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Solar Powered E-Car

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Abstract*: The basic idea behind a solar electric car is to utilise the power that is stored in a battery both during and after a solar panel charge. Due to the fact that they don't release any greenhouse gases or other pollutants while in operation, solar automobiles are made with environmental protection in mind. Solar-powered cars have the ability to rapidly minimize the demand on fossil fuels, which would slow their depletion and reduce the negative effects of climate change. In this project, we'll investigate how a charge controller can be used to control the flow of electricity produced by a solar panel array into a battery pack. The stored energy will subsequently be used to power a PMS motor, which will drive the car. The direction and speed of the car's movements will be under our control via a motor controller. Additionally, we'll talk about the procedure for assembling the car's mechanical components. Finally, we'll demonstrate how to attach the electrical system to the car's mechanical frame.
Keywords: solar E-car, charge controller , solar panels design , solar panel calculations , working overview of solar E-car

I. INTRODUCTION

The search for a reliable, clean, safe, and environment-friendly fuel never ends. Fossil fuels and other carbon-based fuels are unsustainable and dangerous for the environment. Alternatives to fossil fuels include biomass, the sun, wind, tides, hydropower, and renewable energy sources, which cover all fuel types and energy carriers. Solar energy is the chosen source among these since it might deliver the cleanest sustainable energy for the longest time—the next few billion years. Since 2002, photovoltaic production has grown by an average of 48% annually, doubling every two years. The world's fastest-growing energy technology is now PV systems because of their numerous advantages in the environmental, economic, and social communities. One may argue that the main obstacle to the widespread use of solar energy as a source of energy is our inability to create equipment that is both efficient and affordable. Despite the fact that nothing on earth is free, what if we could adopt free rides? Yes, it would be amazing if we could keep our automobiles running without having to spend billions of dollars annually on fossil fuels and cope with the environmental problems that their combustion leaves behind. That automotive fantasy would come true if we could travel in a solar-powered car. Solar panels on solar cars would be used to collect energy from the sun. A solar panel is a bundled, interconnected collection of photovoltaic cells, also known as solar cells, which are solid-state electronics capable of directly converting solar energy into electrical energy through quantum mechanical transitions. They produce no noise or pollution, have no revolving parts, and require no maintenance. The battery that powers the car's motors would then be fueled by the electricity thus produced. As a result, we would have an electrically powered car that runs on "free" energy, emits no harmful gases, can travel at any speed, and requires very little upkeep.

II. LITERATURE SURVEY

In 1980, Arye Braunstein and his coworkers at Tel Aviv University's engineering department in Israel developed a solar vehicle. The solar automobile has a 432 cell solar panel on the roof and the hood that could produce 400 watts of peak power. To store the photovoltaic energy, the solar car has 8 batteries, each with a voltage of 6 volts.

Since this time, various solar cars have been developed at universities for competitions like the Shell Eco Marathon. The GM Sun Racer completed an 1866-mile journey in 1987 at an average speed of 42 mph.

The Venture Astrolabe is another solar E-car that is offered for sale. Technology employed by solar cars is typically found in the aerospace, bicycle, alternative energy, and auto industries.

As opposed to solar thermal energy, which transforms solar energy into heat for other domestic or commercial uses, or to be turned into electricity. In strictly covert PV cells, electrons are excited and allowed to move, generating an electric current. PV cells directly convert sunlight into electricity. Silicones and indium, gallium, and nitrogen alloys are just a couple of the semiconductor materials used in the construction of PV cells.

Semiconductor materials like silicones and indium, gallium, and nitrogen alloys are used to create PV cells. The most often used material, silicon, has an efficiency of 15 to 20 percent.

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There is a shortage of fuels made with carbon, and they are also bad for the environment. Since solar energy offers clean, secure, and sustainable energy, it is chosen as an option. Among other forms of energy, solar energy provides a plethora of advantages. We are working on a project to power the E-car entirely with solar energy rather than with other fossil fuels; this makes the solar E- car completely eco-friendly and superior to combustion engines in every way.

