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Solar Operated Multi-Functional Agricultural Vehicle

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ABSTRACT: The Solar Operated Multi-functional Agricultural Vehicle (SMAV) embodies a cutting-edge approach to sustainable farming practices by integrating renewable energy, electric propulsion, and advanced agricultural capabilities. Equipped with solar panels for power generation, electric motors for propulsion, and versatile attachments for various agricultural tasks, SMAVs offer a comprehensive solution to modern agricultural challenges. Precision agriculture technologies, including GPS, sensors, and automated control systems, further enhance productivity and resource efficiency, enabling farmers to optimize crop management practices for higher yields and reduced environmental impact.

I. INTRODUCTION

Solar Power Generation: The vehicle is equipped with solar panels mounted on its surface to capture sunlight and convert it into electricity. These panels may be integrated into the vehicle's structure or deployed as removable modules for flexibility.
Electric Drive System: SMAVs typically utilize electric motors for propulsion, powered by the electricity generated from the onboard solar panels. This eliminates the need for fossil fuels and reduces greenhouse gas emissions associated with traditional combustion engines.
Versatile Attachments: The vehicle can be equipped with various attachments and implements to perform a wide range of agricultural tasks, including plowing, seeding, planting, fertilizing, spraying, harvesting, and transporting crops.
Precision Agriculture: SMAVs may incorporate advanced technologies such as GPS, sensors, and automated control systems to enable precision agriculture practices. This allows for precise application of inputs (such as seeds, fertilizers, and pesticides) and optimized crop management, resulting in higher yields and resource efficiency.
By implementing this project we can eliminate a lot of difficulties in agriculture sector. The system runs on solar power which is the cleanest energy in the world. Crop cultivating machines have become very popular today. Most common machines are used for soft grass furnishing. It is placed in a suitable machine structure. The motor has 1000 RPM and it is connected to the electric supply by the use of a roll of wire. The motor rpm increased by the help of gears.
Motor controlled by an electric switch for easy operation. The machine will be controlled by smart phone. The system is like a moving robot having four wheels and the cultivator is attached to back side of the robot. The seed sowing system is mounted on the on the robot. The water pump and the water tank is mounted on the system and can be control wirelessly. These features makes the system is perfect for the farming.

II. PROBLEM STATEMENT

- Energy Dependence: Conventional agricultural vehicles rely heavily on fossil fuels, leading to high operating costs and environmental pollution.
- Limited Access to Electricity: Many agricultural areas lack access to reliable electricity, hindering the adoption of electric vehicles or machinery.
- Labour Intensive Operations: Traditional farming methods often require significant manual labor, leading to inefficiencies and labor shortages.
- Environmental Impact: Agricultural practices can contribute to soil degradation, water pollution, and greenhouse gas emissions, necessitating sustainable solutions.

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- Equipment Versatility: Farmers require versatile machinery capable of performing various tasks such as plowing, planting, harvesting, and transportation.
- Farming is a very tough work to do.
- Cultivation is very expensive.
- No portable means of watering is available.
- Seed sowing is done manually.
- Soil flattering and crop cutting is also manual time consuming and a very hard work to do.

III. OBJECTIVES

The objective of the Solar Operated Multi-functional Agricultural Vehicle (SMAV) concept is to revolutionize farming practices by promoting sustainability, efficiency, and productivity.

- Enhance Agricultural Productivity: The SMAV aims to improve agricultural productivity by offering a range of functions to assist farmers in various tasks such as plowing, planting, spraying, harvesting, and transportation of crops.
- Reduce Environmental Impact: By utilizing solar power as a primary energy source, the SMAV aims to reduce dependence on fossil fuels and minimize greenhouse gas emissions associated with traditional agricultural machinery.
- Cost Savings: The use of solar energy can lead to significant cost savings for farmers by reducing fuel expenses and maintenance costs associated with conventional diesel-powered machinery.
- Versatility and Adaptability: The SMAV is designed to be versatile and adaptable to different agricultural tasks and environments

IV. MODE SETUP AND MATERIAL

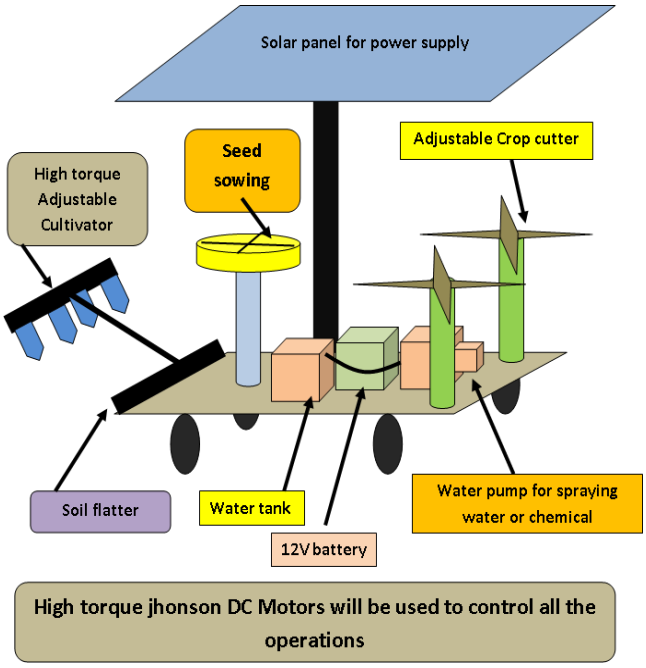

Figure 1: Structure representation of Solar Operated Multi-functional Agricultural

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V. MODEL WORKING

- The machine will be a moving robot having four wheels and everything is attached to the machine.
- The system will use cultivator to cultivate the field which is attached to the back side of the robot.
- Cultivator can be move up and down with the help of rack and pinion and motors.
- Soil flatter will used to flat the soil.
- Two high RPM 12V drill machine will be modified and used with cutting blades to cut the crop.
- We used seed sowing system that is mounted on the robot.
- We can use solar panel and battery for power supply. And whole system will work on solar energy. We can also use 12V adaptor.
- Water pump and water tank is also mounted on the system for proper watering can be done.

