Design of Automatic Seed Sowing Machine

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Abstract:- This paper presents the development of an automated seed-sowing machine aimed at improving the precision and efficiency of agricultural planting practices. The machine utilizes a microcontroller to control movement and seed dispensing, allowing for programmed, looped operations. Key components include high-torque DC motors, a seed dispenser, and an RTC module for precise timing. The system enables consistent seed spacing and reliable field coverage with minimal human oversight. Through extensive testing, adjustments were made to optimize seed-drop intervals and turning functions, ensuring adaptability across various soil types. This automated solution offers a low-cost, user-friendly approach to modern agriculture, meeting the growing demands. The project aims to contribute to adopting scalable automation in agriculture, promoting efficient resource use, and supporting small-scale farmers.

***Keywords:-** Automated Seed-Sowing, Agriculture Planting, Accurate Seed Placement, Crop Yield, Sustainable Farming.*

I. INTRODUCTION

There has recently been a steady trend in agriculture towards automation due to labor shortages, increases in demand for agriculture in India and greater role of automation in making farming both more productive and precise. The presented machine is an economically viable replacement compared to the traditional methods based on dependability, ease of use, and adaptability towards numerous seed types. The technical document further includes other information on the methodology of the machine, component design, and field testing outcomes, which further clarify its potential as a practical solution that can improve the efficiency of sowing [1].

The authors present their design in which they integrate a multifunctional robot capable of automating seed sowing that is of a row type. Equipped with a four-wheel mobile platform, digging and seed dropping mechanisms, and an irrigation system, this robot can perform automatically or under a remote control by an android app that can offer real-time monitoring. This mechanism will decrease labor costs, thereby allowing more effective efficiency in agricultural practice. It gives a sustainable and cost-effective alternative against the normal ways of Conducting agriculture. It underlines the development of robotics in agriculture about precision, eco-friendliness, and adaptability to field conditions [2].

Agricultural robot that is to be designed to make the process of seed sowing and fertilizer spraying easy and efficient without hampering the normal working schedule as India always faces labor problems and among such robots, this one is unique as it is handy, operated by a Bluetooth-based Android application, thus freely permitted to operate in narrow crop rows or spray at variable heights, unlike similar systems that either depend on manual or tractor-based methods taking lengthy hours or are somehow expensive or even taxing to the environment. The robot, powered by solar energy, provides an ecologically friendly and affordable alternative that brings advanced farming technology to the small-scale farmer [3].

As one of the most important process with seriousness and labor-intensive nature. This introduction outlines the design and construction of a semi-automatic robot, representing a significant advancement toward the automation of seed sowing and thereby reducing human labor. It has four DC gear motors for movement and its front has a mechanism that slots soil, seed-dispensing system, and a mechanism that places soil on top of the seed once it has been planted. It tries to create an electro-mechanical system which could be efficient without being too expensive to produce, where productivity can be made more potent with lower labor costs to farmers [4].

That automation in agriculture has been produced as the only solution to deal with manpower shortage issues and increase efficiency in the event of a shortage of manpower. Laborious seeding process is expensive in terms of time, labor, and so on. The present paper introduces an automatic seed sowing machine with a minimum level of human intervention while producing maximum yields. The machine uses an automatic seed planter equipped with a DC motor. The spacing in the seeds is adjustable, and it also makes use of microcontrollers. Additionally, it has the ability to use Bluetooth for remote directional control, which makes it adaptable to the various field conditions [5].

II. LITERATURE REVIEW

Aniruddha D Dharmadhikari, Surajmal Sharma, Makarand Baviskar, Shantanu Kakad, and Manish Chandekar in [1] propose an alternative to traditional tractors commonly used in agriculture, addressing specific challenges faced by small-scale farmers. While tractors are effective for large-scale farming, they often require skilled operators, which increases labor costs, and can be difficult to maneuver in smaller fields, reducing efficienc.

