Today's Need & Importance Role of Solar based Automobile System

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Abstract

As the world population increases, so does the demand for transportation. Automobiles, being the most common means of transportation, are one of the main sources of pollution. Therefore, in order to meet the needs of the society and to protect the environment, scientists began looking for a new solution to this problem. Before they suggested any answers, the scientists first looked at all aspects surrounding the issue. Solar energy is produced when sunlight strikes the photovoltaic cell. This energizes any electrical or battery found along the way. Developing solar cells to produce electricity has several big challenges, especially in solar cars. The first obstacle that has remained all intrusive in this quest is predicting the sun's availability. The second obstacle is to find an effective method of capturing, converting, and storing the sun energy when it is available. Then finally, the last obstacle is to make this solar energy competitively priced to compete with current cheaper energy sources.

Keywords: Automobile, Photovoltaic Cell, Lightweight, Electricity, Solar-Powered, Prefabricated

I. INTRODUCTION

The first model solar car invented was a tiny 15-inch vehicle created by General Motors employee, William G. Cobb. Called it the Sun mobile, he displayed it in 1955 at the Chicago, Power convention. It was made up of 12 selenium photovoltaic cells and a small electric motor.

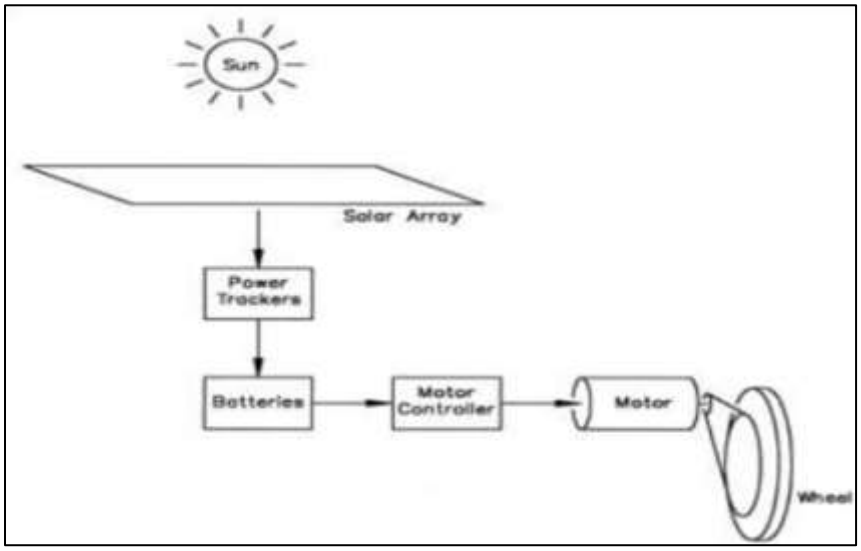

Fig. 1: Basic Introduction of Solar Vehicle

A solar car is a solar vehicle used for land transport. Solar cars are usually run on only power from the sun, although some models will supplement that power using a battery, or use solar panels to recharge batteries or run auxiliary systems for a car that mainly uses battery power. Solar cars combine technology typically used in the aerospace, bicycle, alternative energy and automotive industries. The design of a solar vehicle is severely limited by the amount of energy input into the car. Most solar cars have been built for the purpose of solar car races. Some prototypes have been designed for public use, although no cars primarily powered by the sun are available commercially. Solar energy could halt worldwide growth in demand for oil and coal. The country plans to generate 175GW of renewable energy capacity by 2022 out of which 100GW should be from solar power projects.

II. MECHANICAL COMPONENTS

A. Solar Array & Power Trackers

We recommend a solar array created from individual solar cells as opposed to one made of prefabricated solar panels. Each solar cell should produce .5 volts at about 3 amps at peak sunlight. The number of cells to use depends on their size and the allowable solar area per Winston rules. Solar cells should be wired in series on a panel and should be divided into several zones.

