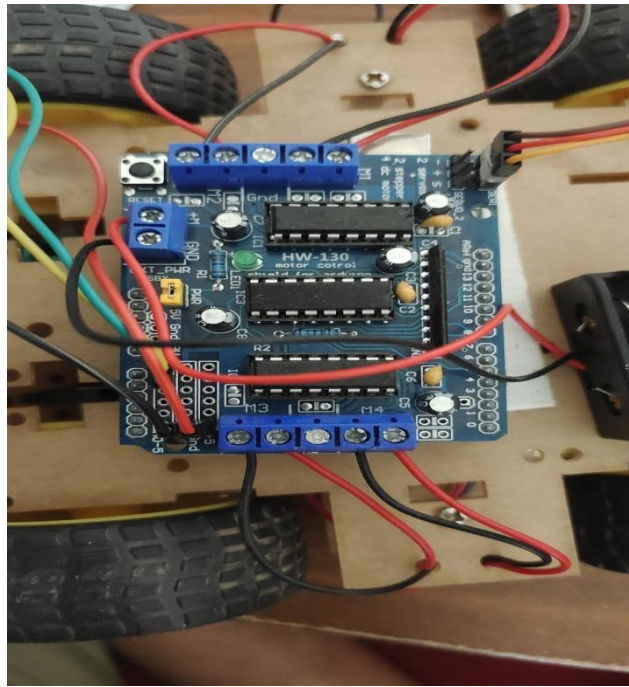
RESULT ANALYSIS:

Efficiency Sowing Speed: Calculate how fast the robot can spread seeds over a specified area in comparison to conventional machinery or manual methods.

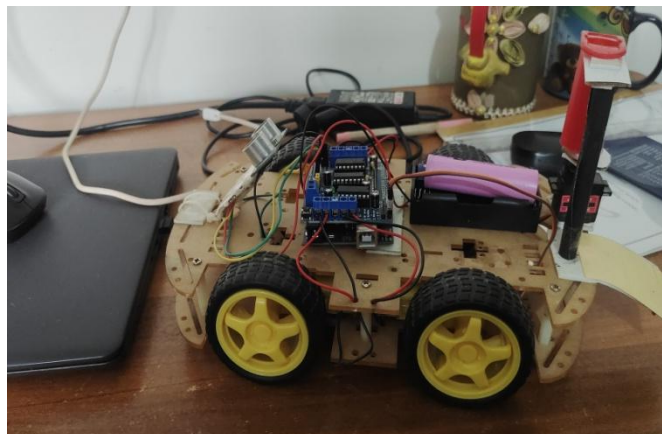
Coverage: Verify that seeds are sown at the proper depth and spacing by assessing the consistency and precision of seed placement.

Efficiency Rates of Germination: Compare the robot's seed germination rates with those of other techniques. High rates show that the robot gave superior planting conditions.

Result: Evaluate the yield of crops per hectare. This illustrates how well the robot can provide the right environment for plant growth.



There is a lot of potential for this seed plantation machine to increase planting output. The primary traction unit used in farming up until now was the tractor. This seed sowing machine's objective will be fulfilled with its customization. Therefore, it is imperative to advance this technology and make it reasonably priced for even small-scale farmers. This machine is easily constructed in readily available workshops and may be made using raw materials as well, saving the cost of the entire project. The sensors and metering equipment are the only expenses. Therefore, we can manage depth variation and obtain distance flexibility for various seeds by utilizing this machine, which is applicable to all seeds.



CONCLUSIONS AND FUTURE WORK

Robots that sow seeds have the potential to greatly boost productivity by automating the planting process. Their ability to work nonstop, day or night, in any kind of weather, without getting tired, results in increased production and lower labor expenses. Better crop yields may arise from these robots' highly precise operations, which guarantee ideal seed placement, planting depth, and seed spacing. Additionally, they can be integrated with other agricultural technologies, such as sensors and GPS, to further optimize planting patterns according to crop requirements and soil conditions.

SUMMARY

In agriculture, innovative seed-sowing equipment has a significant impact. The amount of time needed for the sowing procedure is decreased by employing cutting-edge seed sowing tools. For small-scale farmers, it is particularly beneficial. The seeds germinate properly because they are sown in the correct order.

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