Cihan Yurtsever, Yasin Ertas, Oben Sustam, and Cenk Ulu in [2] developed an agricultural romachine that integrates several subsystems to perform row-type seed sowing. The r is equipped with a four-wheel drive and mechanisms for digging, seed dropping, and irrigation, providing a comprehensive solution for automated planting.

Megha Kotur, Rutuja Huddar, Veena Bhagoji, Kumar Nayak, Sanjay Ankali in [3] Address the inefficiencies of manual spraying in agriculture, which is often time-consuming and labor-intensive. They propose a robotic system capable of performing tasks such as seed sowing and fertilizer spraying, aimed at improving efficiency and reducing direct human contact with potentially harmful chemicals.

Mosam K. Sangole, Dipak P. Patil, Ketan A. Dhamane, Rohit K. Jathar, and Rushikesh S. Kardile in [4] present a project that leverages Bluetooth technology for communication between a Bluetooth module and an Arduino system. This communication controls motor drivers, ensuring precise motion control of the robot. The system aims to enhance the efficiency of planting processes, making it a promising tool for increasing agricultural productivity.

Bhushan Deshmukh and Durgesh Verma in [5] Focus on improving the seed dispensing process by eliminating seed blockages during dispensing through the use of water pressure. The project consists of two main mechanisms: the first mechanism involves the assembly of the vehicle and its motion control, while the second mechanism is designed to prepare a seedbed on plowed land.

Ms. Trupti Shinde, and Dr. Jayashree Awati in [6] Focus on improving the seed-sowing process to overcome the limitations of traditional sowing methods. The project introduces a cost-effective machine designed for use by unskilled farmers, making it accessible to a wider audience.

Ratnesh Kumar, Aadhar Govil, Parth Daga, Shubh Goel, and Saurabh Dewangan, in [7] provide a comprehensive review of automatic seed-sowing machines. The paper discusses various designs and technologies aimed at automating the seed-sowing process to improve efficiency in agriculture. By highlighting the advantages of mechanization, such as reduced labor costs, increased sowing speed, and enhanced precision, the review underscores the importance of developing cost-effective and efficient machines for the agricultural sector.

