IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 3, December 2025
Impact Factor: 7.67

# Solar Operated Electric Vehicle for Disabled People

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**Abstract:** *In recent years, the transportation sector has shifted towards sustainable mobility to combat pollution and fossil fuel depletion. This paper presents the design and development of a Solar Operated Electric Vehicle specifically tailored for disabled people. The project aims to provide mobility independence to physically challenged individuals using a renewable energy source. The vehicle is a three-wheeled tricycle equipped with a Brushless DC (BLDC) motor, a solar panel, and a battery bank. It utilizes a 100W solar panel to charge two 12V batteries, which power a 250W hub motor, ensuring a clean, noise-free, and cost-effective mode of transport. The design focuses on ergonomics, stability, and ease of operation with hand-controlled mechanisms. Testing results demonstrate a range of approximately 40 km on a full charge with a top speed of 22 km/h, making it a viable solution for rural and urban mobility.*

**Keywords***:* Solar Electric Vehicle, Disabled Mobility, BLDC Motor, Renewable Energy, Sustainable Transport

## I. INTRODUCTION

The rising concerns over environmental pollution, fossil fuel depletion, and climate change have urged engineers to develop vehicles that are energy-efficient and eco-friendly. Solar-powered electric vehicles utilize renewable solar energy as their main source of power, reducing carbon emissions and minimizing dependency on conventional fuels.

For millions of people with physical disabilities, mobility remains a daily challenge, particularly in developing nations where public transport systems are not adequately designed to accommodate them. This reliance on others leads to a loss of independence. The proposed project bridges this gap by designing a solar-powered mobility vehicle specifically tailored for disabled individuals.

He vehicle utilizes a solar panel mounted on the roof to capture sunlight and convert it into electrical energy via the photovoltaic effect. This energy is stored in a rechargeable battery, which powers the electric motor. Since the energy source is renewable, the running cost is negligible, making it affordable for everyday use. Additionally, the vehicle can be charged using a conventional AC supply during cloudy days, ensuring uninterrupted performance.

## II. PROBLEM STATEMENT

People with physical disabilities often face significant challenges in mobility and transportation, especially in areas where public facilities are not easily accessible or affordable. Conventional electric vehicles require frequent charging from grid electricity, which is not always available in rural or underdeveloped regions. Moreover, dependence on fossil fuels and non-renewable energy sources contributes to pollution and high operating costs. Therefore, there is a need for a self- charging, eco-friendly, and cost-effective transportation system that provides independent mobility to disabled individuals without relying on external power sources.

## III. LITERATURE REVIEW

**Ramana and Krishna (2018)** designed a solar-assisted tricycle, emphasizing that integrating solar panels enhances energy sustainability and is suitable for personal mobility vehicles for differently-abled persons.

**Rahman et al. (2019)** introduced an improved design using efficient charge controllers and lightweight body construction, finding that renewable energy can drastically reduce operational costs.
**Divya et al. (2020)** developed a prototype focusing on user comfort and ergonomic seating, concluding that solar EVs are effective for short-distance commuting for people with physical disabilities.
**Bhosale and Patil (2023)** highlighted that optimizing solar panel tilt and controller design significantly improves performance, making such vehicles practical for personalized transport.
**Reddy and Prasad (2024)** analyzed energy optimization through simulation, proving that features like smart energy management can extend vehicle range and lifespan

## IV. METHODOLOGY

The methodology adopted for this project focuses on designing a stable, cost-effective, and energy-efficient mobility solution for disabled individuals. the process was divided into three key phases: design concept, material selection, and fabrication.

### A. Design Concept

The vehicle design utilizes a three-wheeled configuration to ensure maximum stability and balance, which is critical for disabled users. the ergonomic structure facilitates easy mounting and dismounting, while the solar panel is positioned on a canopy frame to capture maximum sunlight. the system follows a simple dc architecture to minimize energy losses and improve overall efficiency.

