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Design and Development of Automated Seed Sowing Machine

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ABSTRACT: The seed sowing robot is an autonomous agricultural system designed to enhance precision farming by automating the process of seed distribution and irrigation. The robot employs geared DC motors for movement and an additional DC motor for the seed dispensing mechanism, ensuring uniform sowing across the field. A moisture sensor is integrated to monitor soil conditions, enabling efficient water management. Based on the sensor's readings, a relay module controls a water pump, ensuring optimal soil moisture levels for seed germination. The system is powered by an ESP32 microcontroller and controlled via an HC05 Bluetooth module, allowing remote operation and monitoring. This smart farming solution aims to reduce manual labor, enhance efficiency, and promote sustainable agricultural practices by integrating robotics and IoT in precision farming.

I. INTRODUCTION

In the current generation most of the countries do not have sufficient skilled man power especially in agricultural sector and it affects the growth of developing countries. The main requirement of Automation is to reduce man power in our country; the buzzword in all industrial firms generally involves electrical, electronic component as well as mechanical part. Automation saves a lot of tedious manual work and speeds up the production processes. So it is a time to automate the sector to overcome this problem. In India there are 70% people dependent on agriculture. Seed has been an important agricultural commodity since the first crop plant was domesticated by pre-historic man. In this model seed sowing process is automated to reduce the human effort and increase the yield. The plantation of seeds is automatically done by using DC motor [1].

As agriculture is extensively supported by technical means like seeding, mowing or harvesting machines, it is widely considered to be a field with a high potential for robotic application as it is a small step from these semi automatically operated machines to fully autonomous robots in both greenhouse and open field applications. Robots are available on all development levels from experimental to market-ready in several agricultural applications but most of them are in research, where institutes have made progress to extend the existing agricultural machines to robotic systems. Most of the robots considered in this publication are developed for harvesting. Seeding is not yet as important since there are already good tractor based seeding systems. In horticulture there are significantly less robotic applications as in agriculture.[1][2]



Fig 1 Seeding robot 3d model [1]

By reducing manual effort, optimizing water usage, and ensuring uniform seed placement, this robotic system enhances efficiency in modern agriculture. Its implementation can significantly improve crop yields while conserving resources, making it a vital step towards smart and sustainable farming practices [2].

A seed sowing robot, also known as a planting robot or seed drill, is an agricultural tool designed to automatically sow seeds into the soil. It aims to automate the planting process, reduce human labor, and increase productivity in agriculture. These robots can be tailored to specific crops, conditions, and even perform tasks like drilling holes for seeds, depositing them at precise depths, and covering them with soil [3].

Key aspects of seed sowing robots:

- **Automation:** They automate the seed sowing process, reducing the need for manual labor.
- **Efficiency:** They can sow seeds at a higher speed and with more precision than manual methods.
- **Accuracy:** They can sow seeds at specific distances and depths, which can lead to better plant establishment and crop yields.
- **Versatility:** Some robots can be adapted to different crops and soil conditions.
- **Integration:** They can be integrated with other agricultural technologies like GPS, sensors, and control systems to optimize the planting process.

1. Problem Statement

This project aims to develop an autonomous seed sowing robot that integrates DC motors for movement and seed dispensing, a soil moisture sensor for real-time monitoring, and a relay-controlled pump for automated irrigation. Controlled via Bluetooth using an HC-05 module and powered by an ESP32 microcontroller, this robot will enhance agricultural efficiency by optimizing seed placement, reducing human intervention, and ensuring better water management.

II. METHODOLOGY

Conceptual Design

Create initial sketches and 3D CAD models for the machine, including components like the seed hopper, metering system, wheels, and chassis. Design the layout for IoT components such as sensors, microcontrollers, and communication modules.



Fig 2 Conceptual CAD model

Seed Dispensing Mechanism Fabrication

Design and fabricate a seed metering system. Test the mechanism for accurate dispensing and minimal seed damage.

Chassis and Framework Construction

Construct the machine's framework using lightweight, durable materials like aluminum or steel. Ensure the design allows easy assembly and integration of components.



Fig 3 Framework/chasis

Automation and Drive System

Install DC or stepper motors for the drive system and seed metering mechanism. Connect the motors to motor drivers and ensure precise control using microcontrollers.

IoT Integration

Connect sensors (e.g., soil moisture, GPS, and temperature) to the microcontroller.

Program the microcontroller to process sensor data and communicate with IoT platforms via Wi-Fi or GSM. Develop a mobile or web-based application for remote monitoring and control.

Assembly and Wiring

Integrate the mechanical and electronic components, ensuring secure mounting and proper alignment. Wire all components, including motors, sensors, microcontrollers, and communication modules, following a clear circuit design.

Hardware Setup

- **Microcontroller (ESP32):** The ESP32 serves as the central processing unit, managing sensor data, controlling motors, and handling communication via Bluetooth.
- **DC Motors for Movement:** Two geared DC motors with motor drivers are used for robot movement, allowing precise navigation across the field.
- **Seed Dispensing Mechanism:** A third DC motor controls the seed dispenser, ensuring uniform seed placement in the soil.
- **Relay Module for Pump Control:** A relay module is used to switch the water pump on and off based on soil moisture readings.
- **Power Supply:** A rechargeable battery powers all components, ensuring uninterrupted operation.

