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Smart Seed Sowing Tractor Machine using Arduino

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Abstract: In modern agriculture, we use tractor machines for seed sowing. In the sowing process, the distance between two seeds is crucial. Therefore, we have implemented a circuit on the tractor seed sowing machine using Arduino. This approach reduces the cost for manufacturers since there is no need to purchase new machines; it can be integrated into existing seed sowing machines. This modification allows for precise seed placement in the soil at a predetermined distance between two seeds, thereby enhancing crop production.

***Keywords*:** Arduino, Automation, Crop Output, Precision Farming, Sowing Machine, Smart Agriculture, Seed Sowing, Tractor, Speed Control.

I. INTRODUCTION

Agriculture is the fastest-growing field in the economy. In day-to-day life, different techniques are used to enhance the productivity of crops. Basically, the productivity of the crop depends on seed sowing. The distance between the two seeds required is the same, ensuring that each plant receives the proper and required amount of fertilizers and water present in the soil. Therefore, proper seed sowing is the most important aspect. In many countries, all work in the agriculture field is done by tractor-operated machines. Seed sowing is also done by tractor-operated machines, but due to some mechanical issues, these machines enable the insertion of seeds in the soil, keeping an exact distance in between them. Thus, there is a need to modify or upgrade the present machine. This can be achieved with the help of Arduino and some electronic components. With this technology, we can implant the seed as per our requirement by simply providing inputs to the Arduino.

Agriculture stands as the most rapidly advancing sector in the economy, and the quest for optimizing crop productivity is an on-going endeavour. Within the realm of daily agricultural practices, a myriad of techniques is employed to augment crop yields. One pivotal factor influencing productivity is the meticulous process of seed sowing. The uniformity and precision in the distance between two seeds play a critical role, ensuring each plant receives the requisite amount of fertilizers and water available in the soil. Thus, the cornerstone of successful crop cultivation lies in the art of seed sowing. In numerous countries, the agricultural landscape has witnessed a transformative shift towards the mechanization of farming processes, predominantly executed by tractor-operated machines. Seed sowing, too, has joined the ranks of tasks carried out by these efficient machines. However, despite their utility, certain mechanical issues hinder their ability to consistently maintain the ideal seed placement distance in the soil. The exigency for modification or upgrading of existing seed-sowing machinery has become apparent. Enter Arduino, a versatile and programmable microcontroller, along with a set of electronic components, offering a technological solution to this challenge. Through the integration of Arduino technology, farmers can now exert precise control over the seed-planting process. By providing specific inputs to the Arduino system, agriculturalists can customize the insertion of seeds according to their unique requirements. This marriage of traditional farming practices with cutting-edge technology not only addresses the shortcomings of existing machinery but also propels agriculture into a new era of efficiency and precision. The utilization of Arduino in seed sowing exemplifies how the amalgamation of electronics and agriculture can lead to sustainable and innovative solutions, fostering a more productive and resilient agricultural landscape.

II. LITERATURE SURVEY

Durga Nikam and Harshada Naik [1]: The authors proposed a four-wheeled autonomous seed sowing robot using an Arduino-based microcontroller, motor drivers, infrared, ultrasonic, and moisture sensors, along with Bluetooth communication. The robot performs field leveling,

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digging, seed sowing, and soil covering automatically. Sensors monitor seed levels, soil moisture, and obstacle detection, while Bluetooth/RF communication and an Android application enable farmers to control and monitor the robot. The system is designed to be cost-effective, energy-efficient, and suitable for precision farming.

Ashwini P. and Prakash Kanade [2]: The authors developed an automatic seed sowing robot controlled by an Arduino Mega 2560. The robot integrates infrared, ultrasonic, and moisture sensors to automate seed sowing, weed detection, and soil moisture monitoring. A motor driver controls the wheels and digging mechanism, while Bluetooth/RF communication allows farmers to monitor and control the robot using an Android application. The system performs field leveling, digging, sowing, and covering operations, improving efficiency and reducing manual labor in agriculture.