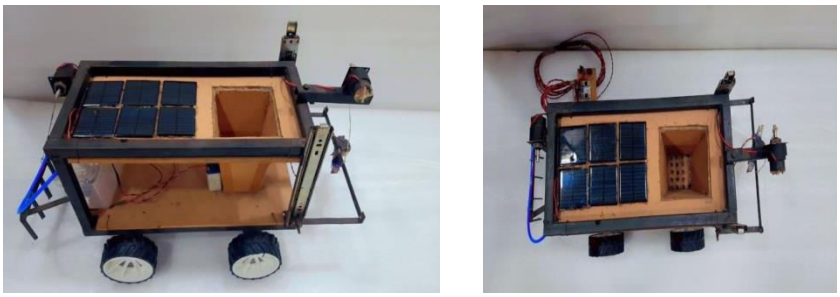

Figure 2: Solar Operated Multi-functional Agricultural Vehicle (SMAV)

VI. FORMULAE

Good science project does not stop with building a motor. It is very important to measure different electrical and mechanical parameters of your motor and calculate unknown values using the following helpful formulas. We will use the International System of Units (SI). This is modern metric system that is officially accepted in electrical engineering in the USA. One of the most important laws of physics is the fundamental Ohm's Law. It states that current through the conductor is directly proportional to applied voltage and is expressed as:

$$I = V / R$$

where I – current, measured in amperes (A);

V – applied voltage, measured in volts (V);

R – resistance, measured in ohms (Ω).

This formula could be used in many cases. You may calculate the resistance of your motor by measuring the consumed current and applied voltage. For any given resistance (in the motors it is basically the resistance of the coil) this formula explains that the current can be controlled by applied voltage.

The consumed electrical power of the motor is defined by the following formula:

$$Pin = I * V$$

where

P_{in} – input power, measured in watts (W);

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I – current, measured in amperes (A);

V – applied voltage, measured in volts (V).

Motors supposed to do some work and two important values define how powerful the motor is. It is motor speed and torque – the turning force of the motor.

Output mechanical power of the motor could be calculated by using the following formula:

$$P_{out} = \tau * \omega$$

Where,

P_{out} – output power, measured in watts (W);

τ – torque, measured in Newton meters (N•m);

ω – angular speed, measured in radians per second (rad/s).

It is easy to calculate angular speed if you know rotational speed of the motor in rpm:

$$\omega = rpm * 2\pi / 60$$

where ω – angular speed, measured in radians per second (rad/s);

rpm – rotational speed in revolutions per minute; π – mathematical constant pi (3.14).

60 – number of seconds in a minute.

If the motor has 100% efficiency all electrical power is converted to mechanical energy. However such motors do not exist. Even precision made small industrial motors such as one we use as a generator in generator kit have maximum efficiency of 50-60%. Motors built from our kits usually have maximum efficiency of about 15% (see Experiments section on how we estimated this). Don't be disappointed with 15% maximum efficiency. All our kits are intended for education and not designed for real applications. This efficiency is not bad at all – it is actually much better than most of other self-made designs on Internet can provide. The motors have enough torque and speed to do all kinds of experiments and calculations. Measuring the torque of the motor is a challenging task. It requires special expensive equipment. Therefore we suggest calculating it. Efficiency of the motor is calculated as mechanical output power divided by electrical input power:

$$E = P_{out} / P_{in}$$

$$\text{Therefore } P_{out} = P_{in} * E$$

After substitution we get $\tau * \omega = I * V * E$

$\tau * rpm * 2\pi / 60 = I * V * E$

and the formula for calculating torque will be $\tau = (I * V * E * 60) / (rpm * 2\pi)$

Connect the motor to the load. Using the motor from generator kit is the best way to do it. Why do you need to connect the motor to the load? Well, if there is no load – there is no torque. Measure current, voltage and rpm. Now you can calculate the torque for this load at this speed assuming that you know efficiency of the motor.

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π – mathematical constant pi (3.14). 60 – number of seconds in a minute.

Efficiency of the motor is calculated as mechanical output power divided by electrical input power:

E = Pout / Pin therefore

Pout = Pin * E

After substitution we get $\tau * \omega = I * V * E$

$$\tau * rpm * 2\pi / 60 = I * V * E$$

and the formula for calculating torque will be $\tau = (I * V * E * 60) / (rpm * 2\pi)$

VII. CONCLUSION

The Solar Multi-functional Agricultural Vehicle (SMAV) concept represents a significant advancement in sustainable farming practices, integrating renewable energy, electric propulsion, and advanced agricultural technologies. By harnessing solar power for electricity generation and employing electric motors for propulsion, SMAVs offer a cleaner and more efficient alternative to traditional fossil fuel-powered vehicles. The versatility of SMAVs, combined with precision agriculture technologies, enables farmers to optimize crop management practices, increase productivity, and reduce environmental impact. As the demand for sustainable food production continues to grow, SMAVs stand as a promising solution to meet the challenges of modern agriculture while promoting environmental stewardship and resource efficiency.

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