B. Batteries

The batteries store energy from the solar array and makes them available for the motor's use. Many different types of batteries are sold. Most high school teams use lead-acid batteries because they are inexpensive, but some teams use lithium-ion or nickel-cadmium. The number of batteries to choose depends on the motor (system) voltage. If the system voltage is 72 volts, you will need 6 12-volt batteries. Also be sure to check the rules for weight or watthour requirements.

C. Motor & Controller

Most teams use DC brush permanent magnet motors to drive their solar cars. Expect a maximum efficiency of 80-90%.Controllers usually drive a particular motor. Once you choose the motor that suits your needs, the same vendor would most likely have a matching controller.

D. Instrumentation

One of the most important pieces of instrumentation is a state-of-charge meter. A state-of-charge meter gives information about system voltage, amp draw, battery energy remaining, and estimates the how much time remains until the battery is out of energy. To ensure that your batteries are running properly, you may invest in getting a voltmeter for each of your batteries.

E. Steering & Suspension

We strongly recommend front wheel steering as it tends to be more stable and safer. If there are two front wheels, it is therefore advisable to work out the geometry so that they run parallel when the car is going straight ahead, but when the car is turning, the front wheels turn at different radii. If the car is turning left, the left front tire is making a smaller circle than the right front tire.

The only advice we can offer with respect to suspension is that it should be soft enough to protect the car and solar array from unnecessary jolts and firm enough to provide a stable ride.

F. Tires & Hubs

Tire selection will affect rolling resistance which affects how far the solar car will travel with the energy available. Tires with thicker rubber and wider tread tend to have higher rolling resistance (a bad thing). Thinner tires with higher pressure have less rolling resistance, but are more susceptible to flats. The best tires we have found are the Bridgestone Ecopia tires made for solar cars. Bearing resistance can be reduced by light minimal lubrication. Bearing seals can be cut away at the contact lip to leave most of the seal protection while removing most if not all seal drag. It is a good idea to get the rolling chassis operational months before your schedule gets critical. Run the chassis as many miles as possible to prove that your bearings, axles, steering and suspension can survive.

III. DESIGN & CONCEPT OF SOLAR BASED AUTOMOBILE

The conceptual design of the solar vehicle was very much dependent on the dimension and profile of the electrical and mechanical components that are being used. For example, the top area of the vehicle was designed to accommodate the 2 solar panels. The chassis was designed to cater the load and to accommodate all the electrical and mechanical. Finally, the body was designed for simplicity, lightweight and easy maintenance.

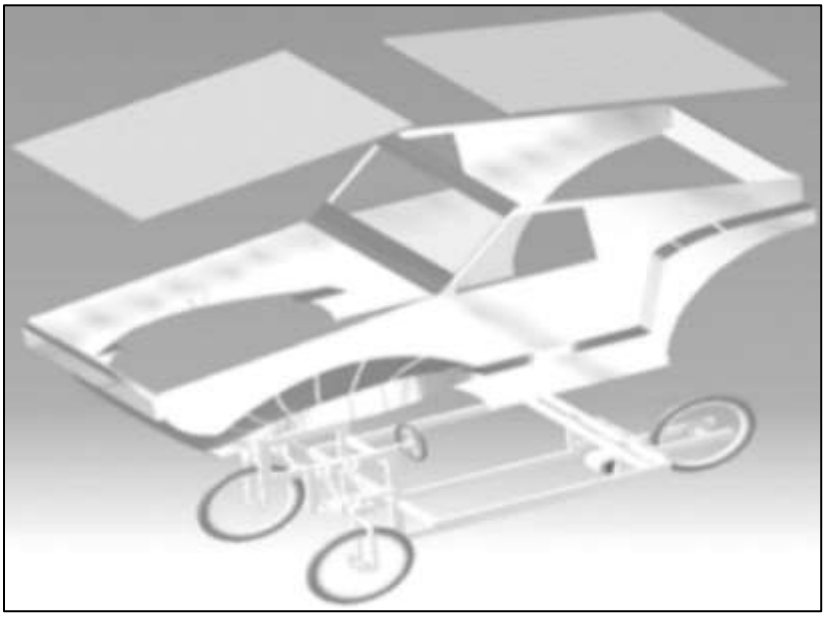

Fig. 2: Design of Solar based Car

The shape of the solar car is made as simple as possible in order to accommodate the shape of the solar panel. The body of the solar car is designed based on the components obtained off-the-shelf.