III. 3-D CAD MODEL

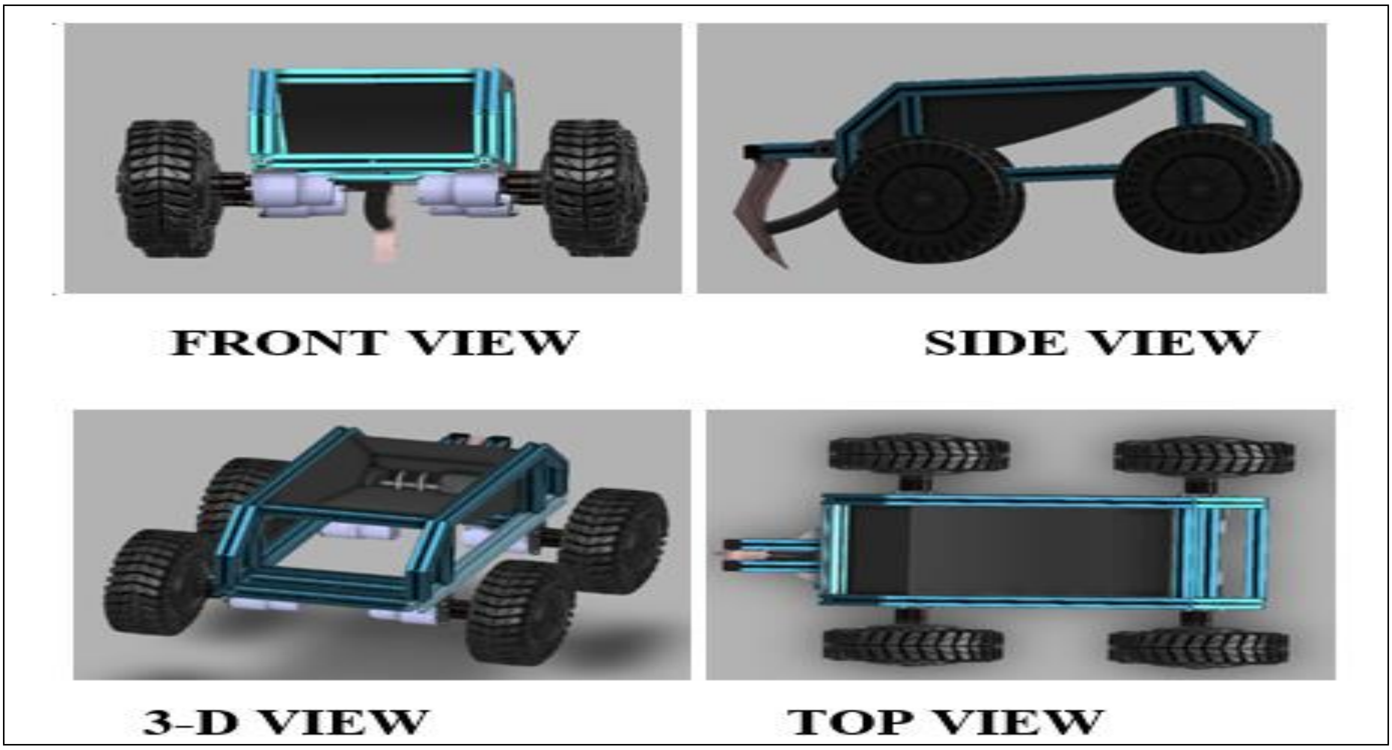

Fig 1: CAD Model

The chassis model created using Fusion 360 captures the detail nature of the structure; it contains views from the front, side, top, and 3D perspective, making it totally useful in understanding its design. Such views help you visualize the shape, dimensions, and features on the chassis. The design has structural strength as a priority and follows key Engineering principles for automotive use. This means that as a result of utilizing Fusion 360, I could make an almost perfect and correct mode as shown in fig. no.1.

Table 1: Specifications

Sr. No.	Components	Dimension	Position (Chassis)	Remark
1.	Motor Mount Area	Length: 5	Width: 5 (Each Side)	For High Torque DC Motor
2.	Wheel Clearance	Length: 10	Width: 5.5 (Each Side)	Adequate Space for wheel Mounting
3.	Battery Compartment	Length: 13	Width: 7	Placed on rear side for the balanced weight
4.	Control Board Area	Length: 10	Width: 8	For Ardunio Nano expansion on board
5.	Plough Mechanism	Length: 12.5	Width: 2.5 (with Sharp Tip)	To prepare the soil before dropping the seeds
6.	Motor Driver Space	Length: 3.5	Width: 13	On the top side of the machine which used for the moment control of the machine.
7.	RTC and Display Area	Length: 10	Width: 8	Near control board for easy access.

