Design and Fabrication of Electric System for Solar Powered Electric Vehicle

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Abstract- **The focus of this paper is to introduce the development of a solar-powered electric vehicle, which serves as a solution to the critical environmental issues of greenhouse gas emissions and limited fossil fuel resources. The utilization of a battery in electric vehicles is crucial in reducing fuel consumption rates and pollution levels. The solar-powered electric vehicle (SPEV) makes use of photovoltaic (PV) panels that capture sunlight radiation and convert it into electrical power. This power is used to charge the vehicle's battery, which can also be charged from an external power source. MATLAB Simulink is used to simulate the speed controller.**

Keywords: **- BLDC Motor, Solar panel, Motor Controller, Battery.**

INTRODUCTION

The world is facing a major engineering challenge in finding clean and sustainable sources of energy as it heavily relies on natural gases and coal for generating electricity. To overcome this issue, solar energy is being extensively researched as a potential solution. Solar panels are being developed to collect solar energy, which has been traditionally considered as inefficient, making it impractical to replace fossil fuels. However, recent advancements in solar panel technology are increasing its efficiency, making it a more viable option[1]. The advancements in materials have opened up new avenues for utilizing solar energy as a sustainable source to meet society's energy demands. Solar-powered vehicles are one such example of harnessing solar energy for practical use. These vehicles rely on photovoltaic cells (PVC) to capture and convert solar energy into electric energy, which powers the motor. The solar cells are directly installed on the vehicle and can power the motor using appropriate arrangements [2]. The manufacturing and production of electric vehicles (EVs) are rapidly evolving and hold great potential for environmental, technical, and economic benefits in the future. The production of carbon dioxide (CO2) resulting from the use of fossil fuels is a major contributor to climate change, and therefore, finding alternatives is of great importance. In addition, there are economic challenges related to the use of battery bank storage in automotive systems that must be addressed. These challenges are among the many factors driving the development of EV technology.[3]. Renewable energy resources are increasingly being considered as a promising technology for the EV industry and the transportation sector. They have the potential to charge the EV batteries, thereby increasing their lifetime and reliability. The use of renewable resources instead of traditional electrical grids to power EVs can improve the overall system efficiency and reduce harmful environmental emissions. This shift towards renewables is driven by the need for sustainable solutions and a cleaner environment. [4]. Compared to other renewable resources, photovoltaic (PV) panels have gained recognition as a competitive energy source for charging EVs. PV systems have become increasingly popular as the primary source of energy for charging EV batteries due to several advantages. These include lower maintenance and operation costs, lower greenhouse gas emissions, and the ability to operate independently of other energy sources. These benefits have made PV systems a preferred choice for charging EVs and promoting sustainable transportation.[5]. Batteries can be charged using PV charging stations, which are suited for a variety of applications and situations. Typically, these charging stations operate during the daytime when the EV is parked in the designated parking area. This approach provides several benefits, including cost savings, load demand shifting, and reduced CO2 emissions. By utilizing PV charging stations, we can promote the use of sustainable energy sources and contribute towards a greener future.

HARDWARE MODEL

Fig-Hardware model

Solar panels on the roof or body of the vehicle capture sunlight and convert it into electrical energy through a process called photovoltaic conversion. The electrical energy is then transferred to the vehicle's battery. The battery stores the electrical energy and can be used to power the electric motor of the vehicle. When the vehicle is in motion, the electric motor draws power from the battery to drive the wheels. The solar panels continue to capture sunlight and convert it into electrical energy while the vehicle is in motion. This energy can be used to charge the battery, or to power auxiliary systems When the vehicle is parked, the solar panels can continue to generate electricity and charge the battery.

