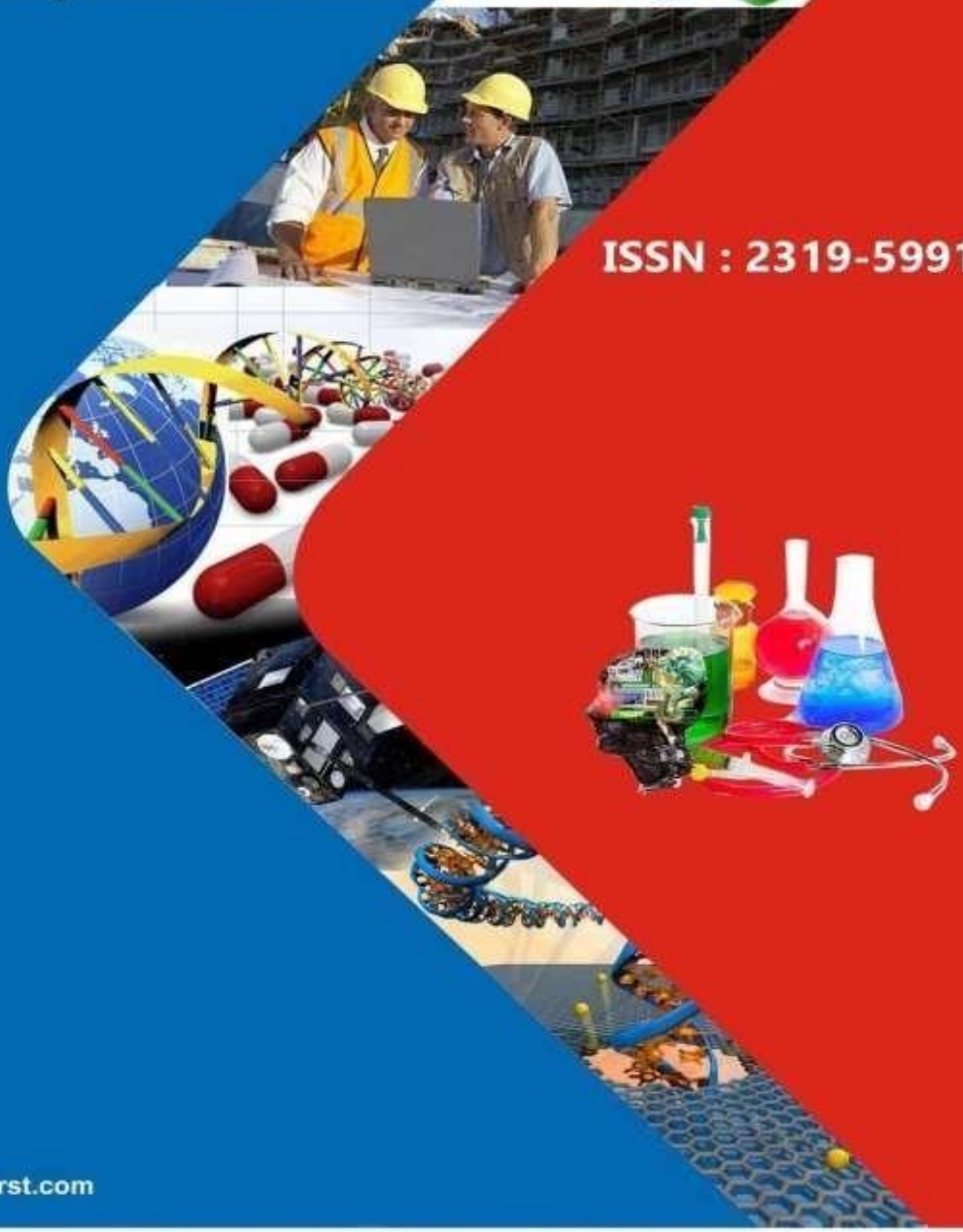
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Solar Based Hybrid Electric Vehicles with Effective Usage of Enormous Solar Energy

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Abstract:

One of the front runners in the area of renewable energy resources today is solar power. Photovoltaic cells are used to convert solar energy in to useful electrical energy. The objective of this paper is to construct an efficient solar car, for the daily office commuters of Dhaka city so that they can travel a fixed distance that they need to commute everyday on a reliable and economical car that essentially runs on free renewable solar energy. All calculations would be made bearing in mind the maximum distance travelled by Dhaka office commuter i.e. from Uttara to Motijheel since overcoming this distance would be the primary objective of the solar car to be built. The paper illustrates how the charge generated by an array of solar panels is received and its flow in and out of a battery pack is to be controlled using a microcontroller based charge controller to ensure efficient storing of charge in a battery pack. The stored energy would be divulged to a DC motor which would run the car. The design of a motor controller to control the car's speed and forward/reverse direction of motion is shown. The mechanical construction from scratch of the chassis along with all necessary mechanical systems is illustrated. Finally the wiring of the electrical system onto the mechanical body is demonstrated. The increasing demand for sustainable transportation solutions has fueled research into alternative energy sources for vehicles. Among these, solar energy stands out as a promising avenue due to its abundance and renewability. Solar-powered cars, in particular, have garnered significant attention as a viable means of reducing dependence on fossil fuels and mitigating environmental impact. This paper provides a comprehensive review of advancements in solar-powered vehicle technology, focusing on recent developments in photovoltaic cells, energy storage systems, aerodynamics, and vehicle design.