IV. SYSTEM DEVELOPMENT

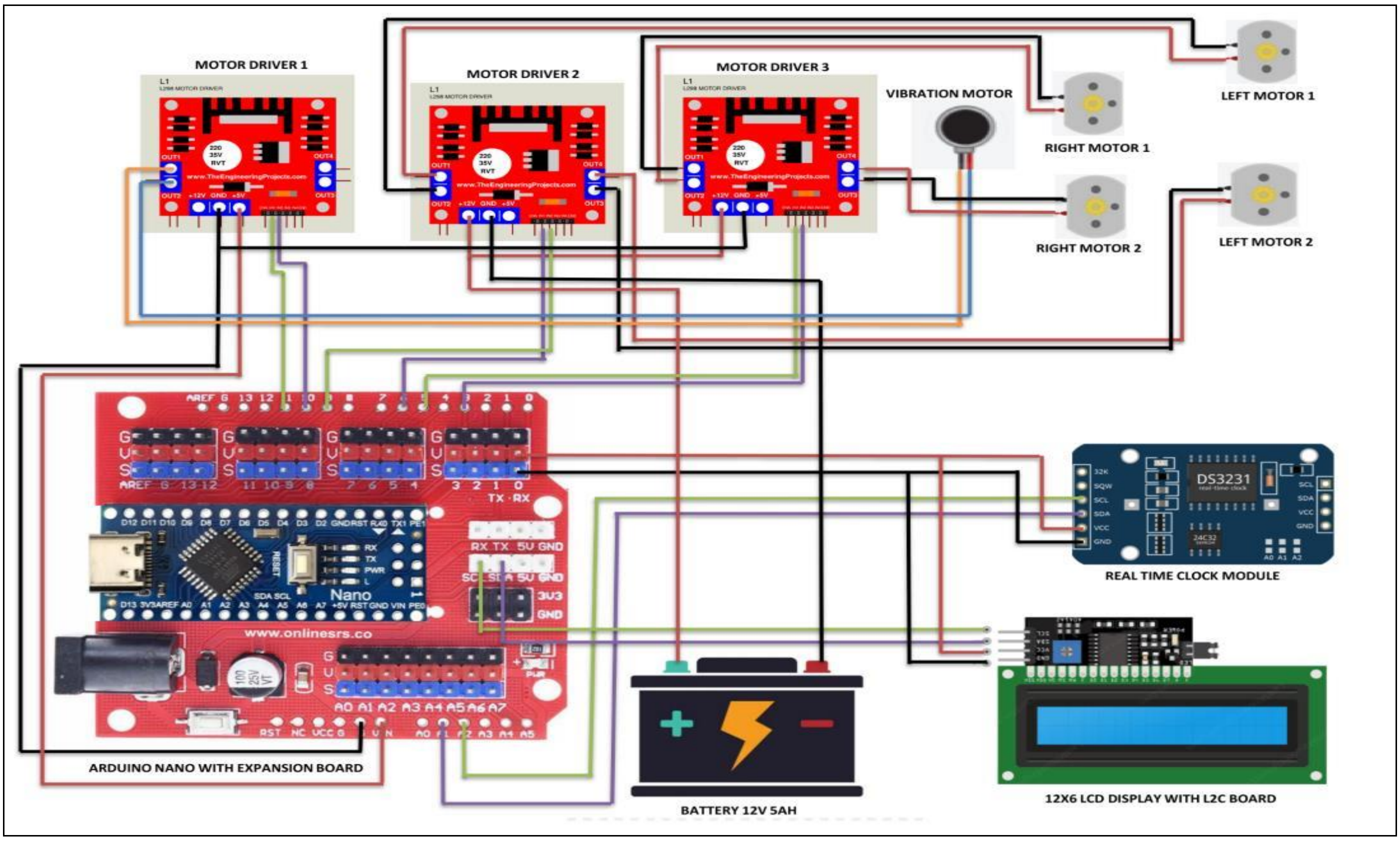

Fig 2: Circuit Diagram of Automatic Seed Sowing Machine

The Automated Seed Sowing Machine circuit integrates an Arduino Nano mounted on an expansion board to provide additional pins and simplify wiring, forming the control hub of the system. Powered through the Vin and GND pins, which connect to a rechargeable battery, the Nano supplies voltage to all other components and is programmed with code that governs the machine's movements, seed dispensing, and timing. As show in the above figure no.2.

Key digital pins (3, 5, 6, 9, 10, and 11) on the arduino nano are designated to communicate with the motor drivers. the motor driver, the motor driver which we have used here L298N, serves as an interface between the arduino and the high-torque dc motors. by modulating the voltage out from their terminals, the motor drivers control the movement of these motors as they have pins IN1, IN2, IN3, and IN4 which are decicated for the motor direction allowing the machine to move forward, stop, and turn as required. the arduino sends directional commands to the motors based on the timing logic specified in the code, enabling autonomous navigation through the field.

➢ *Motor Driver 1-*

This driver is used here for the vibration motor, thus the PWM signals generated by the Arduino Nano are given to the motor driver, and the OUTPUT PINS, OUT1, and OUT2 of the motor drivers are connected tobthe vibration motor. The supply voltage of 5V from the expansion board's Vin pin is given to the motor drive and the GND is connected to the expansion board's GND.

