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Design and Development of Solar Powered Automated Agriculture Bot

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Abstract: ***The development of a solar-powered seed sowing machine with an integrated pesticide tank aims to address the challenges of traditional farming by enhancing efficiency and sustainability. This innovative machine leverages solar energy to power its components, reducing reliance on fossil fuels and minimizing environmental impact. The machine is equipped with a high-pressure diaphragm pump for precise pesticide application, ensuring optimal pest control while conserving resources. The machine is powered by a 12-volt battery charged by solar panels, ensuring uninterrupted operation even in remote areas without access to the electrical grid.***

The sowing mechanism features a spiked metal wheel and a chain sprocket system designed to ensure seeds are sown at equal distances. This precise seed placement promotes uniform crop growth and maximizes yield. The spiked wheel penetrates the soil to the desired depth, while the chain sprocket mechanism accurately dispenses seeds at regular intervals. Additionally, the inclusion of a pesticide tank and high-pressure diaphragm pump enables simultaneous sowing and pest control. This integrated approach reduces labor and time, making the sowing process more efficient. The high-pressure pump ensures that pesticides are evenly distributed over the sown area, providing effective protection against pests and diseases.

This solar-powered seed sowing machine represents a significant advancement in agricultural technology, offering a sustainable solution to enhance crop production. By utilizing renewable energy, precise mechanical systems, and integrated pest control, the machine reduces operational costs and environmental impact while improving productivity. Its deployment in agricultural practices can lead to more sustainable and efficient farming, contributing to food security and economic development in rural areas. The project highlights the potential of combining renewable energy with innovative engineering to solve critical challenges in agriculture.

Keywords: Solar energy in agriculture, renewable energy in agriculture, automated system in agriculture, seed sowing, pesticides spraying.

I. INTRODUCTION

This project focuses on designing a solar-powered seed sowing machine equipped with a pesticide tank, high-pressure diaphragm pump, PMDC gear motor, 12-volt battery, spiked metal wheel, and a chain sprocket mechanism to ensure precise and equal-distance seed sowing. The primary objective of this project is to develop a sustainable and efficient seed sowing system that minimizes human labor and maximizes productivity. The proposed solar-powered seed sowing machine addresses these challenges by leveraging renewable energy and automation to deliver a more consistent and reliable sowing process.

The core of the machine's operation is its solar power system, which harnesses energy from the sun through photovoltaic panels to charge a 12-volt battery. This battery powers the PMDC (Permanent Magnet Direct Current) gear motor, which drives the mechanical components of the machine, including the spiked metal wheels and the chain sprocket mechanism. The use of solar power not only reduces the dependence on fossil fuels but also makes the machine more environmentally friendly and cost-effective in the long run. The inclusion of a high-pressure diaphragm pump connected to a pesticide tank allows the machine to perform dual functions: sowing seeds and applying pesticides simultaneously.

The spiked metal wheels play a crucial role in the sowing mechanism, as they penetrate the soil at equal intervals, ensuring that seeds are sown at consistent depths and distances.

In summary, the solar-powered seed sowing machine represents a significant advancement in agricultural technology. By combining solar energy, automated seed sowing, and pesticide application, this innovative solution promises to increase efficiency, reduce labor costs, and promote sustainable farming practices. This project not only addresses the immediate needs of farmers but also contributes to the broader goals of environmental conservation and food security.

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II. PROBLEM STATEMENT

Modern agriculture faces significant challenges, including labor shortages, increasing operational costs, and environmental concerns due to excessive use of fossil fuels and pesticides. Traditional seed sowing methods are labor-intensive and often result in uneven seed distribution, affecting crop yield and efficiency. Additionally, the manual application of pesticides is both time-consuming and hazardous to farmers' health.

The project aims to address these issues by developing a solar-powered seed sowing machine with an integrated pesticide spraying system. The machine will utilize solar energy to operate, reducing dependency on non-renewable energy sources and lowering operational costs. The inclusion of a high-pressure diaphragm pump and dual brass nozzles will ensure precise and efficient pesticide application, minimizing waste and environmental impact.