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1. Introduction:

Solar cars are an ingenious combination of aerodynamics, clean converted energy, and laws of motion. The end product is a means of transportation that leaves a minimal footprint. Moreover, it saves the environment as well as the monetary expenses.

Solar panels with built-in Photovoltaic cells help in the conversion of solar power into usable electricity that can be stored in batteries. Hence, we can use these batteries as the fuel which we require to run the vehicles.

1.1 Key Distinction between a Solar car and a Standard Car

The standard cars come with an Internal Combustion Engine to operate the vehicle. The ICE uses fuel like Gasoline, Diesel, Petrol, etc to generate the energy needed for the movement of the vehicles. The heat generated by burning these fuels helps in the movement of the engine pistons thus resulting in the movement.

However, Petrol, diesel, etc are fossil fuel that generates a huge amount of additional carbon compound gases like Carbon Monoxide and Nitrogen Oxide among a few others too. These gas remnants along with the pollutants in the fossil fuels are the reason for the extensively growing air pollution seen worldwide.

A solar Vehicle solely depends on the photovoltaic cells to absorb the sunlight and convert it into usable energy to power the engine. Photovoltaic cells bypass the original principal of solar thermal energy by converting solar energy directly to usable electricity instead of thermal conversion. Therefore, we can easily store converted electricity in the batteries and use them to power the engine of a vehicle just like a normal Electric Car.

1.2 Working Principle of a Solar car

Solar cars have solar panels custom-designed to be mounted on the surfaces receiving maximum sun rays, which is generally the rooftop. The photovoltaic cells on the solar panels comprise of Silicon and a combination alloy of Galium and Indium and Nitrogen gas.

These elements have a natural retentive property that allows them to absorb the light energy from the solar rays. The retained energy then releases in form of free-moving electrons into specially designed storage sections.

In fact, we refer to this storage facility as batteries. They comprise of special elements like Lithium-ion, and Nickel – Cadmium, etc. These batteries have the ability to convert free electrons into usable energy to power the vehicle engine.

The speciality of these batteries is that we can use them repeatedly to power a vehicle. We can do it by recharging them using solar energy. With an ability to generate 80 to 150 volts of energy, solar-powered cars can cover 60 to 90 km on a single full charge.

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Fig. solar array

2. Problem Formations:

There are many problems with most cars today that can be fixed by a Solar Panel Car. Today's cars consume high amounts of gas and produce exhaust, which is harmful to the environment. Solar cars have the capability to eliminate this problem because solar energy is clean energy and is pulled from the Sun, a natural resource. The design the group has chosen is a simple and unique model that can be created with a low budget, but still have a favorable performance. Our requirements and constraints include: going in a straight line, must have correct parts, and have a budget under $50.



Fig. solar car model

Design and implement a solar panel system for a residential building located in a suburban area. The system should maximize energy generation efficiency while considering factors such as available space, budget constraints, and local weather conditions. The goal is to create a sustainable energy solution that reduces the reliance on traditional grid electricity and minimizes the environmental footprint of the household.

Determine the required energy production capacity based on the household's average energy consumption. Consider factors such as peak energy demand times and seasonal variations.

Choose appropriate solar panels based on efficiency, durability, and cost-effectiveness. Consider factors such as monocrystalline vs. polycrystalline panels, panel wattage, and manufacturer warranties.

Design the layout and configuration of the solar panel system to maximize exposure to sunlight. Consider factors such as roof orientation, tilt angle, and shading from nearby trees or buildings.

Select an inverter system compatible with the chosen solar panels to convert DC electricity generated by the panels into usable AC electricity for household appliances.

Evaluate the feasibility and cost-effectiveness of incorporating battery storage to store excess energy generated

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during peak sunlight hours for use during periods of low sunlight or high energy demand.