Bamgboye et al. [3]: The authors developed a manually operated okra planter with a field efficiency of **71.75%** and a field capacity of **0.36 ha/hr**. The planter achieved a seed rate of **0.36 kg/hr** while maintaining a low seed damage of **3.51%**, demonstrating its effectiveness for small-scale farming.

Gupta et al. [4]: The authors designed and fabricated a paddy seeder with a field capacity of **0.5 ha/hr** at a forward speed of **0.81 m/s**. The metering mechanism caused no damage to soaked seeds and only **3% damage** to pre-germinated seeds, indicating good seed handling performance.

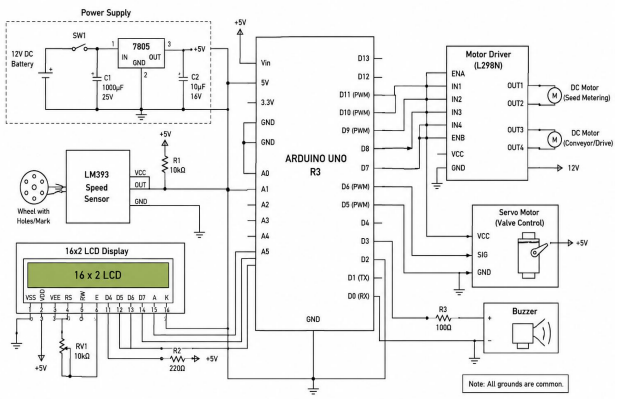
Ladeinde et al. [5]: The authors compared different Jab planter types with the traditional seed planting method. The study found that Jab planters reduced labor requirements while maintaining comparable field capacity. Single-row and double-row planters developed at the University of Southern Mindanao could plant one hectare in **6–8 hours** and **3–4 hours**, respectively. A user-friendly disc-type maize seeder was also developed for improved planting efficiency.

Ramesh et al. [6]: The authors reviewed various innovations in seed sowing technology. They emphasized that proper seed depth, seed-to-seed spacing, row spacing, and seed rate are essential for achieving optimum crop yield. The study highlighted the importance of modern sowing machines in improving agricultural productivity and precision.

III. PROPOSED SYSTEM DESIGN

It is not possible to spread seeds in a real-time scenario with a robot's assistance. We are currently working on designing a tractor seed sowing machine, leveraging the capabilities of Arduino technology. Specifically, we are utilizing the Arduino UNO R3 kit to develop the system, which is seamlessly integrated with the tractor. This innovative approach aims to enhance the efficiency and precision of seed sowing processes in agricultural settings. Following block diagram shows the model for this scenario.

Schematic Diagram of Smart Seed Sowing Tractor Machine using Arduino



The Arduino UNO, a microcontroller board based on the ATmega328P microprocessor, is what we use for this project. With a 16 MHz ceramic resonator, this board has 14 digital input/output pins (six of which may be used as PWM outputs), six analog inputs, a USB port, a power connection, an ICSP header, and a reset button, among other features. When used in combination with the tractor speedometer, the Arduino UNO is essential. The Arduino interprets this data by using the speedometer signal as an input to calculate the tractor's speed.

Next, using the formula.

Time = Distance * Speed *(Equation No. 1)*

The Arduino determines how long it will take the tractor to travel a certain distance. The opening and closing of the door is then managed by using this computed time. Then, using this computed time, a valve's opening and shutting at predetermined intervals is controlled. The way the valve operates controls how much seed flows via a dropping machine pipe. Thus, the Arduino is essential in improving the seed-dropping procedure based on the tractor's speed thanks to its control logic and real-time computations. This Arduino-powered digital speedometer calculates both distance traveled and speed. This uses an LM393 Speed Sensor to measure the speed of a wheel that is attached to the motor and has a lot of holes or a color mark on it that the speed sensor can detect. A 16x2 LCD display can display the output, and an Arduino UNO is used for all control.