The machine's design will feature a PMDC gear motor powered by a 12-volt battery, ensuring reliable performance in various field conditions. Spiked metal wheels will provide stability and traction, while a chain sprocket mechanism will facilitate consistent seed spacing, improving crop uniformity and yield.

III. OBJECTIVE

The objective of this project is to design and develop a solar-powered seed sowing machine equipped with a pesticide tank and an integrated high-pressure diaphragm pump. This innovative agricultural tool aims to enhance the efficiency and precision of seed planting and pesticide application, thereby promoting sustainable farming practices. The key components of the machine include:

Solar Power System, Pesticide Tank and High-Pressure Diaphragm Pump, Brass Nozzles, PMDC Gear Motor, 12 Volt Battery, Spiked Metal Wheels, Chain Sprocket Mechanism

By integrating these components, the solar-powered seed sowing machine aims to:

Improve planting efficiency and reduce manual labor by automating the seed sowing process.

Enhance the accuracy and consistency of seed placement, leading to better crop emergence and growth.

Promote sustainable agricultural practices using renewable solar energy.

Reduce the environmental impact by minimizing the use of chemical pesticides and optimizing their application.

Increase the productivity and profitability of farmers by providing a cost-effective and efficient solution for seed sowing and pesticide application.

IV. METHODOLOGY

1) System Design and Component Selection
2) System Integration and Assembly
3) Control and Automation
4) Testing and Calibration
5) Documentation and Finalization

For this project work we used different components such as:

- DC motor
- Wheels
- Solar Panel
- Diaphragm pump

A. DC motor

A PMDC (Permanent Magnet Direct Current) gear motor with specifications of 25 RPM and 12 volts is ideal for agriculture seed sowing applications. This motor provides precise control and sufficient torque to drive the seed sowing mechanism, ensuring consistent seed placement at equal distances. The low RPM ensures that seeds are sown at an optimal speed, preventing damage and ensuring uniform distribution. Its 12-volt operation makes it compatible with common battery and solar power systems, enhancing its utility in remote agricultural settings. Additionally, its durability and efficiency make it suitable for prolonged field operations.

Here we are using 1 DC motors

Features: RPM=25 rpm

DC motor Voltage-12V

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B. Wheels

The nails spike metal wheel is a crucial component in agricultural seed sowing machines, designed to improve traction and soil interaction. Below are detailed aspects of its construction:

1) Material

Steel or Iron: The wheel is typically made of durable metals like steel or iron to withstand the harsh conditions of agricultural fields.