IV. WORKING PROCESS

People are becoming more and more aware of solar power as an alternative energy resource. Solar power is used in many different residential and commercial uses, including cars. How do solar cars work and why can't we simply go out and buy one at our local car dealership? True solar-powered cars are actually electric vehicles that are powered by solar panels. The panels are used produce electricity by converting the sun's rays into energy, which is then stored in solar batteries. The car runs by using the energy that is stored in the batteries. Currently, the solar cars available today still have several problems, as solar-powered cars are still a fairly new concept and research is continuing. First, solar-powered cars have to be extremely lightweight and streamlined to be effectively powered by the sun. The problem is that this becomes a safety issue: ideally, cars would be sturdy and able to hold up safely in the event of an accident -- and lightweight solar cars aren't quite there yet.

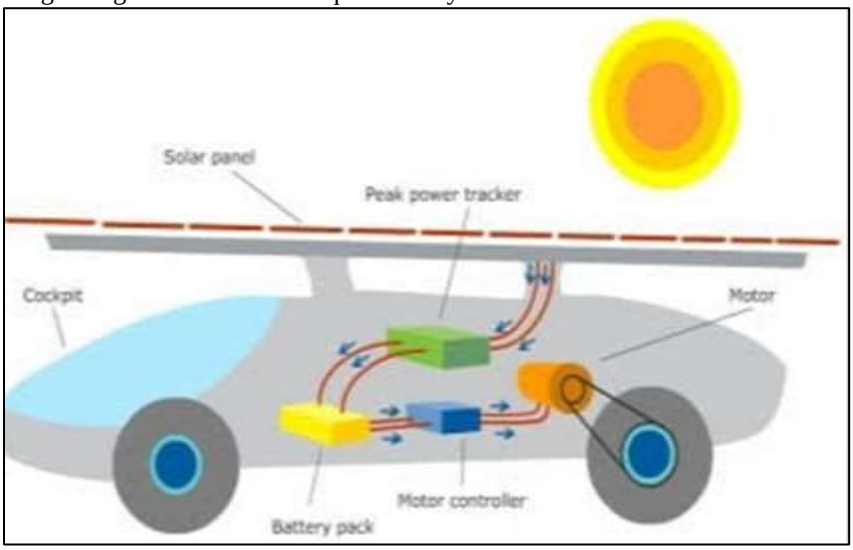

Fig. 3: Basic Working of Solar Automobile

Right now solar cars tend to have room for only one person (in a few cases, two people). This also makes it impractical for regular household use. The closest thing you can find to a "green" car today is a hybrid vehicle. Although also fairly new, hybrid vehicles are becoming the new wave of the future in the auto industry. One company was reportedly considering placing solar panels on the roofs of hybrid vehicles. Perhaps this will start a new wave of solar-powered hybrid vehicles and one day lead to solar cars readily available to consumers.

V. EFFICIENCY OF SOLAR POWER

Efficiency can be measured by the number of kWh (kilowatt-hours) of energy produced an "average" 150 watt solar panel of one square meter in size. How efficient is solar energy, and is it a viable option for homeowners?

The average solar cell efficiency is thought to be between 12% and 22%. In 2007, a team lead by the University of Delaware, produced a record-breaking solar cell efficiency of 42.8% (the previous record was 40.7% efficiency). In 2015, it was reported that a team of researchers created the solar sunflower - with a crazily awesome efficiency of about 80%! The downside cost.

The efficiency of solar panels is dependent on many factors:

- How much sunlight it gets;
- The angle of the solar panels;
- Whether parts of the cell are shaded;
- And how clean the solar panels are.