SIMULATION OF SPEED CONTROLLER

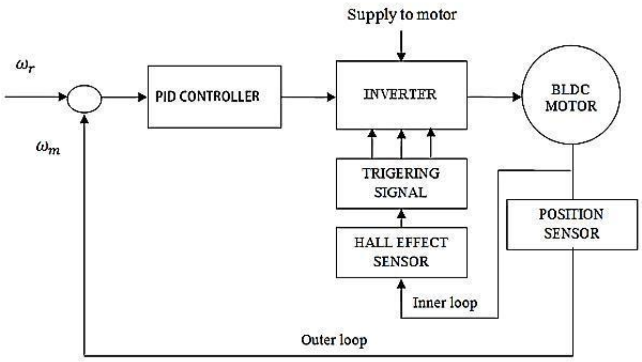

Fig -Block Diagram of BLDC Motor Speed Controler

A 3-phase brushless DC (BLDC) motor utilizes six electronic switches (power transistors) to generate three-phase voltage to a full-bridge configuration power converter. The switching sequence of the transistors is determined by the rotor position. Typically, motor starters are monitored using three hall sensors, which provide information to the decoder block for generating the reference current signal vector to the back electromotive force (BEMF). To operate the motor in the opposite direction, the current must be reversed or the switching order of the controller changed.

The performance of the proposed PID controller for a BLDC motor operating at 2500 rpm is shown in the figure below. The X and Y axes represent time in seconds (sec) and the speed (rpm) of the BLDC motor under no-load conditions, respectively. The figure indicates that the settling time of the controller is approximately 0.018 sec with minimal overshoot and undershoot. After 0.018 sec, the motor runs at a constant speed of the preset value of 2500 rpm.

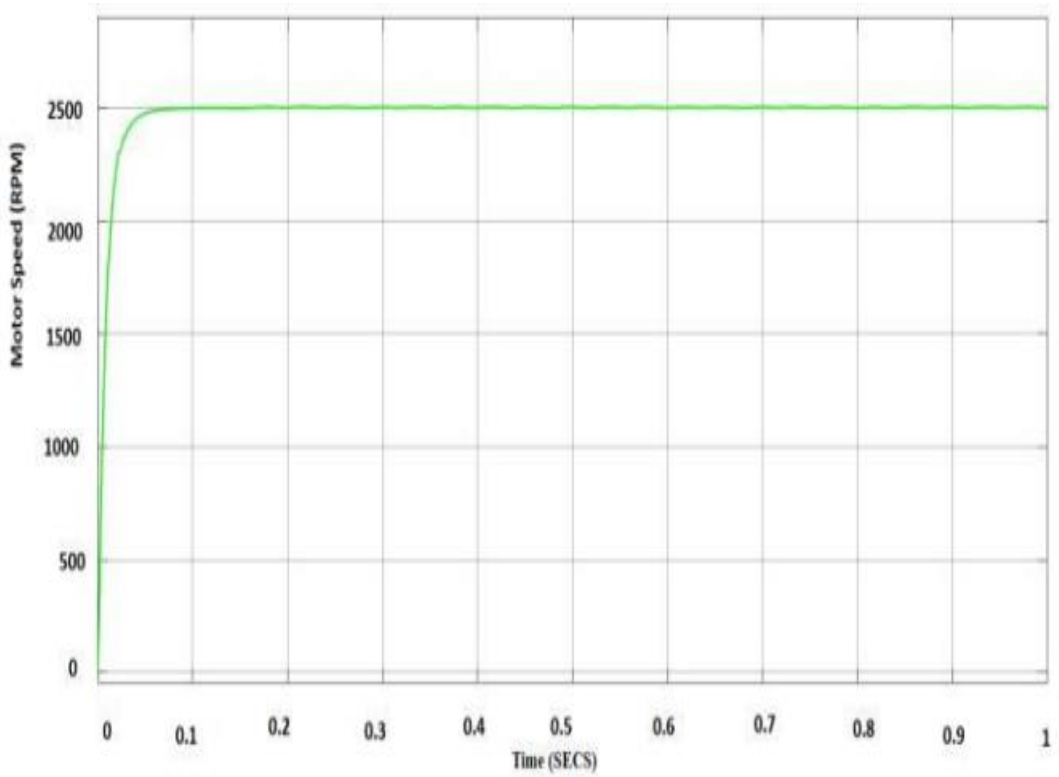

Fig-The no-load performance of the BLDC motor

Below Fig. shows the 3-phase signals generated from Hallsensor. Here the green, pink and yellow color lines are represented the individual phase signal generated by the sensor.