Ensure compliance with local regulations, building codes, and permit requirements for the installation of solar panel systems

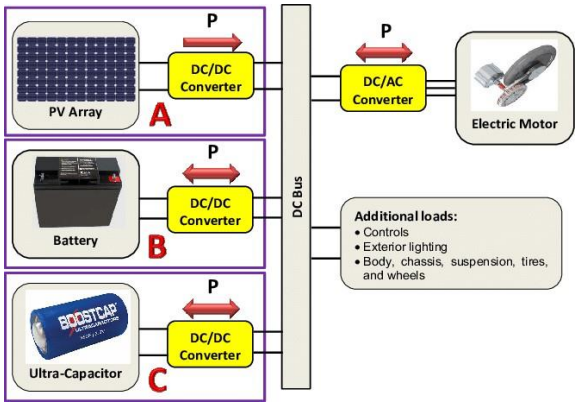


fig. Solar car block diagram.

3. Result and discussion:

One of the key results of a solar car project is its energy efficiency. This can be measured by the distance traveled per unit of energy consumed. Solar cars typically demonstrate high levels of energy efficiency due to their reliance on solar power, which is a renewable and abundant energy source. The efficiency of the solar panels in converting sunlight into electricity, as well as the efficiency of the electric motors in converting electrical energy into mechanical energy, are crucial factors influencing the overall performance of the solar car. The speed and performance of a solar car are significant aspects of its evaluation. Solar cars are generally not designed for high-speed performance like conventional gasoline-powered cars but rather for efficient cruising at moderate speeds. The design and engineering of the car's aerodynamics, weight distribution, and propulsion system play vital roles in achieving optimal speed and performance while maximizing energy efficiency.

Another important aspect to consider is the range and endurance of the solar car, i.e., how far it can travel on a single charge or under continuous solar power. Range is influenced by factors such as battery capacity, solar panel efficiency, terrain, weather conditions, and driving behavior. Extensive testing and optimization are typically conducted to improve the car's range and endurance, ensuring its practical usability for various application. Solar cars often incorporate battery storage systems to store excess energy generated by the solar panels for use during periods of low sunlight or high energy demand. Efficient charging and battery management systems are essential to maximize the utilization of solar energy and extend the vehicle's range. Advanced battery technologies and smart charging algorithms are continuously developed and implemented to enhance the performance and reliability of solar car batteries.

Solar cars offer significant environmental benefits compared to conventional gasoline-powered vehicles by reducing greenhouse gas emissions and dependence on fossil fuels. The use of renewable solar energy for propulsion contributes to mitigating climate

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change and reducing air pollution, making solar cars an environmentally sustainable transportation solution.

Despite their advantages, solar cars face several challenges and limitations. Limited energy storage capacity, variability in solar irradiance, weight constraints, and cost considerations are some of the primary challenges that need to be addressed in solar car design and engineering. Overcoming these challenges requires innovative solutions and advancements in technology, materials, and design methodologies.

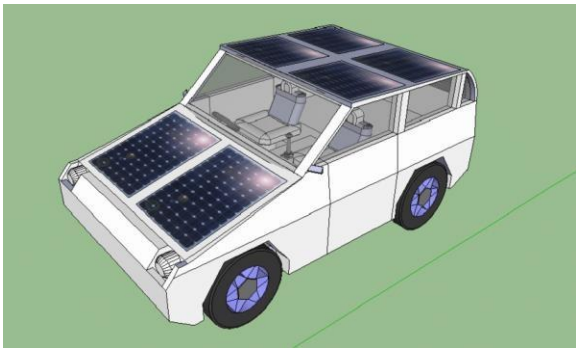


Fig.3solar panels attached to car body

Conclusion:

Solar cars represent a compelling vision for sustainable transportation, harnessing the abundant energy of the sun to power electric vehicles while minimizing environmental impact. Despite facing challenges such as energy efficiency, cost, infrastructure development, regulatory adaptation, and public perception, significant progress has been achieved in advancing solar car technology.

Through ongoing research and development efforts, improvements in solar panel efficiency, battery technology, and energy management systems have enhanced the performance and practicality of solar cars. Cost reduction strategies, including innovations in manufacturing processes and economies of

scale, have made solar cars more accessible to consumers, although further cost reductions are needed for widespread adoption.

Infrastructure development, such as the deployment of solar-powered charging stations and support networks tailored to solar cars, is essential to facilitate their integration into existing transportation ecosystems. Moreover, regulatory frameworks must evolve to accommodate the unique characteristics of solar cars and ensure safety and compliance standards.

Public awareness and acceptance of solar cars have grown, driven by increasing concerns about climate change and environmental sustainability. Continued education and outreach efforts are crucial for dispelling misconceptions and fostering broader acceptance of solar car technology among consumers, policymakers, and industry stakeholders.

In conclusion, while challenges remain, the progress made in advancing solar car technology and the growing momentum towards sustainable transportation solutions underscore the potential of solar cars to play a significant role in shaping the future of mobility. With ongoing innovation, collaboration, and support from stakeholders, solar cars have the potential to transition from niche applications to

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mainstream adoption, contributing to a cleaner, greener, and more sustainable transportation landscape for generations to come.

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