III. WORKING OF BLOCK DIAGRAM

Instead than relying on fossil fuels, the solar car is carried by a PMSM motor supplied by a DC battery. The batteries are charged using solar energy, which could increase how effective the electric car is overall. A plug-in charger can also be used to charge the batteries using an external power source.

The Solar E-Car essential parts are as follows:

1) PMS motor
2) PMS motor Controller
3) Battery pack
4) Solar panels

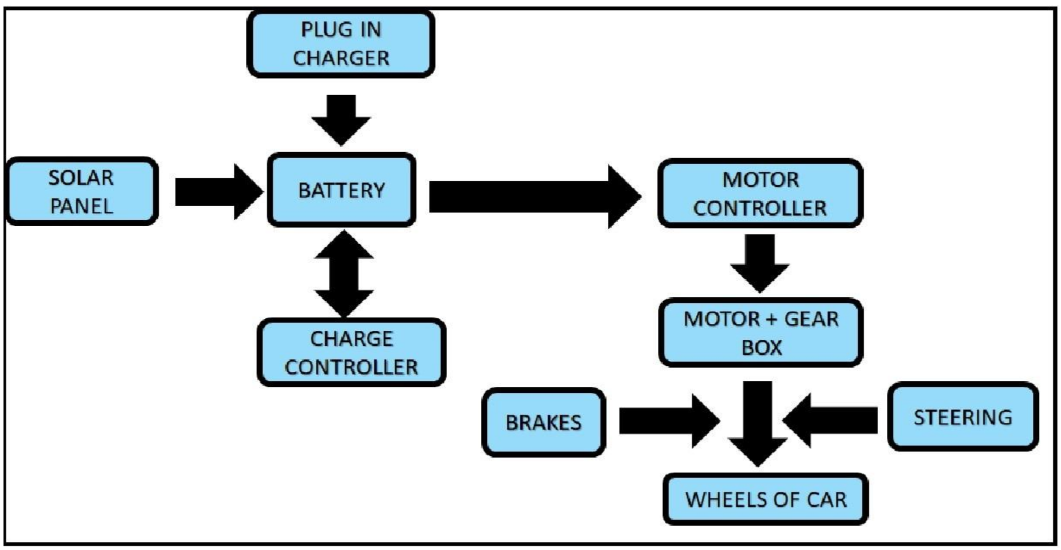

Figure 1. Block Diagram

Through the charge controller, the solar energy gathered by the solar panels is used to charge the batteries; alternatively, we can use a plug-in charger to charge the batteries. Through a speed controller, the electric motor is driven by the batteries charged energy. According on the position of the speed throttle, the speed controller determines how much power should be sent to the motor. When the acceleration throttle is fully depressed, the motor receives its entire rated output; when it is released, the output is zero volts. The car's gearbox, which provides mechanical power to the wheels' shafts, is attached to the motor.

IV. DESCRIPTION AND THEIR FUNCTION OF EACH COMPONENT

A. PMS Motor

The stator and rotor of a synchronous motor are essentially the same as those found in rotating alternators. Stators have three-phase balanced windings, but instead of windings, permanent magnets installed on the rotor are used to excite the revolving magnetic field. It operates on the idea of magnetic locking.

B. Motor Controller

High dynamic performance, protection uniformity, and efficiency are every feature of PMSM motors. Less noise and smooth torque are produced. The PMSM motors' torque and speed are controlled via field-oriented control (FOC).Due to its advantages over other conventional motors, PMSM and BLDC are extremely ideal for driving E-car in all respects.

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Figure 2.Motor and motor controller

C. Battery Charging Time - When It Is Charged Through An E Charger

Figure 3. E- Car Charger

Battery capacity = 100Ah Charge current rating = 15A Charger voltage = 60 V
E-Car (Lead Acid battery over all efficiency) = 80-85 %
Charge period = (Battery power in amper-hour x DOD) / (Charge flow in Amps x Efficiency of the charge)
= (100 x 50%) / (15 x 85%)
= 3.92 hours
= 4 hours Approx

D. Charge Controller

The charge controller is a tool that stops overcharging and over-discharging of solar batteries. Batteries cannot be overly drained or overly recharged, which is one of their most prevalent issues. By correctly controlling the battery voltage and current, a charge controller regulates the charge. Charge controllers are designed to maintain the solar system's effectiveness while protecting the battery and giving it the longest feasible life. The fact that charge controllers only manage DC loads should be noted.