Average efficiency of solar PV are 25% but let's take the high end number i.e. suppose it as 30%. i.e. 10+ (10x25/100) = 12.5 Kw

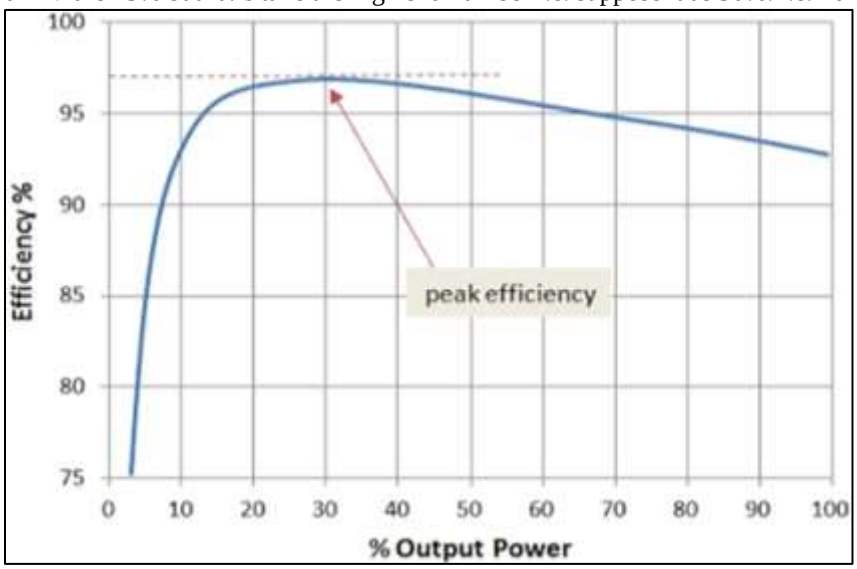

Fig. 4: Efficiency of Solar Power

VI. ADVANTAGE OF SOLAR BASED AUTOMOBILE

A. Eco-Friendly & Quiet

Solar-powered vehicles have zero emission level, as they don't utilize non-renewable resources and burn fuel. The electric motors generate electricity that doesn't emit any greenhouse gases or any other pollutants. These cars are quieter than the vehicles powered by conventional fuels, which don't cause noise pollution as well.

B. Energy Availability

Solar cars derive their power from the sun, indirectly, that always shines and provides endless energy. The efficient solar panels can produce and store more horsepower for the vehicle.

C. No Fuel Costs

Unlike the conventionally fueled vehicles, solar vehicles have no fuel costs and a low cost of maintenance.

D. Driving Comfort

Having aluminum and lightweight components, the solar-powered cars run faster and more smoothly than petrol and diesel engine vehicle.

VII. LIMITATIONS OF SOLAR BASED AUTOMOBILE

A. Design Challenge

The solar vehicles require large surface area on roof for mounted solar panels, have low wind resistance and space only for two passengers.

B. Poor Practicality

These green cars don't have any driver safety features and other equipment such as wiper blades, headlights and rear view mirrors. Aspects like suspension, chassis strength, steering, brakes, secured solar panels and batteries arrangement also need to be taken seriously.

C. Expensive Batteries

The efficient solar panels and batteries and their replacement are way too expensive that need to be changed so often. This is what makes the solar vehicles a costly affair.

D. Energy Storage Capacity

The photovoltaic cells or solar panels can convert 15-30% of sunlight into electricity, depends on the material used, which is quite limited.

VIII. CONCLUSION

With the fuel options getting limited, there will be time when the world will have to look for other fuel options. That is the reason why we are seeing different automakers working on alternative fuel. Among several technologies that different automakers are working on, solar is one of them. Several innovators are working on solar-powered vehicles. The sun is an eternal and the most sustainable source of energy that can be used to produce electricity to run vehicles. The solar powered cars are not a common sight in India, as these are still under the experimental phase, but these could become a potential alternative for eco-conscious buyers.

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