

SOLAR POWERED ELECTRIC CAR

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Abstract

The overall objective of the project is to design and fabricate a solar-powered electric vehicle. The objective of the project thus far was to produce a detailed first iteration design with planning materials. The vehicle is to adhere to the engineering guidelines stated for the Shell Eco-Marathon Urban Division competition. The competition does not require the use of a solar module, but this project will incorporate the use of solar energy to charge the vehicle battery.

This competition is based on efficiency; therefore, energy efficiency will be of higher priority. Other major constraints on the project were time and budget. To accomplish this goal, subsystems such as the frame, drivetrain, power, suspension, and steering were designed individually and integrated into a master assembly model.

SolidWorks, a computer-aided design (CAD) software, was used for design and modeling, as well as finite element analysis (FEA). Secondary support software such as Excel, VSusp, and solar analyzing software were used to assist in the planning of the various subsystems, as well as data collection and assortment.

Subsystems that were modeled and analyzed through quantitative methods were purchased and fabricated. Subsystems that did not complete the design and analysis phase were not constructed. Further analysis is required to move these subsystems forward.

In the future, optimization and new subsystem configurations should be prioritized. This project concluded with the first iteration of what will someday be a Shell Eco-Marathon competition vehicle.

INTRODUCTION

Solar cars combine technology typically used in the aerospace, bicycle, alternative energy, and automotive industries. The design of solar vehicles always emphasizes energy efficiency to make maximum use of the limited amount of energy they can receive from sunlight. Most solar cars have been built for the purpose of solar car races. However, several prototypes of solar cars designed for use on public roads have been designed and built.

There are various solar car competitions around the world that are generally partaken by collegiate and company teams. The most notable competition is the World Solar Challenge, which is an international competition that takes place in Australia. Some other competitions include the American Solar Challenge and the United Solar Challenge.

METHODOLOGY

The methodology for developing a solar-powered electric car involves integrating photovoltaic (PV) panels onto the vehicle's surface to convert sunlight into electrical energy, which charges a battery pack through a maximum power point tracker (MPPT) charge controller to drive an electric motor. The process includes designing lightweight structures, designing electrical systems, simulating performance, and optimizing energy efficiency.

Design & Modeling: Using CAD software (e.g., SolidWorks) and simulation tools (e.g., MATLAB/Simulink) to design the chassis and model solar energy extraction.

Photovoltaic System: Installing flexible or efficient solar cells on the rooftop or body, connecting them to convert sunlight into DC electricity.

Power Management (MPPT): A charge controller, likely utilizing MPPT (Maximum Power Point Tracking), ensures maximum power extraction from panels and manages the battery charging to avoid overcharging.

NEED OF STUDY

Studying solar-powered electric cars is essential to advance sustainable transportation, reduce reliance on fossil fuels, and achieve zero-emission mobility. It offers insights into improving energy efficiency, optimizing solar panel integration on vehicles, reducing charging costs, and developing lightweight, eco-friendly materials to create a cleaner, self-sustaining transport future.

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Energy Storage: Using high-density batteries (e.g., Lithium-ion) to store the energy generated, powering the vehicle during operation.

OBJECTIVES

1. The long-term objective of this project is to design, fabricate and assemble a fully functioning vehicle powered by solar energy, which in the future can be used to compete in the Shell Eco-Marathon. The racecar competition is sponsored by Shell and takes place in Detroit, MI. The goal for this year's team is to develop a complete Set of plans, design solar car's concept, and to purchase critical components within our budgetary constraints.

SCOPE OF STUDY

The scope of solar-powered electric vehicles (EVs) lies in enhancing sustainability by integrating photovoltaic cells to charge batteries, reducing dependency on the grid, and decreasing carbon footprints. While currently limited by low energy generation for high-speed use, they offer significant potential as range extenders, promising daily driving convenience and lower operational costs.

Range Extension and Convenience: Solar cells integrated into car roofs and body panels can provide roughly 10–23 km of daily range, reducing charging frequency by 35% to 55% and decreasing reliance on grid electricity.

Technological Advancements: Increased efficiency of solar cells and lightweight, flexible photovoltaic integration (VIPV) are making it possible to adopt these vehicles on public roads rather than just for competition.

Short Commutes and Urban Mobility: They are highly applicable for city driving where average daily travel is low, offering noiseless, zero-emission transportation.

Key Future Research: Research is focused on balancing solar integration with car aesthetics, optimizing battery weight, developing Vehicle-to-Grid (V2G) systems, and lowering costs.

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