V. BATTERY AND SOLAR PANEL CALCULATIONS

1) To calculate battery capacity in watt hours, multiply battery voltage by battery amp hours. Battery capacity thus equals 12 × 100 x 5 = 6000 Wh.
2) To determine how much of the battery's capacity has been depleted, multiply battery watt hours by battery depth of discharge.
3) Assume the battery is 50% drained.
4) After then, the discharged battery capacity (Watt-Hour) is equal to 6000 x 50%=3000 (Watt-Hour).
5) To calculate the amount of energy needed to fully charge the battery after accounting for charging losses, divide the capacity of the battery after it is depleted by the battery's rule-of-thumb charge efficiency factor (lead acid: 85%; lithium: 99%).
6) Assume for the moment that we utilise lead-acid batteries. Secondly, at 85% efficiency
7) The energy needed for a complete charge is hence 3000 x 85% = 3529 Wh (watt-hour).
8) To estimate solar output, multiply the wattage of the solar panels by the charge controller's efficiency (PWM: 75%; MPPT: 95%).

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9) We are utilising an MPPT charge controller and a 200W solar array. Thus, solar output is equal to 200 x 0.95 = 190 W.
10) To account for system losses, multiply the solar output by 100% minus a certain percentage.
11) I'll use the default value for system losses from the PV Watts Calculator at the National Renewable Energy Laboratory, which is 14.08% in this case.
12) 190 x (100% - 14.08%) = 163.248 W is the adjusted solar output.
13) To calculate your projected charge time, divide the amount of energy needed to fully charge the battery (in watt hours) by the modified solar output (in watts).

Charge Time thus equals 3529/163.248 =21.86 hours

VI. BATTERY AND SOLAR PANEL DESINGING

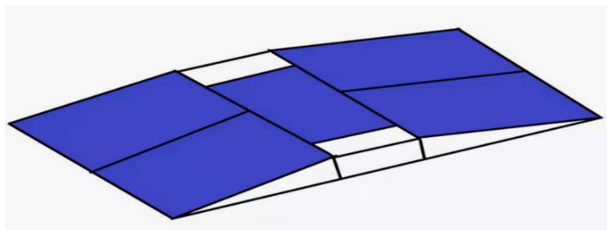

Figure 4. Solar Panel Design

Figure 5. Solar Panel Output Design

VII. BATTERY CHARGING TIME -WHEN IT IS CHARGED THROUGH AN SOLAR PANEL

In a similar manner, the charging time is determined and will be as follows if the battery is to be charged from 100% of DOD, Watt-hours in a discharged battery equal 6000 x 100%= 6000 Wh.