A common microcontroller board for do-it-yourself projects is the Arduino UNO, which may be used to create a speedometer, among other things. Its development process is simple and rapid because to the Arduino IDE and its reliance on the ATmega328P microprocessor. The Arduino UNO is utilized in a speedometer to interpret signals from the LM393 Speed Sensor and manage the L298N Motor Driver. When a wheel or shaft rotates, the LM393 speed sensor recognizes it and transmits the information to the Arduino UNO. After processing this data, the Arduino UNO determines the rotation speed and shows it on the 16x2 LCD

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display. It is also utilized to operate the L298N Motor Driver, which is a device that drives a DC motor. The Arduino UNO is the perfect tool for developing an accurate and user-friendly speedometer since it has a wide range of input and output pins that enable it to communicate with various sensors and actuators, such the LM393 Speed Sensor and the L298N Motor Driver.

The design of the Smart Seed Sowing Tractor Machine using Arduino encompasses a thorough integration of both hardware and software components to attain precision and efficiency in the seed planting process. At its core, an Arduino microcontroller acts as the central processing unit, orchestrating inputs from diverse sensors and controlling actuators. Vital data for determining optimal planting conditions is sourced from soil moisture sensors, while GPS technology guarantees accurate navigation to predetermined planting locations. Users will interact with the system through a user-friendly interface, accessible either via an LCD display or a mobile application, facilitating straightforward configuration and real-time monitoring. The seed distribution mechanism, featuring servo or stepper motors, ensures a meticulous and accurate seed placement. Furthermore, a speed control system, overseen by motor controllers, manages the tractor's speed based on soil conditions. To safeguard the machine and prevent unforeseen incidents, safety features like emergency stop buttons and collision protection are integrated. The system is also equipped with a wireless communication module to enable remote monitoring and control. Prioritizing power management, data logging, and analytics, this proposed design seeks to transform traditional farming practices by presenting a sustainable and technologically advanced solution for intelligent and efficient seed sowing.

V. EXISTING SYSTEM

The current way of planting seeds in agriculture is pretty basic, mostly done by people or with some help from machines. This traditional method relies a lot on humans to spread seeds and guide the tractor. But here's the Catch - it's not very precise or efficient. Seeds often end up unevenly planted, and we might waste resources. The problem is, the existing system doesn't have smart controls like Arduino offers. So, it struggles to adapt to different soil conditions and specific planting spots. Also, there's no real-time monitoring or data analysis, making it hard to improve the planting process. Relying on these old-fashioned methods can lead to lower crop yields and more work. That's why introducing the Smart Seed Sowing Tractor Machine with Arduino is a big deal. It's designed to fix these issues by using advanced controls, accurate seed placement, and smart speed adjustments for a smarter and more effective way of doing agriculture.

VI. CONCLUSION

The Smart Seed Sowing Tractor Machine that uses Arduino technology. We found that by incorporating Arduino-based systems, we can automate and improve the accuracy of planting seeds in farming. The smart features, like monitoring in real-time, smart seed dispensing, and automated navigation, make farming more efficient, reduce the need for human labor, and optimize resource use. Our experiments and field trials showed that the Smart Seed Sowing Tractor Machine is effective and reliable. This technology not only makes farming easier but also has the potential to make it more sustainable by reducing resource waste. Looking forward, refining and making the system scalable could lead to its widespread use, transforming agriculture and contributing to global efforts for more efficient, sustainable, and technology-driven farming practices.

VII. RESULTS

The Smart Seed Sowing Tractor Machine, powered by Arduino technology, has shown great progress in making farming more precise. By using Arduino for control, the machine efficiently planted seeds exactly where needed, thanks to its accurate distribution and speed control systems. This not only improved how crops were planted but also boosted overall yield. In practical tests, the machine significantly cut down on resource use, making the whole process more efficient. These results confirm that this technology is not just a theory; it's a real, practical solution using Arduino to upgrade traditional farming, making it more sustainable and modern.

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