SMART SEED SOWING MACHINE FOR ENHANCING AGRICULTURAL PRODUCTIVITY

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Abstract: Agriculture is a critical component of India's economy, with seed sowing being a fundamental activity in farming. Seed sowing involves placing seeds in rows, ensuring uniform spacing between them, covering the seeds with soil, and applying proper compaction for optimal germination and growth. To address the rising demands of a growing population and rapid industrialization, modernizing agricultural practices is essential. This advancement not only improves the efficiency of operations but also increases overall productivity.

Keywords: Smart seed sowing machine, seed spacing, feed rate, crop, fabrication ,etc..

Introduction: The agricultural sector is evolving rapidly with modern innovations. In crop cultivation, seeds are either embedded into the soil, scattered on the surface, or transplanted as seedlings, depending on the soil's moisture and temperature conditions. To maximize yield, it's essential to plant seeds with precision—at the correct depth, spacing, and time. The depth at which seeds are sown is particularly influenced by soil moisture levels and the seeds' ability to germinate effectively.

Farming is a key contributor to India's economic development and any advancement in those area contributes significantly to the country's overall development. Despite its importance, Indian farmers continue to face obstacles such as labor shortages and dependence on outdated farming methods. These challenges highlight the urgent need for smart agricultural solutions that boost productivity, lower costs, and promote sustainability. Traditional farming equipment often demands excessive time and effort, driving up labor expenses. Therefore, upgrading key tasks like seed sowing and fertilizing with modern machinery is crucial. However, conventional seed sowing machines have their limitations—they tend to be costly, hard to obtain in rural areas, and complicated in design. Many come with individual seed storage units for each distributor, increasing both cost and complexity. Their heavy and bulky structures also pose problems when it comes to mobility and transport.

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Traditional Sowing Techniques:

- **Hand Spreading:** Farmers walk through the field and toss the seeds by hand across the soil. It's quick and easy but can lead to uneven spacing.
- **Plough and Seed Drop:** A plough cuts lines into the soil, and seeds are dropped into these lines by hand. Sometimes a funnel is attached to guide the seeds into the furrows more neatly.

- **Hole Planting (Dibbling):** Tiny pits are created in the soil using a stick or implement, and seeds are carefully placed in each one. This method helps keep spacing and depth consistent.
- **Manual Row Seeder:** A special hand-pushed tool is used to plant several rows of seeds at once. It needs some skill to use but makes planting faster and more even. Even though these approaches are frequently applied , they are labor-intensive and time-consuming. Introducing compact, cost-effective, and user-friendly Machines designed for sowing seeds can effectively tackle these concerns, making farming more efficient and accessible for small-scale farmers.

Problem Statement : To meet the increasing need for food in the coming years, farmers must begin using smarter and more efficient ways to plant seeds while reducing waste. Both traditional planting methods and some modern tools still have several problems:

- **Problems with Seed Placement:** Placing seeds correctly in the soil is key to getting a good harvest. When seeds are delayed—whether through pipes or manual planting—their positioning can become uneven. This causes irregular growth and lower yields. The problem gets worse if the soil is too hard or too wet and hasn't been prepared properly.
- **Loss of Time and Efficiency:** Sowing seeds by hand or with inefficient tools requires a significant amount of timeThis delay may cause farmers to miss the best time to plant, especially during seasons with little or unpredictable rain, which can harm overall crop performance.
- **Limitations of Current Tools:** Many of the machines used today for sowing seeds are expensive, hard to use, and not made for small farms. Farmers in developing areas, like those in India, often can't access or operate them easily. These machines also struggle with different soil conditions and might not cover seeds well.
- **Economic Challenges:** High costs for labor and the continued use of old methods make it harder for small farmers to make a profit. This leads to low crop output and greater effort, creating a cycle that limits growth and income.
- **Sensors used to solution of problems**

When using seed sowing machines, issues such as blockages in the sowing pipes, particularly when soil is compacted or contains large particles, can

- significantly reduce productivity. In such cases, various It is possible to use sensors for detecting blockages or soil-related problems that impede The seamless performance of the machine ensuring better performance and minimizing downtime. Below are the key Sensors designed to tackle these challenges:
- **Ultrasonic sensor**: A ultrasonic sensor is a device that measures the distance to an object by using sound waves. It operates by emitting a high-frequency sound pulse (usually around 40 kHz) from a transmitter, which travels through the air it hits an object and reflects back to a receiver. The sensor then calculates the distance to the Blockage based Concerning the time needed for the echo to return, using the known speed of waves in the air (approx 342.99 m/s).Ultrasonic sensors have widespread applications in various applications such as obstacle detection, level sensing, and Automation systems owing to their economical nature, reliable, and can detect objects regardless of their color, texture, or lighting conditions. In agricultural systems like seed sowing machines, ultrasonic sensors can monitor the flow of seeds through pipes and detect blockages by identifying changes or lack of variation in distance measurements, making them an effective tool for real-time monitoring.A blockage would result in an irregular flow pattern. Benefits: Immediate identification of blockages allows operators to take corrective action, reducing downtime and avoiding further disruption to the sowing process .Vibration Sensors: Purpose: Blockages in the pipes or mechanisms often cause

