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DESIGN AND DEVELOPMENT OF SOLAR POWERED FOUR WHEELER

J. SHIVA [1*] | A. KARTHIK [2] | M. NIRMALA [3] | G. AJAY KUMAR [4] | M. PRASANTH [5]

[1] ASSISTANT PROFESSOR, DEPARTMENT OF EEE, AVANTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, TAGARAPUVALASA, INDIA.

[2, 3, 4,5] STUDENT, DEPARTMENT OF EEE, AVANTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, TAGARAPUVALASA, INDIA.

ABSTRACT:

The increasing demand for sustainable and eco-friendly transportation systems has led to the development of solar-powered electric vehicles. Conventional vehicles rely on fossil fuels, which contribute to environmental pollution and global warming. This paper presents the design and development of a solar-powered four-wheel electric vehicle that utilizes a 20W photovoltaic solar panel integrated with a battery system. The solar panel converts sunlight into electrical energy, which is stored in a rechargeable battery and used to drive a 350W BLDC geared motor. Due to limited solar power output, the panel functions as an auxiliary energy source for battery charging. The proposed system ensures improved energy efficiency, reduced dependency on external charging, and enhanced environmental sustainability. Experimental observations demonstrate effective operation with solar-assisted charging, making the system suitable for small-scale applications and short-distance transportation.

KEYWORDS:

SOLAR POWERED VEHICLE, PHOTOVOLTAIC SYSTEM, BLDC MOTOR, RENEWABLE ENERGY, ELECTRIC VEHICLE, BATTERY SYSTEM, ENERGY EFFICIENCY, SUSTAINABLE TRANSPORTATION, SOLAR CHARGING.

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INTRODUCTION

Transportation systems play a vital role in modern society, but conventional vehicles powered by fossil fuels contribute significantly to environmental pollution and energy depletion [1]. The increasing demand for clean and sustainable energy sources has led to the development of electric vehicles (EVs) [2]. However, EVs still depend on grid-based electricity, which may not always be generated from renewable sources [3].

Solar energy is one of the most abundant and renewable energy sources available, offering a clean alternative to conventional fuels [4]. Photovoltaic (PV) systems convert solar energy into electrical energy, which can be used for various applications, including transportation [5]. Solar-powered vehicles integrate solar panels with battery systems to improve energy efficiency and reduce dependency on external charging [6].

BLDC motors are widely used in electric vehicles due to their high efficiency, reliability, and low maintenance requirements [7]. Energy storage systems, particularly batteries, play a crucial role in maintaining continuous power supply in solar-powered systems [8]. However, limitations such as low solar panel efficiency and dependence on sunlight remain significant challenges [9].

Therefore, there is a need for a cost-effective and efficient solar-powered vehicle system that integrates solar energy with battery storage for improved performance and sustainability [10]. This paper presents the design and development of a solar-powered four-wheel electric vehicle addressing these challenges.

MATERIALS AND METHODS:

The proposed system was developed by integrating solar energy generation, energy storage, and electric propulsion into a single platform. The system consists of a 20W photovoltaic solar panel, a rechargeable battery, a charge controller, a motor driving circuit, a 350W BLDC geared motor, and a four-wheel chassis. The solar panel converts sunlight into electrical energy, which is regulated through a charge controller and stored in the battery. The battery acts as the primary power source, supplying energy to the motor through the motor driver.

The BLDC motor converts electrical energy into mechanical motion, enabling vehicle movement. Due to the limited power output of the solar panel, it is primarily used for charging the battery rather than directly driving the motor. The mechanical design includes a four-wheel configuration for improved stability and load distribution.

The system operates based on a power flow mechanism: solar panel → battery → motor driver → BLDC motor → wheels. All components were integrated and tested to ensure proper functionality, energy efficiency, and reliable performance under different operating conditions.

RESULTS:

FIG. 1: SOLAR POWERED FOUR-WHEELER PROTOTYPE

The developed solar-powered four-wheeler was tested under different conditions to evaluate its performance. The system successfully demonstrated solar-assisted battery charging and efficient vehicle operation. The 20W solar panel contributed to battery charging, reducing dependency on external power sources.

The BLDC motor provided smooth and stable motion with sufficient torque for small-scale applications. The vehicle maintained good stability due to its four-wheel design. The experimental results indicated that the system operates efficiently for short-distance travel and low-load conditions.

The prototype, as shown in **Fig. 1**, illustrates the integration of the solar panel, battery system, motor, and chassis into a functional vehicle. The results confirm that the system is suitable for sustainable transportation and educational applications.

DISCUSSION:

The proposed system demonstrates the feasibility of integrating solar energy with electric vehicles for sustainable transportation. The use of a BLDC motor improves efficiency and performance, while the battery system ensures continuous operation. However, the system is limited by the low power output of the solar panel, which restricts direct motor operation. Environmental factors such as sunlight availability and weather conditions also affect performance. Despite these limitations, the system provides a cost-effective and eco-friendly solution. Future improvements may include the use of higher-capacity solar panels, advanced battery technologies, and intelligent energy management systems to enhance performance and scalability.

CONCLUSIONS:

This paper presents the design and development of a solar-powered four-wheel electric vehicle using renewable energy. The system successfully integrates solar energy with battery storage and electric propulsion, providing an efficient and eco-friendly transportation solution.

The results demonstrate that solar-assisted electric vehicles can reduce dependency on conventional energy sources and contribute to sustainable mobility. The system is suitable for small-scale applications and provides a foundation for further research in solar-powered transportation systems

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