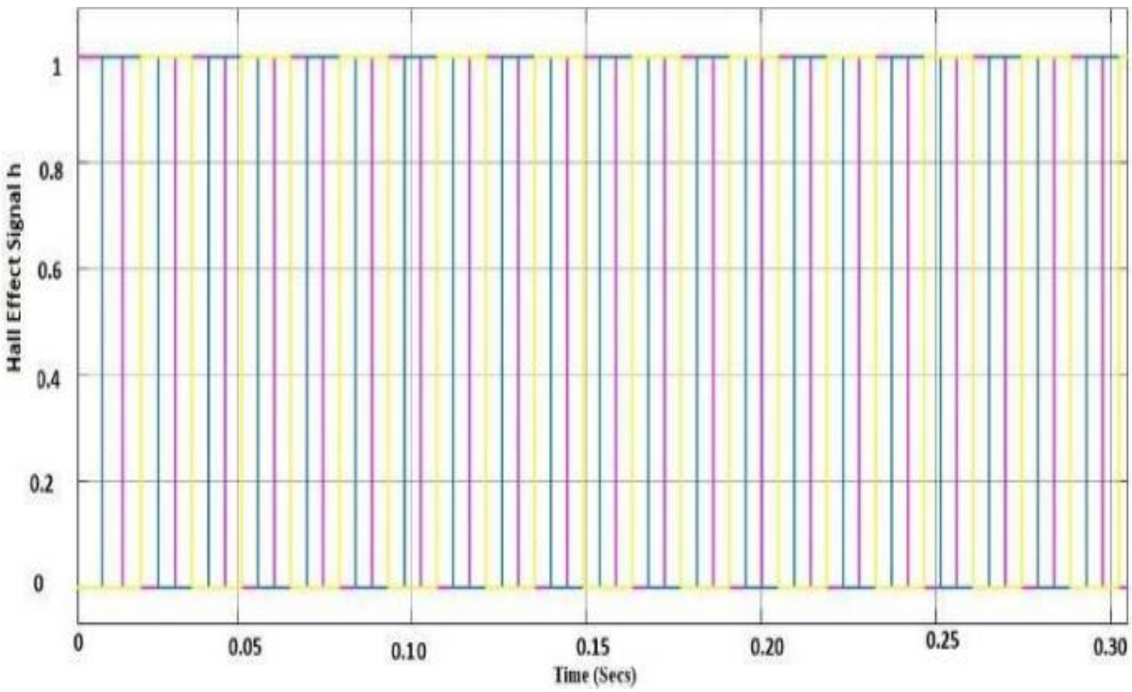

Fig- BLDC Motor Hall Effect Signal.

RESULT AND DISCUSSION

With a solar panel capacity of 340W, the solar-powered EV would be able to generate up to 0.34 kWh of energy per hour of direct sunlight exposure. Assuming an average of 5 hours of sunlight per day, this would result in a daily generation of 1.7 kWh of energy. This energy would be used to charge the battery, which has a capacity of 48V 100Ah (4.8 kWh). It would take approximately 2.8 days of full sunlight exposure to fully charge the battery.

The electric motor of the solar-powered EV has a power output of 1.2 kW and can achieve a speed of 40 km/h. At full load the motor draws 1.2kW/h so the fully charged battery is going to discharge in 4 hours.

The solar-powered EV with these specifications would be best suited for short commutes or leisurely rides in areas with high levels of sunlight exposure. The limited range and charging time of the vehicle may make it less practical for longer trips or daily use in areas with less sunlight exposure.

However, the use of solar energy as a renewable and clean source of power offers significant environmental benefits. The reduction in greenhouse gas emissions and dependence on fossil fuels can contribute to mitigating climate change. As technology continues to improve and costs decrease, solar-powered EVs may become increasingly practical and accessible to consumers, providing a sustainable and eco-friendly transportation option.

CONCLUSION

In conclusion, solar powered electric vehicles offer a promising solution to reduce green house gas emissions and improve energy independence in the transportation sector. Advances in solar cell technology and battery storage have increased the efficiency and practicality of these vehicles, but further improvements are necessary to make them more cost-effective and accessible to the general public. One of the advantages of solar powered electric vehicles is the ability to harvest renewable energy directly from the sun through solar panels integrated into the vehicle's design. This allows for a cleaner and more sustainable energy source compared to traditional fossil fuels, which are finite and produce harmful emissions.Overall, while there are still technical obstacles to overcome, the potential benefits of solar powered electric vehicles make them an important avenue for sustainable transportation and energy independence in the future.

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