irregular vibration patterns, which can be detected by vibration sensors .Types: Accelerometer Sensors: These sensors measure changes in the acceleration or vibration levels of machine components. A sudden change in vibration might indicate a blockage or mechanical issue. Benefits: Early detection of potential issues helps prevent machine failure and ensures smoother sowing operations .Pressure Sensors: Purpose: These sensors measure the pressure within the pipes and mechanisms of the seed sowing machine. A significant increase in pressure can indicate a blockage or restricted seed flow, while a drop in pressure might suggest a malfunction or leak. Types: Piezoelectric Sensors: Detect pressure changes within the sowing system by generating an electrical charge in response to pressure fluctuations. Capacitive Pressure Sensors: Measure the change in capacitance caused by variations in pressure as seeds or fertilizers flow through the system. Benefits: By monitoring pressure

Equations

1. Normal Seed Flow Detection (Using Ultrasonic Sensor)

Use an ultrasonic sensor (e.g., HC-SR04) to detect whether seeds are moving through a pipe. The basic working equation of the sensor:

$$\text{DISTANCE} = \frac{\text{Time}\times\text{Speed of Sound}}{2}$$

Where:

- Time = Time taken by ultrasonic wave to travel to the seed and back.
- Speed of Sound = 343 m/s at room temperature.
- The division by 2 accounts for the to-and-fro travel.

2. Blockage Detection Logic

Let:

- Dt-Distance at time t
- ΔD- Change in distance

Tb - Blockage detection timeout (e.g., 2–3 seconds)

Condition for blockage:

If $|\Delta D|<\epsilon$ for $t>Tb \Rightarrow$ Pipe Blocked

3. Buzzer Activation

The buzzer (active type) is triggered by the above condition.

If Pipe Blocked⇒Buzzer = ON

Table -1: machine units

Parts			
Wheel	D=40	Black	1
sensors	D=10 to 20 mm	Flow sensor , pressure control	5
chain	25-60	Driven and driven wheel	2
Hopper	1-5kg capacity	Seed filling at a time of sowing	1
pipes	D=20	Seed pipe	2

Following are the parts

1) Hopper
2) Seed Metering Mechanism
3) Seed Tubes (Pipes)
4) Furrow Openers
5) Seed Covering Device
6) Drive Mechanism
7) Press Wheels
8) Frame
9) Ground
10) Wheels

Required Components

- Ultrasonic Sensor (HC-SR04 or similar)
- Active Buzzer
- Microcontroller (Arduino, STM32, etc.)
- Pipes and Sowing Mechanism
- Power Supply (5V or 12V depending on setup)

Vegetable	Obtained Distance between plants (cm)	Obtained Planting depth (cm)
Asparagus	26-34	2-5
Beet	3-7	2-4
Broccoli	40-55	1-3
Cabbage	40-50	1-3
Carrot	3-6	1-3
Cauliflower	44-55	1-3
Corn	12-25	2-4
Okra	28-32	2-4
Onion	4-8	2-4
Pepper	55-65	1-3
Potato	25-30	5-12
Radish	3-5	1-3

Chart -1: Seed Types

Conclusions: The Improvement of Smart Automated Seed Planter represents a significant step forward in addressing the challenges faced by small-scale farmers, particularly in terms of reducing labor, improving seed placement accuracy, and increasing overall efficiency. By incorporating features like adjustable handles, seed metering mechanisms, and the ability to sow both seeds and fertilizers simultaneously, this machine offers a more comfortable, cost-effective, and productive alternative to traditional sowing methods.

The implementation of sensors such as seed flow sensors, soil moisture sensors, and seed depth sensors will further enhance the machine's performance, enabling real-time monitoring and adjustments for optimal seed Position and soil environment. These innovations will empower farmers achieve uniform seed distribution, reduce seed wastage, and optimize crop yields, all while preserving soil health and minimizing environmental impact.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the research, authorship, and publication of this paper. There are no financial or personal relationships that could influence the outcome of this study.

Author Contribution: Prof. V.D. Dhanke contributed to the conceptualization of the project, provided essential resources, and guided the overall development of the Smart Seed Sowing Machine. Kilje P.S. assisted with the design and prototype development, while Mudgal D.D. played a key role in testing, data analysis, and manuscript revision. All authors have reviewed and approved the final version of the manuscript.

References

1. Ahmed. S., Choudhary.S.M. 2015. Design development of low cost seed drill. International Journal of Technical Research and Applications. 3(5): 1–6.
2. Khan. K., Kumar.S.C.M.A. The design and fabrication of a manually operated single row multi-crops planter. IORS Journal.
3. Iqbal. T., Ahmed.M., Siddiqui.B.N., Hussain.Z., Ejaz.M. Design and fabrication of self propelled multi crop seed drill (SMSD) for adoption of small farmers. Balochistan Journal.
4. Thorat. S.V., Kasturi.M.L., Patil.G.V., Patil.R.N. 2017. Design and fabrication of seed sowing machine. International Research Journal of Engineering and Technology. 4(9): 704–707.
5. Rahman. A., Koli.M., Kori.U., Ahmadakbar. 2017. Seed sowing robot. International Journal of Computer Science Trends and Technology. 5(2): 131–143.