➢ *Motor Driver 2-*

This driver is used here for propelling the wheels of the left side of the machine, thus the PWM signals are generated at a time for rotating the left side wheels, the OUT1 and OUT2 are connected to LM1 on the other hand OUT3 and OUT4 are connected to LM2. IN1 and IN2 pins control the spinning direction of the motor. IN1 is connected to pin number 6 and IN2 is connected to pin number 9 of Arduino. The supply Voltage of 12V is provided by a battery.

➢ *Motor Driver 3-*

This driver is used here for propelling the wheels of the Right side of the machine, thus the PWM signals generated at the time for rotating the Right-side wheels, the OUT1 and OUT2 are connected to RM1 on the other hand OUT3 and OUT4 are connected to RM2. IN1 and IN2 pins control the spinning direction of the motor. IN1 is connected to pin number 5 and IN2 is connected to pin number 3 of Arduino. The supply Voltage of 12V is provided by a battery.

An essential aspect of the machine's operation is its ability to dispense seeds at specific intervals based on a time-and-distance approach. For this purpose, an RTC (Real-Time Clock) module is connected to the Arduino's SDA (A1) and SCL (A2) pins, allowing it to keep accurate track of time. The RTC helps control intervals for movement and seed release, ensuring that the seeds are spaced correctly as the machine advances. To provide user feedback on the machine's current status, an LCD is incorporated, Connected via an I2C module. The I2C module reduces the connection requirement from 16 pins to 4, optimizing space and allowing the Arduino's SDA and SCL pins to be connected with the I2C module, and allowing the GND and VCC pins to be shared with the RTC module. The LCD's operational messages, such as instructions for setting parameters, errors, and progress updates, make the machine's processes visible to the user.

The seed-dispensing mechanism involves a vibrator motor. The vibration motor works when there is a need for dispensing a seed at a particular point. The signal to the driver for the vibration motor gets PWM pulses from a microcontroller (ARDUINO NANO). Each component in the circuit works in a coordinated manner under the control of the Arduino Nano, resulting in an automated seed-sowing machine that can precisely and efficiently plant seeds across a field

V. RESULTS AND DISCUSSION

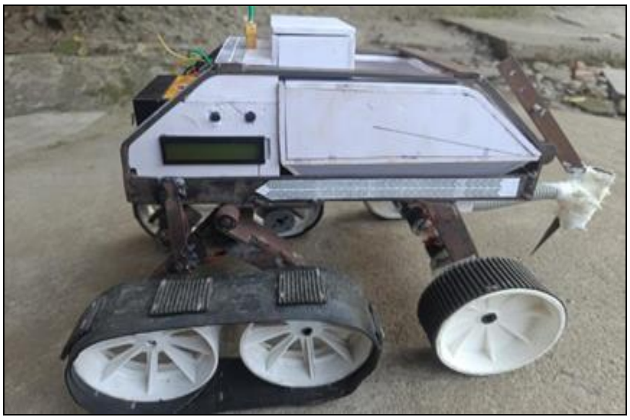

Fig 3: Final Modal of Automatic Seed Sowing Machine

We successfully developed a seed sowing robot aimed at automating and enhancing the efficiency of agricultural sowing processes. The primary objective was to design a robot capable of autonomously planting seeds in a precise and uniform pattern, thereby reducing manual labor and optimizing crop yields. Our design incorporated a programmable microcontroller, which controlled the navigation and sowing mechanisms in show in figure. No. 3.

The table below presents the parameters of test expected results, theoretical basis, and performance benchmark developed for the assessment of the accuracy of spacing, adjustment depth, and reliable operation of the Automated Seed Sowing Machine.