Charge Time: 5100/163.248 = 31.24 hours

Energy Required: 6000 x 85% = 5100 Wh

Charge Required: 5100 Wh

VIII. CIRCUIT DIAGRAM

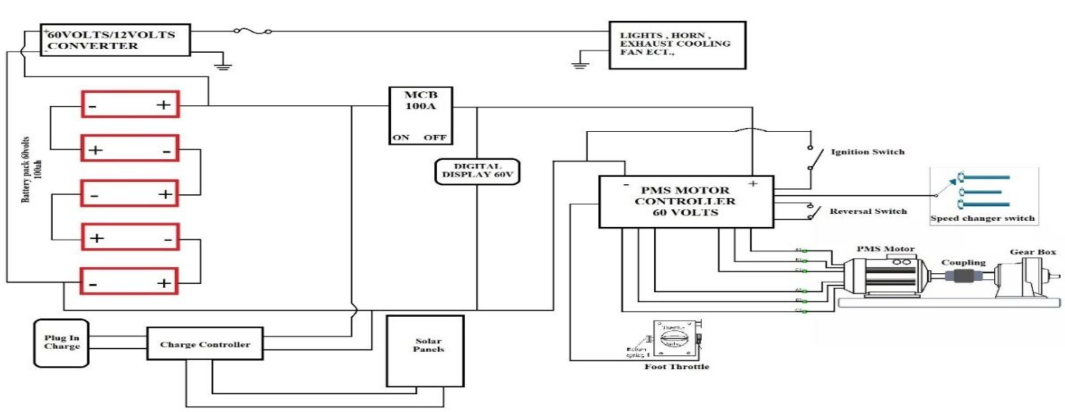

Figure 6.Circuit Diagram

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Through the employment of a charge controller, the batteries are charged with the help of the 200-watt solar panels. Under moderate sunlight, the batteries may be charged in around 37 hours. The battery pack can also be charged quickly using a plug-in charger; this process takes the batteries about 3 hours. A PMSM motor is powered by a controller using five 12-volt, 100-amp-hour batteries connected in series. For protection, an MCB is installed between the batteries and PMSM controller. According to the acceleration throttle position, the controller delivers the necessary output power, and the motor is connected to the car's gearbox, which transmits mechanical power from the PMSM drive to the wheels' shafts.

Figure 7. Overview Of The Car

Attach the engine to a 4-speed gearbox coupler and fit it to the gearbox using the pressure plate, clutch plate, and flywheel after removing any unneeded parts of the automobile, such as the gasoline tank and the silencer.By doing this, we can convert our combustion engine into an electrical one that uses less energy and runs more quickly and effectively. This car has series-connected lead-acid batteries with a 12V and 100ah capacity, a 3000w PMS motor, and a 100ah controller. On road testing of this car produced great results. Due to the use of lead acid batteries, the solar E-car has a range of 50 to 60 kilometres and a top speed of 60 km/h with 4 passengers. Its gross weight is 800 kg.The manual gear mechanism provides the essential torque needed for movement while increasing the motor's rpm from 3000 to 6000. electric current flowing from a solar panel array into a battery pack. Thereafter, the previously saved energy will be used to power a PMS motor.

IX. CONCLUSION

The project's aim is to create a less expensive Solar-Powered E-Car. The aim is that the solar-powered E-car is intended for a range of about 50-60 kilometres. Because it lacks of harmful gases and other pollutants, the solar car is very cost-effective for contemporary mobility.

REFERENCES

[1] "Global EV Outlook 2020 - Prospects for electrification in transport in the coming decade (Technology report)," International Energy Agency, 2020. https://www.iea.org/reports/global- ev-outlook2020#prospects-for-electrification-in-transport-in-the-coming-decade (accessed Sep. 14, 2020).
[2] Permanent-Magnet Synchronous Machine Drives Adhavan Balashanmugham and Mockaisamy Maheswaran.
[3] Permanent Magnet Synchronous and Brushless DC Motor Drives R. Krishnan Electrical and Computer Engineering Department Virginia Tech Blacksburg, Virginia, U.S.A
[4] T. Nazghelichi, F. Torabi, V. Esfahanian, Prediction of temperature behavior of a lead- acid battery by means of Lewis number, Electrochim. Acta 275 (2018) 192–199, doi: 10.1016/J. ELECTACTA.2018.04.092.
[5]]. P. Krivík, Changes of temperature during pulse charging of lead acid battery cell in a flooded state, J. Energy Storage 14 (2017) 364–371, doi: 10.1016/J.EST.2017.03.018.
[6] Chopra, K.L., Paulson, P.D. and Dutt, V. (2004) Thin-Film Solar Cells: An Overview. Progress in Photovoltaics, 12, 69-92. http://dx.doi.org/10.1002/pip.541
[7] Retrieved from: http://dspace.bracu.ac.bd/xmlui/bitstream/10361/9118/12221046%2C%2EE.pdf
[8] Suresh V 2019Forecasting solar PV output using convolutional neural networks with a sliding window algorithm. Retrieved from: https://www.mdpi.com/1996-1073/13/3/723