### B. Material Selection

- Chassis: mild steel was selected for the chassis due to its high mechanical strength, cost-effectiveness, and ease of fabrication.
- Power source: monocrystalline solar panels were chosen for their higher efficiency in converting sunlight to electricity. sealed maintenance-free (SMF) batteries (2x12v, 33ah) were selected for their reliability and low maintenance requirements.
- Propulsion: a 24v, 250w brushless dc (BLDC) hub motor was preferred as it eliminates the need for mechanical transmission, thereby reducing noise and increasing efficiency.

### C. Fabrication Process

the fabrication process began with the cutting and welding of mild-steel pipes and angles to form the main chassis and canopy structure. grinding and finishing operations were performed to remove sharp edges, followed by painting to prevent corrosion the motor, controller, and battery were securely mounted centrally to maintain a low center of gravity. finally, the solar panel was mounted on the canopy using brackets, and the system integration was verified through electrical continuity tests

## V. WORKING

**WORKING PRINCIPLE:**

**Step 1: Solar Energy Collection** The process initiates when sunlight strikes the 100W monocrystalline solar panel mounted on the vehicle's canopy. The panel utilizes the photovoltaic effect to convert solar irradiance into Direct Current (DC) electricity.
**Step 2: Voltage Regulation** The raw DC voltage generated by the panel fluctuates with sunlight intensity. This power is fed into a 24V, 10A PWM (Pulse Width Modulation) Charge Controller. The controller regulates the current and voltage to ensure a stable output and protects the battery from overcharging and reverse current flow
**Step 3: Energy Storage** The regulated electrical energy is stored in a battery bank comprising two 12V, 33Ah Sealed Maintenance-Free (SMF) batteries connected in series. This creates a 24V DC power supply that serves as the main energy reservoir for the vehicle.

**Step 4: System Activation** To start the vehicle, the rider turns the **Ignition Key**. This completes the electrical circuit, allowing power to flow from the battery bank to the Electronic Speed Controller (ESC) and other system components

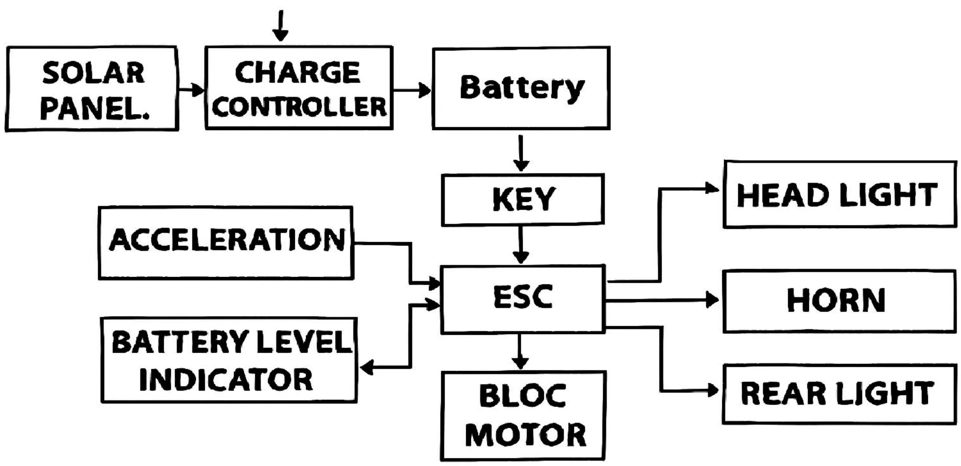
**Step 5: Speed Input** The rider controls the speed using a hand-operated **Throttle** (twist grip) mounted on the handlebar. Twisting the throttle sends a signal to the ESC indicating the desired speed.

**Step 6: Motor Control** Electronic Speed Controller (ESC) processes the throttle signal. It draws the required amount of power from the battery and delivers it to the motor, managing the speed and ensuring smooth acceleration

**Step 7: Propulsion** The **250W BLDC Hub Motor** receives electrical energy from the controller and converts it into mechanical energy (rotational motion). Since it is a hub motor, it directly drives the rear wheel, propelling the vehicle forward without the need for chains or gears.

**Step 8: Auxiliary Power** Simultaneously, a **DC-DC Converter** is used to step down the main 24V supply to 12V. This lower voltage powers the safety accessories, including the headlight, rear light, and horn.