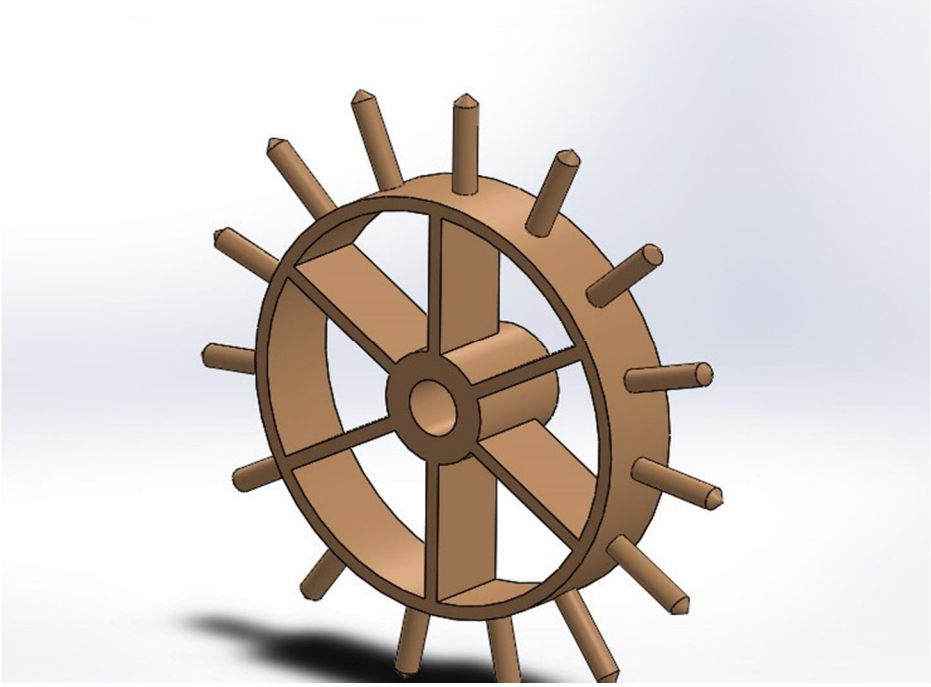
2) Spikes

Nails or Studs: Spikes made of hardened steel are welded or bolted onto the wheel's surface.

3) Diameter and Width

Diameter: Generally, the wheels are between 12 to 24 inches in diameter, providing a balance between stability and maneuverability.

Width: A width of 2 to 4 inches ensures sufficient surface area for stability while allowing the spikes to dig into the soil effectively.



C. Solar panel

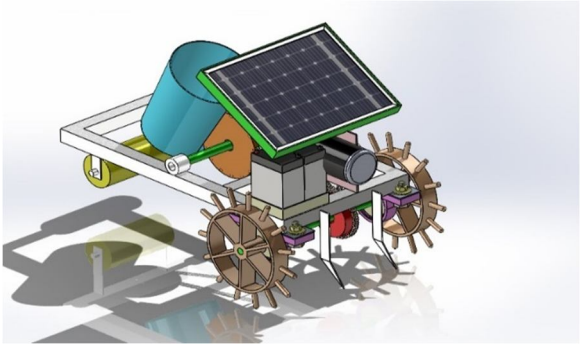
A 2.5-watt, 4.9-volt solar panel is well-suited for small-scale agricultural applications such as seed sowing machines. This solar panel can power low-energy devices, including a PMDC motor used in seed sowing mechanisms. It harnesses solar energy to drive the motor, which ensures consistent seed placement without relying on external power sources. The compact size and efficiency of the panel make it ideal for field use, promoting sustainable farming practices by reducing dependency on fossil fuels and minimizing operational costs. The panel's renewable energy source is particularly advantageous for remote or off-grid agricultural areas.

D. Diaphragm pump

A 12V diaphragm pump is an essential component for a pesticide spraying system in an agricultural seed sowing machine. This pump is designed to generate high pressure and ensure a consistent flow rate, making it ideal for delivering pesticides through brass nozzles. The diaphragm pump operates by using a flexible diaphragm that oscillates, creating a suction and discharge action to move the liquid.

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CAD model



Fig(a)

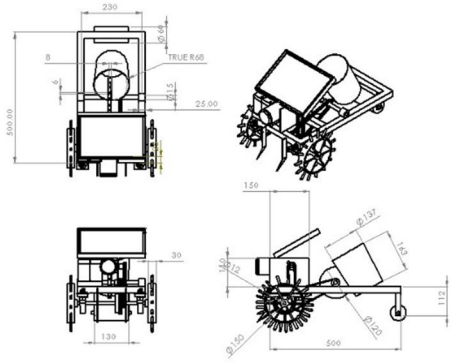


Fig (b)