Table 2: Result & Conclusion

Sr. No.	Parameter	Observed Results
1.	Battery Backup.	The battery has 12V output and 2A capacity, also battery consistently lasts for approximately 3 hours on a full charge under continuous use.
2.	Seed Sowing Depth and Distance Control.	The machine features switches for controlling the distance between seeds, enhancing precision in planting, The least setting for distance control on the seed sowing machine is 5 cm to maintain adequate and sufficient span.
3.	Plough Mechanism	The system allowed variation in sowing depth as the lever is adjustable so can be adjusted depth to 12 cm depending on soil type. also, The plough mechanism penetrates the soil deeply enough for seed placement which is crucial for ensuring that seeds are adequately buried

This prototype of the Automated Seed Sowing Machine was developed and tested to throw light on several design decisions, functionality, and potential enhancements for small-scale farming. An embedded system was chosen over an IoT solution on account of simplicity, power efficiency, and independence from internet connectivity, specifically aimed for deployment in rural settings. Testing showed that the machine was reliable while placing the seeds accurately, had an ability to adjust depth and could make looped movements on a controlled test plot, though upon rough terrain minor flaws in turning abilities were recognized. Battery life would support continuous operation for 2-3 hours with further possibilities of solar charging in future models. The idea in the lever system was for depth adjustment to serve a greater variety of crops by improving functionality in service for various types of farming needs. A second saving from the single development is also experienced due to the accuracy of the machine as opposed to the labor-intensive methods used in the conventional hand sowing. The experiment also served as an opportunity for some upgrades to the machine, including a belt system that allows more flexibility and therefore proves that upgrade can enhance performance, especially on different types of terrain. Overall, the machine is very cost-effective, efficient, and flexible, a huge asset to small-scale farmers, although future models may address longer battery life and terrain adaptability.

VI. CONCLUSION

Automated Seed Sowing Machine brings a useful and inexpensive option for small-scale farming because it eliminates labor and provides precise seed placement. The testing had uniform and accurate spacing across rows, with adjustable seed depth which depended on the crop, and such a small plot could make use of a 2 to 3-hour battery life. This provided long-term savings based on one-time investment compared to the usual costs in manual sowing. While improvements in wheelbase design could enhance performances on uneven grounds, it would be more likely to be effective on controlled terrain. Therefore, its application will make it a more useful tool in sustainable farming practices.

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REFERENCES

[1]. Aniruddha D Dharmadhikari, Surajmal Sharma, Makarand Baviskar, Shantanu Kakad, and Manish Chandekar,"Novel Approach for Automatic Seed Sowing Machine" Volume 10, Issue 05, May 2023 Published in the International Research Journal of Engineering and Technology (IRJET)
[2]. Cihan Yurtsever, Yasin Ertas, Oben Sustam, and Cenk Ulu, “Development of an Agriculture Robot for Row-Type Seed Sowing Applications" Journal of Selcuk-Technic, Special Issue 2020 (ICAT'20), ISSN 1302-6178
[3]. Megha Kotur, Rutuja Huddar, Veena Bhagoji, Kumar Nayak, Sanjay Ankali, "Seed Sowing and Fertilizer Spraying Robot" Research and Reviews: Advancement in Robotics, Volume 3 Issue 1, 2020 - Computer Science and Engineering, KLECET, Chikodi, India
[4]. Mosam K. Sangole, Dipak P. Patil, Ketan A. Dhamane, Rohit K. Jathar, and Rushikesh S. Kardile, "Semi-Automatic Seed Sowing Robot" Published in the International Journal of Innovative Technology and Exploring Engineering (IJITEE), Volume 9, Issue 6, April 2020, ISSN: 2278-3075.
[5]. Bhushan Deshmukh and Durgesh Verma, "Fabrication and Implementation of Automatic Seed Sowing Machine" Published in the International Journal of Engineering Sciences & Research Technology, January 2018
[6]. Ms. Trupti Shinde, Dr. Jayashree Awati, “Design and Development of Automatic Seed Sowing machine” A Review. SSRG International Journal of Electronics and Communication Engineering - (ICRTESTM) - Special Issue – April (2017).
[7]. Ratnesh Kumar, Aadhar Govil, Parth Daga, Shubh Goel, Saurabh Dewangan, “Design of automatic seed sowing Machine for agriculture sector” A Review, International Conference on Advances in Mechanical Engineering and Nanotechnology. ISSN: 2214-7853, (2022)