2. Component parts:**Seed storage tank:**

Storage device is one of the important device of the system. And is designed according to weight sustained by the robot as well as the required capacity for planting. This component is stationary. To the bottom of this tank seed sowing disc is arranged. This disc serves the function of distribution of the seeds, as for each complete rotation of the rotating wheel, seeds falls from the tank. Also number of seeds falling from tank is varied according to requirements. This disc evenly opens the way to seed hence planting is done smoothly and accurately.

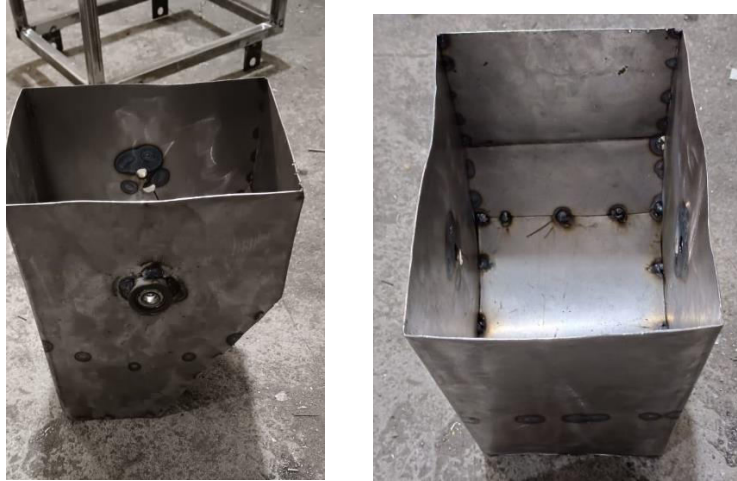


Fig 5 seed storage tank

Hopper:

Hopper is made by mild C. R. Sheet which contains Seed. There are two hopper mounted on frame on each side. The seeds in the seeds storage tank inserts from the hopper. It is the component from which desired amount of seed can be placed in required field.



Fig 6 Hopper

Water Storage tank

A water storage tank in a seed sowing machine is used for moistening soil, seed priming, fertilizer application, or dust control. It is typically made of polyethylene or stainless steel, with a capacity of 5 to 50 liters. Water is distributed via a gravity-fed or motorized pump system with nozzles for even application. Advanced systems may include automated flow control for precision farming.



Fig 7 water storage tank

III. RESULT

The combined seed sowing mechanism is built to be compact and efficient to cut the crops. The machine was tested in a laboratory to check its capability and efficiency. The test results were successful as the machine performed flawlessly. The cost of seed sowing by this machine is considerable less compared to manual seed sowing. It is found that engine is capable for required power to run a sowing.



Fig 8 water storage tank



Fig 9 Seed Sowing Machine (Different views)

Advantages of the project

- Reduces manual labor and increases efficiency in farming operations.
- Ensures uniform seed distribution for optimal crop growth.
- Automates irrigation based on real-time soil moisture levels, preventing over- or under-watering.
- Reduces seed and water wastage, improving resource utilization.
- Remote control via Bluetooth allows easy operation from a smartphone.
- Enhances precision in farming, leading to higher crop yields.
- Operates on battery power, making it suitable for remote agricultural areas.
- Reduces dependency on human workers, addressing labor shortages in agriculture.

Application of the project

- **Agriculture:** Used for automated seed sowing and irrigation in large farms.
- **Smart Farming:** Integrated with IoT for real-time monitoring and automation of farming processes.
- **Greenhouse Cultivation:** Helps in controlled environments where precise seed placement and watering are essential.
- **Precision Agriculture:** Enhances efficiency by optimizing seed placement and irrigation based on soil conditions.
- **Urban Gardening:** Can be used in automated home or rooftop gardening setups.
- **Research and Development:** Useful for agricultural universities and research institutions to test automated farming techniques.

IV. CONCLUSION & SCOPE FOR FUTURE WORK**Conclusion**

This seed plantation machine has great potential for increasing the productivity of the planting. Till now tractor was the main traction unit for nourishment in farming. With the adaptation of this seed planting machine its purpose will be done. Hence there is need to promote this technology and made available to even small scale farmers with affordable prices. This machine can be made by raw materials also which saves the cost of whole project and is easily manufactured in available workshops. The only cost is of metering device and sensors. Hence by using this machine we can achieve flexibility of distance and control depth variation for different seeds, hence usable to all seeds. This project is made with pre planning, that it provides flexibility in operation. This innovation has made the more desirable and economical. This project “Design and Fabrication of Seeds Sowing and Spraying Machine for Agriculture Purpose” is designed with the hope that it is very much economical and help full to agricultural field. This project helped us to know the periodic steps in completing a project work. Thus, we have completed the project successfully.

Scope for Future Work

- A. Seed sowing and spraying machine is a device which helps in the sowing of seeds and spraying in the desired position hence assisting the farmers in saving time and money.
- B. Future is fully all machines are operated in renewable energy sources
- C. The machine can be made more portable.
- D. Cost can also be reduced to some extent by manufacturing it on a mass scale.

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