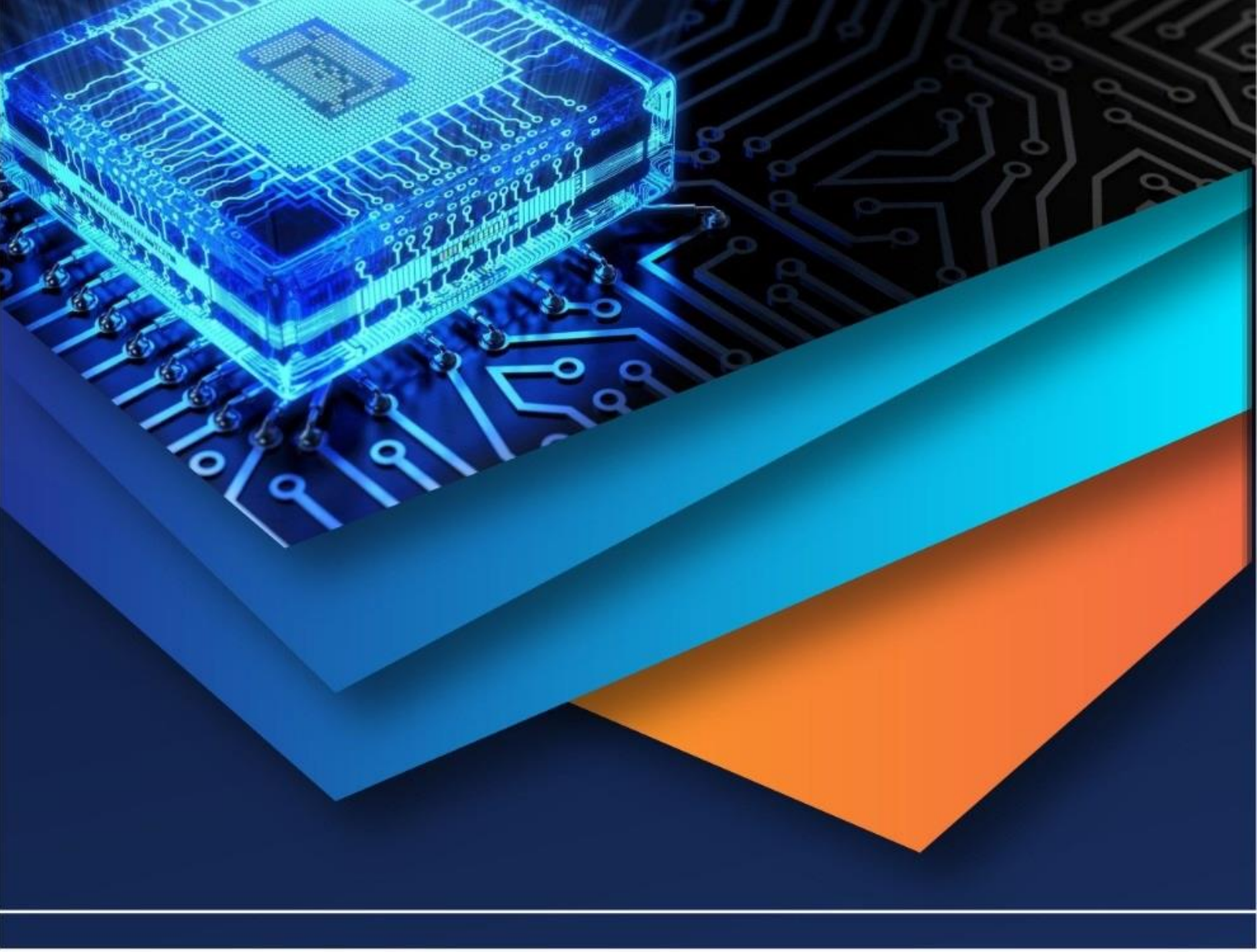
V. CONCLUSION

Hence, we have successfully completed the project on a 'Solar powered Automated Agriculture Bot' by using components such as DC motos, Solar panel, Battery, Chain drive, Diaphragm pump, Wheels. Hence the the machine will perform agricultural operations like seed sowing, pesticide spraying in efficient way using renewable energy.

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These sources provide comprehensive insights into the development, design, and implementation of solar-powered seed sowing and pesticide spraying machines, highlighting their potential to enhance agricultural efficiency and sustainability.



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