## VI. BLOCK DIAGRAM




**COMPONENTS USED**

- Solar Panel
- Charge Controller
- Battery
- BLDC Motor
- Electronic Speed Controller (ESC)
- DC-DC Converter
- Ignition System
- Auxiliary Accessories
- Chassis Frame

## VII. COMPONENTS DESCRIPTION

**Step 1: Solar Energy Harvesting** The process begins when sunlight strikes the photovoltaic (PV) solar panel mounted on the canopy. The panel converts solar irradiance into Direct Current (DC) electricity using the photovoltaic effect.

**Step 2: Voltage Regulation** The generated DC electricity is fed into the **PWM Charge Controller**. The controller regulates the fluctuating voltage from the panel to a steady level required for charging. It ensures the battery is not overcharged during peak sunlight and prevents reverse current flow from the battery to the panel at night.

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**Step 3: Energy Storage** The regulated electrical energy is stored in the **Battery Bank**, which consists of two 12V, 33Ah Sealed Maintenance-Free (SMF) batteries connected in series to create a 24V system. This stored chemical energy acts as the reservoir for the vehicle's power.

**Step 4: System Activation** The user activates the vehicle by turning the **Ignition Key**. This completes the electrical circuit, allowing current to flow from the battery pack to the Electronic Speed Controller (ESC) and other system components.

**Step 5: Speed Control Signal** To move the vehicle, the rider rotates the hand-operated **Throttle** (accelerator). The throttle sends an analog signal to the ESC corresponding to the degree of rotation, indicating the desired speed.

**Step 6: Motor Regulation** The **Electronic Speed Controller (ESC)** receives the signal from the throttle. It draws the required amount of current from the battery and delivers it to the motor in a controlled manner. The ESC manages the speed and torque, ensuring smooth acceleration.

**Step 7: Propulsion** The **250W BLDC Hub Motor** receives the electrical energy from the ESC and converts it into mechanical energy (rotational motion). Since it is a hub motor, it directly drives the rear wheel, propelling the vehicle forward without the need for chains or gears.

**Step 8: Auxiliary Operations** Simultaneously, a **DC-DC Converter** steps down the 24V main supply to 12V. This lower voltage powers the safety features, including the headlight, rear light, and horn, ensuring the vehicle is safe to operate in all conditions

## VIII. ADVANTAGES

- **Eco-Friendly:** Operates entirely on solar power with zero emissions
- **Low Cost:** Negligible running costs and low maintenance requirements.
- **Independent Charging:** Can charge anywhere under sunlight, ideal for remote areas.
- **User Friendly:** Designed with ergonomic controls specifically for disabled and elderly people.
- **Quiet Operation:** No noise pollution, preserving beach tranquility. Ideal for sensitive ecosystems and tourist areas.

## IX. LIMITATIONS

System performance depends on sunlight availability, making it less reliable during cloudy or rainy days.
High initial setup cost for solar panels, BLDC motor, battery and automation components.

## X. CONCLUSION

The solar-operated electric vehicle for disabled people is a step towards social empowerment and environmental sustainability. It embodies the principles of clean energy utilization, accessibility, and independence. The project successfully demonstrates that integrating solar technology into electric mobility is technically feasible and economically viable. With further development, such vehicles can become an essential part of inclusive transport systems, promoting a greener society

## XI. FUTURE SCOPE

The current design of the solar-operated electric vehicle demonstrates feasibility and efficiency, but there are several avenues for further improvement and technological advancement:

**oT and Smart Monitoring:** The vehicle can be upgraded with Internet of Things (IoT) technology to provide real-time monitoring of battery health, solar charging status, and vehicle location via GPS, enhancing safety for disabled users.

**Advanced Battery Technology:** Replacing the current Lead-Acid (SMF) batteries with Lithium-Ion batteries would significantly reduce the vehicle's weight, improve charging speed, and increase the overall lifespan of the power storage unit.

**Higher Efficiency Solar Panels:** Utilizing flexible or higher-wattage monocrystalline solar panels can improve the energy conversion rate, allowing for faster charging times within the limited roof surface area.

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