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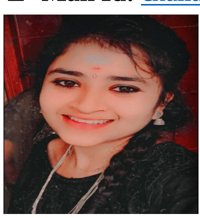

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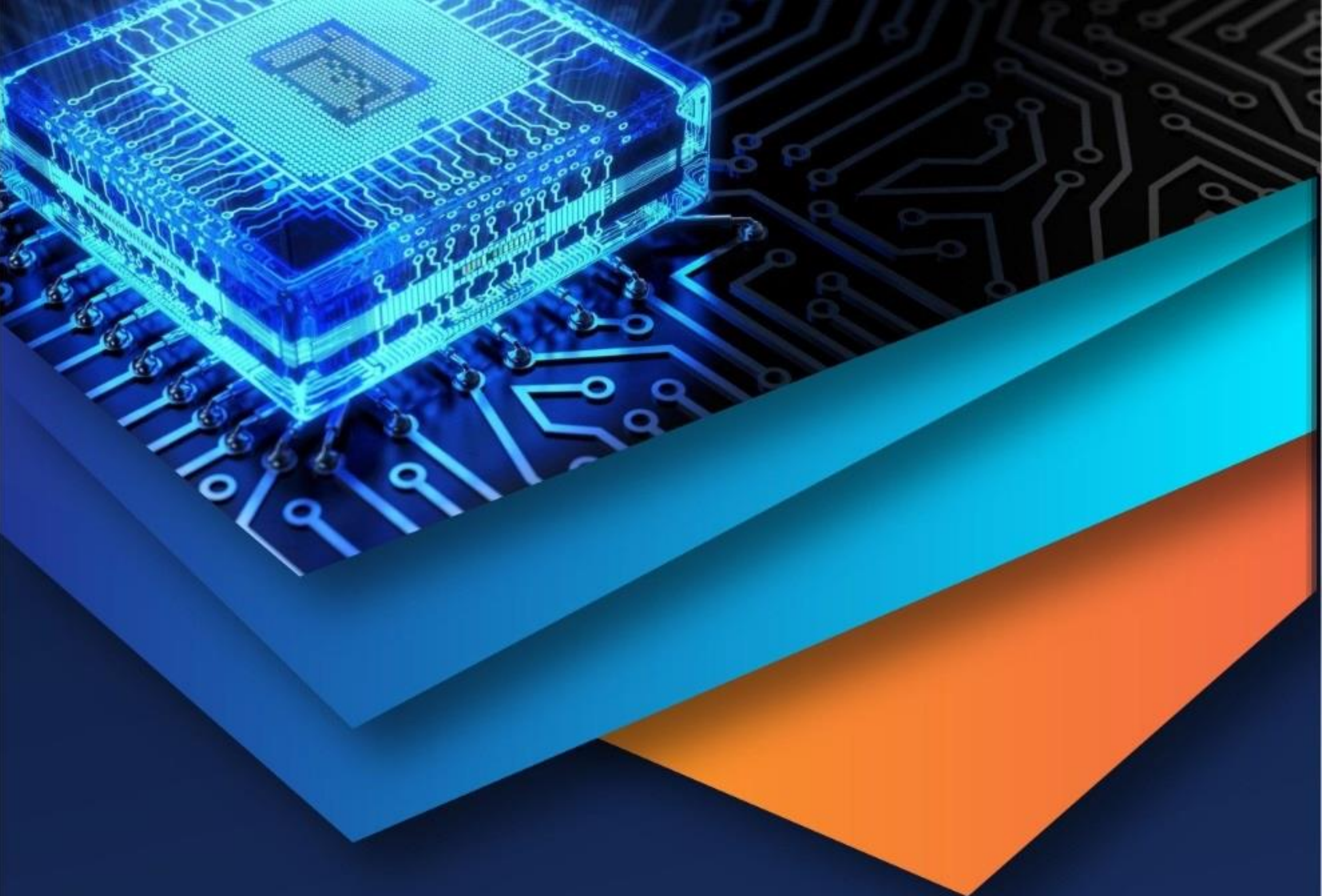

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